Prepared for:

TOLSON AND ASSOCIATES, LLC

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PHASE II AND III REPORT

PERMIT MODIFICATION APPLICATION, VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL CROFTON, ANNE ARUNDEL COUNTY, MARYLAND

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Project Number: ME1606

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Revised November 2020

Professional Certification: I hereby certify that this document was approved by me, and that I am a duly licensed Professional Engineer under the laws of the State of Maryland,

License No. 32252

Expiration Date: 09-08-2021

C.H. Pendleton

TABLE OF CONTENTS

TABLE

APPENDICES

EXECUTIVE SUMMARY

The Tolson Rubble Landfill (TRL, Site, or site) facility is located in Crofton, Anne Arundel County, Maryland, approximately one mile northwest of Maryland Route 3, and accessed via Capitol Raceway Road and is currently permitted under Refuse Disposal Permit 2019-WRF-0580, issued December 10, 2019, expiry December 9, 2024. The waste footprint of the proposed expansion is 72.1 acres. A vertical expansion is proposed to increase the height of the landfill from the current permitted height of 230 feet above mean sea level (ft-msl) to 244 ft-msl (with top of waste at 240 ft-msl). The vertical expansion also sees a lowering of base grades, and the addition of a herringbone cap to optimize airspace.

A Phase I permit application for a vertical and lateral expansion of the TRL was submitted to the Maryland Department of the Environment (MDE) in May 2019 (Geosyntec, 2019). This report is intended to satisfy the requirements of both the Phase II and III reports for the vertical component of the expansion, which is the only portion currently being proposed. Because the proposed expansion is limited to a vertical expansion, the current, approved Phase I Report (ETS, 2003) and Phase II Report (ERM, 2016) are still applicable to this Site. The approved Phase II permit application comprises a Site Geologic Study (Marshall, 1995), Groundwater Monitoring Data and Analysis and Supplemental Phase II Site Geology Report (ERM, 2006), and Focused Groundwater Evaluation submitted within Document 5 of 5 (ERM, 2011).

During and since March 2019, additional data was collected in support of the lowering of base grades. A field investigation was conducted that included the installation of nine soil borings at the Site of which six were completed as monitoring wells. Site-wide monthly water level measurements were recorded. Based on the information collected, the proposed base grades will maintain a minimum separation of three feet with respect to the maximum recorded groundwater levels in accordance with COMAR 26.04.07.16(6)(a). At the western portion of the landfill, there is a vertical separation of five feet to accommodate the leachate sump and maintain the minimum buffer. The supplemental information regarding site geology and hydrogeology is summarized in Section 2, and includes monthly groundwater levels and time trend hydrographs, maximum potentiometric surface maps for the shallow and deep aquifers, and updated site cross-sections located in Appendix B. The approved Phase II report (ERM, 2006) is also included in Appendix B.

Phase III of the Application for a Sanitary (Rubble) Landfill Permit (permit application), of which this Phase II and III Report (Report) is a part, is the final submittal in the MDE solid waste permit application process. This Report is organized in a format that addresses the specific requirements of COMAR 26.04.07.16, including types and quantities of anticipated waste, landfill cell design, cover material, site access and operating procedures, leachate, landfill gas, and stormwater management, and contingency and closure plans. In this Report, the term “Drawings” refers to the drawing package entitled, “Phase III Report Permit Modification Application, Vertical Expansion of Tolson Rubble Landfill, Crofton, Anne Arundel County, Maryland” dated July 2020, revised November 2020, and prepared by Geosyntec Consultants, Inc. (Geosyntec).

1 INTRODUCTION

1.1 Organization and Terms of Reference

The Tolson Rubble Landfill (TRL, Site, or site) facility is located in Crofton, Anne Arundel County, Maryland, approximately one mile northwest of Maryland Route 3, and accessed via Capitol Raceway Road (**Drawing 1**) and is currently permitted under Refuse Disposal Permit 2019-WRF-0580, issued December 10, 2019, expiry December 9, 2024. The waste footprint of the proposed expansion is 72.1 acres (**Drawing 2**). A vertical expansion is proposed to increase the height of the landfill from the current permitted height of 230 feet above mean sea level (ft-msl) to 244 ft-msl (with top of waste at 240 ft-msl). The vertical expansion also sees a lowering of base grades, and the addition of a herringbone cap to optimize airspace.

Phase III of the Application for a Sanitary (Rubble) Landfill Permit (permit application), of which this Phase III Report (Report) is a part, is the final submittal in the Maryland Department of the Environment (MDE) solid waste permit application process. Because the proposed expansion is limited to a vertical expansion, the current, approved Phase I Report (ETS, 2003) and Phase II Report (ERM, 2016) are still applicable to this current Phase III Report. Phase II of the permit application comprises a Site Geologic Study (Phase II Report), Groundwater Monitoring Data and Analysis and Supplemental Phase II Site Geology Report (ERM, 2006), and Focused Groundwater Evaluation submitted within Document 5 of 5 (ERM, 2011). Additional discussion regarding the applicability of the existing Phase II Report is presented in Section 1.3 of this Phase III Report.

This report was prepared by Geosyntec Consultants, Inc. (Geosyntec) of Columbia, Maryland, on behalf of Tolson And Associates, LLC (Tolson), the owner and operator of the TRL.

This Report is organized in a format that addresses the specific requirements of COMAR 26.04.07.16. In this Report, the term “Drawings” refers to the drawing package entitled, “Phase III Report Permit Modification Application, Vertical Expansion of Tolson Rubble Landfill, Crofton, Anne Arundel County, Maryland” dated July 2020 and prepared by Geosyntec Consultants, Inc. (Geosyntec). A reduced-size copy of the Drawings is included as **Appendix A**.

1.2 Site Location and Description

As shown on the area map provided as **Drawing 1**, the existing TRL facility is located in Anne Arundel County, Maryland, approximately one mile northwest of Maryland Route 3, and accessed via Capitol Raceway Road. The existing TRL currently comprises a permitted waste footprint of 72.38 acres with one constructed active waste disposal cell (Phase 1 Cell A). The majority of the site is currently being mined for sand and gravel under various Special Exception permits issued from 1993 to 2016. The south and west of the site is bordered by forested area beyond which is the Little Patuxent River, while the north and east are surrounded by residential and commercial/industrial developments. Its topography and current conditions are presented in **Drawing 2**.

The TRL property encompasses four parcels with a combined area of approximately 313.84 acres. Tolson owns three of the four parcels and have a 30-year lease for the fourth parcel, Parcel 262, which contains the 32.8-acre closed Cunningham Rubble Landfill (CRL). These four parcels are listed in the table below.

Parcel	Owner	Area (acres)
Tax Map 36, Grid 10, Parcel 262 Liber 3026, folio 00275	Capitol Raceway Promotion, Inc. 11555 Haughs Church Rd. Key Mar, MD 21757	50.59
Tax Map 36, Grid 4, Parcel 9 Liber 28096, folio 00273	Tolson And Associates, LLC 24024 Frederick Rd. Clarksburg, MD 20871	129.5
Tax Map 36, Grid 35, Parcel 239 Liber 28096, folio 00301	Tolson And Associates, LLC 24024 Frederick Rd. Clarksburg, MD 20871	1.76
Tax Map 36, Grid 4, Parcel 10 Liber 28096, folio 00301	Tolson And Associates, LLC 24024 Frederick Rd. Clarksburg, MD 20871	131.99

In addition, Tolson has a perpetual deeded easement through Parcel 37 to provide access to the site. Details for Parcel 37 are outlined in the table below.

Tax Map 36, Grid 17, Parcel 37 Liber 27935, folio 00388	Ventura Properties, LLC 11555 Haughs Church Rd. Keymar, MD 21757	117.0

The TRL site area is 204.6 acres of the property. Of the TRL site area, 203.25 acres are part of a special exception issued by Anne Arundel County, which allows Tolson to operate the landfill and sand and gravel operations under the existing zoning for the property. The special exception covers a total area of 203.25 acres, of which 184.25 acres was included in the original special exception approval in 1993, with an additional 19 acres approved as an expansion to the original special exception area in 2016. The existing and proposed facility areas are located within the special exception area. Natural elevations of the site and surrounding areas range from approximately 110 feet above mean sea level (ft-msl) to 210 ft-msl.

1.3 Project Description

The proposed expansion encompasses the current footprint of the TRL, as shown in **Drawing 3.** The proposed final grading for the facility is shown in **Drawing 11**. The proposed expansion includes the following:

(i) a vertical expansion above the 72.1 acres footprint of to a maximum final elevation of 244 ft-msl (with a top of waste elevation of 240 ft-msl), which complies with the special exception requirement and Anne Arundel County Code 18-11-129(12) that operations on the site be limited to a height of 30 feet above grade (maximum surrounding grade is at elevation 210 ft-msl, as shown on **Drawing 2**);

(ii) a reconfiguration of the disposal cells as compared to the existing permit;

(iii) lowering of the base grades from the currently permitted minimum elevation of 122 ft-msl to a minimum elevation of 95 ft-msl, which complies with the special exception requirements that: (1) the excavation not exceed 50 feet below the existing surrounding grade (surrounding grade within the footprint of the proposed expansion is as low as approximately 115 ft-msl, as shown on **Drawing 2**); and (2) excavations may not enter into the clay layer base for the site (the subsurface clay layer for the site is generally present below an elevation of 90 ft-msl); and

(iv) addition of a herringbone pattern cap to maximize airspace.

1.4 Requirements for the Phase III Report

1.4.1 Overview of Pertinent Regulations

MDE requires that a Phase III Report include information on a number of issues in sufficient detail to permit a comprehensive review of a proposed project. These issues are identified in two separate regulatory and guidance documents: (i) COMAR 26.04.07.16; and (ii) Current Terms and Conditions of Permit No. 2019-WRF-0580. In the following three subsections, the specific issues from each separate regulatory source are reproduced in italic type, followed by a description of where that particular requirement is met and/or addressed in the remainder of this Report, Drawings, and/or appendices. For ease of review, this information is also provided in the form of a checklist in **Table 1**, which identifies where in the permit application the information is provided.

1.4.2 Requirements of COMAR 26.04.07.16

COMAR 26.04.07.16(A) requires that a Phase III Report include information on twenty (20) specific issues. Below, each of these issues is listed in italic text followed by, in regular text, the location where the issue is addressed in this permit application.

(1) A map which designates the property boundaries, the actual area to be used for filling, and existing and proposed structures and on-site roads.

- Drawings 2 and 3

(2) A description of any vehicle weighing facilities, communications (telephones, radios), maintenance and equipment storage facilities, and water supply and sewerage systems. On-site water supply and sewerage systems shall be approved by the Approving Authority.

- Section 3

(3) A description of the: (a) Types of solid waste: (i) To be accepted, (ii) Not to be accepted; (b) Area and population to be served by the facility.

- Section 4

(4) The anticipated quantities of solid waste to be accepted and the calculations used to determine the useful life of the facility.

- Section 5

(5) Proposed methods of collecting and reporting data on the quantities and types of solid waste received and for revising facility life expectancy projections.

- Section 6

(6) The volume and type of available cover material, the calculated volume of earth needed for periodic, intermediate, and final cover, the location of earth stockpiles, and provisions for saving topsoil for use as final cover.

- Section 7

(7) Proposed means of controlling unauthorized access to the site.

- Section 8

(8) Proposed operating procedures including: (a) Hours and days of operation; (b) Number and types of equipment to be used; (c) Number of employees and their duties; (d) Provisions for fire prevention and control; (e) Means of preventing public health hazards and nuisances from blowing paper, odors, rodents, vermin, noise, and dust; and (f) Proposed method of daily operation including wet weather operation.

- Section 9

(9) The location and depth of solid waste cells and the sequence of filling.

- Section 10

(10) Natural or artificial screening to be used.

- Section 11

(11) Methods of controlling on-site drainage, drainage leaving the site, and drainage onto the site from adjoining areas. Erosion and sediment control provisions shall be approved by the local soil conservation district and satisfy the requirements of Environment Article, Title 4, Subtitle 1, and COMAR 26.09.01.

- Section 12

(12) A contingency plan for preventing or mitigating the pollution of the waters of this State.

- Section 14 and Appendix N (Contingency Plan).

(13) Proposed methods for covering and stabilizing completed areas.

- Section 16

(14) A system for monitoring the quality of the waters of the State around and beneath the site, including the location and types of monitoring stations, and the methods of construction of monitoring wells. Wells shall be installed by a State licensed well driller in accordance with COMAR 26.04.04.

- Section 17

(15) If the Department determines that contamination of waters of the State has occurred or is liable to occur as a result of operation of the landfill, the Approving Authority may: (a) Require the permit holder to periodically collect and analyze ground water or surface waters at the permitted site and to submit the results to the Approving Authority; (b) Specify the number and location of the sampling stations, the frequency of the analyses, the sampling and analyses procedures, the pollutants to be monitored, and the reporting period.

- Section 17 and Appendix J (Environmental Monitoring Plan)

(16) A schedule for implementing construction and implementation of the operation plans and engineering specifications once the refuse disposal permit has been issued.

- Section 18

(17) A landfill closure and post-closure plan to be followed over a period of not less than 5 years after application of final cover.

- Section 19 and Appendix O (Closure and Post-Closure Plan)

(18) The name, address, and telephone number of the person or agency responsible for the maintenance and operation of the site. Changes to this information shall be submitted to the Approving Authority once effected.

- Section 20

(19) An engineered design, as described in §C of this regulation, for a liner system and leachate collection system for the proposed rubble landfill based upon geotechnical information developed in Regulations .14 and .15 of this chapter.

- Section 13

(20) A proposed method, engineering specifications, and plans for the collection, management, treatment, and disposal of leachate generated at the facility, including the calculations used to determine the estimated quantities of leachate to be generated, managed, stored, treated, and disposed.

- Section 13

1.4.3 Permit Conditions

Terms and conditions in "*Part III: General Conditions*" of the TRL's existing refuse disposal permit 2019-WRF-0580 include information on the following seventeen specific items. It is anticipated that similar terms and conditions will apply to the TRL expansion; therefore, these items are identified below in italics followed by, in regular text, the location where the issue is addressed in this permit application.

(A) Waste Restrictions: (1) The permittee may accept solid waste as specified in this facility's Refuse Disposal Permit Application and its supporting documents identified in Part I of this permit, except as restricted or prohibited in this condition. (2) If the permittee accepts the following classes of waste as defined below, the acceptance of these materials is subject to the exceptions noted… (3) The following waste materials are specifically prohibited from being accepted at this site, regardless of their origin or type… (4) If sewage sludge, processed sewage sludge, or any other product containing these materials are proposed for storage, handling, or utilization at the landfill site, a separate application shall be submitted to the Biosolids Division

for a sewage sludge utilization permit. That permit must be issued prior to the acceptance on site of any sewage sludge. (5) Department, upon written request of the permittee, may amend the list in General Condition III.A…

- Section 4.2 and Appendix D (Operation and Maintenance Plan)

(B) Cell Floor Construction: (1) The permittee shall notify the Department… (14) No waste placement may commence in any cell unless and until the following requirements are fulfilled…

- Sections 10 and 13

(C) Protection of Liner and Leachate Collection System: A minimum of 4 feet of select waste containing no long pipes, boards, or other materials that could damage the liner and leachate collection system must be placed over the protective layer before compaction, to minimize the risk of damage to the liner and leachate collection system. No refuse hauling vehicles, equipment used for landfilling operations, or any heavy equipment shall operate over the leachate collection pipes and liner on the floor and side of the cell slopes until there is at least 4 feet of select waste placed upon the protective drainage layer. The permittee must notify the Department prior to the placement of the select waste.

- Sections 10 and 13 and Appendix D (Operation and Maintenance Plan)

(D) Leachate: (1) All ponded leachate occurring in areas…shall be collected and treated… (10) Should a force main be constructed to convey leachate to a sewer system, the following conditions shall be met: a) All pretreatment requirements established in COMAR 26.08.08 shall be met; b) A flow meter.. c)The force main shall be pressure tested prior to use…

- Section 13 and Appendix D (Operation and Maintenance Plan)

(E) Water Level Measurement: (1) The water elevations in all existing monitoring wells and piezometers shall be measured monthly and the readings shall be included in the semiannual water quality report referenced in this permit. (2) If examination of this information by either the permittee or the Department…

- Section 17 and Appendix J (Environmental Monitoring Plan)

(F) Written Reports on Water Quality Analysis: (1) Within 90 days of the effective date of this permit, the permittee shall submit a hard copy and a searchable electronic/digital copy to the Department for review and approval a Groundwater and Surface Water Monitoring (G&SWM) Plan. The Plan shall be prepared in accordance with COMAR 26.04.07.16A(14) and (15), and with the guidelines established by the Department… (5) A copy of a current groundwater contour map depicting the location of all monitoring wells from which groundwater data is collected shall

be included in each semiannual report on water quality. Multiple aquifers shall be depicted on separate groundwater contour maps.

- Section 17 and Appendices B (Groundwater Monitoring) and J (Environmental Monitoring Plan)

(G) Spreading and Compaction: Solid waste shall be spread in uniform layers and compacted to its smallest practicable volume before application of cover material.

- Sections 9 and Appendix D (Operation and Maintenance Plan)

(H) Solid Waste Lifts: A lift of solid waste may not exceed 8 feet in height except as specifically authorized in writing by the Department.

- Section 9 and Appendix D (Operation and Maintenance Plan)

(I) Periodic Cover: A uniform compacted layer of clean earth at least 6 inches in depth, or an approved cover material of a thickness specified by the Department, shall be placed over exposed solid waste by the end of the third day's operation, or more frequently as may be determined by the Department…

- Sections 9 and 16; Appendix D (Operation and Maintenance Plan)

(J) Intermediate Cover: Weather permitting, a uniform, compacted layer of clean earth not less than 1 foot in depth shall be placed over each portion of a lift not later than 1 month following completion of that lift. The intermediate cover layer may not be removed without written authorization from the Department.

- Sections 9 and 16; Appendix D (Operation and Maintenance Plan)

(K) Final Cover: (1) A uniform compacted layer of earthen material not less than 2 feet in depth shall be placed over any part of the final lift of refuse not later than 90 days following completion of that final lift. (2) Areas which have received final cover shall be mowed at least once a year, or more often if necessary, to control growth of woody vegetation and to allow facility personnel to inspect for signs of erosion, settlement, ponding of water, and leachate seeps.

- Sections 9 and 16; Appendix D (Operation and Maintenance Plan)

(L) Grading and Drainage: The disposal site shall be graded and drained to: (1) Minimize runoff onto the fill area of the sanitary landfill; (2) Prevent erosion and ponding within the fill areas; and (3) Drain water from the surface of the sanitary landfill.

- Section 12 and Appendices D (Operation and Maintenance Plan) and G (Stormwater Management System)

(M) Erosion and Sediment Control Plan: The permittee shall have a signed copy of a valid Erosion and Sediment Control Plan prepared in accordance with the requirements of COMAR 26.17.01 and approved by the appropriate approving authority prior to the construction of the landfill as authorized by this permit. An approved plan as required under COMAR 26.17.01 that covers all areas of the permitted facility must be maintained at all times during the life of this permit.

- Sections 12, 16, and 17. The Erosion and Sediment Control Plan dated October 2014 was revised in October 2019 by Bay Engineering (Revision 6).

(N) Stormwater Management Plan: (1) The permittee shall have a signed copy of a valid Storm Water Management Plan prepared in accordance with the requirement of COMAR 26.17.02 and approved by the appropriate approving authority prior to the construction of the landfill as authorized by this permit. (2) Means for separating and diverting uncontaminated storm water from the landfill cells may be proposed by the permittee. If approved by the Department, the plans and specifications for the separation and diversion of uncontaminated stormwater shall be incorporated into and become as part of this permit.

- Section 12, Appendix D Attachment 3 (Stormwater Pollution Prevention Plan) and Appendix G (Stormwater Management System)

(O) Water Supply Contingency Plan: (1) If a risk to public health due to contamination of the groundwater by the landfill has developed to the extent that provision for an alternative water supply for offsite water users may become necessary…(4) Should the Department determine that migration of contaminants from the property on which the landfill is located has occurred or is likely to occur, the permittee shall immediately implement the water supply contingency plan in accordance with the approved schedule.

- Section 14, Appendix N (Contingency Plan)

(P) Closure and Post-Closure: When the design capacity has been exhausted, the permittee shall cap the landfill in accordance with the requirements of COMAR 26.04.07.21. Furthermore, at least 6 months prior to cessation of landfilling operations, a closure plan shall be submitted to the Department. The plan shall contain the following elements…

- Section 19 and Appendix O (Closure and Post-Closure Plan)

(Q) Wetlands and Wildlife Protection: (1) Landfill construction and operation may not impact any regulated wetlands area until necessary authorization is received from the applicable State and federal wetland authorities. This includes construction of access roads, landfill cells, or other land disturbance, and pertains to wetlands regulated by the State of Maryland and/or the U.S. Army Corps of Engineers. (2) Landfill construction and facility operations, which may impact upon State or federally regulated endangered species, may not begin unless all necessary permits or authorizations are obtained from the applicable State or federal wildlife regulatory agencies.

2 SITE GEOLOGY AND HYDROGEOLOGY

2.1 Overview

As discussed in the previous section, the currently approved footprint remains unchanged; however, in order to optimize the capacity within the existing footprint, as shown in Drawing 3, the base grade will be lowered by approximately 26 ft. Therefore, the site geology and hydrogeology are mostly unaffected. However, this section presents a summary of the site geology and hydrogeology characteristics to facilitate the demonstration that the proposed vertical expansion complies with all pertinent requirements. Several field investigations were conducted to evaluate subsurface geologic conditions at the Site. The Site was originally proposed to be part of an expansion of the Cunningham Rubble Landfill (CRL) with a Phase I Report and Phase II Geologic Report completed by Marshall Engineering in 1993 and 1995, respectively. Environmental Technical Services (ETS) then revised and updated the expansion plan with a Phase I report in 2003. A Phase II Geologic report prepared by Environmental Resources Management (ERM) in 2006 built upon the 2003 report, proposing a new landfill on the Site and is included in **Appendix B**. In 2016, ERM submitted a Phase III report which was approved by the MDE. In March 2019, a field investigation was conducted at the Site to supplement the existing monitoring network. The following sections describe the regional and local site geology and hydrogeology as it applies to the proposed vertical expansion.

2.2 Regional Geology

The site lies within the Coastal Plain Physiographic Province. The sediments of the Coastal Plain consist of interbedded sands, silts, and gravels deposited unconformably over crystalline basement rock that dips in an eastwardly direction. These Coastal Plain sediments begin at the “fall-line”, located approximately 20 miles to the west of the site, and generally thicken to the east at a low angle. At the surface in the area of the site are Upper Cretaceous sediments of the Magothy Formation and Lower Cretaceous sediments of the Patapsco, Arundel Clay, and Patuxent Formations of the Potomac Group. There are also Pleistocene Age Patuxent River Terrace deposits near the Patuxent River that lie unconformably on top of the Cretaceous sediments.

2.3 Local Site Geology

The geology of the site is described in the Phase I Solid Waste Report and Phase II Geology Report (ETS 2003 and ERM 2006) and is classified as silt-clay facies of the Potomac Group overlying granular deposits of the Patuxent River Terraces. This is consistent with the surficial geology of the site and Anne Arundel County which has the site straddling fine-grained sands and silts in the northeast and sands and gravels to the southwest. Within the site boundary, the northeast area contains argillaceous, micaceous, glauconitic fine-grained sands and silts. The southwestern area of the site contains quaternary alluvium and tertiary terraces consisting of quarzitic sands, gravels, silts, and clays.

In March 2019, a field investigation was conducted that included the installation of nine soil borings at the Site. Soil borings were advanced using hollow-stem auger (HSA) drilling methods and soil samples were collected using a standard penetration test (SPT) split-spoon sampler. Samples were collected at 5 ft intervals starting at the ground surface and extending to the bottom of the soil boring. Six of the soil borings were completed as monitoring wells with depths ranging from 20 to 95 ft bgs and identified as MW-32A through MW-37A. The three remaining soil borings were advanced to depths between 55 and 105 ft bgs. The locations of monitoring wells are shown on **Drawing 2**. The wells installed are used to supplement the existing monitoring network. The following subsurface strata were encountered during the 2006 (ERM) and 2019 (Geosyntec) investigations:

- The Magothy Aquifer (0-50 ft thick; Upper Aquifers 1-4) was identified in all boring locations. While much of this layer has been excavated due to mining activities at the Site, the lower area of the Magothy Formation remains, and is characterized by interbedded layers of sand and white to light gray clay, with some coarse gravel.
- Four discontinuous layers of clay to clayey sands (~0-5 ft thick; Clay Lenses 1-4) were identified in many boring locations within the Magothy Aquifer at elevations of approximately 100-130 feet above mean sea level (ft-msl). These layers are characteristic of the lower area of the Magothy Formation.
- The Patapsco Formation (~0-200+ ft thick; Confining Units 1-4 and Lower Aquifer) was encountered in many deeper boreholes. This formation is the upper-most layer of three lithographic layers which make up the Potomac Group. The Patapsco Formation contains alternating aquifers and confining units.
- Three discontinuous layers of sand to silty sand (~0-10 ft thick: Sand Lenses 1-3) were identified in deeper boring locations extending into the Confining Unit of the Patapsco Formation. These lenses were found between 80 and 30 ft-msl, and are characteristic of the interspersed sand deposits often found in the Patapsco Formation.

The geologic and stratigraphic units are consistent across the site and are depicted in cross-sections A through D in **Appendix B**.

2.4 <u>Hydrogeology</u>

The hydrogeology of the site has been extensively characterized and monitored. There are two aquifers at the Site, the upper, unconfined aquifer and a deeper, confined aquifer beneath a dense confining layer that appears to be continuous across the Site. The unconfined aquifer lies above the low-permeability silt and clay sediments that are a hydrologic confining unit for the deeper aquifer (ERM, 2006). The shallow unconfined aquifer is present at depths ranging from approximately 15 to 40 feet below the landfill and is underlain by the confining unit at a depth of approximately 80 feet below the landfill.

The monitoring network consists of forty wells: 27 monitoring wells screened in the shallow aquifer and thirteen wells screened in the deeper aquifer. The shallow groundwater surface is located at approximately 93 to 117 ft -masl, and the deeper groundwater surface is located at approximately 50 to 65 ft -masl from the south to the northern portion of the site. Due to the anticipated lowering of base grades, depth to water level measurements were recorded monthly from January 2019 to October 2020 and they are tabulated in Table B-1. The maximum recorded water level for each monitoring well is shaded in grey. Time trend plots included in **Appendix B** present the long-term hydrographs for each well demonstrating that water levels have remained generally constant with minor seasonal fluctuations. Trends observed show lower than average water levels around May 2018 with maximum water levels reached in August 2019 followed by a return to previously observed typical conditions. Contour maps depicting the estimated potentiometric surface for the shallow and deep aquifers were created using maximum measured water levels between January 2019 and October 2020. The shallow potentiometric surface was created using the maximum monthly groundwater level for each well individually to so they can be used to compare against the proposed base grades. These contours are presented on **Drawing 2** and this surface is also shown on the Site the cross-sections included in **Appendix B**. This surface indicates that there is a vertical separation of greater than three feet between the maximum groundwater levels and the proposed base grades. The deep potentiometric surface is included in Appendix B (Figure B-1).

The direction of groundwater flow is generally south to southwest towards the Little Patuxent River. There appears to be a local groundwater high at shallow well MW-4A. The Focused Groundwater Evaluation (ERM, 2011) included with the Tolson Phase II report (ERM, 2016) identifies MW-4A as a location with a hydraulically upward gradient. Location MW-4A is adjacent to the wash pond which is likely influencing the groundwater characteristics in the vicinity of MW-4A. The sand and gravel unit that hosts the shallow unconfined aquifer is sufficiently permeable that the elevated groundwater in the vicinity of MW-4A is likely due to the local influence of the wash pond and does not reflect the long-term groundwater conditions at the site.

It should also be noted that random pockets, lenses, and thin layers of clays and silts may exist within the upper aquifer above the confining unit. These sediments may occasionally create areas of "perched" elevated groundwater by trapping the infiltrating precipitation. These areas are not continuous nor are they usable to extract groundwater. Mining operations at the Site also cause these isolated locations to dissipate quickly. Therefore, these areas of perched water are not considered to be aquifers.

2.5 Summary

In general, based on the information collected, the geology is consistent across the landfill Site. Water levels in the shallow aquifer fluctuate, on average, approximately 2.8 ft over the twenty-month monitoring period. The majority of the maximum measured groundwater levels in the shallow wells were recorded in May, June, and August 2019. Overall, the proposed base grades will maintain a minimum separation of three feet with respect to the maximum recorded groundwater level. There is a vertical separation of 4.5 feet in the western portion of the landfill to maintain the minimum buffer at the leachate collection sump in accordance with COMAR 26.04.07.16(6)(a).

3 OPERATIONAL FACILITIES

3.1 Introduction

In accordance with the requirements of COMAR 26.04.07.16.A(2), operational facilities are described in this section. It is noted that many existing operational facilities at the existing TRL facility will continue to be used during operation of the proposed TRL expansion. Such operational facilities are described below, including: (i) entrance and vehicle weighing facilities; (ii) communication equipment; (iii) maintenance and equipment storage facilities; (iv) employee sanitary and safety facilities; and (v) water supply and sewerage systems.

3.2 Facility Entrance and Vehicle Weighing Facilities

The entrance to the TRL is at the end of Capitol Raceway Road, where a combined entrance facility is located, which includes scale house, two-way scales, and administration building.

3.3 Communication Equipment

In addition to telephone service at the existing office building, a two-way radio system is used to facilitate communication among personnel throughout the landfill and to link the landfill working face with the scale house and office. The two-way radio system allows immediate response to any emergency and improves control over operations. Emergency contact numbers are also displayed next to the front door to the landfill office.

3.4 Maintenance and Equipment Storage

Site maintenance is conducted on site in coordination with sand and gravel mining operations and made available through an agreement with the operator of the mining operation. Servicing of small landfill operating equipment, as well as storing maintenance supplies and smaller backup equipment (i.e. submersible pumps), is conducted in the area with storage containers by the scale house.

3.5 Water Supply and Sewage System

Water, sewer, electric, and telephone services currently exist at the site in support of the existing waste disposal operation. Water is supplied to the scale house, which doubles as the site office, from a deep water well located approximately one-half mile south of the existing landfill. Sewage disposal for the scale house/office is provided by 1,500 gallon septic tanks.

4 WASTE TYPES AND SERVICE AREA

4.1 Introduction

In accordance with COMAR 26.04.07.16.A(3), a description of the types of solid waste that will be accepted, the types of solid waste that may not be accepted, and the area and population that will be served by TRL are described in this section.

4.2 Acceptable and Unacceptable Wastes

The expanded TRL will continue to accept only those waste types permitted at the existing TRL under current refuse disposal permit 2019-WRF-0580. A designated list and description of acceptable and unacceptable waste types is provided in the Operation and Maintenance Plan (**Appendix D**). Solid waste disposal at the TRL will be brought from municipalities, industries, collection, or transportation entities. Generally, wastes disposed at TRL will be a heterogeneous mixture of land clearing waste, demolition debris, construction debris, household appliances, and non-friable asbestos waste. Procedures for inspection and visual observation of incoming waste at the TRL entrance area and the landfill working face, as well as procedures to be followed if unauthorized wastes are identified, are provided in the Operation and Maintenance Plan (**Appendix D**).

4.3 Service Area

The TRL will receive rubble and other acceptable wastes (e.g., construction debris, land clearing debris, demolition debris) from any municipality, industry, collection, or transportation entity that demonstrates that the waste intended for disposal meets the criteria for acceptable waste types identified in the final Refuse Disposal Permit issued for the facility. The facility will primarily serve Anne Arundel County and surrounding areas, but may also receive acceptable waste from outside of the area without geographic limitations.

4.4 Population

According to 2010 U.S. Census data, the total population of Anne Arundel County was about 538,000 and projected to 2018 is 579,000. Based on projected data from Maryland Department of Planning, the county's population has grown by about one percent per year since the year 2000 and is expected to continue to grow. Tolson intends to use the proposed vertical expansion of TRL to provide additional waste disposal capacity to accommodate population and construction growth. The anticipated quantities of waste received, and facility life projections based on these population estimates, are described in Section 5.

5 ANTICIPATED WASTE QUANTITIES AND FACILITY LIFE PROJECTION

In accordance with COMAR 26.04.07.16.A(4), the anticipated quantities of solid waste that will be accepted and the calculations used to determine the useful life of the expanded TRL are presented in this section. Calculation details are provided in **Appendix C**.

The 2019 Solid Waste Report for TRL indicates that 283,000 cy of waste has been placed to date. The original permitted airspace is 5,762,060 cy. Based on the original permitted design, and budgeted yearly tonnage of 400,000 tons, TRL will exhaust their current permitted disposal capacity in 2028. Assuming construction of the first cell of the new TRL to allow uninterrupted transition of waste disposal operations, it is anticipated that about 400,000 tons of CDD waste will be disposed annually. Using an airspace utilization factor of 0.6 tons/cubic yard, the estimated remaining disposal capacity for the vertical expansion of TRL of approximately 9,160,000 cy, calculations of the projected annual waste disposal rate, and placed waste to date, TRL will exhaust the expanded disposal capacity in 2034.

6 METHODS OF REVISING WASTE TYPES, QUANTITIES, AND FACILITY LIFE PROJECTION

In accordance with COMAR 26.04.07.16.A(5), this section describes the proposed methods for: (i) collecting and reporting data on the quantities and types of solid waste received at the landfill; and (ii) revising the projections of the expanded TRL life expectancy.

The quantity of solid waste landfilled will be reported both in tons (weight) and in-place cubic yards (volume). The volume of solid waste received at the Site (i.e., airspace) will be estimated based on aerial surveys of the landfill disposal areas. Consumed airspace will be calculated by comparing the pre-waste disposal contours to the post-waste disposal contours. The weight of the waste will be estimated based on the sum of weights of waste in all vehicles that enter the Site, as measured at the truck scales. As described in detail in the Operation and Maintenance Plan (**Appendix D**), the scale house attendant will record the type of waste received and will perform random spot inspections as they enter the Site.

The life expectancy of TRL will be revised by dividing the total remaining airspace by the volume of waste that is expected to be received each year. A projected consumption of 400,000 tons per year is used to estimate the current yearly consumption and the growth rate of airspace consumption. Note that the projected date at which the landfill will reach its capacity is dependent on the actual in-place density of solid waste. The cumulative in-place density of solid waste will be estimated by dividing the cumulative weight of waste by the cumulative consumed airspace. This data can be then used to verify the life expectancy of TRL based on the annual tonnage records.

A written report will be submitted annually to MDE concerning the status of TRL for each year the landfill is in use. The report will be submitted no later than 60 days following the date specified in the permit and will include:

- The quantity (reported both in tons and in-place cubic yards) of solid waste that was landfilled and materials recycled at the facility during each of the preceding 12 months;
- An estimate of the total quantity of soil material that was used in the landfill during each of the previous 12 months;
- An estimate of the percentage of total landfill capacity that was used for placement of solid waste and the percentage that was used for soil cover materials; and
- An estimate of the projected date at which the landfill will reach its maximum disposal capacity and the premises upon which this determination was made.

7 COVER MATERIAL

7.1 Introduction

In accordance with the requirements of COMAR 26.04.07.16.A(6), the volume and type of available cover material, the calculated volume of earth needed for daily, intermediate, and final cover, the location of earth stockpiles, and provisions for saving topsoil for use as final cover are presented in this section.

7.2 Volume and Type of Available Cover Material

The primary source for cover materials will be: (i) existing soil borrow areas from the on-site sand and gravel operations; (ii) approved plastic tarps; or (iii) alternative cover materials approved by MDE.

7.3 Volume of Cover Soil Requirements

The calculated net airspace of TRL is approximately 9,440,000 cy. The maximum volume of soil needed for periodic and intermediate cover soil is estimated as a percentage of the net airspace (available volume between the bottom of the final cover and the top of the protective layer). Typically, well-operated landfill facilities use about ten percent of the net airspace for periodic and intermediate cover. Hence, approximately 944,000 cy of soil will be needed for periodic and intermediate cover.

The total area of the proposed TRL is approximately 72.1 acres. The volume of soil needed for the installation of a 2-ft thick final cover, (1-ft thickness of intermediate cover plus 1-ft thickness of final cover soil above the intermediate cover, to provide a total 2-ft thick grading layer below the geomembrane as shown on **Drawing 12**) plus 2-ft thickness of closure cap soil over the entire five-cell landfill area is 465,000 cy, of which 58,000 cy will be topsoil (see **Appendix K.1**).

In total, therefore, the volume of soil needed for the operation and final closure of the landfill is approximately 1,409,000 cy.

7.4 Stockpile Locations

Because the site is currently also being used for soil and aggregate extraction and due to the proximity of the site's soil borrow areas to the working face, there will not be a specific stockpile area as it will be more practical to haul the soil from the borrow soil areas directly to the working face. However, small soil stockpiles may be located close to the working face for use as periodic cover or for rehabilitation of the driving and tipping areas. The location of these stockpiles will be determined as necessary and they will be of temporary use.

7.5 Topsoil

Topsoil has already been removed for current site operations and is stored in a distinct topsoil pile. Topsoil will be redistributed in a six-inch layer over the completed, capped landfill cells as one of the final steps in construction of the final landfill cover system.

8 SITE ACCESS CONTROL

In accordance with the requirements of COMAR 26.04.07.16.A(7), the means for controlling public and unauthorized access to the site are described in this section.

The existing means of access control at the TRL will continue to be utilized during operation of the expanded facility. Chain-link fences have been installed around the facility perimeter to restrict access by unauthorized personnel and vehicles. All traffic entering the facility must enter using the main entrance road from Capitol Raceway Road, directly observable from the scale house. The entrance is controlled via double chain-link lockable gates. Disposal of waste and delivery of construction and other materials is only allowed during the facility's operating hours, which are posted on a conspicuous sign before the entrance when driving down Capitol Raceway Road. Security, monitoring for unacceptable waste, and direction of individuals (as necessary) is provided during operating hours by site personnel stationed at the scale house. Only authorized trucks and personnel are allowed past the scale house; unauthorized trucks and personnel are turned back. Signage is provided to direct landfill traffic to appropriate disposal locations. Further details of site access control and security measures are provided in the Operation and Maintenance Plan (**Appendix D**).

9 OPERATING PROCEDURES

9.1 Introduction

The Operation and Maintenance Plan for the expanded TRL was developed based on the approved Operation Manual for the existing TRL. The Operation and Maintenance Plan is included in **Appendix D**. In accordance with the requirements of COMAR 26.04.07.16.A(8), proposed operating procedures are described in the Operation and Maintenance Plan as summarized in this section, including: hours and days of operation; number and types of equipment to be used; number of employees and their duties; provisions for fire prevention and control; means of preventing public health hazards and nuisance from blowing paper, odors, rodents, vermin, noise, and dust; and proposed method of daily operation including wet weather operation.

9.2 Hours and Days of Operation

Consistent with the existing TRL Facility, the expanded TRL will be open to receive solid waste between the operating hours of 7:00 a.m. and 5:00 p.m. Monday through Friday. Compaction and application of periodic cover will normally be completed within one hour of the daily closing time at the end of each third day's operation. The landfill will be closed on Saturdays, Sundays, and some holidays.

9.3 Operating Equipment

On-site equipment is identified in Table 2 of the Operation and Maintenance Plan (**Appendix D**). The operating equipment generally falls into three categories, listed below:

Heavy compaction equipment specifically designed for landfill applications is used to crush and densify solid landfilled material. Special cleats break up materials of awkward dimensions (e.g., lumber). These wheel-like machines are driven across relatively thin layers of waste and can achieve in-place waste densities up to 1,200 lb/yd^3 (70 kN/m^3).

Heavy earth-moving machinery is required to remove soil overburden, excavate cover material, and to relocate construction materials for berms, roadways, and drainage features. Additionally, this machinery is used to move daily, intermediate, and final cover materials during landfill operations. Bulldozers, loaders, scrapers, and dump trucks will be maintained on site at all times.

Service and light machinery are used to support landfill operations and, to a lesser extent, construction. Included are: a machinery service truck for carrying fuel, lubricants, engine fluids, easily-replaced parts, and tools; a pickup truck primarily for transporting employees and collecting litter; surface maintenance equipment; miscellaneous vehicles such as water trucks and a hydro-seeder; and water pumps to relocate rainwater that may pond during construction and drain groundwater at soil excavations.

All equipment will be routinely serviced and thoroughly cleaned according to the manufacture's servicing policy, at a minimum. In the event that essential equipment becomes inoperable, the Landfill Supervisor will procure appropriate replacement equipment from local equipment rental companies within 24 hours.

9.4 Landfill Staff and Responsibilities

Landfill personnel requirements are identified in Section 5 of the Operation and Maintenance Plan (**Appendix D**). The landfill operational staff will consist of a Landfill Supervisor, equipment operators, laborers, and scale house attendants. The scale house attendants will be on site during operating hours to monitor and measure incoming waste and direct traffic. Ultimate responsibility for accepting/rejecting waste shall rest with the Landfill Supervisor.

The operation of the landfill must be directed by a responsible, knowledgeable person for the proper implementation of the landfill operations and maintenance plans. The Landfill Supervisor must be able to: communicate with landfill personnel, administrators, and haulers; understand and implement the intent of plans and specifications; maintain all components of the landfill in a fully operational posture; have a working knowledge of construction, engineering, equipment, sequence of operations, grading, and all other operations related to landfill development.

9.5 Fire Control

Procedures that will be taken to protect against fires are identified in Section 9.4 of the Operation and Maintenance Plan (**Appendix D**). Protection against fires will include providing fire extinguishers on the landfill equipment. In addition, all operators will be on alert for any indication that a load of waste may be smoldering or about to ignite. Operators will also be trained in procedures to follow in the event that a smoking or smoldering load of waste is observed. Smoking will be prohibited on site except in designated areas. Burning of solid waste shall not be allowed except as permitted by MDE. Emergency procedures to be followed in the event of a non-waste fire are described in the Section 11 (Contingency Plan) of the Operation and Maintenance Plan (**Appendix D**).

9.6 Public Health Hazards and Nuisances Prevention

Procedures that will be followed to protect public health and prevent nuisances, as required by COMAR 26.04.07.10(N,P), COMAR 26.02.03, and MDE standard permit conditions, are addressed in Section 3.2 of the Operation and Maintenance Plan (**Appendix D**). Specific measures for control of litter, dust, vectors, noise, odors, and unacceptable wastes are summarized below.

Litter Control. Preventive measures are necessary to preclude the unwanted release of solid waste to the environment. Litter can be controlled through "trap laws," which are local requirements that all transported debris is secured and/or covered. Incoming refuse hauling vehicles shall remain covered until they have reached the designated untarping area. Vehicles are untarped at the scale house so that the incoming load can be inspected, but are then re-tarped until reaching the active working face to reduce the potential for the release of litter and debris. In the event that a hauling vehicle is present on the haul road uncovered, the driver of the vehicle will receive a written warning; the driver will be provided with a copy of the warning and a copy will also be included in Tolson files. On a second offense, the waste hauler will no longer be permitted to dispose of refuse at TRL. Litter at the working face will be kept to a minimum by quick compaction coupled with the practices of providing some shelter from prevailing winds through the construction of screening berms. Placement of approximately six inches of periodic cover material onto the working face at the end of each third working day is one preventive measure that will be employed at the landfill to minimize blown litter.

Portable litter fencing will be placed immediately downwind of the working face to collect windblown material. The fences will be cleaned daily (more frequently during windy days) by operations personnel, and the waste will be redeposited in the active working face area.

Blown litter and debris will be collected daily by laborers. Debris that falls off trucks or otherwise occurs at the Site will be picked up as discussed above and disposed in the landfill disposal area. The Site access roads, vehicle staging areas, maintenance area, and other active operational areas will have daily inspection for litter and litter will be picked up as needed. The boundary will be monitored on a daily basis, and the waste that collects along the boundary will be collected as necessary to prevent nuisance conditions. Capitol Raceway Road will be inspected on a weekly basis and as needed to respond to nuisance complaints. Collected waste will be disposed of at the working face.

Odor Control. The application of periodic cover is generally a satisfactory measure to prevent the development of odor problems. Regular inspection and maintenance of periodic cover for soil shrinkage cracks or erosion of previously filled areas will help to minimize odors. Should odors become a problem at TRL, an on-site evaluation will be performed and appropriate remedial actions taken based on the results of the evaluation.

Vector Control. Periodic application of cover soil prevents problems associated with rodents, vermin, and birds. A rodent population generally will not establish on a rubble landfill, nor will populations of birds or other vermin.

Noise Control. The noise generated at the site is potentially derived from two sources: waste compaction or earthmoving equipment and waste-carrying vehicles. The equipment creates high noise levels when operating, but this type of noise should not become a nuisance problem off site due to buffers around the site and the low volume of traffic. On-site noise control for employees will be governed by the Occupational Safety and Health Administration (OSHA) Standards. Noise control measures for the site will be implemented in accordance with COMAR 26.02.03.

Dust Control. A comprehensive dust prevention and control program will be implemented at the Site. The landfill perimeter road and the temporary access roads in and around the disposal and borrow areas will be constructed and maintained, when possible, with an aggregate or asphalt milling surface instead of dirt surface, to limit the generation of dust. Dust will primarily be controlled through the application of water to access roads and other surfaces from which dust could be generated. A truck equipped with a portable water storage tank (water wagon) will be used periodically to dampen these surfaces as conditions warrant. Commercially available chemical dust suppressants may also be utilized to reduce dust as needed and as approved by MDE. The generation of dust will also be reduced by the establishment of vegetative cover on final and intermediate slopes of the landfill as soon as practicable. Finally, a power broom will be used to remove accumulated soil from paved roadways in order to minimize the spread of dust and mud drag out onto public roads.

9.7 Daily Operation

Daily operation of the expanded TRL will be performed in full accordance with the requirements of COMAR 26.04.07.18(A-U), as well as conditions stipulated in the operating permit for the facility. Daily operating procedures are discussed in detail in Section 2 of the Operation and Maintenance Plan (**Appendix D**). Section 2.7 of the Operation and Maintenance Plan outlines the procedures for preventing acceptance and disposal of unauthorized wastes. A brief description of daily operating procedures is provided in this section.

A controlled flow of waste materials will be directed at all times to the working face of the landfill where placing, spreading, and compaction of waste will occur on a systematic basis. Cells will generally be filled starting at their low point to minimize leachate generation and maximize landfill stability, and no waste will be placed in ponded water. Furthermore, grading at the Site will be maintained to minimize runoff onto fill areas, to prevent erosion and ponding, and to drain water from the surface of the landfill. All incoming loads of solid waste will be inspected at the scale house and at the working face and only acceptable waste will be allowed for filling as described in Section 4.2 of this Report. Lifts will be placed and compacted in layers not exceeding eight feet in height. The working face slope will be maintained at 4H:1V or flatter to enhance landfill stability and to facilitate proper compaction.

At the end of each third working day, a six-inch-thick periodic soil cover layer (or other approved alternative periodic cover material) will be spread over the waste, as described in Section 2.10 of the Operation and Maintenance Plan. The following morning when the working face is opened, an area of the periodic cover will be pushed into a stockpile to be used as part of the cover at the end of the third day. The cover material will be stockpiled at or near the working face, with runoff from the stockpile confined to the working face to prevent the runoff of waste to other locations of the Site. Stockpiled material will be used to cover flat, finished areas of the landfill before being covered with additional clean cover material. Stockpiled material will not be reused in other areas of the landfill. This practice will create a window between the two lifts that minimizes barriers in the landfill for leachate and gas movement.

9.8 Inclement Weather Operation

Operation of the TRL during inclement weather is described in Section 2.14 of the Operation and Maintenance Plan (**Appendix D**). During hard rain events, waste compaction will continue. The stormwater management system has been designed to handle such events. The presence of mud can create traffic difficulties on sloped or can mire vehicles on level ground. Therefore, use of soils will be carefully planned and precautions taken, such as:

- Stormwater in cells will be removed as leachate or handled as stormwater runoff;
- The drainage system will be maintained and kept free of debris and silt collected therein;
- Slope angles will be maintained to promote positive drainage, especially at the working face; and
- Stabilizing haul roads and temporary the waste tipping area at the working face will be kept passable.

Any area of eroded intermediate or final cover material will be maintained by promptly filling, grading, and stabilizing with vegetation, as necessary, to control further erosion. No special waste placement procedures are necessary during inclement weather beyond the minimization of the working face area and maintenance of soil cover in order to minimized infiltration and odors.

10 LANDFILL CELL DESIGN

10.1 Introduction

The proposed TRL expansion has been designed to conform the minimum requirements outlined in COMAR 26.04.07.16.C(3). In this section, a discussion of the following landfill cell design issues is provided below.

1. Post-settlement grades of the landfill cell are sufficient for leachate flow (i.e., COMAR 26.04.07.16.C(3)(e)).

2. Buffer distance between the liner system and groundwater table complies with regulatory requirements (i.e., COMAR 26.04.07.16.C(6)(a)).

3. Differential settlement will not cause excessive strain in the liner system (i.e., COMAR 26.04.07.16.C(3)(a));

4. The liner system should have sufficient puncture resistance to construction and operation loading (i.e., COMAR 26.04.07.16.C(3)(a));

5. The drainage/protective layer material can be placed on the sideslope while maintaining sufficient stability (i.e., COMAR 26.04.07.16.C(3)(a));

6. The components of the liner system should be compatible with the expected leachate constituents of municipal solid waste;

7. The landfill should have sufficient factor of safety against instability under short-term and long-term conditions; and

8. The landfill should have sufficient factor of safety against instability during a design seismic event.

The first six design issues above are discussed in Section 10.2 next, while the seventh issue is discussed in Section 10.3. With regard to the eighth issue, the site is not located in a seismic impact zone. According to 40 CFR 258.14, a seismic impact zone is identified as an area with a ten percent or greater probability that the maximum horizontal acceleration (MHA) in lithified earth material, expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10g in 250 years. The MHA in bedrock for the proposed facility is estimated to be less than 0.08g (USGS, 2013). A two percent probability of exceedance in 50 years is approximately equivalent to a 10 percent probability of exceedance in 250 years. Hence, the TRL is not considered to be located in a seismic impact zone.

10.2 Description of Solid Waste Cells and Liner Design

10.2.1 Landfill Cell Layout and Liner System

The proposed expanded TRL covers an area of approximately 72.1 acres. **Drawing 3** shows a grading plan of the prepared subgrade for the liner system while **Drawing 4** shows a grading plan for the leachate management system (i.e., top of clay). The base of the landfill cells will be graded to maintain a minimum two percent post-settlement slope. Leachate on the cell floor will be collected by 8-inch diameter perforated HDPE pipes and transferred to the leachate collection system. The leachate collection pipe corridor within the cells will be constructed to maintain a minimum 0.5 percent post-settlement slope. The cell will have excavated below-grade sideslopes with a maximum inclination of 2H:1V; the maximum height of the side slopes is 74 feet. Details of the liner and leachate collection system are shown on **Drawings 5 to 10**.

The liner system proposed for TRL is comprised of the following components, from top to bottom (see details on **Drawing 5**):

- 12-in. minimum sand protective/drainage layer with hydraulic conductivity greater than 10^{-3} cm/sec;
- Geocomposite drainage layer;
- 60-mil HDPE textured geomembrane; and
- 24 in. thick prepared subbase with hydraulic conductivity less than or equal to 1×10^{-5} cm/s.

Engineering specifications for the above liner components are provided in **Appendix L**. The surface of subgrade soils will be prepared in accordance with specifications prior to installation of the geomembrane. The thickness of the subgrade soils shall be such that a minimum 36-in. buffer exists between the base of the prepared subbase and the top of groundwater (based on highest observed conditions, see **Appendix B**) across the entire base area of the landfill, in compliance with COMAR 26.04.07.16.C(6)(a).

10.2.2 Landfill Cell Grades and Liner Settlement

Geosyntec conducted liner settlement analyses based on filling the landfill to the proposed elevation of 240 ft-msl. Calculated settlements are used to determine if the minimum specified slopes of the drainage layer and the leachate collection pipes are adequate to provide positive drainage throughout the life of the facility. The analyses are presented in **Appendix E.1**.

Seven cross sections were selected for settlement analysis. Six of these sections (A-A’, B-B’, C-C’, D-D’, F-F’, and G-G’) run along the proposed leachate collection pipe corridors and section

E-E' runs perpendicular to the liner slope (i.e., in the direction of leachate flow towards the leachate collection pipe). These cross sections were chosen for analysis as they are all located near the center and the highest point of the landfill (240 ft-msl) where the most settlement is likely to occur, or because the waste height differential across the length of the cross sections produced a higher likelihood of grade reversal post-settlement. To reduce the potential of grade reversal throughout the life of the landfill, the post-settlement liner slope should be steeper than two percent. Similarly, the leachate collection pipes must also maintain positive drainage after settlement has occurred, with a slope of 0.5 percent or greater. The minimum post-settlement slopes along Sections A-A', B-B', C-C', D-D', F-F', and G-G' is 0.51 percent along Section F-F', which will maintain positive post-settlement drainage along the leachate collection pipe. The minimum post-settlement slopes along Section E-E' is 2.16 percent. This exceeds the required minimum post-settlement liner slope of 2.0 percent.

10.2.3 Liner Strength and Puncture Resistance

The maximum calculated geomembrane strain due to differential settlement is 0.0079 percent (see **Appendix E.1**), which is much lower than the typical yield strain of HDPE geomembrane of approximately four to five percent. Therefore, the integrity of the liner system is not expected to be influenced by differential settlement.

In order for the geomembrane to work efficiently as a barrier layer, puncturing of the geomembrane should be prevented. If a puncture on the geomembrane occurs, the puncture will be repaired, and the repair will be leak tested. The capability of the liner system to resist the additional overburden loading imposed by the overlying waste is evaluated in **Appendix E.2**. The analysis shows that the puncture resistance of the HDPE liner exceeds the expected overburden loading with sufficient FS. Therefore, the integrity of liner system will be maintained during waste filling.

10.2.4 Liner Veneer Stability

Because sliding during placement of the sand drainage/protective layer may take place, veneer stability of the liner system on the 2H:1V sideslope was evaluated. Among the different components of the liner system, the geomembrane-geocomposite interface (above the geomembrane) and geomembrane-CCL or geomembrane-GCL interface (below the geomembrane) were identified as most critical (i.e., the interface with the lowest interface friction angle).

The FS against veneer slope failure was calculated using a published sliding wedge failure analysis method for geosynthetic-soil layered systems along a critical interface of a finite slope length as presented in **Appendix E.3**. The calculation showed that the FS against veneer instability above the geomembrane is 4.76, while the FS against veneer instability below the geomembrane is 2.63.

Both values are greater than the required factor of safety of 1.25, indicating that slippage along the liner interfaces is unlikely to occur.

10.3 Landfill Stability Analyses

Geosyntec conducted a slope stability analysis to calculate the factor of safety against global sliding. The stability analysis is included as **Appendix F**. Based on the results of subsurface investigation presented in the Phase II Report (ERM, 2006), four idealized cross sections representing the most critical conditions were developed as indicated on Figure 2 in **Appendix F**. All three cross sections cut through the landfill at its near-maximum height.

Conservative values were assumed for the material properties used in the analysis. Based on the subsurface investigation, there are two main foundation soils at the site. The top layer consists of loose to medium dense fine to medium sands with standard penetration test (SPT) blow counts ranging from 2 to 48 blows/ft. Based on empirical correlations between friction angle and SPT blow counts for medium sand, the friction angle was assumed to be 30˚. A layer of generally stiff to very stiff high-plasticity clay was found beneath the sand layer. The SPT blow counts within the clay layer ranges from 20 to 40 blows/ft. Based on empirical correlations between friction angle and SPT blow counts for cohesive soils, the effective shear strength envelope was represented by a friction angle of 30.5˚ with a cohesion of 500 psf, and the undrained shear strength was assumed to be a cohesion of 3,000 psf. Clay seams were found in the sand layer. Based on empirical correlations between friction angle and SPT blow counts for cohesive soils, the effective shear strength envelope was represented by a friction angle of 30.5˚ with no cohesion and the undrained shear strength was assumed to be a cohesion of 1,100 psf.

The global stability of the selected cross-sections was evaluated based on limit equilibrium theory using the methods of slices. Both circular and block failure surfaces were evaluated. The circular failure surface analyses search for the minimum factor of safety against global instability. For block (non-circular) failure surface analysis, two search windows were used to search for critical non-circular failure surface that cut through the potentially weak material within the foundation soil. Additionally, a polyline was used to evaluate the failure along the liner system. The geomembrane-CCL or geomembrane-geocomposite interface was identified as the most critical interface, which was assumed to have a friction angle of 17°. The minimum calculated factor of safety was 1.52, which exceeds the minimum factor of safety for the long-term condition of 1.5 recommended in the technical manual entitled "Solid Waste Disposal Facility Criteria" (USEPA, 1993).

10.4 Liner Overlay Tie-In at the Cunningham Rubble Landfill

The Tolson liner system will overlay the closed CRL, as shown in **Drawing 3**. When the overlay liner system is constructed, the existing gas vents will be cut and extended beneath the liner system (described in Section 15.5) and the overlay liner will be tied in to the existing CRL liner, as shown in Details 3 and 4 on **Drawing 8**. At the location of the tie-in, a toe drain will be installed to intercept precipitation that has infiltrated cover soils at CRL and is travelling above the CRL liner system, and will outlet into the stormwater conveyance system on either side of the closed CRL. An evaluation of the overlay liner toe drain pipe capacity is included in **Appendix E.4**. The analysis shows that the pipe capacity of the toe drain exceeds the potential water infiltration. The location of the toe drain is shown on **Drawing 11**.

11 NATURAL AND ARTIFICIAL SCREENING

In accordance with the requirements of COMAR 26.04.07.16.A(11), natural or artificial screening will be used as presented in this section.

Natural screening of tree lines will be used at the Site. Currently, the northwest, west, and southeastern perimeters of Site are predominately forested with mature trees. To the northeast of TRL, there is a strip of mature trees above a 30-foot screening berm which screens the existing quarry operation from the abutting residential area. Additional trees will be added if necessary.

It is believed that the existing and proposed vegetation will adequately screen landfilling operations and associated noise from nearby residents and motorists traveling on adjacent roadways. Should nuisance occur, the area of concern will be evaluated, and appropriate actions taken if necessary.

12 SITE DRAINAGE AND STORMWATER MANAGEMENT

12.1 Overview

In this section the design and methods for controlling on-site drainage and stormwater runoff associated with TRL expansion are presented. As required by COMAR 26.04.07.16.A(11), the stormwater and erosion and sediment control (ESC)designs will be submitted, reviewed, and approved by the appropriate local agencies. The Anne Arundel County Soil Conservation District (SCD) will also review stormwater management plans for conformance with COMAR 26.17.01 requirements for ESC. The site currently has an approved ESCC plan (ERM, 2014, Bay Engineering, revised 2019).

The following aspects of the stormwater design for TRL are presented in the remainder of this section:

- Overview of the local stormwater and ESC permit review and approval process;
- Analysis and design for permanent ESC structures; and
- Analysis and design for permanent stormwater management conveyance and detention features.

12.2 Local Stormwater Review and Approval

In accordance with the requirements of Anne Arundel County Stormwater Management Act (2007), site development projects require implementation of Environmental Site Design (ESD) procedures in accordance with the *2009 Maryland Stormwater Design Manual*. Implementation of ESD requires early contemplation, review, and approval of conceptual plans that incorporate low-impact stormwater design elements and strategies, followed by two additional rounds of detailed design preparation, review, and approval. The three stages of stormwater management design preparation, review, and approval are identified as Concept Plan, Preliminary Plan, and Final Plan.

Because the stormwater management plan for TRL is for the final closed configuration, and because of the long-term horizon associated with constructing, developing, and filling TRL (closure is not expected until 2034, **Appendix C**), the approved ESC plan provides the appropriate level of detail for inclusion in this Report. A detailed design of the remaining ESD stages (i.e., Preliminary and Final Plans) will be completed as part of the Closure Plan for the Landfill prior to preparation of Closure Construction Documentation.

The specific aspects of stormwater management, erosion, and sediment control planning and design presented in this Report, include:

- Evaluating the minimum sizing requirements for permanent sediment control features;
- Verify the proposed geometry of the various stormwater management features;
- Verify the lining material for the proposed downchutes; and
- Verify that the sizing and hydraulic function of the stormwater management pond and sediment traps are not exceeded by the proposed expansion.

12.3 Erosion and Sediment Control

Erosion and sediment control practices will be the primary methods used to manage and treat runoff from the site throughout landfill operations. The current ESC Plan (2014, Revised 2019) for operations and submitted to the Anne Arundel SCD will continue to be implemented in accordance with the expansion of TRL. The existing stormwater pond and sediment traps will continue to be utilized through the lifetime of the facility and following closure. The primary features used for permanent erosion and sediment control at the site will be the landfill perimeter channel, stormwater management/sediment pond, sediment traps, drainage terraces, and downchutes. Temporary ESC during construction and operation of TRL will be managed through use of practices from the *2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control* including, but not limited to, stabilized construction entrances, staging areas, stockpile areas, super silt fence, perimeter swales and dikes, and sediment trapping devices. Erosion and Sediment Control Plan for operations will be updated and resubmitted every five years for approval as required by the Anne Arundel County SCD.

12.4 Stormwater Management

The Stormwater Management Plans that illustrate the specific details for grading and construction of permanent and temporary erosion and sediment control structures, as well as details for grading and construction of permanent stormwater management features will be prepared as part of the Closure Plan for the TRL prior to initiating construction of the final closure capping system. These plans must be consistent with the approved TRL permit design.

Permanent stormwater management features will be used to convey and treat stormwater runoff from the landfill final cover. Runoff will be treated to manage post-development stormwater quality and quantity prior to discharge. The stormwater management features to be designed for this project include the following typical conveyance and structural detention features.

- Perimeter channels, cover terraces, downchutes, and the cover access road channel will convey surface-water runoff based on the 25-year, 24-hour storm event
- A storm water detention basin (existing) will collect and detain surface water runoff from the 2-year frequency storm event, provide WQ_v management, and safely pass the runoff

from the 100-year frequency storm event prior to discharging to onsite natural stream channels; and

- Three sediment traps will collect surface water runoff and provide WQ_v management prior to discharging to stable outfall locations

Stormwater runoff from the landfill cover will be managed using cover terraces, downchutes, the cover access road channel, and perimeter channels. Water will be conveyed from the cover terraces to downchutes, which will empty into the perimeter channels. The cover access road channel will convey runoff from the cover access road to the perimeter channels. The perimeter channels will convey runoff to the stormwater detention basin and sediment traps for treatment. The perimeter channels, cover access road channel, and cover terraces will be spaced such that the maximum vertical drop of overland flow of water is not generally greater than 40 ft. Cover terraces will slope longitudinally at approximately two percent and the perimeter access road will slope toward the pond/traps at roughly one percent. The layout and main features of the final stormwater management system, based on the stormwater management analysis provided in **Appendix G,** are shown on **Drawing 11**. Details are provided on **Drawings 12** through **14**.

13 LEACHATE MANAGEMENT

13.1 Introduction

In accordance with the requirements of COMAR 26.04.07.16.C(7), the existing leachate collection system was designed: (a) such that the materials are chemically resistant to the waste managed in the landfill and the leachate expected to be generated; (b) such that the materials are of sufficient strength and thickness to prevent collapse under the pressures exerted by overlying wastes, waste cover materials, and by any equipment used at the landfill; (c) so the system will function without clogging; (d) to ensure that the leachate depth over the liner does not exceed 30 centimeters (1 foot); and (e) to operate solely by the force of gravity in all areas where the system will directly underlie solid waste. In what follows, a description of the existing leachate collection system and how it meets the requirements outlined above is presented.

13.2 Leachate Quantity Estimates and Pipe Sizing

The USEPA's Hydrologic Evaluation of Landfill Performance (HELP) Model, Version 3.07 (USEPA, 1994) was used to estimate the leachate generation rate and head on the liner. Leachate quantities generated were calculated based on estimated rates of leachate production during four different phases of landfill cell development and operation (i.e., open cell, periodic cover (daily cover), intermediate cover, and final cover) The HELP Model performs a water-budget computation to predict leachate generation rates for a given configuration of soil, waste, geosynthetic layers, and precipitation conditions.

The HELP analysis is provided in **Appendix H.1**. The HELP analysis results provide peak daily, average monthly, and average annual leachate flow rates. The same design liner system was modeled in all four scenarios. The modeled average peak daily leachate head on liner was less than 12 inches for all four landfill development conditions. During operation, the maximum monthly leachate generation rate is estimated to range from approximately 55,900 gal./acre for the open cell condition to between 24,400 gal./acre and 25,000 gal./acre for the periodic and intermediate cover conditions, respectively. Based on the various operating scenarios modeled in **Appendix H.1** (i.e., realistic combinations of open, daily/intermediate cover, and final closure of the various cells), the maximum average daily leachate generation rate is about 71,300 gallons. This represents the worst-case scenario when all seven of the cells have been developed, with cells 1 through 5 having an intermediate cover, cell 6 having a periodic cover, cell 7 in an open condition. To reduce the total quantity of leachate generated in later stages of landfill operation, Toslon could elect to sequentially cap portions of completed cells rather than waiting to cap the entire landfill at the end of its operating life. Once all cells are final capped, the average daily leachate generation is expected to reduce to about 2,600 gallons per day.

13.3 Leachate Collection System

The leachate collection system (LCS) is designed to convey leachate to low points within each cell which subsequently flows to a single sump for removal to the leachate transmission system (LTS). The LCS will include the following elements:

- Drainage layers, comprising a 12-in. thick granular drainage layer/protective cover overlying a geocomposite drainage layer;
- 8-in. diameter perforated HDPE leachate collection pipes that gravity drain leachate from the drainage layer to a central low point (sump) within the landfill adjacent to the perimeter berm; and
- A riser structure that pumps the leachate into a perimeter forcemain.

The layout of the LCS is shown on **Drawing 4**. Details of the LCS features are shown on **Drawings 5, 6 and 7**. Design calculations have been performed to evaluate the flow capacity of the selected leachate collection pipes (see **Appendix H.2**). In the remainder of this section, each component of the LCS is described. Features of the LTS are discussed in Section 13.5.

Drainage Layer/Protective Cover: A 12-in. thick granular soil layer will be placed to provide even drainage of leachate from across the liner area and protect the liner system from damage during construction and waste filling operations. The liner is sloped to achieve a minimum 2 percent post-settlement grade to a central leachate collection pipe. The soil layer is designed to promote leachate drainage and help limit leachate head on the liner. The results of the HELP modeling performed for the cell (see **Appendix H.1**) indicate that if a granular soil layer having a hydraulic conductivity of no less than 1×10^{-3} cm/s is used, then the maximum static leachate head on the liner will be maintained below one foot under all cell operational conditions if the calculated maximum drainage lengths across the proposed cell floor are used.

Geocomposite: The geocomposite drainage layer (GDL) will function as the primary means of leachate collection by promoting efficient drainage of leachate from the drainage layer sand to the leachate collection pipe and maintaining a hydraulic head of less than one foot above the liner system. The GDL will consist of a 250-mil thick HDPE geonet with an 8 oz/yd^2 nonwoven geotextile heat-bonded onto both sides. Complete requirements for geocomposite material properties, placement methods, and construction quality assurance (CQA) documentation, are provided in the Engineering Specifications (see **Appendix L)** and CQA Plan (see **Appendix M**).

Collection Pipes: Leachate collection pipes will be placed in the soil drainage layer along a central drainage line to gravity drain leachate to a low point at the external landfill boundary. The proposed pipes comprise an 8-in. diameter SDR-11 perforated HDPE leachate collection pipe surrounded by a coarse aggregate "burrito" wrapped in 8 oz/yd^2 non-woven geotextile (see detail on **Drawing 5**). As shown on **Drawings 4 and 9** the pipes will be built at a 1 percent slope and have been designed to maintain positive post-settlement drainage (see **Appendix E.1**). Based on a conservative assumption that the post-settlement slope of the pipe will be reduced to 0.5 percent, the calculations in **Appendix H.2** show that the selected leachate collection pipes have more than enough flow capacity for the anticipated maximum leachate flow.

Leachate Riser Structures: A leachate riser from the sump located at the low end of the landfill at the toe of the perimeter berm pumps the leachate up the side slope of the cell floor via a 2-inch HDPE pipe to a valve vault located at the top of the perimeter berm. where the leachate is discharged into the perimeter forcemain. Details of the riser structure are shown in **Drawings 6 and 7**.

13.4 Leachate Collection Pipe Strength

An evaluation of the structural capacity of the leachate collection pipes is provided in **Appendix H.4**. The analysis shows that the existing LCS pipes have sufficient structural capacity to withstand the anticipated overburden loads that will be applied by developing the landfill as proposed, inclusive of the maximum weight of the protective cover soil, waste in place, intermediate cover soil, final cover material, and landfill operation equipment.

13.5 Leachate Transmission System and Storage Tank

As shown on layout Drawings 4 and 9 and the details on Drawing 6, leachate collected from each cell will drain to a central collection pipe that drains to a single sump in the southwest portion of the landfill. From the sump, leachate will be pumped up the sideslope, via riser pipe, to a valve vault located in the landfill perimeter berm where the leachate will discharge into the perimeter forcemain. A single leachate transmission system (LTS) corridor is proposed. Leachate collected from all 7 cells will be collected in the sump at the base of Cell 6 and Cell 7, pumped to a single valve vault, and transmitted clockwise via forcemain to a valve vault located to the north of Cell 5. From the valve vault leachate is pumped to the existing leachate storage tank where it will be collected by a tanker truck for treatment.

Details of the valve vaults are shown on **Drawings 7 and 9**. All valve vaults are 7-feet tall, 5-feet wide and 8-feet long precast concrete structures. The profile of the LTS corridor is depicted on **Drawing 10**.

The perimeter forcemain will be 4-in. diameter double-walled SDR-11 HDPE pipe. Design calculations for the LTS system provided in **Appendix H.3** show that the pumping capacity exceeded the peak leachate flow rate by a large factor of safety.

The leachate forcemain and riser pipe has a series of check valves to prevent backflow of leachate as shown in the details on **Drawing 7**. Additionally, a ball valve is included in the system at the valve vault to isolate it from the forcemain as necessary.

The perimeter forcemain terminates at the common valve vault located north of Cell 5. From here, leachate will flow into a single 4-inch diameter double-walled HDPE SDR-11 pipe and discharge into the existing storage tank. No additional pumps are necessary to pump the leachate from the common valve vault to the storage tank. The single sump pump is designed with enough pumping capacity and total available head to pump the leachate from its sump directly to the storage tank while maintaining enough leachate velocity to mitigate the settlement of solids in the forcemain.

13.6 Leachate Flow Monitoring and Control

The forcemain from the pumped leachate sump is fitted with a check valve to prevent backflow into other pipe sections. In addition, the valve vault is fitted with a ball valve to allow flow to be turned off to upstream portions of the leachate forcemain. For the valve vaults, access to the check and ball valves are provided via a vault (see detail on **Drawing 7**). There is one final valve vault located north of Cell 5 that will transmit all leachate to the existing leachate storage tank. This valve vault has a check valve on each incoming pipe and an in-line flowmeter. This flowmeter will enable Tolson to keep a record of leachate quantities transmitted to the storage tanks and transported off site.

COMAR 26.08.08 requires that the quality of leachate shall meet the pretreatment requirements of the WWTP where the leachate is disposed. Leachate is currently transported to Washington County Sewage Treatment Facility (**Appendix D**) which is currently planned to continue for the foreseeable future.

Pressure transducers are present in the leachate storage tank and will be linked to an integrated system of high-level alarms to shut down pumps in each of the cells as necessary to prevent overfilling of the tank. Tank level data and pump operational status, and all high-level alarms, are communicated to the landfill office. All pump control panels will also be fitted with visual red-light alarms.

All pump failure alarm conditions will be promptly addressed. Tolson will track tank level data diligently and will schedule tanker truck removal of leachate from storage tanks well in advance of a high-level alarm condition occurring. Response measures to a high-level alarm condition are outlined in the Operation and Maintenance Plan (see **Appendix D**). Contingency responses to accidental leachate spills are outlined in the next section and in Section 11 of the Operation and Maintenance Plan (see **Appendix D**).

14 CONTINGENCY PLAN

14.1 Introduction

In accordance with the requirements of COMAR 26.04.07.16.A(12), a contingency plan for preventing or mitigating the pollution of the waters of the State is presented in this section. The contingency plan will address the following items:

- Emergency provisions for users of potable water supply;
- A spill containment and prevention plan for any leachate collected or stored at the site; and
- Emergency telephone numbers and contact persons for fires and medical emergencies, and leachate spills.

These items are addressed in the **Appendix N**.

14.2 Emergency Provisions for Users of Potable Water Supply

Should MDE determine that contaminants have breached the liner system and migrated off site to neighboring residential water supply wells, Tolson will replace the potable water source as quickly as possible and design a plan detailing a long-term solution to the problem. In order for the expanded TRL to be confirmed as the source of contamination, the following must occur:

- Tolson must be provided with the results of analytical tests that indicate that the water supply source may have been impacted by TRL;
- Tolson must be given the opportunity to sample the ground water from the source and analyze the sample; and
- Tolson must be given access to all records that are available regarding the water supply source.

If testing by Tolson confirms that TRL has impacted the source, then Tolson will replace the potable water source as soon as possible using a short-term method chosen by Tolson. Short-term replacement methods may include supplying bottled drinking water to affected areas. In the meantime, Tolson will develop a plan describing the manner in which alternative long-term water supplies will be provided to potentially affected areas around the landfill.

14.3 Leachate Spill Containment and Prevention

14.3.1 Introduction

TRL is designed to contain all leachate that is generated in the landfill. However, because leachate will be transferred into leachate hauling trucks and hauled off site, it is possible that leachate spills may occur. In this section, a plan is presented that is designed to minimize the impact of leachate spills and to mitigate adverse impacts should leachate spills occur.

14.3.2 Spill and Leak Prevention

Leachate generated by TRL could adversely impact the quality of groundwater supplies or surface water supplies if the leachate were released to the environment by spill or leak. In this section, the design and operation measures that will be taken to prevent spills and leaks at the Site are described.

TRL is designed and constructed using a liner system, with construction methods and materials that meet the requirements of COMAR 26.04.07.16. To minimize the possibility of leaks, all five cells include a liner system that is highly effective in containing leachate, leachate transmission piping, and a leachate storage and transfer facility having a secondary containment area. All of these features are designed to prevent leaks or spills of leachate to the environment. A comprehensive quality assurance/quality control program will be implemented during cell liner construction events to verify that the materials and methods used met the requirements of the permit and the project specifications.

Leachate from all five cells will be collected by the leachate collection system and routed to an external leachate forcemain (see **Drawing 4**). Leachate will be transferred through pumping from the cells to the storage tank, which is housed in a secondary containment structure to contain potential leachate leaks. As noted in Section 13.6 previously, an integrated system of high-level alarms are present in the storage tank to shut down upstream pumps as necessary to prevent overfilling.

14.3.3 Leachate Spill Response Plan

In the event of an on-site leachate spill, members of the spill response team listed in Section 14.4 will be called immediately and measures taken, under the direction of the spill response team, to contain the spilled leachate. Following the response, measures will be taken to prevent the release from recurring and any features that are damaged or contaminated by the release will be repaired.

14.3.4 Leak Response Plan – Landfill Area

Leachate releases into the environment are minimized through the use of a composite liner system. A groundwater monitoring system will be maintained at the site (see Section 17) to detect any groundwater contamination resulting from landfill operations. The locations of groundwater monitoring wells are identified in the Environmental Monitoring Plan (**Appendix J**). Should the analyses of samples from the groundwater monitoring wells indicate potential pollution from TRL, the procedures outlined in the Environmental Monitoring Plan will be followed.

14.3.5 Leak Response Plan – Leachate Storage and Transfer Area

The leachate storage area consists of one 28,000 ft^3 (206,000 gallon) storage tank and a truck loading area adjacent to the leachate storage area to allow for trucking leachate to an off-site WWTP. The tank is housed in a secondary containment structure to contain potential leachate leaks. If a leak into the containment is detected, audio and visual alarms will be activated. Should a leak be detected, the tank will be emptied into a leachate truck. The tank will be inspected and repaired as necessary.

If leachate is spilled on the ground surface during loading or transporting, the contaminated earth will be removed and landfilled, and the affected area will be regraded. If leachate is spilled on a paved surface, leachate will be contained and pumped back into the tank or absorbed and returned to the landfill along with the material used to clean up the spill.

14.3.6 Material Compatibility

All components of the leachate collection and transmission system which may contact the leachate are made of materials that are compatible with the leachate.

14.3.7 Inspection and Monitoring Programs

Visual inspection of the various components of the leachate collection, transmission, and storage systems will be conducted during routine daily activities. This includes the inspection of pipes, pumps, valves and fittings, storage tanks, and monitoring equipment. Site personnel will be trained to identify any deviations from normal operating conditions. Any identified problems will either be immediately remedied or reported to the Landfill Supervisor so that maintenance can be scheduled.

The leachate transmission system will be monitored periodically for leaks. The pump control panels will be checked weekly during normal operations to verify proper performance. The leachate storage tanks will be visually inspected on a regular schedule for corrosion or leaks. Each tank will be equipped with a high-level indicator that transmits data to the electrical control panel to alert site personnel of a potential overflow. Detailed inspections and monitoring of the components of the leachate collection, transmission, and storage system will be conducted periodically as part of a scheduled maintenance program.

The landfill will be monitored for leakage by sampling groundwater monitoring wells and surface water monitoring stations. Samples will be taken and analyzed semiannually.

14.4 Emergency Telephone Numbers

An Emergency Coordinator is designated for the landfill. The Emergency Coordinator on duty will be responsible for directing all emergency response measures necessary to minimize or prevent harm to human health and the environment as a result of an incident described in Sections 14.2 and 14.3, or in the event of a fire, explosion, potentially hazardous emissions, and/or other emergency situation at the Site as defined in Section 11 of the Operation and Maintenance Plan (see **Appendix D**). Contact details for the Emergency Coordinator are provided in Section 11 of the Operation and Maintenance Plan.

The following telephone numbers should be called in the event of an emergency.

- Fire
  Anne Arundel Volunteer Fire Department
  2380 Davidsonville Road
  Gambrills, MD 21054
  (301) 261-0060

- Medical Emergency
  Anne Arundel Medical Center
  2001 Medical Parkway
  Annapolis, MD 21401
  (443) 481-1000

15 LANDFILL GAS CONTROL

15.1 Introduction

As required under COMAR 26.04.07.08.B(15), the proposed method for controlling atmospheric emission and/or subsurface migration of landfill gas (LFG) at TRL is presented in this section. The active gas collection and control system (GCCS) proposed in this section was designed to efficiently manage LFG throughout the operational and post-closure life of TRL while minimizing disruption of landfill operations and management. The use of an active GCCS is specified under the facility-specific conditions of Refuse Disposal Permit No. 2019-WRF-0580. The active GCCS will mitigate hydrogen sulfide odors created during decomposition of gypsum waste (e.g., plaster and drywall), which is commonly found in construction and demolition debris landfills.

The TRL vertical expansion also includes an overlay over the closed CRL. This closed landfill has a series of four gas vents that will be cut and their venting redirected under the liner system. This is discussed in Section 15.5.

15.2 Gas Collection and Control System Design

15.2.1 Overview

The main features of the proposed GCCS are:

1. Vertical gas extraction wells;
2. Solid transmission header and lateral piping connecting the wells to the flare station;
3. A system for managing condensate; and
4. The flare station, featuring a blower, enclosed flare, and flame arrester.

Specific operational criteria were applied during design of the GCCS, which should:

- Efficiently manage LFG generated throughout the operational and post-closure life of the proposed TRL without disrupting landfill operations;
- Prevent leachate, free liquid within the landfill (if present), and/or LFG condensate from clogging LFG transmission piping and/or impairing GCCS operations and performance; and
- Remain operable over the operational and post-closure periods without being damaged by settlement of the landfill.

The GCCS is designed to function in accordance with standard industry practice in conformance with generally applicable Federal regulations and design guidance. The expected performance of the GCCS based on design computations are discussed in the remainder of this section. Calculations regarding: (i) the expected LFG generation rate; (ii) radius of influence (ROI) of vertical extraction wells; (iii) head loss, flow velocity, and sizing of transmission piping; (iv) expected condensate generation and removal; and (v) required blower and flare capacity are presented.

15.2.2 Landfill Gas Generation

The quantity and rate of LFG generation at a landfill is a function of the landfill size, operating conditions (in particular, moisture content), and waste properties. The maximum LFG generation rate affects the design of all components of the GCCS. The maximum rate of LFG generation at the landfill was estimated using the Landfill Gas Emissions Model (LandGEM) developed by the United States Environmental Protection Agency (U.S. EPA). The model was coded into a Microsoft Excel® spreadsheet published by the U.S. EPA (2005). LandGEM is defined by the following first-order decomposition rate equation:

$$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10}\right) e^{-kt_{ij}}$$

where:

Q_{CH_4} = annual methane generation in the year of the calculation (m^3/year)
i = one-year time increment
n = year of the calculation minus initial year of waste acceptance
j = 0.1-year time increment
k = methane generation rate (yr^{-1})
L_o = potential methane generation capacity (m^3/Mg)
M_i = mass of waste accepted in the i^{th} year (Mg)
t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (years)

LandGEM was primarily developed for estimating emissions from decomposition of municipal solid waste (MSW). Because TRL is expected to contain significantly more nondegradable waste (e.g., concrete, brick, glass, plastics, metals) than MSW landfills, this analysis is expected to provide a conservative estimate of gas generation at TRL.

The maximum estimated volume of LFG generated from the landfill is 1,270 standard cubic feet per minute (scfm). The maximum LFG generation rate will occur during the final year of landfill operation. The peak non-methane organic compound (NMOC) emission rate estimated by

LandGEM is 38 Mg per year. Computations for estimating LFG generation rates are provided in **Appendix I.1** along with input parameters and assumptions.

15.2.3 Vertical Extraction Wells

In order to provide adequate LFG extraction coverage, vertical gas wells must be placed such that "dead spots" are minimized and reasonable ROI overlap occurs. To provide full LFG collection coverage, 31 LFG extraction wells will need to be installed following final closure of the landfill. The layout of vertical gas wells is shown on **Drawing 15**. Details for proposed LFG collection features are shown on **Drawings 16 and 17**. The methodology used to calculate the ROI for wells is provided in **Appendix I.2**, along with input parameters and assumptions.

The nominal horizontal ROI of the proposed wells was calculated to be 150 feet. Therefore, wells locations were selected in a triangular pattern with an approximate spacing of 260 feet in order to provide a reasonable amount of overlap in coverage. Only horizontal ROI is calculated for vertical wells because gas is assumed to only travel radially towards the wells in the horizontal direction. The well bottom elevations shall be 15 feet above the top-of-liner elevations to avoid potential damage to the LCS or liner during well drilling.

15.2.4 Gas Transmission Pipe Sizing

To reduce entrainment of condensate, piping components are sized such that the gas velocity will be less than 1,200 ft/min (fpm) for upslope pipes (i.e., LFG flow direction opposite to that of condensate) and less than 2,400 ft/min (fpm) for downslope pipes (i.e., LFG and condensate flow in the same direction). The design also restricts head losses to one inch of water column (in.-w.c.) per 100-foot length of pipe to minimize power requirements for the blower. The calculation in **Appendix I.3** describes the approach used to size lateral pipe connections between proposed wellheads and perimeter header and the perimeter header and main header connection to the LFG flare station. It was conservatively assumed that 100 percent of the peak generation rate would be collected by the GCCS. The maximum quantity of LFG handled by each component of the transmission system was designed for normal operations, as summarized below:

- The peak LFG generation rate is assumed to be distributed evenly among the 31 in-waste vertical gas wells and distributed proportionally between laterals based on the number of wells feeding each lateral.
- The perimeter header was sized to handle the peak LFG generation. The header is a complete circuit around the landfill perimeter and was designed in two sections. The number of wells attributed to each header section was used to size each header section.
- The main LFG header which connects the perimeter header to the flare station was sized to carry the peak LFG flow for the entire landfill.

The final size selected for the laterals is 6-in. diameter. Although smaller pipe could be used to accommodate the predicted flow, it is not recommended to use a smaller diameter pipe to avoid potential clogging issues due to differential settlement. The size selected for the perimeter header is 12-in. diameter. The size of the main header connection to the flare station is 16-in. diameter. The alignment of the laterals and header is shown on **Drawing 15**.

15.2.5 Condensate Management

In the eastern United States, LFG is typically saturated with water vapor and has a temperature between 80°F and 120°F in the landfill. When LFG is extracted, it cools, causing water vapor to condense. This condensate must be managed to prevent the flooding of LFG transmission lines and damage to the flare station equipment. The expected maximum volume of condensate generated was calculated based on the largest LFG flow rate that the GCCS is expected to handle. The expected maximum volume of condensate was calculated to be approximately 800 gallons/day (see **Appendix I.4**).

Condensate will be managed using a combination of features. Four condensate knockouts will be located along the perimeter LFG header. Condensate will gravity drain from the condensate knockouts to condensate sumps (i.e., CS-01, CS-02, CS-03, CS-04) which then pump condensate into the LTS. Details depicting these condensate management features are provided on **Drawing 17**.

15.2.6 Blower and Flare Station

As a final component of the GCCS, the flare station will be used to provide efficient destruction (i.e., combustion) of LFG methane and NMOC. The enclosed flare should be sized to have sufficient capacity to handle peak LFG generation of about 1,270 scfm, which will occur during the final year of landfill operation .

When sizing the blower, the negative pressure provided by the blower should be capable of overcoming the head loss through the pipe network at the maximum gas flow rate from the landfill while maintaining sufficient vacuum at the wellheads and supplying adequate positive pressure for delivery of the collected LFG to the flare. Sizing of the blower will be included in the detailed design prepared prior to constructing the GCCS at TRL.

15.3 <u>Gas Collection and Control System Components</u>

15.3.1 Layout of Primary Elements

The layout of the proposed GCCS for TRL is illustrated on **Drawing 15**. The main features of the proposed system are:

1. 31 vertical gas extraction wells (EW-01 through EW-31) consisting of perforated piping installed in aggregate back-filled boreholes and fitted with a wellhead;

2. Solid transmission header and lateral piping (i.e. 6-in. diameter laterals, 12-in. diameter perimeter header, and 16-in. main header) connecting wells to the flare station;

3. Four condensate knockouts which each gravity drain to a condensate sump (CS-01 through CS-04) which pump condensate into the LTS;

4. Five gas flow control-isolation valves (V-01 through V-05) on the perimeter header; and

5. The LFG flare station, featuring a blower, enclosed flare, and flame arrester.

Specific components comprising or associated with each of the primary elements listed above are described in the remainder of Section 15.3.

15.3.2 Vertical Extraction Wells

Each well will comprise: (i) a wellhead assembly; (ii) a well casing; (iii) a pipe sleeve; (iv) aggregate backfill; and (v) a bentonite grout seal. Each of these components is described below. Well and wellhead details are shown on **Drawing 16**.

Wellhead Assembly: The wellhead assembly will provide monitoring, sampling, and adjustment functions. The monitoring and sampling functions will be provided by self-sealing quick connect fittings that can be used for gas sampling, static pressure measurement, dynamic pressure measurement, and temperature monitoring. The flow rate and level of vacuum applied to the well will be manually adjustable by means of a valve on the wellhead. The wellhead will be connected to the transmission piping by a flexible PVC hose to allow for differential settlement. A union (i.e., a threaded connection) included on the wellhead will allow for easy disconnection from the transmission piping, if needed.

Well Casing: The vertical well casing will consist of 8-in. diameter or larger Schedule 80 PVC pipe that is slotted for a certain length above the base of the well. The top of the slotted portion of the casing will be located a minimum of 7 ft below the surface of the final cover soil in order to minimize the potential for drawing air into the landfill. Schedule 80 PVC pipe is used to withstand the impact of gravel backfill being dropped into a deep borehole. Slotting details are shown on **Drawing 16**.

Pipe Sleeve and Bentonite Grout: The landfill surface surrounding each extraction well is expected to settle more than the well. To allow for this, a PVC pipe sleeve will surround the top of the well casing. The annular space between the well casing and pipe sleeve will be filled with bentonite grout to provide a slip surface as well as a hydraulic barrier. Another 2-ft of bentonite grout is applied on top of the backfill aggregate in the well.

Backfill Material: The annular material around the perforated portion of the well casing will consist of AASHTO No. 57 aggregate or engineer-approved alternatives such as crushed stone, alluvial gravel, or waste materials such as tire shreds or glass chips, which will provide a high-permeability medium resistant to fouling by the surrounding waste. A large size of aggregate is required to minimize the potential for clogging of the GCCS.

15.3.3 Transmission Piping

LFG will be conveyed from the wells to the LFG flare station through the LFG transmission piping network.

Transmission Pipes: The LFG transmission piping will be HDPE SDR-17 pipe designed to be chemically resistant and to withstand the expected external loads. The LFG transmission piping network will consist of: (i) a 12-in. diameter perimeter header around the landfill, sloped at minimum 6 percent to low points for condensate drainage; (ii) 6-in. diameter downslope lateral pipes connecting vertical wells to the perimeter header; (iii) five control/isolation valves (with associated monitoring and sampling features) on the perimeter header; and (iv) a 16-in. diameter main header connection to the existing flare station. Four condensate knockouts will be located along the perimeter LFG header. Condensate will gravity drain from the condensate knockouts to condensate sumps (i.e., CS-01, CS-02, CS-03, CS-04) which then pump condensate into the LTS. The layout and locations of the transmission network is shown on **Drawing 15**. All transmission piping will be buried. Transmission piping details are shown on **Drawing 16**.

Control Valves: Five control/isolation valves V-01 throughV-05 will be installed on the perimeter header at locations shown on **Drawing 15**. These will be used to isolate or throttle the vacuum applied to groups of vertical wells. In addition, they provide quick connect samples ports for LFG sampling and monitoring if necessary. Valve details are provided on **Drawing 16**.

Condensate Drains: To minimize the quantity of condensate requiring removal at the flare station, the GCCS design focuses on minimizing entrainment of condensate into the LFG transmission system. Beyond limiting the velocity of gas flow in transmission piping, this is achieved in part through sloping laterals at minimum 1.5 percent downslope to their perimeter header connection (see **Drawing 15**). In addition, four condensate knockouts will be located along the perimeter LFG header. Condensate will gravity drain from the condensate knockouts to condensate sumps (i.e., CS-01, CS-02, CS-03, CS-04) which then pump condensate into the LTS. The condensate sumps will be fitted with a submersible pump with a float switch or pressure transducer control system to automatically empty the sump when it fills to a predetermined level. Accumulated condensate will be expelled from the sump via a 2-in. diameter HDPE forcemain to the LTS as shown on **Drawing 15.** The condensate forcemain will be buried along its length between the condensate sump and the LTS. Details of the condensate knockouts and sumps are shown on **Drawing 17**.

15.3.4 Flare Station

The transmission piping network will terminate with delivery of LFG to an LFG flare station via the main header. The main header from TRL will be connected to a condensate tank immediately upstream of the flare station, where the header will be tied in. The location of the LFG flare station and proposed header tie-in is shown on **Drawing 15**. The location of the flare station location was selected to be in the vicinity of the leachate tank which can be accessed readily.

In accordance with the manufacturer's recommendations, a seven times stack height setback of trees should be cleared radially around the flare stack.

The LFG flare station should include the following:

- A prefabricated flare system, comprising:
    - A condensate knockout and associated condensate drain;
    - A blower capable of creating sufficient vacuum throughout the GCCS as previously described in Section 15.2.6;
    - A flame arrestor and pilot igniter, with pilot gas (propane) and actuator gas (bottled N_2 or compressed air);
    - Electrical controls, flow meter, gas analyzer, datalogger, and wiring to provide for auto-ignition and automatic shut-down; automated LFG flow, composition, and temperature recording; and alarm systems; and
    - An enclosed flare capable of handling the maximum flow from TRL while providing 98 percent destruction of organic compounds (methane and NMOC).
- A flare support pad constructed per flare system manufacturer's recommendations;
- A lockable shed housing the flare control and monitoring instrumentation;
- A chain link fence with lockable gate to control access to the flare system; and
- A condensate header drainage system and manhole.

As previously discussed, it is expected that a daily maximum of approximately 800 gallons of condensate may be generated, although a number of condensate drainage features are already provided to remove as much condensate as possible upstream of the flare station. Nevertheless, a simple condensate drainage system comprising a condensate knockout and condensate sump with a connection to the LTS should be included on the main header immediately upstream of the flare station connection.

15.4 Control and Monitoring of Subsurface Gas Migration

COMAR 26.04.07.03(9) and 40 CFR 258.23 require that the concentration of explosive gases generated by a facility or practice shall not exceed 25 percent of the lower explosive limit (LEL) for the gases in on-site facility structures (excluding LFG control or recovery systems components) or the LEL for the gases at the property boundary.

Control of subsurface gas migration at TRL will be achieved by the low permeability liner system for all cells and operation of an active GCCS as described in the preceding sections. The performance of the GCCS will be monitored in accordance with the Operation Manual for the GCCS, which will be developed as part of the detailed design prior to construction of the GCCS.

Monitoring of potential subsurface gas migration will be performed in accordance with the gas monitoring provisions in the Environmental Monitoring Plan (EMP), which is provided as **Appendix J** to this Report. The gas migration monitoring network consists of thirteen gas migration monitoring probes (GP-1 through GP-10, GP-21, GP-22, and GP-23). Additional wells will be installed to the east and south prior to landfill operations in these areas of the Site. Gas probe monitoring is performed on a quarterly basis as typically required by Maryland refuse disposal permits. This includes monitoring at eight gas wells associated with the former CRL.

As described in more detail in the EMP, natural barriers to gas migration at the Site include the underlying groundwater and surface water features (i.e., Gravel Run and the unnamed tributary of Gravel Run and associated wetlands located generally coincident with the northern and western Site boundaries, respectively). Therefore, subsurface gas migration beyond the western and northern Site boundaries will be prevented by these perennial surface water features. If needed, additional gas probes will only be installed along the eastern and southern Site boundaries as shown on in the EMP (**Appendix J**).

Gas monitoring in the existing scale house/ landfill office located at the gated entrance (see **Drawing 2**) and any other enclosed structures constructed in the future will also be performed until demolition of these structures (if they remain after commencement of waste disposal).

The results of gas monitoring will be compiled and submitted to MDE semi-annually in accordance with protocols outlined in the EMP. However, if gas migration monitoring indicates that lateral migration of explosive gases has occurred, then immediate procedures necessary to protect human health will be taken, MDE will be notified, a note will be placed in the operating record within seven days describing the readings and the steps taken to protect human health, and a remediation plan will be submitted to MDE within 60 days.

15.5 Gas Collection at the Cunningham Rubble Landfill

There are four gas vents located on the closed CRL that are within the proposed expansion area. A detail depicting the typical gas vent modification construction is included in Detail 5 on **Drawing 16**. At the time of construction of the overlay liner, the gas vents will be cut six inches below grade and extended with a flexible elbow and additional six-inch diameter HDPE piping to the limit of the final cover system. The six-inch riser pipe, stabilization stake, and vent will be reattached outside the proposed limit of construction, as shown in Detail 4 on **Drawing 8**.

An evaluation of the structural capacity of the landfill gas overlay pipes is provided in **Appendix I.5**. The analysis shows that the overlay pipes have sufficient structural capacity to withstand the anticipated overburden loads that will be applied by developing the landfill as proposed, inclusive of the maximum weight of the protective cover soil, waste in place, intermediate cover soil, final cover material, and landfill operation equipment.

Until the final cover is installed, gas vent piping beyond the edge of liner (approximately 16 feet) will be covered with soil and stabilized with vegetation (**Drawing 17, Detail 6**).

16 COVERING AND STABILIZING COMPLETED AREAS

16.1 Introduction

In accordance with the requirements of COMAR 26.04.07.16.A(13), the proposed methods for covering and stabilizing completed areas are presented in this section.

Ground surfaces which are disturbed during landfill operations will be vegetated according to the vegetation plan presented in this section. The goal of establishing vegetation on disturbed surfaces is to minimize erosion and sediment migration in surface waters at the Site. Vegetation promotes reduced runoff velocities of surface water, reduces runoff volumes by promoting increased percolation rates, binds soil with roots, and protects soil from wind, thereby minimizing the sediment loads entering the surrounding waterways.

Covering and stabilizing operations will be accomplished by vegetation when sufficiently large areas are developed. Stabilization will be performed within seven days of completion of construction for the following: final and intermediate cover surfaces, all disturbed areas with slope of 4H:1V or greater (whenever possible), and all grass-lined drainage terraces and ditches. All other disturbed surfaces will be vegetated within 14 days of disturbance (whenever possible) or completion of construction.

The procedures for vegetating temporary and permanent surfaces associated with landfill development are summarized in this section. For both temporary and permanent surfaces, procedures involved in vegetation include site preparation (grading and fertilizing), seeding, mulching, and maintenance; each of this is described in detail below.

16.2 Temporary Vegetation

16.2.1 Overview

Temporary surfaces to be vegetated during landfill development include all intermediate cover surfaces within the disposal area. The criteria for vegetation of these surfaces will follow the *2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control*. Temporary vegetation will be performed by site personnel or by contracted services.

16.2.2 Site Preparation

To promote the vegetation on intermediate cover surfaces, both the consistency and chemical content of the soil must be considered. If the intermediate cover is packed, crusted, and hard prior to seeding, the top three inches of soil will be loosened by disking or tack-walking with a bulldozer. Fertilizer will be applied to the surface at a rate of 600 pounds per acre. This fertilizer will consist of 10-10-10 or an equivalent fertilizer. In addition, the pH of the soil will be tested prior to seeding to determine if agricultural lime is needed. Fertilizer and lime (if used) will be disked into the intermediate cover to a depth of 6 to 12 inches before seeding. All temporary surfaces to be revegetated will be tack-walked using a bulldozer before seeding, with tack marks oriented parallel to contours, to minimize seed washout.

16.2.3 Seeding

The type of seed to be used to vegetate temporary surfaces will vary depending on the seeding date. For seeding during the period of 1 February through 30 November, perennial ryegrass will be applied at a rate of 40 pounds per acre. For all cases, certified seed will be used when available. Between the fall and spring seeding dates given above, only mulch will be applied to temporary surfaces, in a manner described in the subsequent sections.

16.2.4 Mulching

Straw mulch will be spread over all seeded areas at the rate of two tons per acre to a uniform loose depth of 1 to 2 inches. Mulch will be applied to achieve a uniform distribution and depth so that the soil surface is not exposed.

16.2.5 Maintenance

The success of vegetation will be assessed based on the occurrence of erosion of the intermediate cover surfaces. Unacceptable amounts of erosion will be indicated by excessive sediment in drainage ditches and/or culverts, accelerated siltation in sediment basins, the presence of erosion gullies, or exposure of waste beneath intermediate cover surfaces. If vegetation is not established to the degree necessary to limit erosion to an acceptable level on the intermediate cover surfaces, the surface will be revegetated in accordance with the *2011 Maryland Standard and Specifications for Soil Erosion and Sediment Control*. Any waste that is exposed due to erosion will be immediately covered by site personnel with a minimum cover thickness of one foot of suitable soil and revegetated.

16.3 Permanent Vegetation

16.3.1 Overview

Permanent surfaces to be vegetated during landfill development include all final cover surfaces within the disposal area as well as all other miscellaneous areas around the Site where surface soils will be disturbed. The criteria for vegetation of these surfaces will follow the *2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control*. Permanent vegetation activities will be performed by either site personnel or private contractor. The final cover will be vegetatively stabilized within 30 days of completing construction as required by COMAR 26.04.07.21.

16.3.2 Site Preparation

To provide a suitable environment for the growth of vegetation on final cover surfaces, both the consistency and chemical content of the soil must be considered. The soil will be loosed and friable to a depth of at least three inches or tack-walked prior to seeding. Disking can be used to achieve this criterion. 19-19-19 fertilizer will be applied to the surface at a rate of 1,000 pounds per acre. In addition, the pH of the soil will be tested prior to seeding to determine if agricultural lime is needed. In lieu of testing, lime will be applied at a rate of two to four tons per acre. Fertilizer and lime (when used) will be disked into the soil to a depth of 6 to 12 inches before seeding, or lime, fertilizer, and seed may be applied as a mixture by hydro-seeding. Permanent surfaces to be vegetated can also be tack-walked using a bulldozer prior to application of lime, fertilizer, or seed, with tack marks oriented parallel to contours, to minimize seed washout.

16.3.3 Seeding

The type of seed used to permanently vegetate completed surfaces will vary depending on the seeding date. For seeding during the period of 1 February through 30 April, or 15 August through 31 October, a mixture of certified Kentucky 31 Tall Fescue and Sericea Lespedeza will be used. The Kentucky 31 Tall Fescue will be applied at a rate of 40 pounds per acre and the Sericea Lespedeza will be applied at a rate of 20 pounds per acre. For seeding during the period of 1 May through 15 August, a 30:1 mixture of certified Kentucky 31 Tall Fescue and Weeping Lovegrass, respectively, will be applied at a rate of 60 pounds per acre. Between the fall and spring seeding dates given above, only mulch will be applied to permanent surfaces, in a manner described in the subsequent sections.

16.3.4 Mulching

The procedure used for mulching permanent surfaces will be identical to the one described for temporary surfaces, except that a straw roller will be used in all cases to anchor the straw.

16.3.5 Maintenance

The success of vegetation on permanent surfaces will be assessed based on the occurrence of erosion. Unacceptable amounts of erosion will be indicated by excessive sediment of surface channels and/or culverts, accelerated siltation in sediment basins, or the presence of erosion gullies. Permanent surfaces which exhibit an unacceptable occurrence of erosion will be revegetated by over-seeding and applying fertilizer using half of the rates originally applied, following the repair of any existing erosion gullies. Fertilizer will be applied to permanent vegetated surfaces yearly, or as needed. The fertilizer used will be 10-10-10 or an equivalent fertilizer, applied at a rate of 500 pounds per acre. If mowing is carried out, the stand will be mowed no closer than 3 inches from the ground surface.

17 GROUNDWATER AND SURFACE WATER QUALITY MONITORING

17.1 Overview

In accordance with the requirements of COMAR 26.04.07.08.B(17), a system for routinely monitoring the quality of the waters of the State around and beneath the Site, including the location and types of monitoring stations and the method of construction and monitoring wells, is discussed in this section.

Details for how groundwater and surface water monitoring will be performed are contained in the approved Environmental Monitoring Plan (EMP) in **Appendix J**, which includes the following:

- The locations and types of monitoring stations;
- Methods of construction for monitoring wells;
- Sampling and analysis procedures and protocols;
- Methodologies for analyzing water quality data;
- Procedures to be followed to report the results of groundwater and surface water monitoring; and
- Measures to implement in the event that monitoring results do not comply with water quality standards.

The EMP also describes the approach taken to provide an adequate number and sampling frequency of groundwater and surface water monitoring points to monitor water quality downgradient of the waste limits, as well as to select sampling locations that are representative of background groundwater and surface water quality.

17.2 Groundwater Monitoring

The existing waste disposal facility at the TRL is a reclamation of the sand and gravel surface mining operations, located northwest of Crofton, Maryland. The total permitted landfill area of the existing facility is approximately 72.38 acres (approximately ten acres are currently constructed as one waste disposal cell, Cell A). The Site is currently occupied by an operating sand and gravel mining, washing, and distribution quarry and the approximately 32.8-acre former CRL, which has been closed and capped

The majority of the groundwater monitoring network has network has been established, and operational for over 25 years as part of the closed CRL monitoring plan, which provided background and historic data. Background groundwater quality was formally established for the TRL as part of the initial landfill permitting process beginning in 2006 using data collected from sampling events between 1985 to 2005. In January 2019, Geosyntec began to re-evaluate depth to groundwater by conducting monthly water level measurements. Water quality was continued to be monitoring quarterly. Depth to groundwater measurements were collected and analyzed from an expanded network of monitoring wells and piezometers, including some preexisting wells. Approved methods for groundwater data assessment and statistical comparison of groundwater data were used to establish background values. The historical and background groundwater water level data are included in **Appendix B**.

The groundwater monitoring network at the Site consists of an adequate number of monitoring wells to provide information on the quality of groundwater at the relevant point of compliance (POC) and has been approved in accordance with the existing permit (ERM, 2016). The approved EMP includes 20 monitoring wells with eight additional wells proposed for installation. Currently there are 40 monitoring wells on-site used to monitor for depth to groundwater, and a subset is used for groundwater quality. The monitoring wells include those also used to monitor the former CRL. Groundwater quality is monitored at twenty of the 40 monitoring wells, including:

- Three background (i.e., upgradient) monitoring wells (i.e., MW-23 and MW-17A and MW17B on the northern Site boundary); and
- Seventeen downgradient or cross-gradient monitoring wells (i.e., MW-4A, MW-5A/ -5B, MW-8A/ -8B, MW-12-AR, MW-15A/-15B, MW-16A/-16B, MW-21A/-21B, MW-26A, MW-27A, MW-28A, MW-29A, and MW-31A).

The remaining monitoring wells and piezometers will only be used for water level monitoring until abandonment. Additional information regarding water level measurement data collected in 2019 to 2020 is included in **Appendix B**.

Groundwater samples will be collected and analyzed on a semiannual basis, typically in the first and third calendar quarters. Results will be used to evaluate data and generate semi-annual monitoring reports for submission to MDE. Additional information on groundwater sampling, analysis, and reporting is provided in the EMP (**Appendix J**).

17.3 Surface Water Monitoring

TRL stormwater discharges are covered under the General Discharge Permit No. 15MM for the Mineral mines, Quarries, Borrow Pits, and Concrete and Asphalt Plants. Surface water quality will be monitored as required in accordance with a General Permit for construction. Currently, discharges from the erosion and sediment control/stormwater management pond located northwest of the landfill flow to a tributary discharging to the Little Patuxent River, located approximately 200 feet from the pond. Discharges from the stormwater management features will occur on an intermittent basis in response to precipitation events. Contributions to the Little Patuxent River from the stormwater management features will consist of uncontaminated runoff collected from those portions of the landfill unaffected by waste disposal.

Surface water sampling for chemical analyses will be performed at all monitoring locations on a semi-annual basis in accordance with the EMP. Surface water monitoring data will be provided to MDE for review in semi-annual monitoring reports for the landfill.

18 CONSTRUCTION IMPLEMENTATION SCHEDULE

This section addresses the requirements of COMAR 26.04.07.08.B(19) regarding a schedule for construction and operation of TRL and the operation plans and engineering specifications after the refuse disposal permit modification has been issued. In general, the implementation schedule is expected to follow these steps:

- Prior to MDE issuing the new refuse disposal permit, Tolson will develop and submit the precursory permit applications and plans necessary for approval to construct the landfill. A Stormwater Pollution Prevention Plan (SWPPP) has been developed for the Site and it is included with the Operations and Maintenance Plan (**Appendix D**)

  In the interests of enabling construction of the landfill to commence in early 2021, the above activities will likely be completed during MDE's final review of the permit application prior to issuing the refuse disposal permit.

- After MDE issues the refuse disposal permit, Tolson will develop a set of construction-grade drawings and bid documents for procurement of a contractor for construction of new cell and the landfill infrastructure necessary for waste filling and cell operation (e.g., access roads, portions of the leachate management system, and portions of the SWM system). The documents will include construction drawings (including an approved ESC plan and SWM plans), technical specifications, and a CQA plan that are consistent with the elements approved in the permit for the facility (as presented in the Drawings in **Appendix A**, the technical specifications in **Appendix L**, and the CQA Plan in **Appendix M** to this Report, respectively). These documents will be provided to MDE for review prior to issuing the bid documents. The bid documents will also include contract terms and conditions, bid schedules, and other items specific to procurement that are not relevant to the permit and, therefore, will not be submitted to MDE for review. It is anticipated that these documents will be submitted to MDE in mid-late 2020.

- Upon approval by MDE and successful procurement of a contractor, construction of Cell 1 and associated landfill infrastructure will begin. Construction of this phase is expected to commence in early 2021. After completion, a Construction Certification Report will be submitted to MDE no later than 90 days after completion of work. It is anticipated that MDE will review and approve the report within 3 months.

- Initial disposal of waste in Cell 1 is anticipated to begin in 2022. Note that placement of the 4-ft initial select waste layer in Cell 1 will begin prior to general disposal. The select waste may be excavated or diverted from currently active Cell A. This select waste layer will consist of rubble waste, notably land clearing debris and other waste that will not damage the liner system.

- The provisions of the various plans governing landfill construction and operation will be implemented as follows:
    - The ESC and SWM Plans will be implemented during Cell 2 construction and landfill operations. These plans will be important to controlling stormwater and preventing environmental impacts during construction.
    - The Operation and Maintenance Plan (**Appendix D**) will be implemented during the operating period of the landfill.
    - The approved Environmental Monitoring Plan (**Appendix J**) will be implemented during the operation of the landfill.
    - The Emergency Contingency Plan (**Appendix N**) will be implemented only in the event that a situation arises that requires action according to the provisions of the plan.
- A similar process to that described above will be followed for phased expansion of the landfill by constructing additional Cell 2, and Cells 3 through 7, along with necessary expansions of associated landfill infrastructure, until the entire landfill buildout as depicted on the Drawings has been completed.
- The Closure and Post-Closure Plan (**Appendix O**) will be implemented during final closure of TRL (expected in 2034) and after the landfill is closed and will supersede the Operation and Maintenance Plan, which will be redundant once waste disposal activities cease.

This schedule will be updated if needed depending on the Tolson's specific needs during landfill operation.

19 CLOSURE AND POST-CLOSURE PLANS

19.1 Regulatory Requirements and Overview of Closure System

In accordance with the requirements of COMAR 26.04.07.16.A(17), a plan for closing TRL and providing post-closure care (PCC) after application of the final cover system is discussed in this section. The Closure and Post-Closure Care Plan (C/PCC Plan) for the landfill is presented in **Appendix O**. The C/PCC Plan includes the following:

- A description of the relevant requirements for closure and post-closure care;
- Methods and procedures to be followed to close the landfill;
- Descriptions of the closure system features and their design;
- Cost estimates for closing the landfill;
- A plan for providing PCC throughout the post-closure period; and
- Methods for determining whether the appropriate amount of post-closure care has been provided and for evaluating whether it is appropriate for regulatory post-closure care to end.

The closure system will consist of several components, including a final cover system (see Section 19.2), a LFG management system (see Section 15), and a stormwater management system (see Section 12). The leachate management system (see Section 13), which will remain in operation during the post-closure period, is not considered to be a closure system component because it will have already been constructed and in operation before final closure. Construction of all closure system components will be performed in accordance with construction quality assurance (CQA) procedures, as described in the CQA Plan provided as **Appendix M**.

19.2 Final Cover System

After the final receipt of waste in TRL and before construction of the final cover system, the surface of the landfill will be graded such that the computed post-settlement elevation of the final grading layer is the required depth below the contours shown on **Drawing 11**. In preparation for construction of the closure cap, a 24-inch thick final grading layer will be applied to provide smooth grades for the overlying closure cap and proper drainage slopes for the final cover system. The final grading layer will also provide temporary control of LFG, minimize the amount of infiltration into the landfill, reduce odors, and minimize the amount of maintenance required. Tolson will attempt to minimize the amount of final grading that is needed by filling the landfill as closely as possible to the required grades.

The closure cap will consist of a geomembrane placed over the soil grading layer, which will be overlain by (in ascending order): (i) a geocomposite drainage layer; (ii) an 18-in. thick protective cover soil layer; and (iii) a 6-in. thick vegetated topsoil layer. The closure cap will be constructed in its entirety across all portions of the landfill once filled to final grades. At the time of final closure, final cover drainage features will be constructed.

A cross section of the completed final cover system is shown on **Drawing 18**. The minimum cover grade slope is four percent. The low permeability cap components of the final cover system will be constructed in accordance with the requirements of COMAR 26.04.07.21. As described in Section 8, soils that will be used for the various soil layers comprising the final cover system will likely be obtained from the site's adjacent soil borrow areas and will conform with the technical specifications provided in **Appendix L**. The quantity of soil required for closure capping is calculated in **Appendix K.1**. Based on a landfill area of 72.1 acres, approximately 233,000 cy of soil will be required for the grading layer (beneath the geomembrane), 174,000 cy of protective cover soil will be required (above the geomembrane), and a further 58,000 cy of topsoil will be required for the uppermost vegetative support layer.

The hydraulic and hydrogeologic design of the final cover system is described in **Appendix K.2**. To ensure that the integrity of the cover system is not compromised by differential settlement and that post-settlement grades are sufficient for effective long-term stormwater management, Geosyntec conducted a cover system settlement analysis, which is presented in **Appendix K.3**. Also, in order for the geomembrane in the cover system to work efficiently as a hydraulic barrier, puncturing of the geomembrane should be prevented. The capability of the cover system to resist equipment and operational loading is evaluated in **Appendix K.4**, which shows that the puncture resistance of the geomembrane exceeds the expected operational and typical equipment loading with sufficient factor of safety. Finally, because sliding during placement of the protective cover soil layer may take place, the veneer stability of the cover system was evaluated in **Appendix K.5** and found to be acceptable. However, due to the large areal extent of the "top deck" (i.e., area graded at four percent) relative to the 4H:1V sideslopes, a seepage interceptor drain was designed for the sideslope crests (see layout on **Drawing 11** and detail on **Drawing 12**). The interceptor drains will remove water from the geocomposite drainage layer above the geomembrane in the top deck area to minimize the potential for this water flow to transition down the sideslopes.

20 RESPONSIBLE AGENCY

In accordance with COMAR 26.04.07.16.A(18), the name, address, and telephone number of the person or agency responsible for the maintenance and operation of the facility is presented in this section.

The agency responsible for operation and maintenance of TRL is:

Tolson & Associates, LLC
24024 Frederick Road
Clarksburg, Maryland 20871
(301) 428-0800

21 REFERENCES

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TABLES

TABLE 1
CHECKLIST OF MDE'S PHASE III REPORT GUIDANCE

Permit Modification Application for a Vertical Expansion: Phase III Report
Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Item	Where Addressed
1. DESIGN DOCUMENTATION	
1.1 Permit Application Check List	
1.1.1 Site Background	Ph. III Section 1.2
1.1.2 General Facility Information	Ph. III Section 3 and Drawing 2
1.1.3 Estimated Project Schedule	Ph. III Section 18
1.1.4 Report Organization	Ph. III Section 2
1.1.5 Phase III Application	See Application Document
1.2 Facility Background	
1.2.1 General	Ph. III Section 1.2
1.2.2 Regulations Check Lists	Ph. III Section 1.4
1.2.3 Local Regulations	Ph. III Section 1.4.2
1.2.4 State Regulations	Ph. III Section 1.4
1.2.5 Federal Regulations	Ph. III Section 1.4
1.3 Site Development	
1.3.1 Introduction	Ph. III Section 1
1.3.2 Property Boundary Defined	Ph. III Drawing 2
1.3.3 A Map that Designates the Property Boundary	Ph. III Drawing 2
1.3.4 Fill Area Defined	Ph. III Drawing 11
1.3.5 Existing and Proposed Structures Located	Ph. III Drawing 2, 3, 4, 5, 12, 18
1.3.6 Detail Adequately Defined	Ph. III Drawing 3
1.3.7 Buffer and Screening Design Criteria	Ph. III Section 11
1.3.8 Flood Plain and Wetland Areas Defined	Ph. III Section 1.4 and ERM (2016)
1.3.9 Wetland Permit/Approval	Ph. III Appendix 2.3
1.3.10 Location Restriction 40 CFR Part 258 Part B	Not applicable
1.3.10.1 Airport Safety COMAR 26.04.07.06B(2), 2604.0706C(1), 26.04.07.0C(4)	Not applicable
1.3.10.2 Is Site within 5,000/10,000 feet of Applicable Runway?	Not applicable
1.3.10.3 Is Site within 5 miles of Applicable Runway?	Not applicable
1.3.10.4 Airport Notified & FAA letter Enclosed?	Not applicable
1.3.10.5 Date of Letter from FAA	Not applicable
1.3.11 Site Access	Ph. III Section 8, 9 & Drawing 2
1.3.12 Type of Solid Waste Acceptable and Unacceptable	Ph. III Section 4.2 and Appendix D, Operation and Maintenance Plan
1.3.13 Area and Population to be Served	Ph. III Sections 4.3 & 4.4
1.3.14 Method of Collecting and Reporting on the Quantities of and Types of Solid Waste Received	Ph. III Section 6

Item	Where Addressed
1.3.14.1 Hours and Days of Operation	Ph. III Section 9.2 and Appendix D
1.3.14.2 Waste Quantities	Ph. III Section 5
1.3.14.3 Site Life	Ph. III Section 5
1.3.14.4 Revision Facility's Life	Ph. III Section 6
1.3.14.5 Site Layout and Landfill Phasing	Ph. III Section 10, 19, Drawings 2, 3, 4, and Appendix D.
2. SOIL BALANCE EVALUATION	
2.1 Volume and Type of Available Cover Material	Ph. III Sections 7.2, Appendix K.1
2.2 Cover Material Requirements	Specification Section 02055
2.3 Earth Stockpiles Storage Capacity	Not applicable – on-site borrow, Section 7.4
2.4 Topsoil Requirement and Availability	Ph. III Section 7.5 and Specification Section 02055
3. SUPPORT FACILITIES	
3.1 Introduction	Ph. III Section 3.3 and Appendix D
3.2 Office and Site Communications	Ph. III Section 3.3 and Appendix D
3.2.1 Telephone/Other Communication Equipment	Ph. III Section 3.3 and Appendix D
3.2.2 Type of Manufacturer	Ph. III Section 3.3 and Appendix D
3.2.3 Location Onsite	Ph. III Section 3.3 and Appendix D
3.2.4 Range	Ph. III Section 3.3 and Appendix D
3.2.5 Description of Operations	Ph. III Section 3.3 and Appendix D
3.2.6 License Required	Ph. III Section 3.3 and Appendix D
3.3 Electric Service & Other Utilities	
3.3.1 Type of Service Described	Ph. III Section 3.5 and Appendix D
3.3.2 Point of Entry Onsite	Drawing 2
3.3.3 Transformer or Other Installations	Ph. III Section 3.5 and Appendix D
3.4 Maintenance and Equipment Storage Facility	Ph. III Section 3.5 and Appendix D
3.4.1 Description or Type of Structure	Ph. III Section 3.5 and Appendix D
3.4.2 Size and Dimensions Stated (maintenance building, office, and scale-house)	Ph. III Section 3.5 and Appendix D
3.4.3 Location Onsite Specified	Ph. III Section 3.5 and Appendix D
3.4.4 Utility Service Provided	Ph. III Section 3.5 and Appendix D
3.4.5 Safety Facilities Described	Ph. III Section 3.5 and Appendix D
3.4.6 Safety Equipment Provided	Ph. III Section 3.5 and Appendix D
3.4.7 Safety Training Defined	Ph. III Section 3.5 and Appendix D
3.4.8 Continues Training for Employees Defined	Ph. III Section 3.5 and Appendix D
3.5 Employee Facilities	
3.5.1 Water Supply and Sewerage Systems	Ph. III Section 3.5 and Appendix D
3.5.2 Source of Supply Identified	Ph. III Section 3.5 and Appendix D
3.5.3 Public Water/Groundwater-Permit Required?	Ph. III Section 3.5 and Appendix D
3.5.4 Location on Site Defined	Ph. III Section 3.5 and Appendix D
3.5.5 Onsite Water Treatment Plan Defined	Ph. III Section 3.5 and Appendix D
3.5.6 NPDES Permit Required	N/A
3.5.7 Sanitary Facility Described	Ph. III Section 3.5
3.5.8 Toilet Facilities Described	Ph. III Section 3.5
3.5.9 Shower Facilities	N/A
3.5.10 Male/Female Facilities	N/A
3.5.11 Location on Site Defined	Ph. III Section 3.5

Item	Where Addressed
3.6 Facilities On Site	
3.6.1 Number and Types of Equipment to be Used	Ph. III Section 8.3 and Appendix D
3.6.2 Number of Employees and their Duties	Ph. III Section 8.4 and Appendix D
3.6.3 Vehicle Weighing Station/ Scale Defined	Ph. III Section 8.3 and Appendix D
3.6.4 Type of Manufacture	Ph. III Section 8.3 and Appendix D
3.6.5 Capacity	Ph. III Section 8.3 and Appendix D
3.6.6 Description of Operation	Ph. III Section 8.3 and Appendix D
3.7 Site Security	Ph. III Section 8.3 and Appendix D
3.8 Paved or All Weather Roads to Facility Defined	
3.8.1 Location of Roads Specified	Ph. III Sections 3.2 and Drawing 2
3.8.2 Public Access Areas Defined	Appendix D
3.8.3 Public Disposal Site Designated	Appendix D
3.8.4 Recycling Collection Site Designated	Appendix D
3.8.5 Traffic Pattern Specified	Appendix D
3.8.6 Traffic Control Specified	Appendix D
3.8.7 Vehicle Queuing Described (need to address truck queuing)	Appendix D
4. STORMWATER MANAGEMENT & EROSION AND SEDIMENT CONTROL	
4.1 Introduction	Ph. III Section 12.1
4.2 Run-on Controls	Ph. III Section 12, Appendix G
4.3 Run-off Controls	Ph. III Section 12, Appendix G
4.3.1 Drainage Caps on Top and Side Slopes	Ph. III Section 12, Appendix G
4.3.2 Down slope Gabion-Lined Channels	Ph. III Section 12, Appendix G
4.3.3 Perimeter Diversion Channels	Ph. III Section 12, Appendix G
4.3.4 Stormwater Quantity and Quality Controls	Ph. III Section 12, Appendix G
4.3.5 Approved Erosion and Sediment Control Provision by Appropriate Approving Agency and satisfy the Requirements of Environmental Article, Title 4, Subtitle 1, and COMAR 26.09.01	Ph. III Section 12, Appendix G
4.3.6 Sedimentation Trap & Size Specification	Ph. III Section 12, Appendix G
5. OPERATING PROCEDURES	
5.1 Introduction	Ph. III Section 9.1 and Appendix D
5.2 Equipment	Ph. III Section 9.3 and Appendix D
5.3 Manpower	Ph. III Section 9.4 and Appendix D
5.4 Hours and Days of Operation	Ph. III Section 9.2 and Appendix D
5.5 Methods of Daily Operation	Ph. III Section 9.7 and Appendix D
5.6 Inclement Weather Operation	Ph. III Section 9.8 and Appendix D
5.7 Maintenance and Equipment Storage	Ph. III Section 3.4 and Appendix D
5.7.1 Description and Type of Structures	Ph. III Section 3.4 and Appendix D
5.7.2 Size and Dimensions Stated	Ph. III Section 3.4 and Appendix D
5.7.3 Location on Site Specified	Ph. III Section 3.4 and Appendix D
5.7.4 Utility Service Provided	Ph. III Section 3.4 and Appendix D
5.8 Prevention of Public Health Hazards	Ph. III Section 9.6 and Appendix D
5.9 Blowing Litters	Ph. III Section 9.6 and Appendix D
5.10 Prevention of Vector Attraction and Scavenging	Ph. III Section 9.6 and Appendix D

Item	Where Addressed
5.11 Fire Prevention and Control	Ph. III Section 9.5 and Appendix D
5.12 Open Burning	Ph. III Section 9.5 and Appendix D
5.13 Record Keeping	Ph. III Section 9.5 and Appendix D
5.14 Contact Person	Ph. III Section 9.4 and Appendix D
6. WATER QUALITY MONITORING	
6.1 Introduction	Ph. III Section 17, Appendix J
6.2 Sampling Procedures and Protocol	Ph. III Section 17, Appendix J
6.3 Sample Collection	Ph. III Section 17, Appendix J
6.4 Sample Collection QA/QC	Ph. III Section 17, Appendix J
6.5 Groundwater Monitoring Network	Ph. III Section 17, Appendix J
6.6 Water Level Measurements	Ph. III Section 17, Appendix J
6.7 Groundwater Monitoring System	Ph. III Section 17, Appendix J
6.8 Surface Water Monitoring System	Ph. III Section 17, Appendix J
6.9 Groundwater Sampling and Analysis	Ph. III Section 17, Appendix J
6.10 Sampling Procedures	Ph. III Section 17, Appendix J
6.11 Laboratory Analysis Procedures	Ph. III Section 17, Appendix J
6.12 Evaluation of Groundwater Quality Data	Ph. III Section 17, Appendix J
6.13 Contingency Plan for Preventing or Mitigating the Pollution of Groundwater	Ph. III Section 14.3, Appendix H
6.14 Sample Custody and Documentation	Ph. III Section 17, Appendix J
6.15 Decontamination	Ph. III Section 17, Appendix J
6.16 Quality Control	Ph. III Section 17, Appendix J
6.17 Data Review	Ph. III Section 17, Appendix J
6.18 Surface Water	Ph. III Section 17, Appendix J
7. GEOTECHNICAL EVALUATION	
7.1 Introduction	Ph. III Section 10.1
7.2 Subbase Settlement Analysis	Ph. III Section 10.2 and Appendix E.1
7.3 Slope Stability Analysis	Ph. III Section 10.3 and Appendix F
7.4 Stability of Waste Slope and Final Slopes	Ph. III Section 10.3 and Appendix F
7.5 Stability of Excavated Slopes	Ph. III Section 10.3 and Appendix F
8. SUBBASE CONSTRUCTION QUALITY ASSURANCE (CQA) PROGRAM	
8.1 CQA Management Organization	CQA Plan (Appendix M)
8.2 State Regulatory Agency	CQA Plan (Appendix M)
8.3 Landfill Owner	CQA Plan (Appendix M)
8.4 Personnel	CQA Plan (Appendix M)
8.5 CQA Manager	CQA Plan (Appendix M)
8.6 CQA Inspectors	CQA Plan (Appendix M)
8.7 Contractor	CQA Plan (Appendix M)
8.8 CQC Manager	CQA Plan (Appendix M)
8.9 Construction Crews	CQA Plan (Appendix M)
8.9.1 Site Preparation	Specification Section 02055 (App. L)
8.9.2 General	Specification Section 02055 (App. L)
8.9.3 Aerial Survey	Specification Section 01721 (App. L)
8.9.4 Control Bench Marks	Specification Section 02055 (App. L)
8.9.5 Clearing and Grubbing	Specification Section 02055 (App. L)
8.9.6 Sedimentation and Erosion Controls	CQA Plan and Specification Section 02370 (App. N)

Item	Where Addressed
8.9.7 Site Grading	Appendix D, Appendix M, and Drawing 11
8.9.7.1 General	CQA Plan, Drawing 3
8.9.7.2 Initial Construction	Appendix D
8.9.7.3 Phase Development	Appendix D
8.9.7.4 Engineering Analyses	Appendix E, F
8.9.7.5 Settlement Potential	Appendix E.1
8.9.7.6 Bearing Capacity and Stability Analyses	Appendix F, Appendix E.3
8.9.7.7 Subgrade Preparation	Specification Section 02055
8.9.7.8 Subgrade Construction	Specification Section 02055
8.9.7.9 Foundation QA/QC	Appendix M and Specification
8.9.7.10 Foundation Certification	Appendix M and Specification
8.9.8 Subbase Construction	Appendix M and Specification
8.9.8.1 General	Specification
8.9.8.2 Soil Source	Specification Section 02055
8.9.8.3 Soil Selection	Specification Section 02055
8.9.8.4 Subbase Preparation	Specification Section 02055
8.9.8.5 Subbase Number of Lifts	Specification Section 02055
8.9.8.6 Soil Tests	Specification Section 02055
8.9.8.6.1 Number of Tests Per Lift and Acre	Specification Section 02055
8.9.8.6.2 Field Testing-Soil Moisture, Permeability, Compaction Optimum Soil Moisture	Specification Section 02055
8.9.8.6.3 Failed Field Testing & Methods Used to Correct the _______?	Specification Section 02055
8.9.8.6.4 Lab Soil Testing for Moisture & Permeability	Specification Section 02055
8.9.8.6.5 QA/QC Subbase Construction	Appendix M and Specification Section 02055
8.9.8.6.6 Subbase Certification	Appendix M and Specification Section 02055
9. LANDFILL DESIGN	
9.1 Introduction	Ph. III Section 10.1 & 10.2.1
9.2 Liner System	
9.2.1 Chemical Characteristics and Compatibility	Ph. III Section 11.2.4; Appendix E.3
9.2.2 Liner System Testing	Section 10.2, Appendix M and Specification Sections 02055, 02072, 02075, 02078
9.2.3 Physical Stress on the HDPE Membrane	Ph. III Section 10.2
9.3 General	Ph. III Section 10
9.4 Geomembrane Deployment	Specification Section 02075
9.5 Geomembrane Protection	Appendix M and Specification Section 02075
9.6 Liner System Design	Appendix M, Specification Sections 02055, 02072, 02075, 02078, Drawing 7, Appendix E, F
9.6.1 CQC/CQA Procedures to Keep Up with Enhanced Materials and Test Methods	Appendix M and Specification
9.6.2 Landfill Floor Liner System	Drawing 7
9.6.3 Landfill Side Slope Liner Anchor Trench	Drawing 13

Item	Where Addressed
9.6.4 Leak Detection Methods	Ph. III Section 14.3.2 and Appendix J
9.6.5 QA/QC Liner Installation	Appendix M and Specification Section 02075
9.6.6 Defects and Repairs	Appendix M and Specification Section 02075
9.7 Granular Drainage Media	
9.7.1 General	Appendix M, Specification Section 02055, Drawing 7
9.7.2 Aggregate Thickness and Placement	Appendix M, Specification Section 02055, Drawing 7
9.8 Leachate Collection System	
9.8.1 Leachate Collection Piping	Ph. III Section 13.2
9.8.2 Leachate Sumps and Appurtenances	Ph. III Section 13.3
9.8.3 Leachate Flow Rate Measurement	Ph. III Section 13.2
9.8.4 Maximum Head of Leachate	Ph. III Section 13.2
9.8.5 Leachate Sampling and Analysis	Appendix D
9.8.6 Leachate Disposal	Ph. III Section 13.3
9.8.7 Pipe Installation	Appendix M, Specification Section 02081, Drawing 5
9.8.8 Pipe Clogging	Ph. III Section 13.1
9.8.9 QA/QC Pipe Installation	Appendix M, Specification Section 02081
9.9 Gas Management System	Ph. III Section 15
9.10 Cover Material	Ph. III Section 7
9.11 Borrow Area	Ph. III Section 7.4 and Appendix D
10. STORMWATER MANAGEMENT AND SEDIMENT & EROSION CONTROL PLAN	
10.1 General	Ph. III Section 12.1
10.2 Run-On Control	Appendix G
10.3 Run-off Control	Ph. III Section 12, Appendix G
10.4 Sedimentation and Erosion Control	Ph. III Section 12 and Appendix D.
10.5 Leachate Management	Ph. III Section 13
10.6 Landfill Gas	Ph. III Section 15
11. OPERATION AND MAINTENANCE	
11.1 General	Appendix D
11.2 Operational Plan Defined	Appendix D
11.3 Operation Procedures	Appendix D
11.4 Waste Collection/Transportation	Appendix D
11.5 Hours of Operation	Ph. III Section 9.2 and Appendix D
11.6 Site Security and Signs	Ph. III Section 9 and Appendix D
11.7 Site Access	Ph. III Section 9
11.8 General Waste Analysis	Ph. III Section 5
11.9 Areas to be Served Defined	Ph. III Section 4.3
11.10 Population to be Served	Ph. III Section 4.4
11.11 Sources of Waste	Ph. III Section 4.2 & 4.3
11.12 Quantities of Waste	Ph. III Section 5
11.13 Volume of Waste to be Received	Ph. III Section 5
11.14 Tonnage of Waste to be Received	Ph. III Section 5
11.15 Useful Life Projection of Landfill Defined	Ph. III Section 6 and Section 6
11.16 Calculation Included	Appendix G
11.17 Waste Stream Volume Reduction Considered/Discussed	Appendix G
11.18 Acceptable Wastes Solid Waste	Ph. III Section 6.2 and Appendix D

Item	Where Addressed
11.19 Acceptable Wastes Defined	Ph. III Section 6.2 and Appendix D
11.20 Non Acceptable Wastes Defined	Ph. III Section 6.2 and Appendix D
11.20.1 Waste Acceptance Procedure	Appendix D
11.20.2 Check-In Procedures	Ph. III Section 9 and Appendix D
11.20.3 Waste Inspection and Acceptance (need more detail)	Appendix D
11.20.4 Waste Placement	Appendix D
11.20.5 Filling Sequence	Appendix D
11.20.6 Filling Procedure	Appendix D
11.20.7 Inclement Weather Operation	Ph. III Section 9.8 and Appendix D
11.20.8 Check-Out Procedures	Appendix D
11.21 Data Collection	Appendix D
11.21.1 Types of Data to be Collected	Appendix D
11.21.2 Format for Collection Data	Appendix D
11.21.3 Data to be Reported	Appendix D
11.21.4 Adequacy of Data Discussed	Appendix D
11.21.5 Relevance of Data	Appendix D
11.21.6 Source, Type, Volume & Tonnage	Ph. III Section 5 and Appendix D
11.21.7 Daily, Weekly, Monthly & Annual Data	Appendix D
11.21.8 Facility Life Estimate Calculation	Ph. III Section 5 and Appendix D
11.21.9 Top Soil Recovery & Storage Plan	Ph. III Section 7.5
11.21.10 Cover Material Stockpiles Defined on Site	Ph. III Section 7.4
11.21.11 Daily Cover Requirements	Appendix D
11.21.12 Volumes Required	Ph. III Section 7.3
11.21.13 Type of Material Specified	Ph. III Section 7.2
11.21.14 Storage Location Onsite Specified	Ph. III Section 7.4
11.21.15 Final Cover Requirements	Appendix D
11.22 Traffic Patterns	Appendix D
11.22.1 Traffic Characterization and Routing	Appendix D
11.23 Runoff Management	Ph. III Section 12, Appendices D and G
11.24 Leachate Management System	Ph. III Section 13 and Appendix D
11.24.1 General	Appendix D
11.24.2 Leachate Collection System	Ph. III Section 14.3 and Appendix D
11.24.3 Leachate Transmission System	Ph. III Section 14.3 and Appendix D
11.25 Landfill Gas Management System	Ph. III Section 15 and Appendix D
11.26 Procedures to Prevent Hazards	Appendix D
11.27 Security	Ph. III Section 9, Appendix D
11.27.1 Entry Control	Appendix D
11.27.2 General Inspection Requirements	Appendix D
11.27.3 Inspection Schedule	Appendix D
11.27.4 Inspection Procedure	Appendix D
11.28 Remedial Maintenance and Hazard Preventive Procedures	Appendix D
11.28.1 Unloading Operations	Appendix D
11.28.2 Fire Protection	Appendix D
11.28.3 Groundwater Quality Protection	Appendix D
11.28.4 Equipment and Power Failure	Appendix D

Item	Where Addressed
11.28.5 Safety Procedures	Appendix D
11.28.6 Communications	Appendix D
11.29 MAINTENANCE PROCEDURES	Appendix D
11.29.1 General Maintenance Program	Appendix D
11.29.2 Site Maintenance	Appendix D
11.29.3 General	Appendix D
11.29.4 Berms and Cover System	Appendix D
11.29.5 Leachate Collection/Transmission System	Appendix D
11.29.6 Method of Leachate Collection System	Appendix D
11.29.7 Leachate Collection Cleanout	Appendix D
11.29.8 Gas Management System	Appendix D
11.29.9 Utilities	Appendix D
11.29.10 Perimeter Roads	Appendix D
11.29.11 Drainage Ditches Defined & Delineated	Appendix D
11.29.12 Sedimentation and Erosion Control Plan Addressed & Approved by Local SCS District	Appendix D, Appendix G
11.29.13 Stormwater Collection Ponds Defined & Calculation for Capacity	Ph. III Section 12,Appendix D, and Stormwater Management Plan
11.30 FACILITIES AND EQUIPMENT MAINTENANCE	Appendix D
11.30.1 General	Appendix D
11.30.2 Leachate Transmission System	Appendix D
11.30.3 Operating Equipment Defined	Appendix D
11.30.4 Leachate Storage Tanks Specified & Capacity	Appendix D
11.31 PERSONNEL	Ph. III Section 9.4 and Appendix D
11.31.1 General	Ph. III Section 9.4 and Appendix D
11.31.2 Manpower Requirements-Staff Described	Ph. III Section 9.4 and Appendix D
11.31.3 Qualifications	Ph. III Section 9.4 and Appendix D
11.32 FACILITIES	Ph. III Section 3 and Appendix D
11.32.1 General	Ph. III Section 3 and Appendix D
11.32.2 Landfill Office/Maintenance Building	Ph. III Section 3.4 and Appendix D
11.32.3 Utilities	Ph. III Section 3 and Appendix D
11.33 Records	Appendix D
11.33.1 General	Appendix D
11.33.2 Financial Records	Appendix D
11.33.3 Operation Records	Appendix D
11.34 Types and Volume of Waste	Ph. III Section 6 and Appendix D
11.35 Personnel	Ph. III Section 10.4 and Appendix D
11.36 Maintenance	Appendix D
11.37 Inspection	Appendix D
11.38 Permits	Appendix D
11.39 Reports	Appendix D
11.40 Training Program	Appendix D
11.41 Safety Program	Appendix D
11.41.1 General	Appendix D

Item	Where Addressed
11.41.2 Safety Training	Appendix D
11.41.3 Salvage and Scavenge	Appendix D
11.41.4 Fire Protection	Appendix D
11.41.5 Hazardous Handling	Appendix D
11.41.6 Hazardous Waste Reporting	Appendix D
11.41.7 Emergency Response	Appendix D
11.42 ENVIRONMENTAL MONITORING AND CONTROL	
11.42.1 General	Appendix J
11.42.2 Monitoring Program	Appendix J
11.42.3 Water Quality	Appendix J
11.42.4 Air Quality	Appendix D
11.43 Environmental Control Program	
11.43.1 Soil Contamination	Appendix D
11.43.2 Dust and Noise	Ph. III Section 9.6 and Appendix D
11.43.3 Run off, Sedimentation and Erosion	Ph. III Section 12 & 16
11.43.4 Leachate	Ph. III Section 13 and Appendix D
11.44 CONTINGENCY PLAN	Appendix N
11.44.1 General	Ph. III Section 13 and Appendix N
11.44.2 Emergency Coordinator	Appendix N
11.44.3 Emergency Coordination	Appendix N
11.44.4 During Operating Hours	Appendix N
11.44.5 During Non-Operating Hours	Appendix N
11.44.6 Limit of Authority	Appendix N
11.44.7 Emergency Personnel	Appendix N
11.44.8 Implementation	Appendix N
11.44.9 Emergency Response Procedures	Appendix N
11.44.10 Emergency Coordinator	Appendix N
11.45 Specific Emergency Actions	Appendix N
11.45.1 General	Appendix N
11.45.2 Spill Procedure: On Site Liquids	Ph. III Section 14.3 and Appendix N
11.45.3 Spill Procedure: On Site Solids	Ph. III Section 14.3
11.45.4 Spill Procedure: Underground	Ph. III Section 14.2
11.45.5 Fire Procedures	Appendix N
11.45.6 Explosion Procedures	Appendix N
11.46 Discovery of Hazardous Waste/Unauthorized Waste Procedures	Appendix N
11.46.1 Erosion Discovery Procedures	Appendix N
11.46.2 Differential Settlement Procedures	Appendix N
11.46.3 Cleanup Activities	Appendix N
11.46.4 Post Incident Actions	Appendix N
11.46.5 Emergency Equipment	Appendix N
11.46.6 Coordination Agreement	Appendix N
11.46.7 Evaluation Plan	Appendix N
11.46.8 Amendments to the Plan	Appendix N
12. CLOSURE PLAN	

Item	Where Addressed
12.1 General	Ph. III Section 19 and Appendix O
12.2 Schedule and Description	Appendix O
12.2.1 Performance Standard	Appendix O
12.2.2 Closure Activities	Appendix O
12.2.2.1 Partial Closure	Appendix O
12.2.2.2 Closure During Operating Life	Appendix O
12.2.2.3 Closure After Landfill Reaches Permitted Capacity	Appendix O
12.2.2.4 Contact for Final Closure	Appendix O
12.3 Notification Procedures	Appendix O
12.4 Restricted Access Assurance	Appendix O
12.4.1 Deed Notation	Appendix O
12.4.2 Closure Cost Estimate and Financial Assurance	Appendix O
12.4.3 Closure System Design	Appendix O
12.4.3.1 General	Appendix O
12.4.3.2 Cover System Design	Appendix O and Drawing 12
12.4.3.3 Final Closure Plan	Appendix O
12.4.3.4 Design of Key System for the Cap	Appendix K, Drawing 12
12.4.3.5 Slope Stability Analysis	Appendix F, Appendix M.5
12.4.3.6 Barrier Layer Integrity	Appendix M
12.4.3.7 QA/QC for Cover System Materials	Appendix M
12.4.3.8 QA/QC for Cover System Inspection	Appendix M
12.4.3.9 Final Cover Availability and Suitability	Ph. III Section 7.2
12.4.3.10 Construction Quality Assurance/Quality Control	Appendix M
12.4.3.11 Vegetation	
12.4.3.11.1 Temporary Seeding	Ph. III Section 16.2
12.4.3.11.2 Permanent Seeding	Ph. III Section 16.3
12.4.3.11.3 Mulching	Ph. III Section 16.3
12.4.3.11.4 General	Ph. III Section 11.1
12.4.3.11.5 Certification of Closure	Appendix O
13. POST CLOSURE CARE	
13.1 General	Ph. III Section 21 and Appendix O
13.2 Post Closure Care	Appendix O
13.3.1 Site Maintenance Plan	Appendix O
13.3.2 Post Closure Activity	Appendix O
13.3 Monitoring Plan	Appendix O
13.3.1 Surface Water Management System	Appendix O
13.3.2 Groundwater Monitoring	Appendix O
13.3.3 Landfill Gas Management System	Appendix O
13.3.4 Leachate Collection System	Appendix O
13.3.5 Cover System	Appendix O
13.3.6 Inspection Plan	Appendix O
13.4 Post Closure Security	

Item	Where Addressed
13.4.1 Site Security	Appendix O
13.4.2 Entry Control	Appendix O
13.4.3 Miscellaneous Items	Appendix O
13.5 Post Closure Maintenance Activities	Appendix O
13.5.1 Repair of Security Devices	Appendix O
13.5.2 Repair of Erosion or Cracking of Final Cover	Appendix O
13.5.3 Repair of Settlement Depressions	Appendix O
13.5.4 Repair of Run-On and Run Off Control Systems	Appendix O
13.5.5 Repair of Leachate Control Systems	Appendix O
13.5.6 Maintenance of Gas Venting Wells and Monitoring Probes	Appendix O
13.5.7 Maintenance of Groundwater Monitoring System	Appendix O
13.5.8 Post Closure Personnel Training	Appendix O
13.5.9 Post Closure Contact	Appendix O
13.5.10 Post Closure Site Use	Appendix O
13.5.11 Post Closure Cost Estimate and Financial Assurance	Appendix O

Appendix A: Reduced Size Drawing Set

APPLICATION FOR A RUBBLE LANDFILL PERMIT: PHASE III REPORT
VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL
CROFTON, ANNE ARUNDEL COUNTY, MARYLAND

JULY 2020
REVISED NOVEMBER 2020

SOURCE: www.bing.com

VICINITY MAP
SCALE: 1" = 1 MILE

LIST OF DRAWINGS

NUMBER	TITLE
1	COVER SHEET
2	EXISTING CONDITIONS
3	PREPARED SUBGRADE PLAN
4	LEACHATE MANAGEMENT PLAN (PREPARED SUBBASE)
5	LEACHATE COLLECTION AND LINER SYSTEM DETAILS I
6	LEACHATE COLLECTION AND LINER SYSTEM DETAILS II
7	LEACHATE COLLECTION AND LINER SYSTEM DETAILS III
8	UTILITY CORRIDOR AND LINER TIE-IN CROSS SECTIONS
9	LEACHATE TRANSMISSION SYSTEM PLAN II
10	LEACHATE TRANSMISSION HEADER PROFILE
11	FINAL COVER GRADING AND STORMWATER MANAGEMENT SYSTEM
12	FINAL COVER SYSTEM AND STORMWATER MANAGEMENT DETAILS
13	STORMWATER MANAGEMENT DETAILS I
14	STORMWATER MANAGEMENT DETAILS II
15	LANDFILL GAS MANAGEMENT SYSTEM PLAN
16	LANDFILL GAS MANAGEMENT SYSTEM DETAILS I
17	LANDFILL GAS MANAGEMENT SYSTEM DETAIL II
18	LANDFILL CROSS SECTIONS

SOURCE: www.bing.com

LOCATION MAP
SCALE: 1" = 3000'

PREPARED FOR: TOLSON AND ASSOCIATES, LLC
24024 FREDERICK ROAD
CLARKSBURG, MARYLAND 20871
PHONE: (301) 428-0800

PREPARED BY: Geosyntec consultants
10211 WINCOPIN CIRCLE, FLOOR 4
COLUMBIA, MARYLAND 21044
PHONE: (410) 381-4333

PROFESSIONAL CERTIFICATION:

I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MARYLAND.

LICENSE No. 32252

EXPIRATION DATE 09-08-2021

PERMIT DRAWINGS - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DRN	APP
1	NOV 2020	UPDATED PER MDE COMMENTS	BGF	CHP

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TOLSON AND ASSOCIATES, LLC
24024 FREDERICK ROAD
CLARKSBURG, MARYLAND 20871

TITLE: COVER SHEET

PROJECT: **VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL**

SITE: **TOLSON RUBBLE LANDFILL**

C.H. Pendleton
SIGNATURE
11-06-2020
DATE

STATE OF MARYLAND · CARRIE H. PENDLETON · 32252 · PROFESSIONAL ENGINEER

DESIGN BY: SS		DATE:	JULY 2020
DRAWN BY: ANA		PROJECT NO.:	ME1606
CHECKED BY: SS		FILE:	ME1606-001
REVIEWED BY: ---		DRAWING NO.:	1 OF 18
APPROVED BY: CHP			

BFERRICK - 10-Nov-20 - 5:59 PM
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LEGEND

- 170 — EXISTING CONTOURS (FEET, MSL)
- PROPERTY BOUNDARY
- EXISTING TREE LINE
- CURRENT PERMITTED WASTE BOUNDARY
- EXISTING WASTE DISPOSAL CELL
- x — x — x EXISTING SECURITY FENCE
- EXISTING ELECTRIC POLES
- E — E — E EXISTING ELECTRIC LINE
- UE — UE — UE EXISTING UNDERGROUND ELECTRIC LINE
- EXISTING ROAD
- GP-1 EXISTING TOLSON LANDFILL GAS PROBES
- GP-1 EXISTING CUNNINGHAM LANDFILL GAS PROBES
- EXISTING CUNNINGHAM LANDFILL GAS VENTS
- MW-26A 102.04 MONITORING WELL WITH HIGHEST OBSERVED GROUNDWATER ELEVATION
- AUG-19 DATE IS MONTH OF MAXIMUM MEASUREMENT
- * ASTERIX DENOTES WATER LEVEL NOT USED IN CREATING POTENTIOMETRIC SURFACE
- — 90 — APPROXIMATE POTENTIOMETRIC SURFACE BASED ON MAXIMUM MEASURED GROUNDWATER ELEVATIONS FROM JANUARY 2019 TO OCTOBER 2020 (FEET, MSL)

NOTES:

1. EXISTING TOPOGRAPHY IS FROM AN AERIAL SURVEY BY QUANTUM SPATIAL, DULLES, VA, PERFORMED ON 30 JANUARY 2020.
2. PROPERTY AND PARCEL BOUNDARIES ARE FROM BAY ENGINEERING FROM FILE, "TO GEOSYNTEC 06-01-2018 15-5132 EXHIBITS FOR ZONING 1-3".
3. GROUNDWATER MONITORING WELL LOCATIONS ARE FROM "ME1606-XB-ACTIVE 2017 GW.DWG"
4. GAS PROBES ARE GOEREFERENCED FROM SOIL-GAS MONITORING POINTS LOCATION MAP CREATED BY ERM.
5. LIMIT OF SPECIAL EXPANSION BA 127-055 2005-0278-6 OBTAINED FROM SURFACE MINE PERMIT/ MINE EXTENSION/ SEDIMENT AND EROSION CONTROL PLANS FOR RESOURCE CONSERVATION GROUP, CROFTON, MARYLAND MDE PERMIT NO. 78-SP-0087-C, BAY ENGINEERING, FEBRUARY 2017.
6. LIMIT OF PHASE 1 CELL A BOUNDARY OBTAINED FROM CONSTRUCTION COMPLETION REPORT TOLSON RUBBLE LANDFILL PHASE I CELL A CROFTON, MARYLAND, 13 MARCH 2017, APPENDIX C, AS-BUILT DRAWINGS.
7. HORIZONTAL COORDINATES CORRESPONDS TO THE NAD83 MARYLAND STATE PLANE ZONE (NAD83), US FOOT.
8. VERTICAL DATUM IS BASED ON NAVD 88.
9. CUNNINGHAM GAS VENT LOCATIONS ARE FROM ENVIRONMENTAL RESOURCES MANAGEMENT, FIGURE 1, CUNNINGHAM LANDFILL DATED 10/25/2017.

REV	DATE	DESCRIPTION	DRN	APP
1	NOV 2020	REVISED WATER LEVELS AND GROUNDWATER CONTOURS AND INCLUSION OF CUNNINGHAM GAS VENTS	AM	CHP

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TITLE: EXISTING CONDITIONS

PROJECT: **VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL**

SITE: **TOLSON RUBBLE LANDFILL**

C.H. Pendleton
SIGNATURE
11-06-2020
DATE

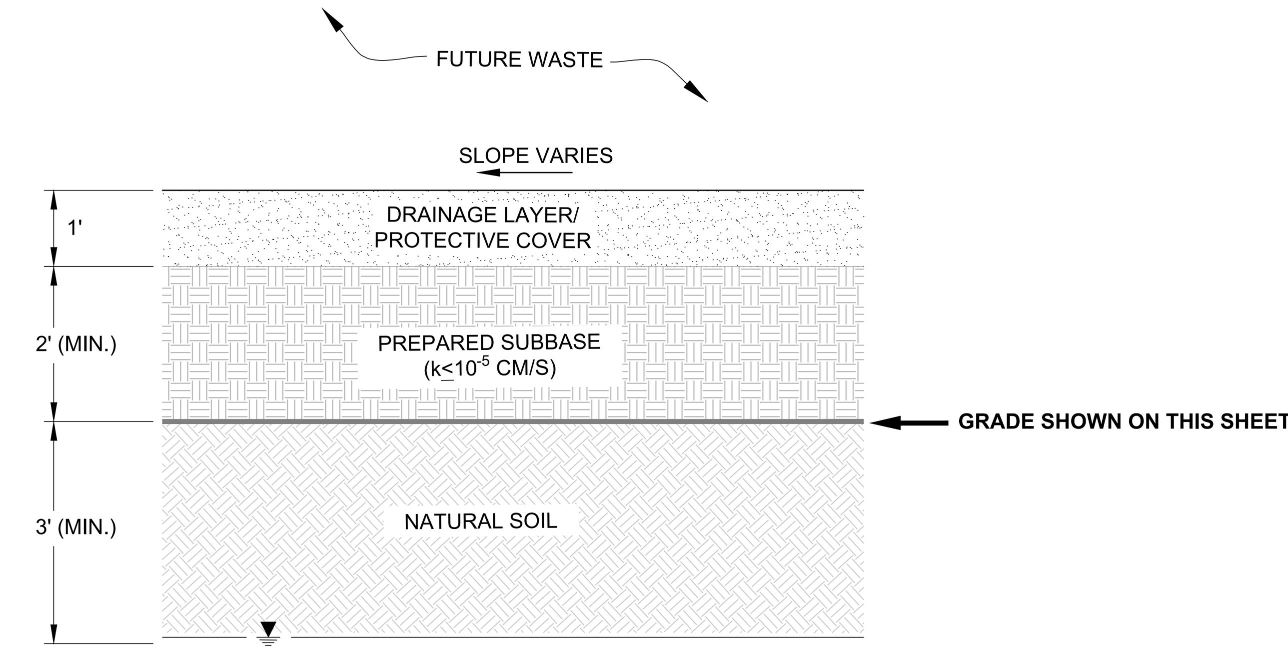
STATE OF MARYLAND · CARRIE H. PENDLETON · 32252 · PROFESSIONAL ENGINEER

DESIGN BY:	SS	DATE:	JULY 2020
DRAWN BY:	ANA	PROJECT NO.:	ME1606
CHECKED BY:	SS	FILE:	ME1606-003
REVIEWED BY:	---	DRAWING NO.:	
APPROVED BY:	CHP	2 OF 18	

PERMIT DRAWINGS - NOT FOR CONSTRUCTION

LEGEND

55	EXISTING MINOR GRADE CONTOUR
50	EXISTING MAJOR GRADE CONTOUR
	EXISTING TREE LINE
x x x	EXISTING FENCE
	EXISTING ROAD
	PROPERTY LINE
118	PROPOSED MINOR GRADE CONTOUR
120	PROPOSED MAJOR GRADE CONTOUR
	EXISTING PHASE 1, CELL A BOUNDARY
	CELL BOUNDARY
	PROPOSED ROAD



1 DETAIL – LINER SYSTEM
SCALE: NTS

REV	DATE	DESCRIPTION	DRN	APP
1	NOV 2020	UPDATED PER MDE COMMENTS	BGF	CHP

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TOLSON AND ASSOCIATES, LLC
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CLARKSBURG, MARYLAND 20871

TITLE: PREPARED SUBGRADE PLAN

PROJECT: **VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL**

SITE: **TOLSON RUBBLE LANDFILL**

C.H. Pendleton
SIGNATURE
11-06-2020
DATE

STATE OF MARYLAND – CARRIE H. PENDLETON – 32252 – PROFESSIONAL ENGINEER

DESIGN BY:	SS	DATE:	JULY 2020
DRAWN BY:	ANA	PROJECT NO.:	ME1606
CHECKED BY:	SS	FILE:	ME1606-004
REVIEWED BY:	---	DRAWING NO.:	
APPROVED BY:	CHP		3 OF 18

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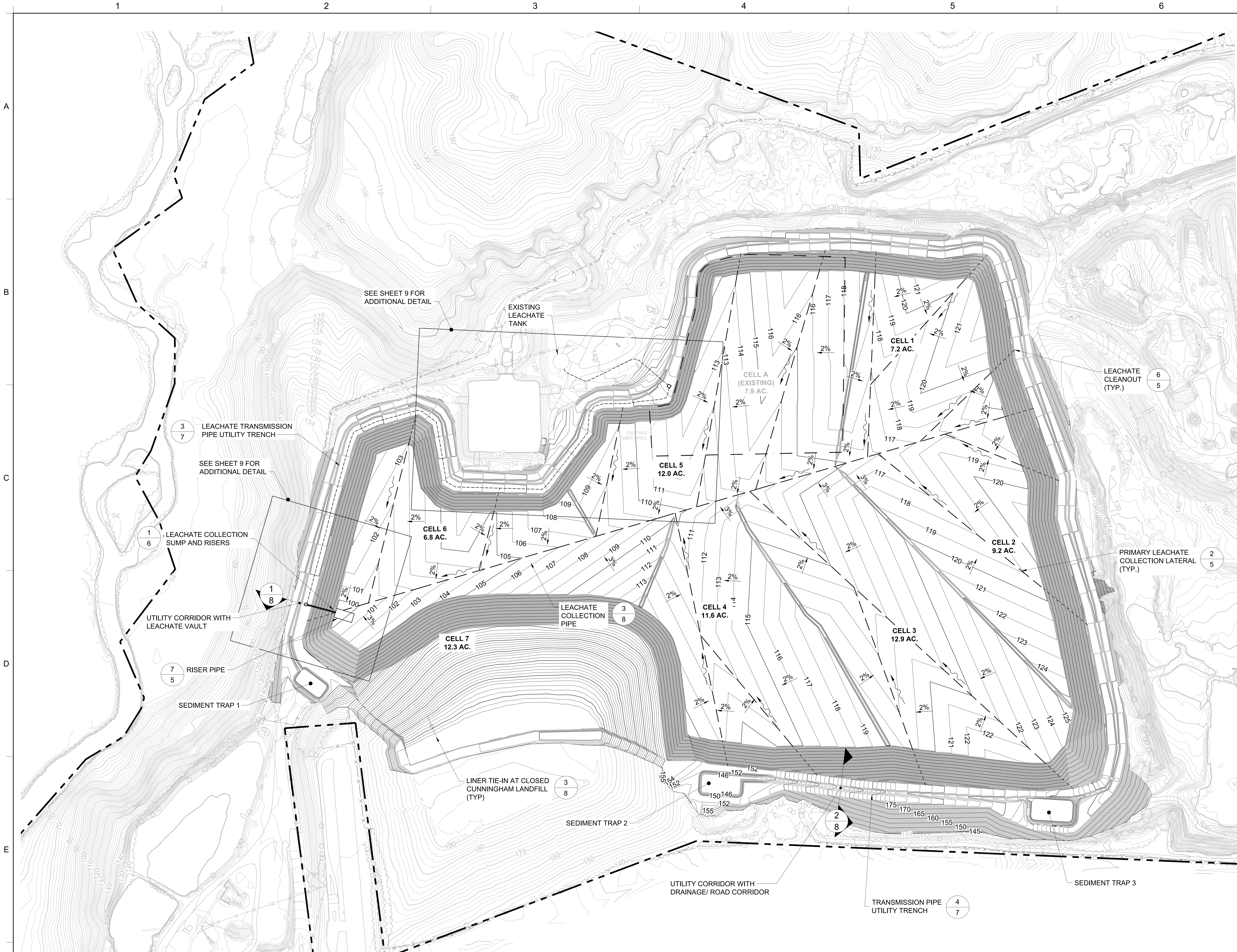
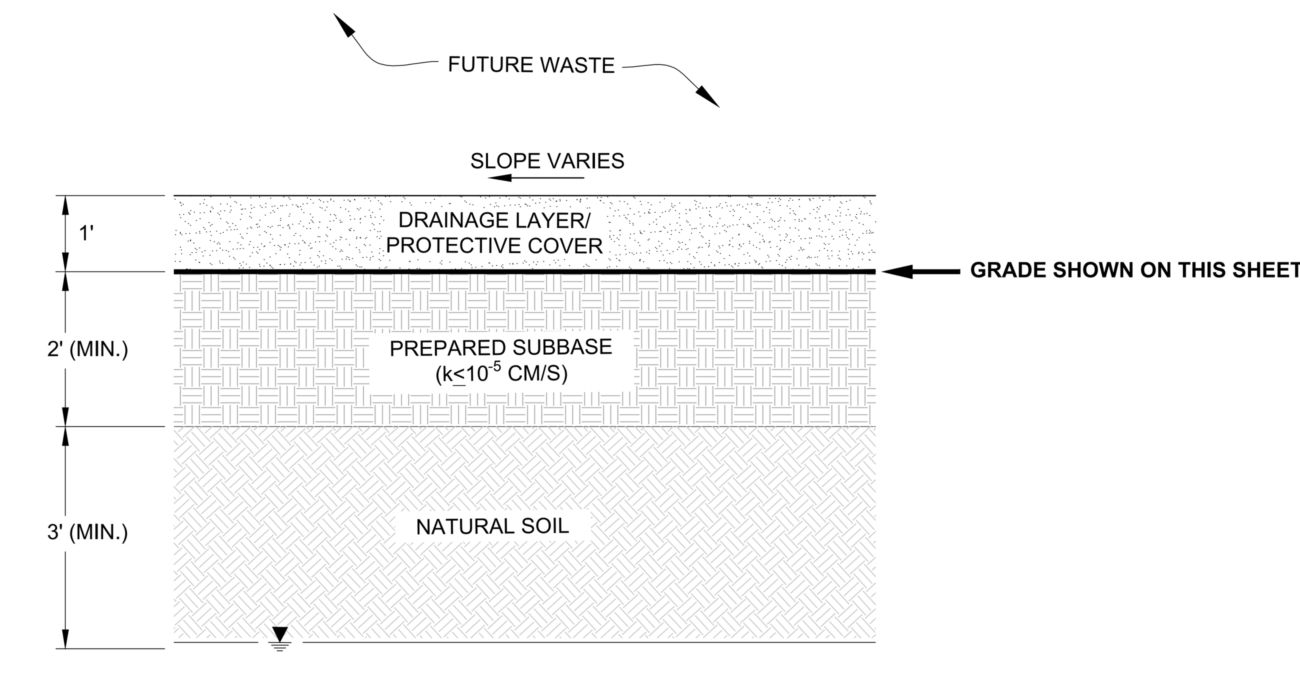


LEGEND

- EXISTING MINOR GRADE CONTOUR (55)
- EXISTING MAJOR GRADE CONTOUR (50)
- EXISTING TREE LINE
- EXISTING ROAD
- PROPERTY LINE
- PROPOSED MINOR GRADE CONTOUR (118)
- PROPOSED MAJOR GRADE CONTOUR (120)
- LEACHATE COLLECTION PIPE
- LEACHATE COLLECTION SUMP
- EXISTING CELL A BOUNDARY



DETAIL
LINER SYSTEM
SCALE: NTS

REV	DATE	DESCRIPTION	DRN	APP
1	NOV 2020	UPDATED PER MDE COMMENTS	AM	CHP

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TOLSON AND ASSOCIATES, LLC
24024 FREDERICK ROAD
CLARKSBURG, MARYLAND 20871

TITLE: LEACHATE MANAGEMENT PLAN (PREPARED SUBBASE)

PROJECT: **VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL**

SITE: **TOLSON RUBBLE LANDFILL**

C.H. Pendleton
SIGNATURE
11-06-2020
DATE

STATE OF MARYLAND CARRIE H. PENDLETON 32252 PROFESSIONAL ENGINEER

DESIGN BY:	SS	DATE:	JULY 2020
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CHECKED BY:	SS	FILE:	ME1606-005
REVIEWED BY:	---	DRAWING NO.:	
APPROVED BY:	CHP	4 OF 18	

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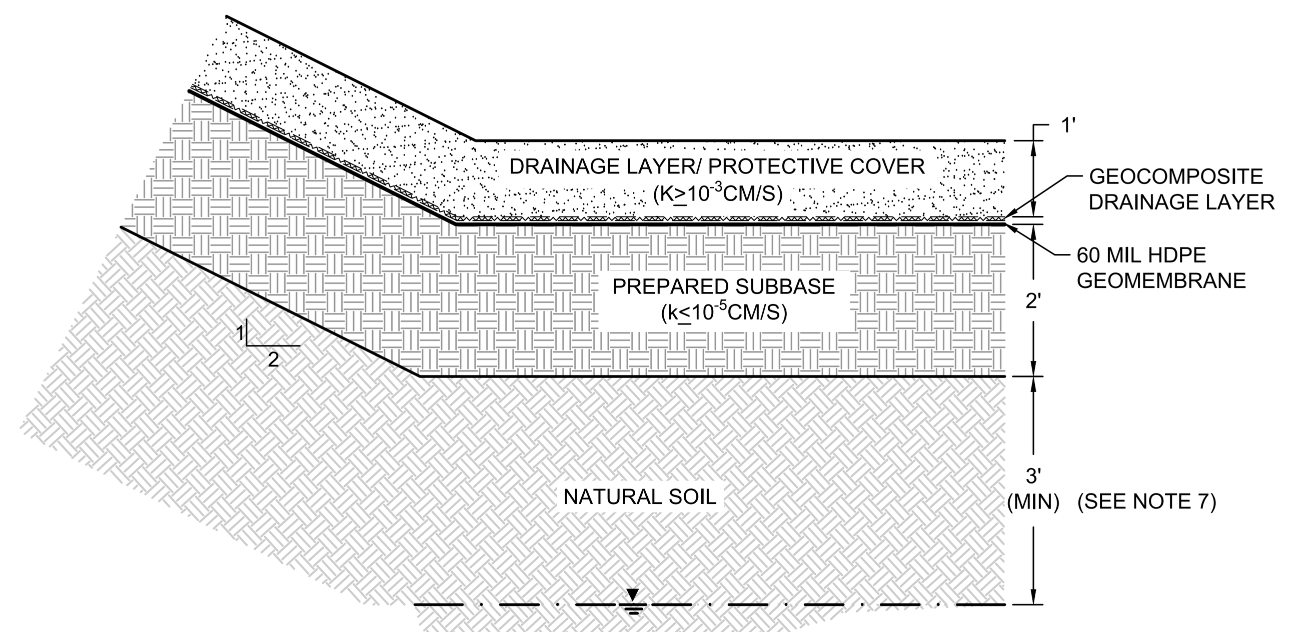
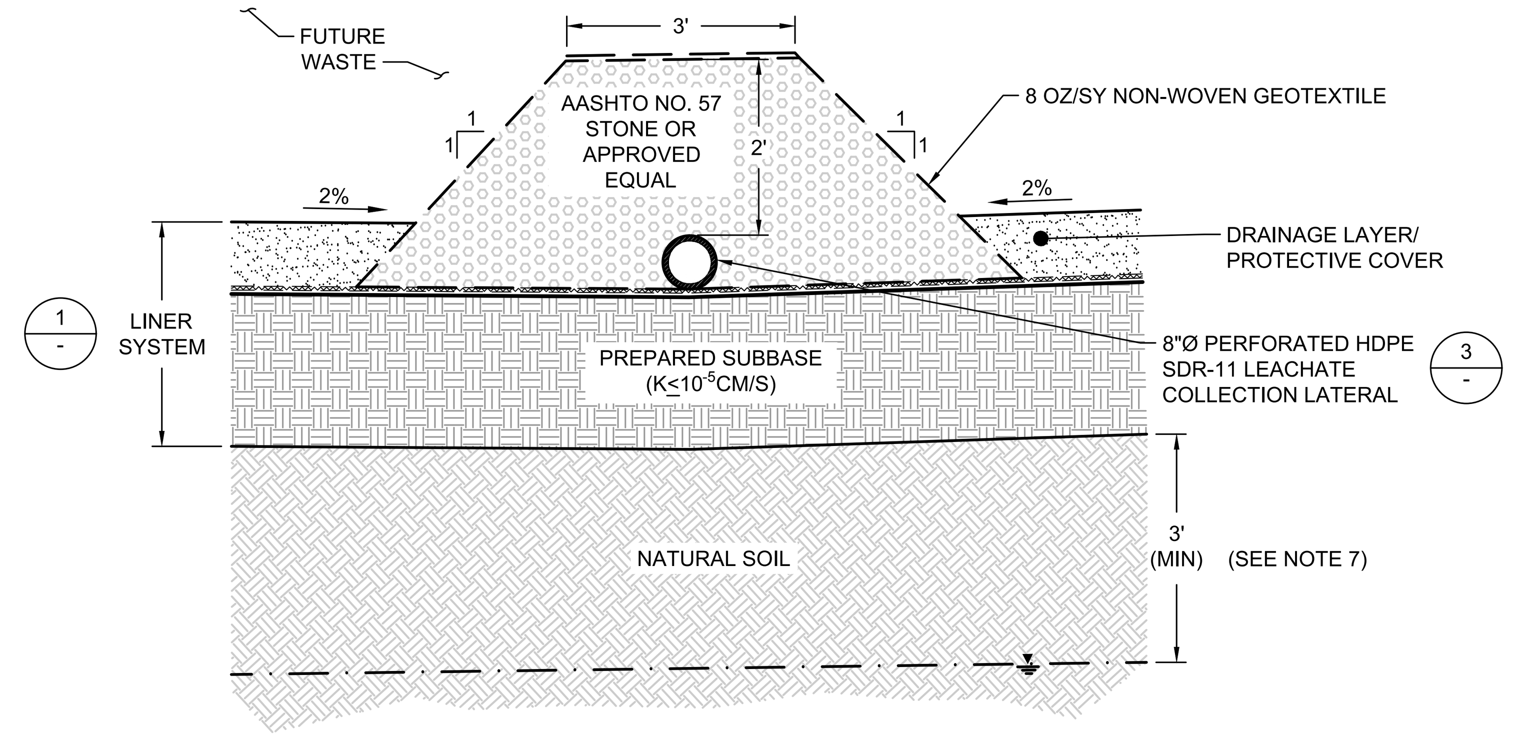
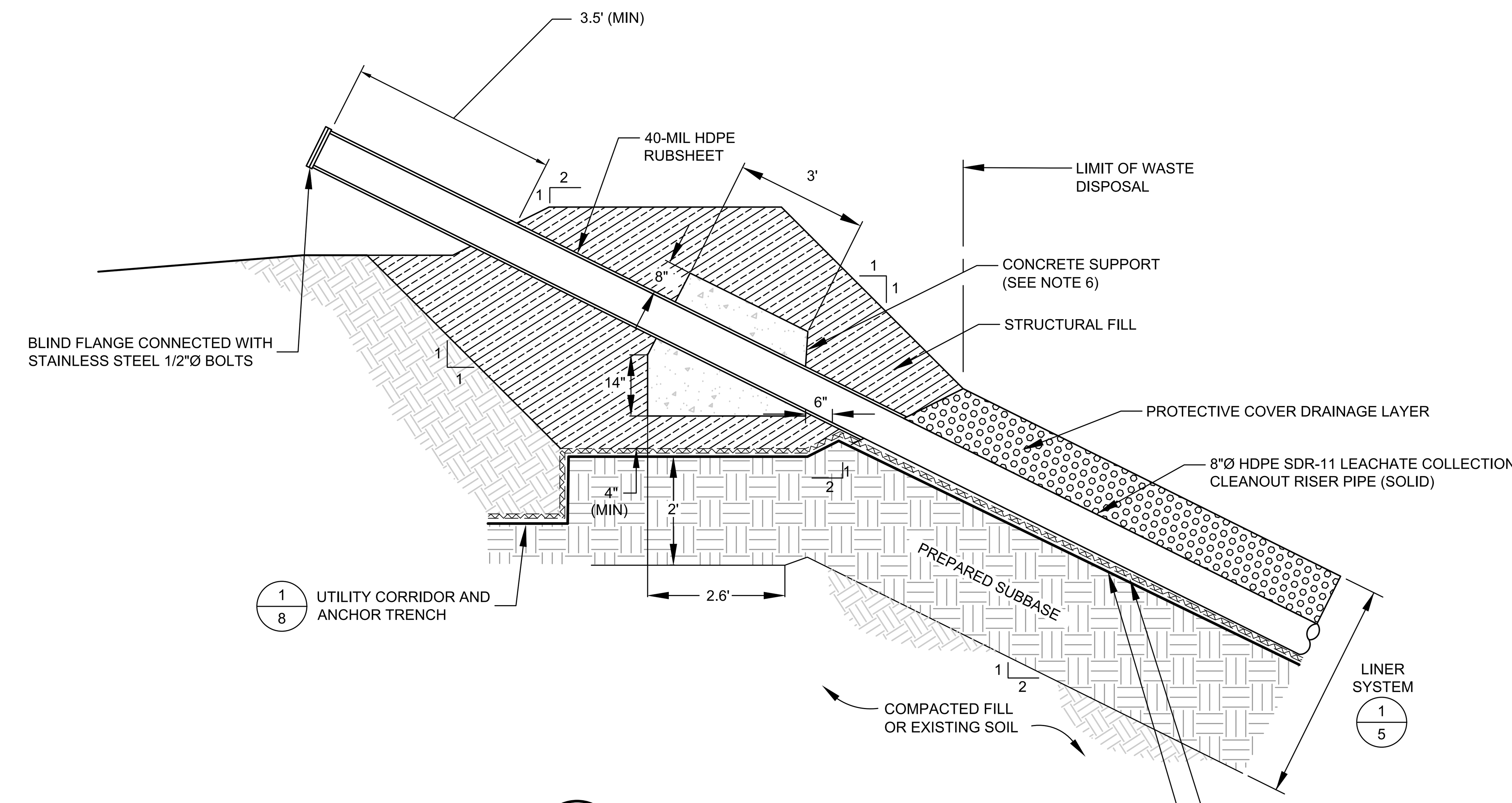


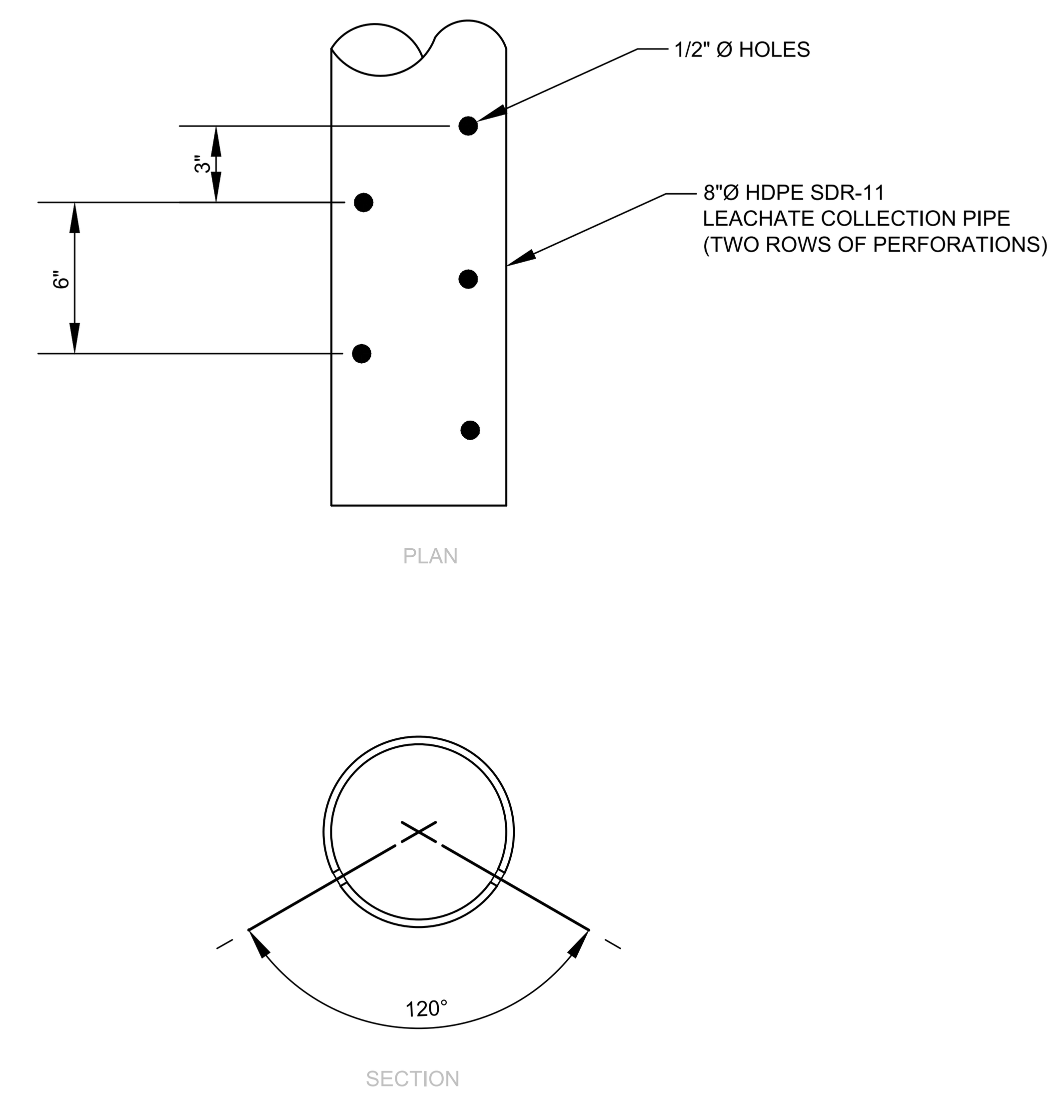
DETAIL 1/3
LINER SYSTEM
SCALE: 1" = 2'
(SEE NOTE 1)



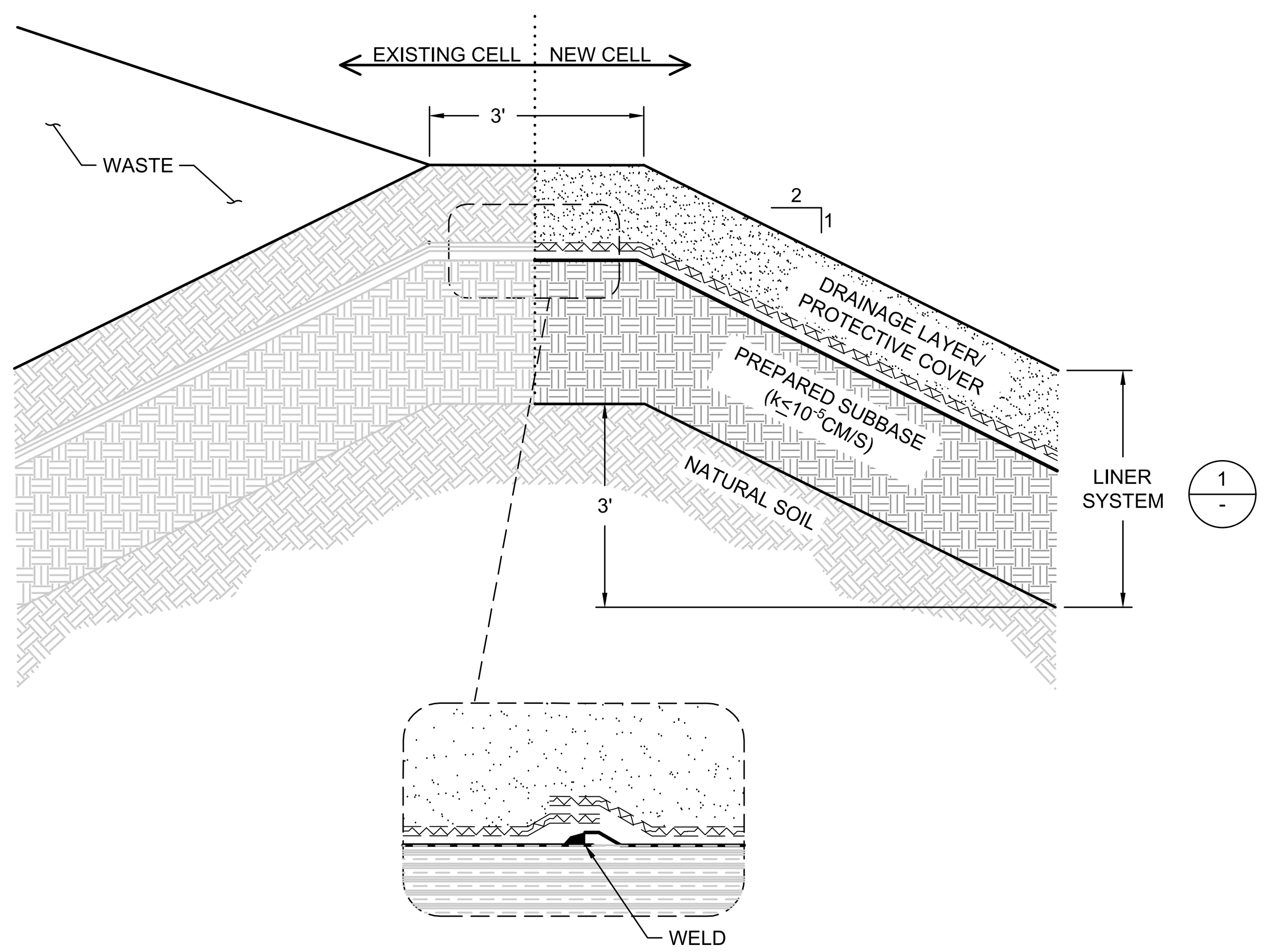
DETAIL 2/4
PRIMARY LEACHATE COLLECTION LATERAL
SCALE: 1" = 2'
(SEE NOTE 1)



DETAIL 6/4
LEACHATE CLEANOUT/RISER SUPPORT
SCALE: 1" = 2'
(SEE NOTES 3, 4, 5 AND 6)



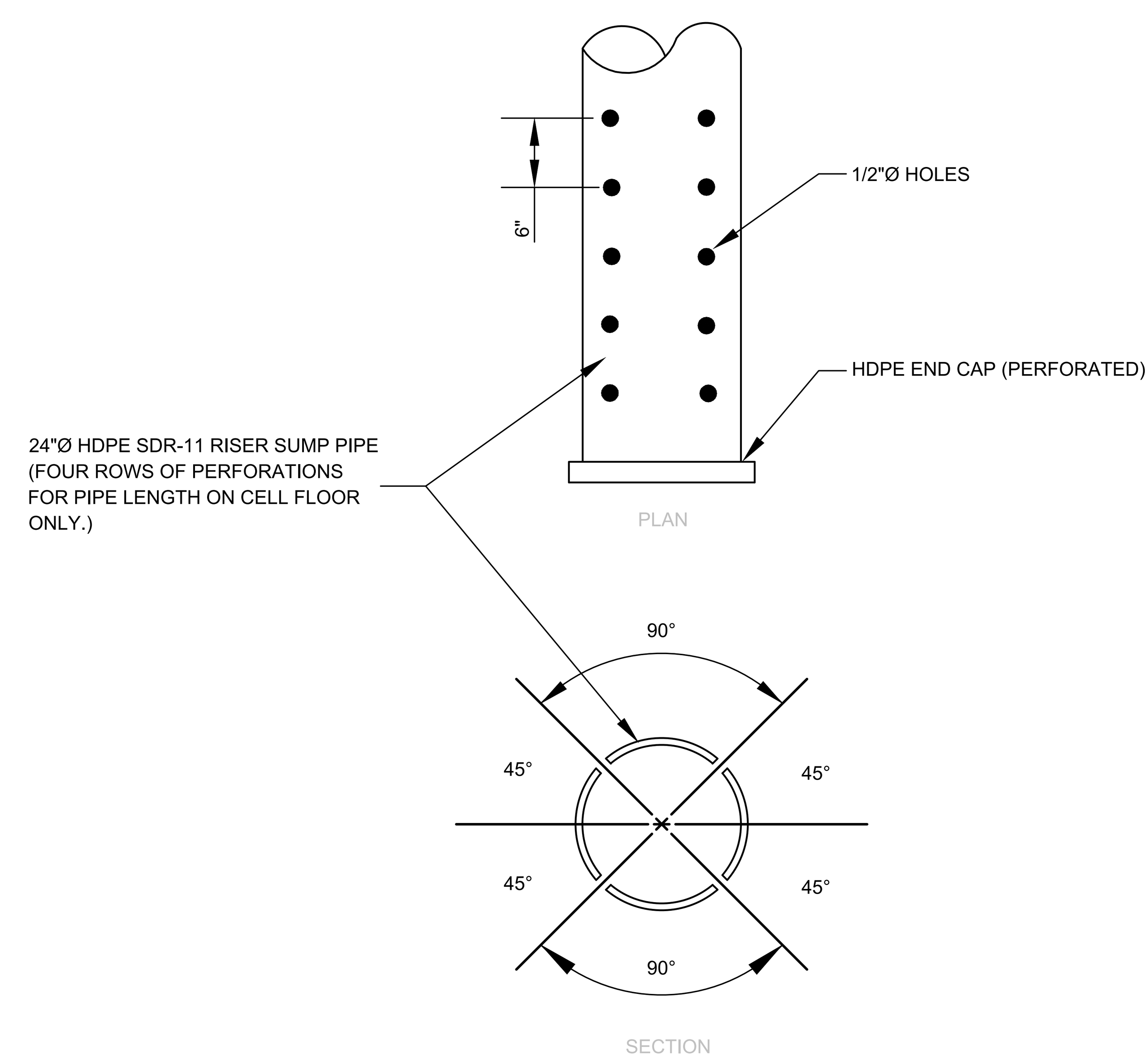
DETAIL 3/4
LEACHATE COLLECTION PIPE
SCALE: NTS



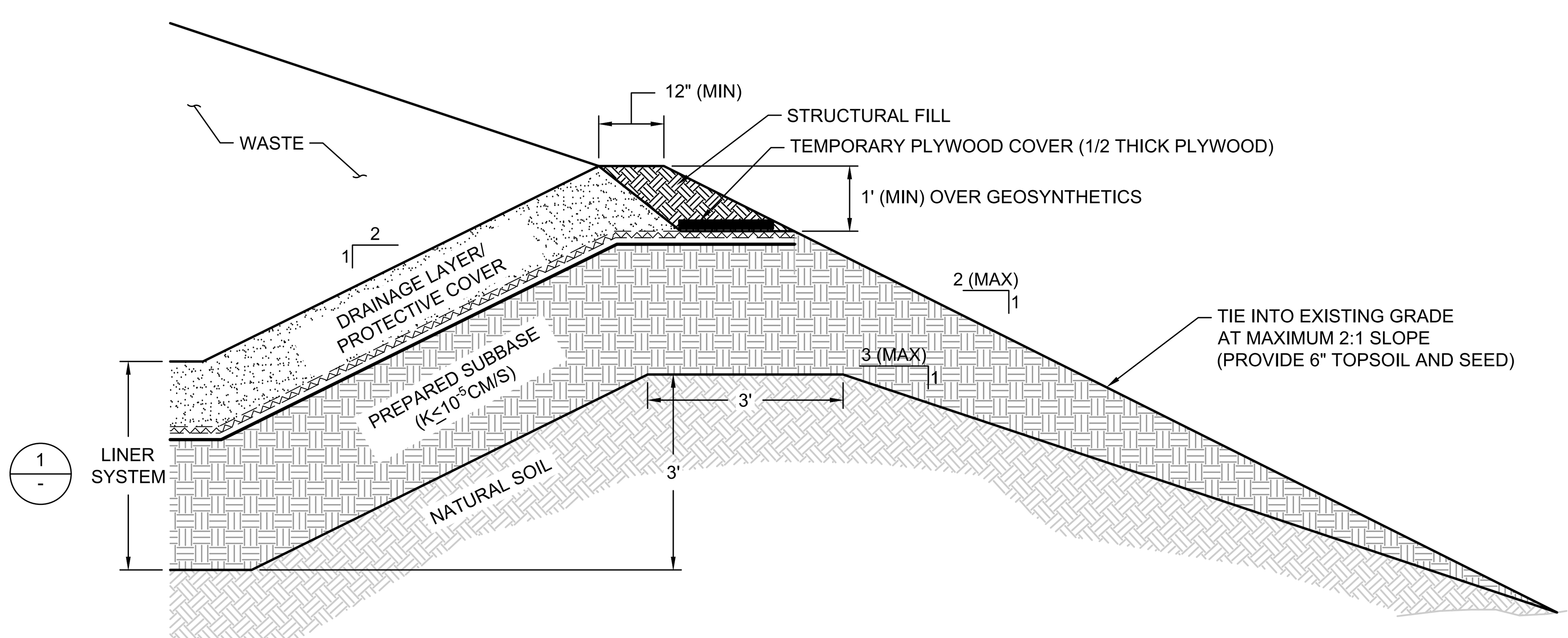
DETAIL 5/3
INTERCELL BERM
SCALE: 1" = 2'
(SEE NOTE)

NOTES:

1. GEOSYNTHETICS ARE EXAGGERATED FOR CLARITY.
2. EXISTING SOILS OVER GEOSYNTHETICS AT INTERIM BERM (DETAIL 5) SHALL BE REMOVED AND NEW GEOSYNTHETICS OVERLAPPED OVER EXISTING GEOSYNTHETICS. GEOMEMBRANES SHALL BE WELDED TOGETHER.GEOCOMPOSITE SHALL BE OVERLAPPED A MINIMUM OF ONE FOOT WITH GEONET ZIP TIED AND GEOTEXTILE SEWN TOGETHER.
3. GEOSYNTHETICS AT INTERIM BERMS WILL BE PROTECTED AS SHOWN ON DETAIL 4 UNTIL TIED INTO FUTURE GEOSYNTHETICS AS SHOWN ON DETAIL 5 ON THIS SHEET.
4. TOP PORTION OF EXISTING GROUND TO BE PREPARED IN ACCORDANCE WITH PROJECT SPECIFICATIONS.
5. ALL LEACHATE PIPES OUTSIDE OF LANDFILL CELLS SHALL BE DOUBLE-WALLED AND, WHERE LOCATED ABOVE GROUND, PROTECTED FROM FREEZING. SIGNS SHALL BE POSTED TO PROTECT PIPES FROM DAMAGE BY VEHICLE/ TRAFFIC ACTIVITIES.
6. CONCRETE SUPPORT SHALL BE EXTENDED A MINIMUM 8" ON ETHER SIDE OF PIPE(S).
7. THE THREE-FOOT MINIMUM BUFFER IS TO THE ANTICIPATED MAXIMUM GROUNDWATER LEVEL.



DETAIL 7/4
RISER PIPES (PERFORATED)
SCALE: 1" = 2'



DETAIL 4/3
INTERIM BERM TERMINATION
SCALE: 1" = 2'
(SEE NOTES 2 AND 3)

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REV	DATE	DESCRIPTION	DRN	APP
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TOLSON AND ASSOCIATES, LLC
24024 FREDERICK ROAD
CLARKSBURG, MARYLAND 20871

TITLE: LEACHATE COLLECTION AND LINER SYSTEM DETAILS I

PROJECT: VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL

SITE: TOLSON RUBBLE LANDFILL

C.H. Pendleton
SIGNATURE
11-06-2020
DATE

STATE OF MARYLAND CARRIE H. PENDLETON 32252 PROFESSIONAL ENGINEER

DESIGN BY:	SS	DATE:	JULY 2020
DRAWN BY:	ANA	PROJECT NO.:	ME1606
CHECKED BY:	SS	FILE:	ME1606-006
REVIEWED BY:	---	DRAWING NO.:	
APPROVED BY:	CHP	5 OF 18	

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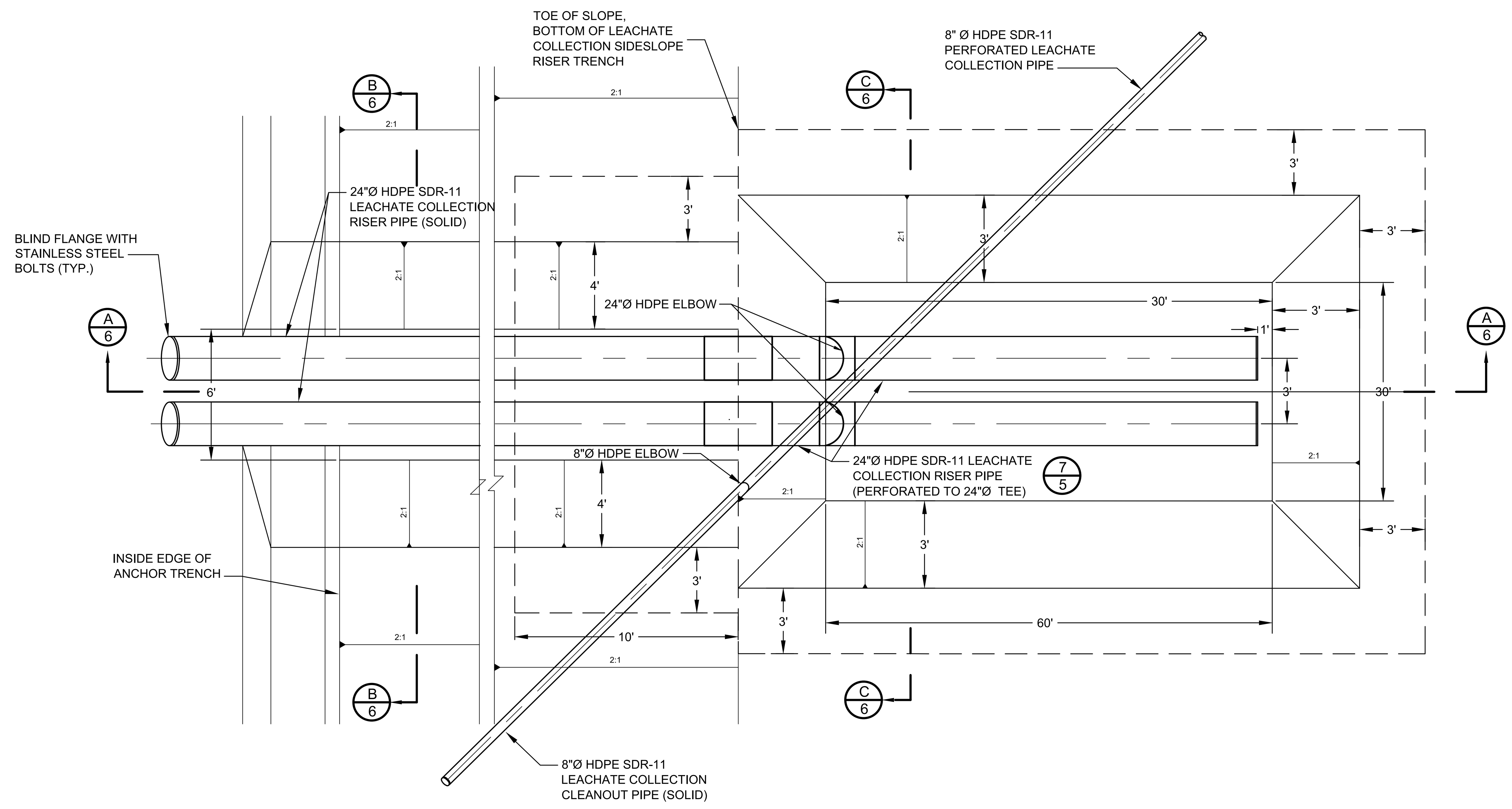
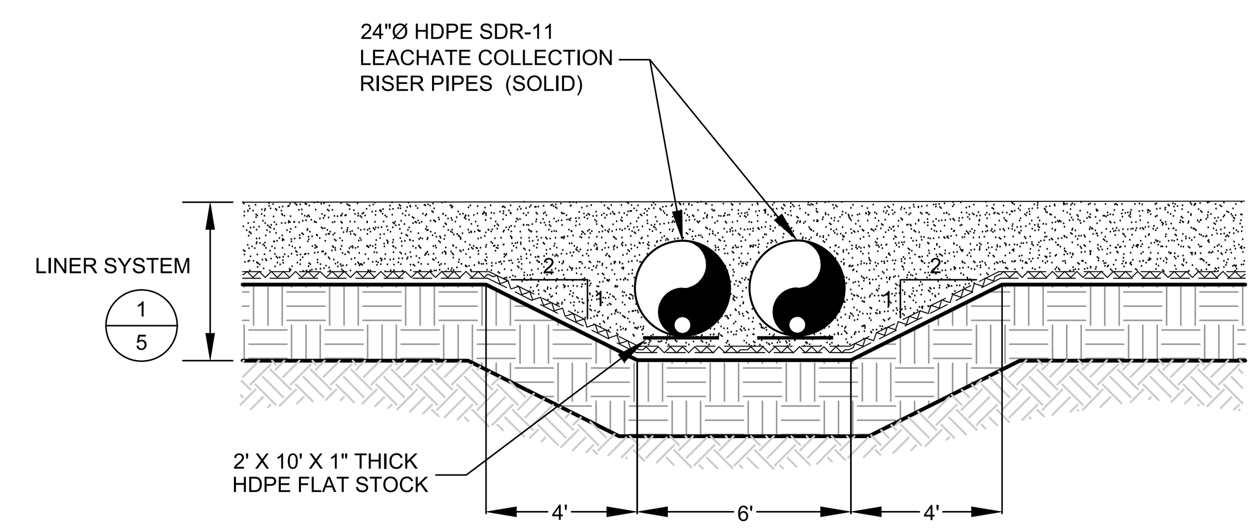


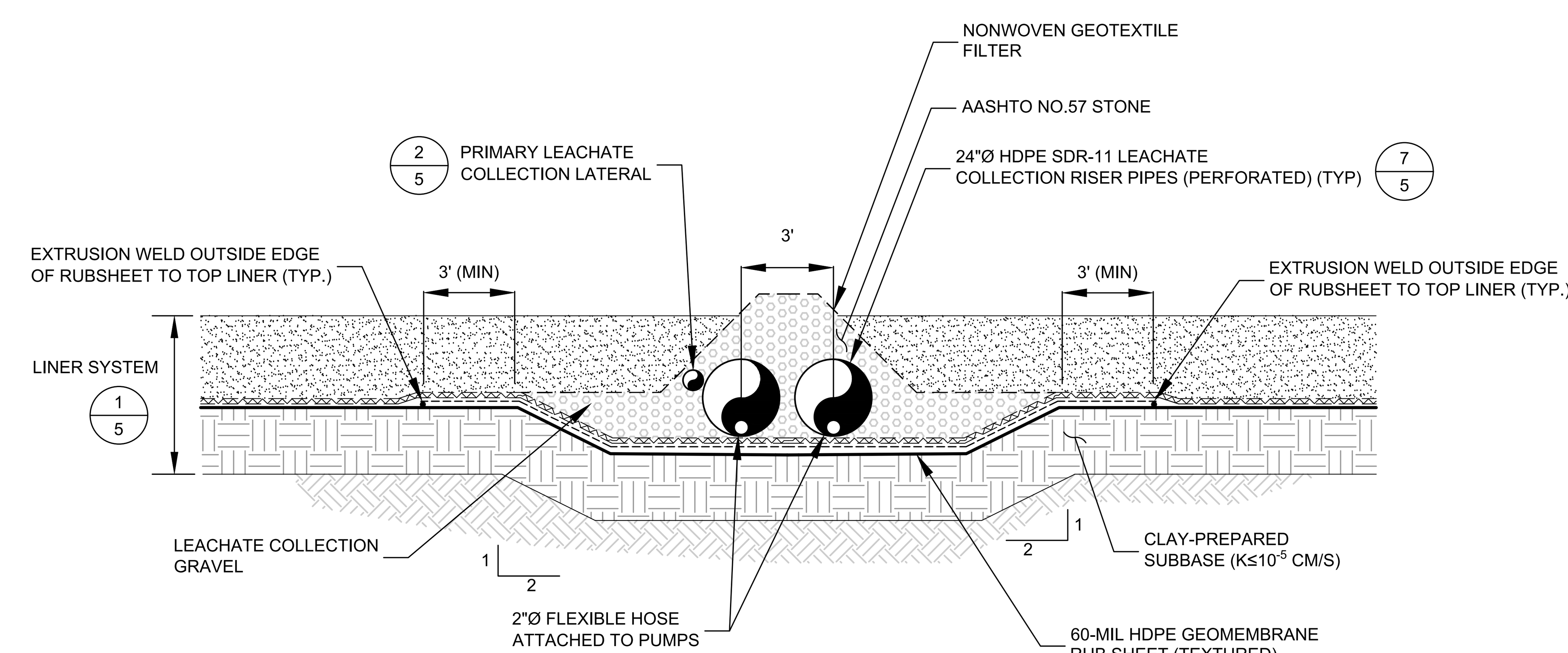
1/4 DETAIL
LEACHATE COLLECTION SUMP AND RISERS

SCALE: NTS
(SEE NOTE 1)



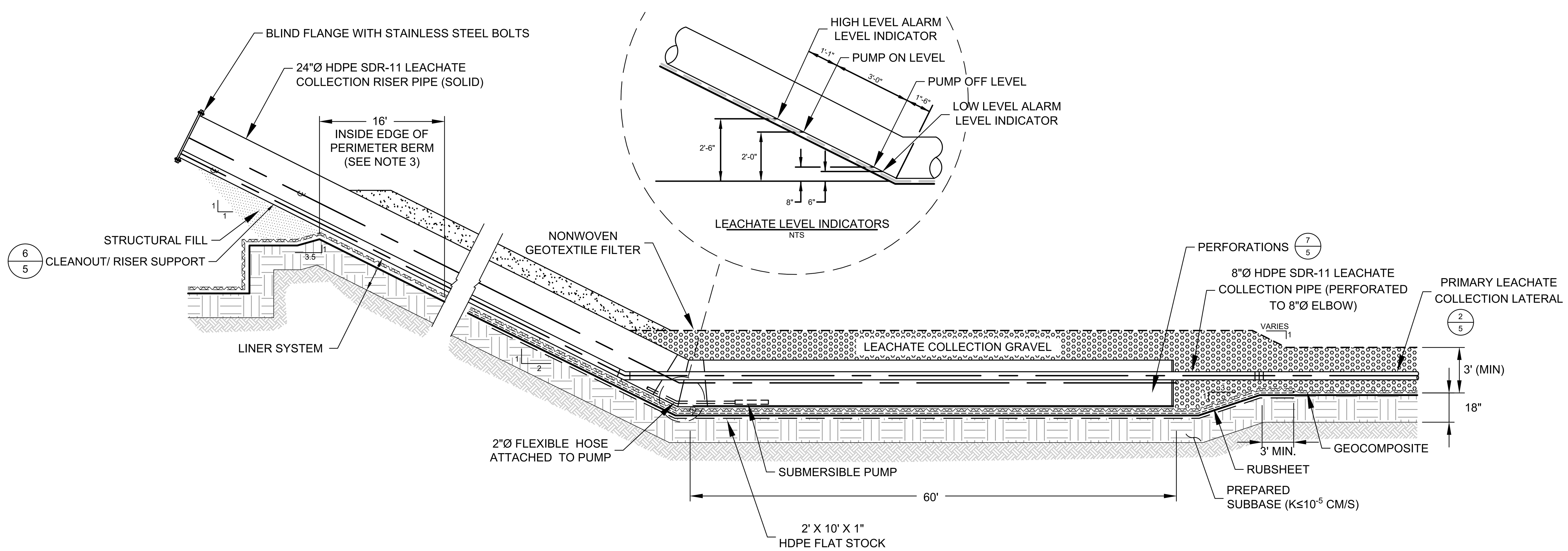
B/6 SECTION
LEACHATE COLLECTION RISER

SCALE: NTS
(SEE NOTE 1)



C/6 SECTION
LEACHATE COLLECTION SUMP

SCALE: NTS
(SEE NOTE 1)



A/6 SECTION
LEACHATE COLLECTION SUMP AND RISER PIPES

SCALE: NTS
(SEE NOTE 1)

NOTES:

1. LEACHATE COLLECTION, RISER, AND CLEANOUT PIPES SHALL BE PERFORATED FOR THE PORTIONS OF PIPE ON THE CELL FLOOR. THE PIPE LENGTH ON SIDESLOPES AND ELBOWS SHALL BE SOLID (I.E., NON-PERFORATED). SEE DETAILS 3 AND 7 ON SHEET 5 FOR PERFORATION PATTERNS.

PERMIT DRAWINGS - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DRN	APP
1	NOV 2020	UPDATED PER MDE COMMENTS	BGF	CHP

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24024 FREDERICK ROAD
CLARKSBURG, MARYLAND 20871

TITLE: LEACHATE COLLECTION AND LINER SYSTEM DETAILS II

PROJECT: VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL

SITE: TOLSON RUBBLE LANDFILL

C.H. Pendleton
SIGNATURE
11-06-2020
DATE

STATE OF MARYLAND CARRIE H. PENDLETON 32252 PROFESSIONAL ENGINEER

DESIGN BY:	SS	DATE:	JULY 2020
DRAWN BY:	ANA	PROJECT NO.:	ME1606
CHECKED BY:	SS	FILE:	ME1606-0077
REVIEWED BY:	---	DRAWING NO.:	
APPROVED BY:	CHP	6 OF 18	

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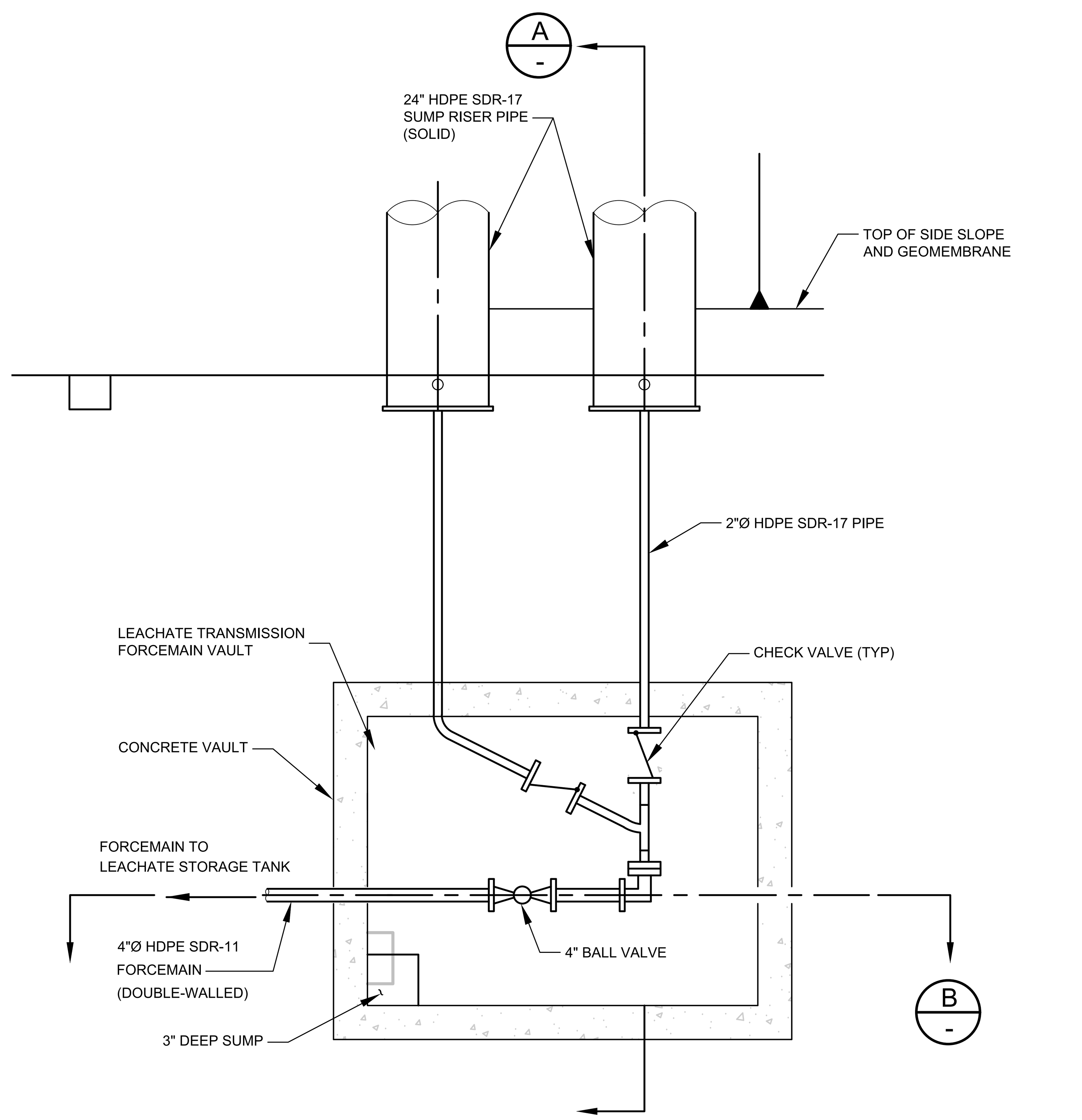
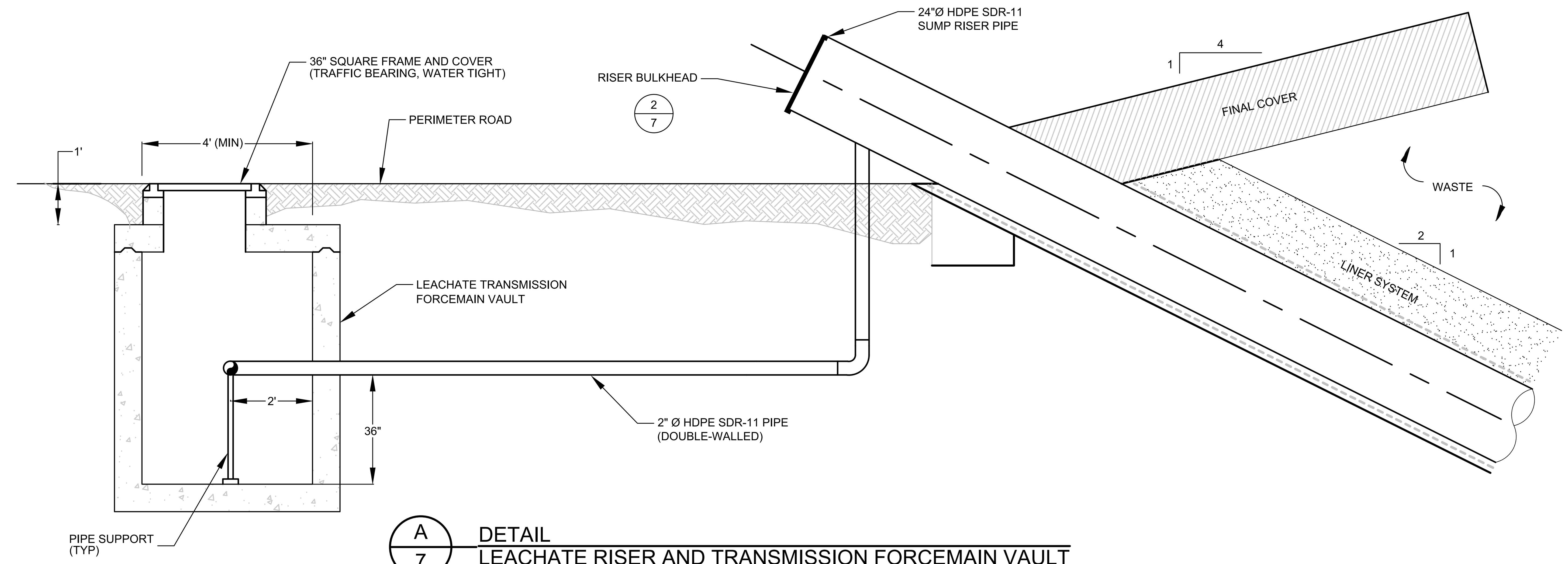
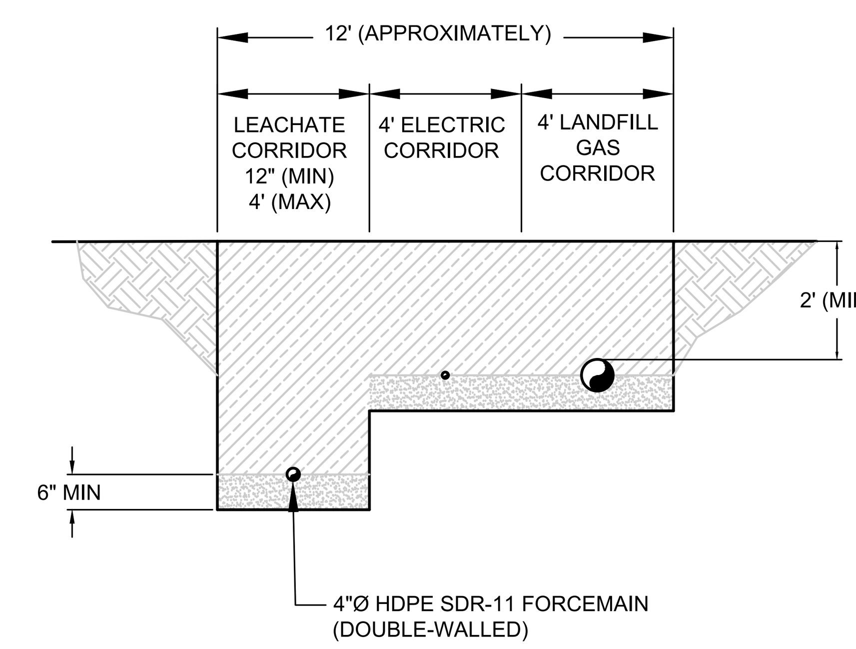


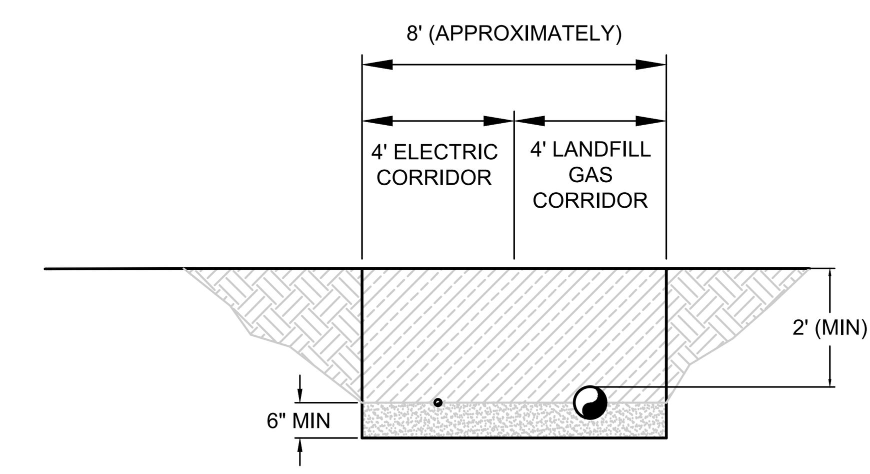
1/9 DETAIL
LEACHATE COLLECTION VALVE VAULT
SCALE: NTS
(SEE NOTE 1)



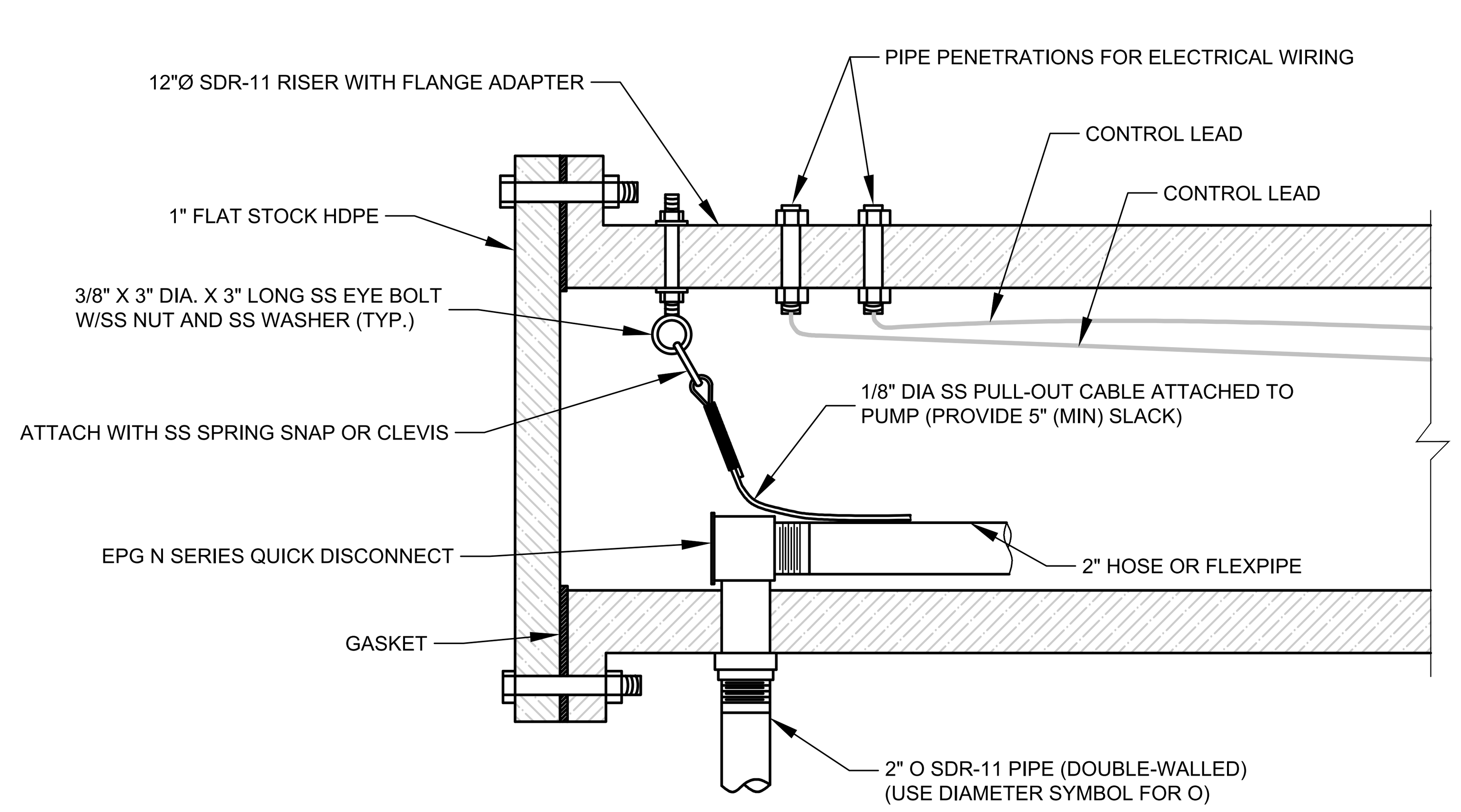
A/7 DETAIL
LEACHATE RISER AND TRANSMISSION FORCEMAIN VAULT
SCALE: NTS
(SEE NOTE 1)



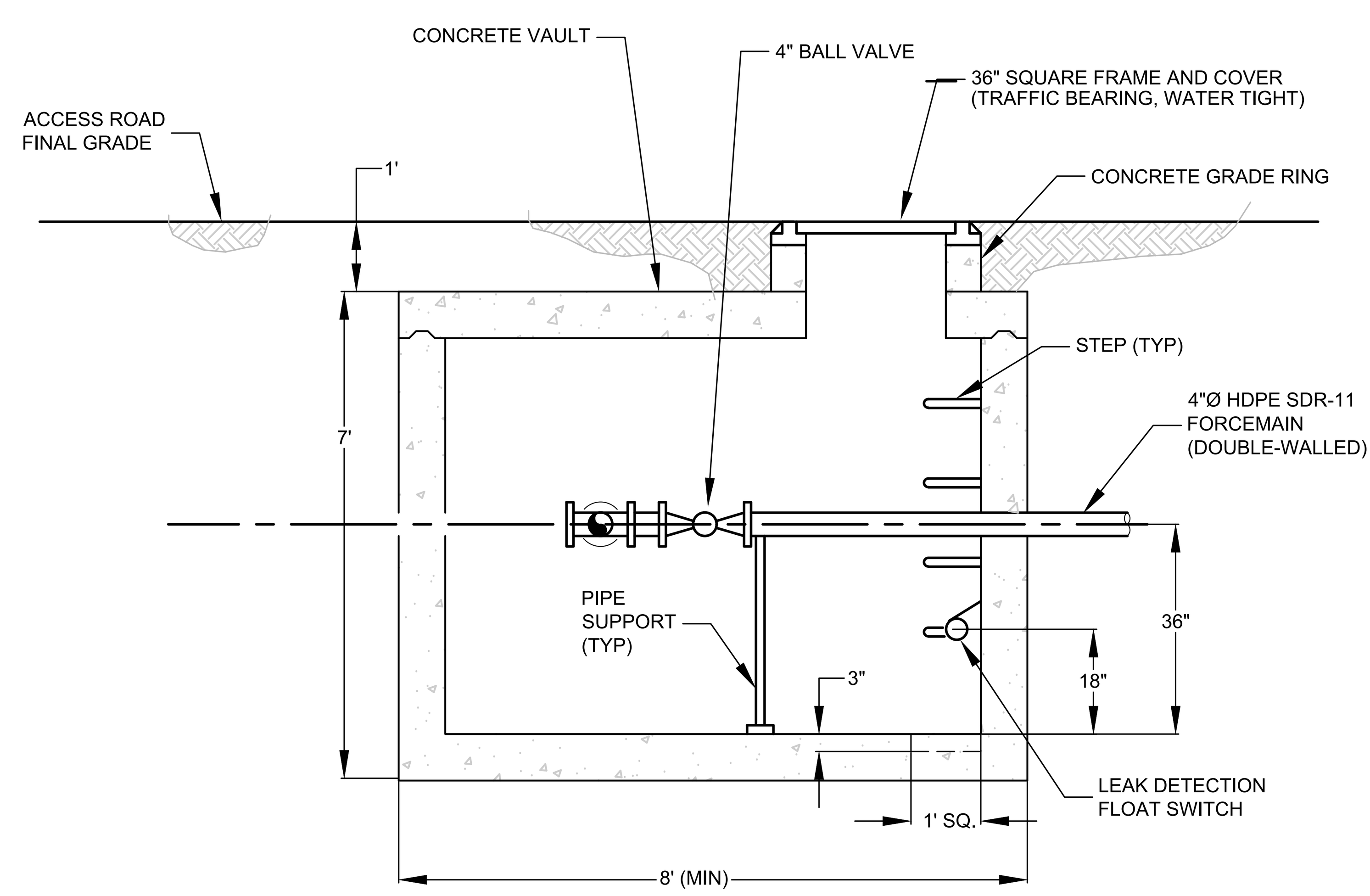
3/4 DETAIL
LEACHATE TRANSMISSION PIPE UTILITY TRENCH
SCALE: NTS



4/4 DETAIL
TRANSMISSION PIPE UTILITY TRENCH
SCALE: NTS



2/7 DETAIL
RISER BULKHEAD
SCALE: NTS



B/7 DETAIL
LEACHATE TRANSMISSION FORCEMAIN VAULT
SCALE: NTS

NOTES:

1. ALL ABOVE GROUND PIPE SHALL BE PROTECTED FROM FREEZING.

REV	DATE	DESCRIPTION	DRN	APP
1	OCT 2020	UPDATED PER MDE COMMENTS	BGF	CHP

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TITLE: LEACHATE COLLECTION AND LINER SYSTEM DETAILS III

PROJECT: VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL

SITE: TOLSON RUBBLE LANDFILL

C.H. Pendleton
SIGNATURE
11-06-2020
DATE

STATE OF MARYLAND CARRIE H. PENDLETON 32252 PROFESSIONAL ENGINEER

DESIGN BY:	SS	DATE:	JULY 2020
DRAWN BY:	ANA	PROJECT NO.:	ME1606
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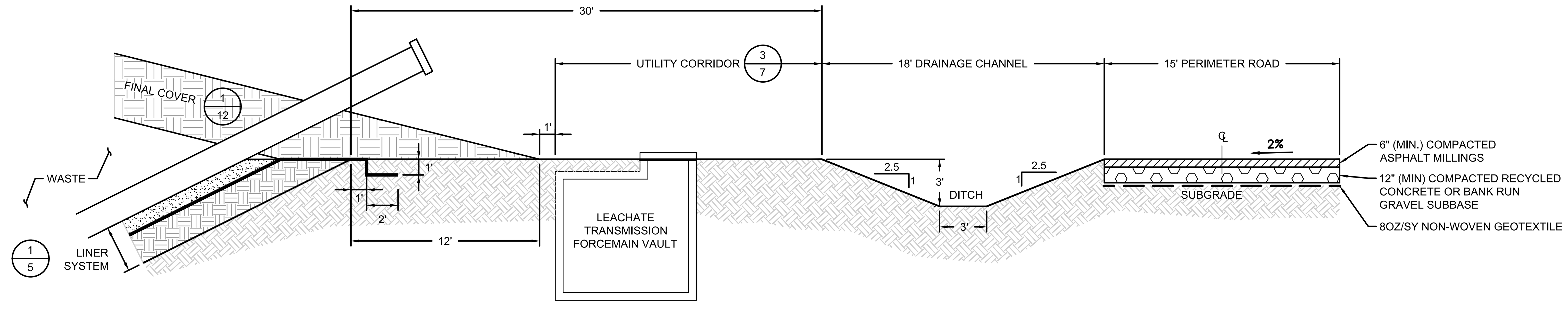
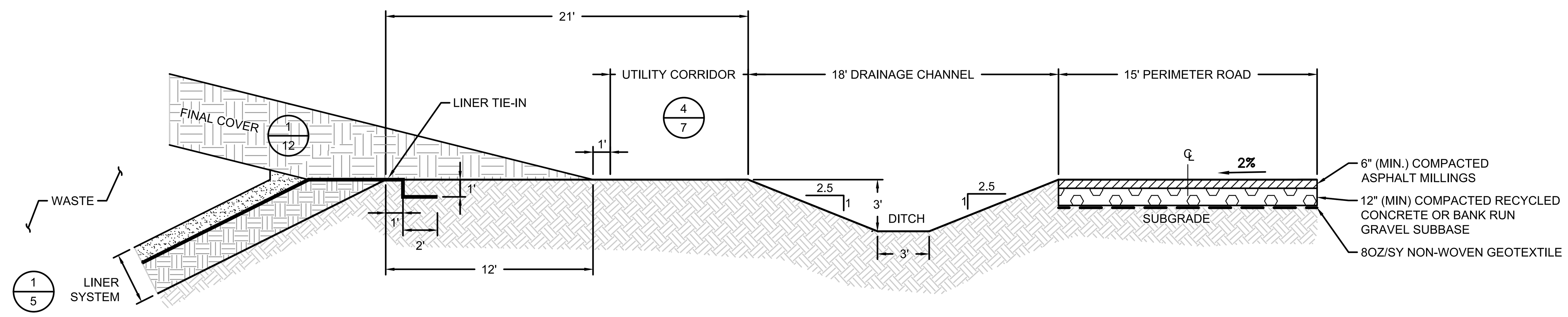


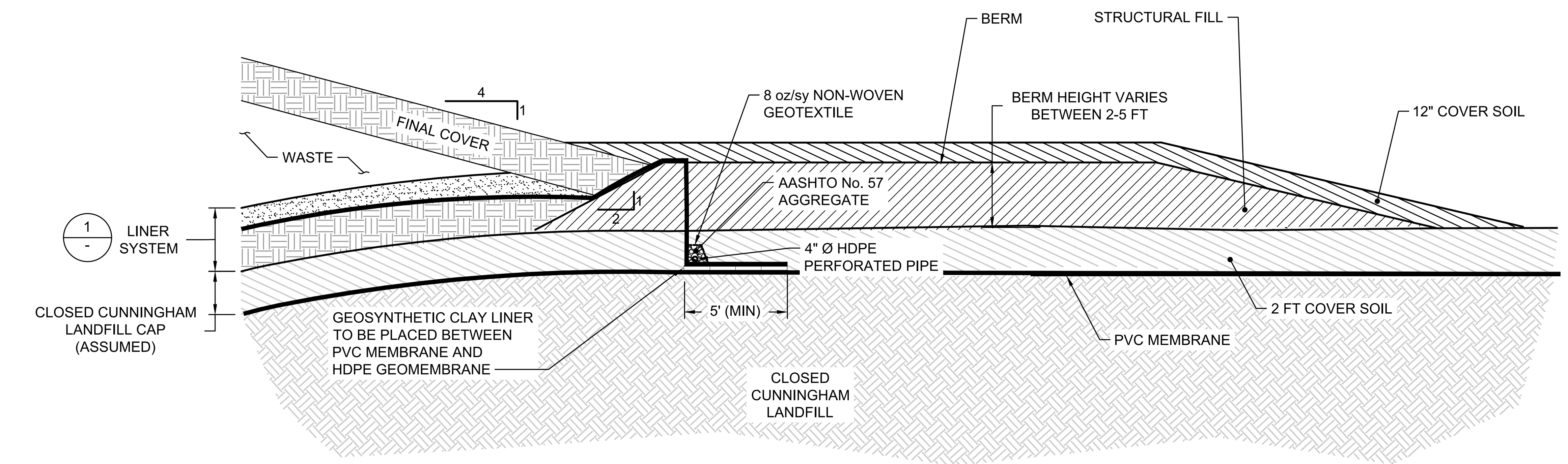
SECTION 1/4 UTILITY CORRIDOR WITH LEACHATE VAULT

SCALE: 1" = 5'



SECTION 2/4 UTILITY CORRIDOR WITH DRAINAGE - ROAD CORRDOR

SCALE: 1" = 5'

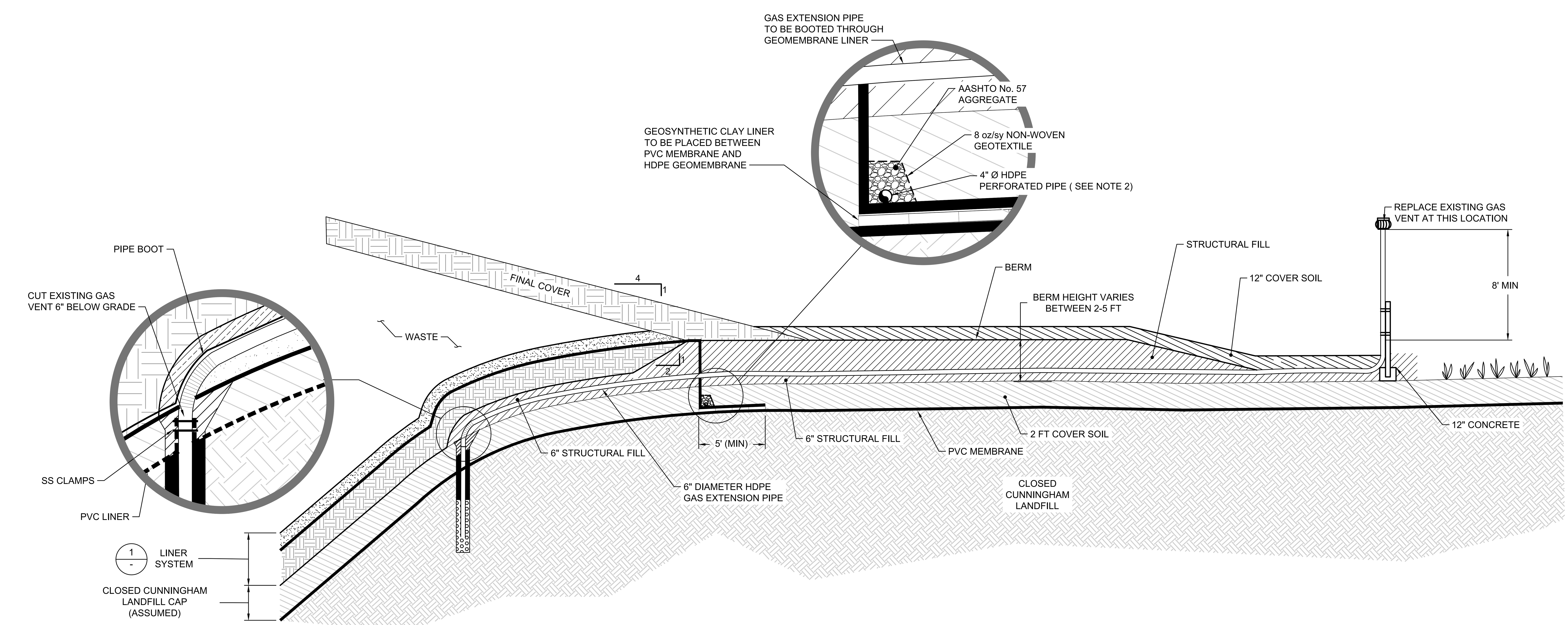


SECTION 3/4 LINER TIE-IN TO CLOSED CUNNINGHAM LANDFILL

SCALE: NOT TO SCALE
(SEE NOTE 1)

NOTES:

1. CONSTRUCTION OF BERM AND BEDDING UNDER PIPE WITH COMPACTED STRUCTURAL FILL WILL LIMIT POTENTIAL FOR LIQUID INFILTRATION BETWEEN THE EXISTING CAP ON CLOSED CUNNINGHAM LANDFILL AND THE OVERLAY LINER SYSTEM.
2. THE TOE DRAIN WILL OUTLET INTO THE STORMWATER CONVEYANCE SYSTEM ON EITHER SIDE OF THE CUNNINGHAM LANDFILL, DISCHARGING TO SEDIMENT TRAP 1 ON THE WEST AND SEDIMENT TRAP 2 ON THE EAST.



SECTION 4/15 LINER TIE-IN TO CLOSED CUNNINGHAM LANDFILL WITH GAS VENTING

SCALE: NOT TO SCALE
(SEE NOTE 1)

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1	NOV 2020	UPDATED PER MDE COMMENTS	BGF	CHP

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TOLSON AND ASSOCIATES, LLC
24024 FREDERICK ROAD
CLARKSBURG, MARYLAND 20871

TITLE: UTILITY CORRIDOR AND LINER TIE-IN CROSS SECTIONS

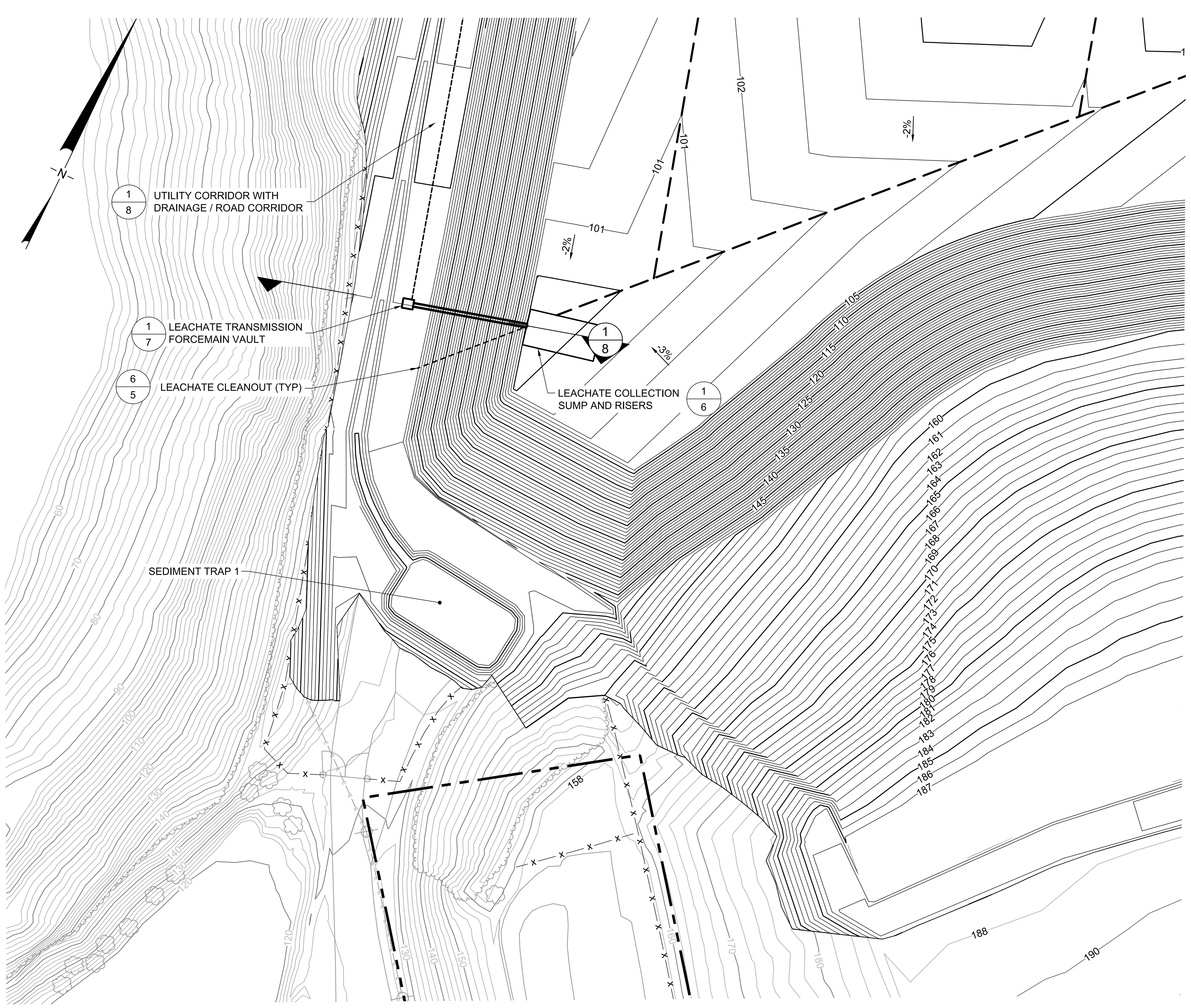
PROJECT: **VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL**

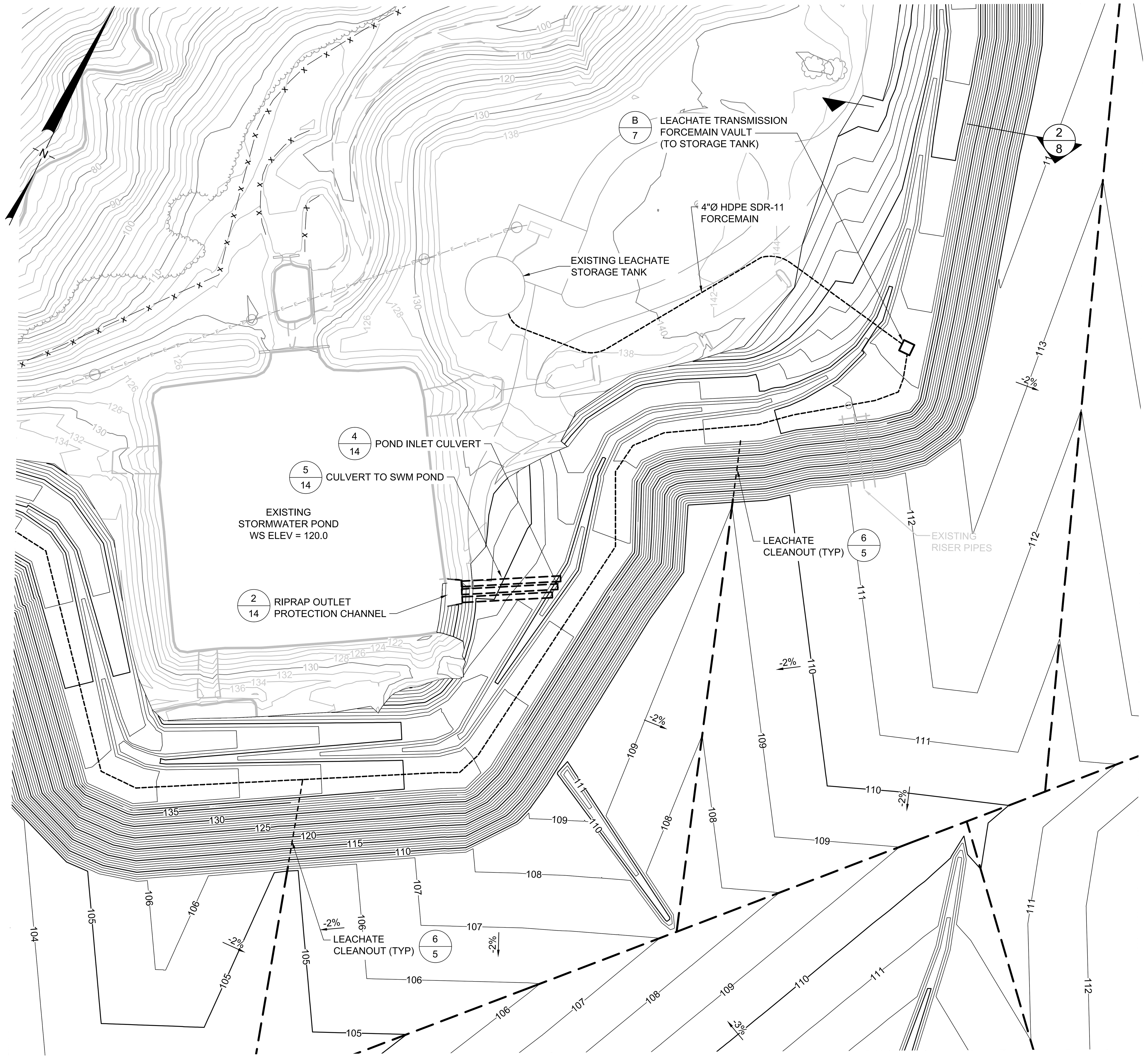
SITE: **TOLSON RUBBLE LANDFILL**

C.H. Pendleton
SIGNATURE
11-06-2020
DATE

STATE OF MARYLAND CARRIE H. PENDLETON 32252 PROFESSIONAL ENGINEER

DESIGN BY:	SS	DATE:	JULY 2020
DRAWN BY:	ANA	PROJECT NO.:	ME1606
CHECKED BY:	SS	FILE:	ME1606-007-009
REVIEWED BY:	----	DRAWING NO.:	
APPROVED BY:	CHP	8 OF 18	





0 60 120
SCALE IN FEET

LEGEND

- EXISTING MINOR GRADE CONTOUR
- EXISTING MAJOR GRADE CONTOUR
- EXISTING TREE LINE
- EXISTING ROAD
- EXISTING SECURITY FENCE
- EXISTING ELECTRIC POLES
- EXISTING ELECTRIC LINE
- EXISTING UNDERGROUND ELECTRIC LINE
- PROPERTY LINE
- PROPOSED MINOR GRADE CONTOUR
- PROPOSED MAJOR GRADE CONTOUR
- LEACHATE TRANSMISSION PIPE

REV	DATE	DESCRIPTION	DRN	APP
1	OCT 2020	UPDATED PER MDE COMMENTS	BGF	CHP

Geosyntec consultants
10211 WINCOPIN CIRCLE, FLOOR 4
COLUMBIA, MARYLAND 21044
PHONE: (410) 381-4333

TOLSON AND ASSOCIATES, LLC
24024 FREDERICK ROAD
CLARKSBURG, MARYLAND 20871

TITLE: LEACHATE TRANSMISSION SYSTEM PLAN II

PROJECT: **VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL**

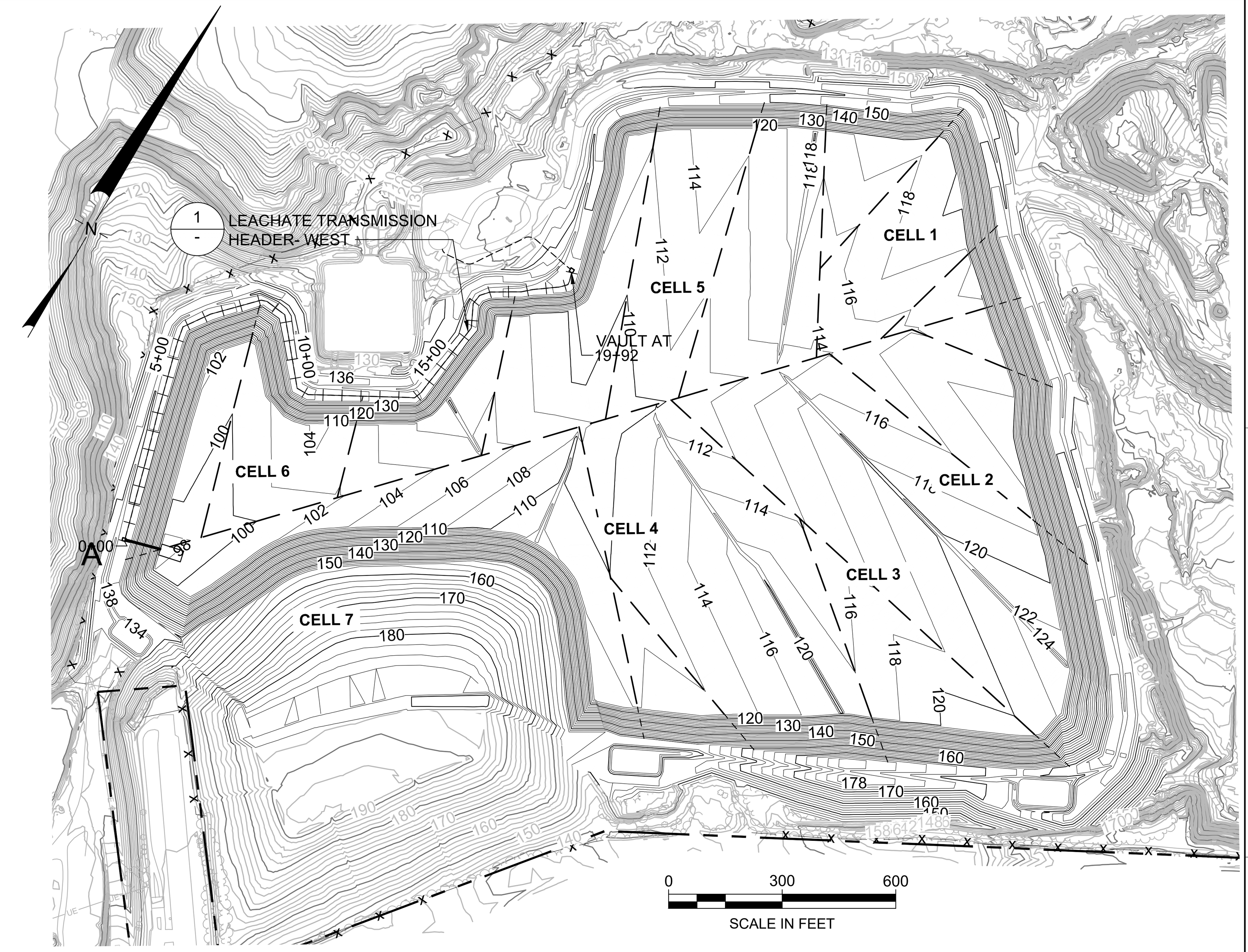
SITE: **TOLSON RUBBLE LANDFILL**

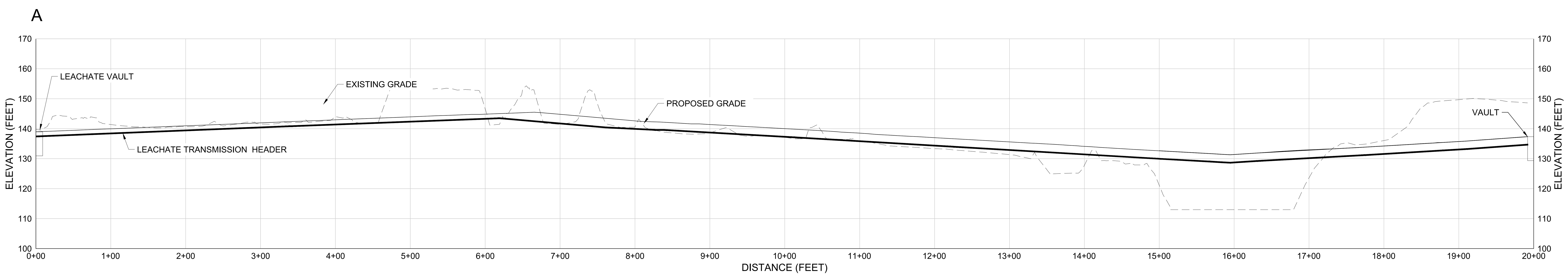
C.H. Pendleton
SIGNATURE
11-06-2020
DATE

STATE OF MARYLAND CARRIE H. PENDLETON 32252 PROFESSIONAL ENGINEER

DESIGN BY:	SS	DATE:	JULY 2020
DRAWN BY:	ANA	PROJECT NO.:	ME1606
CHECKED BY:	SS	FILE:	ME1606-007-009
REVIEWED BY:	---	DRAWING NO.:	
APPROVED BY:	CHP	9 OF 18	

PERMIT DRAWINGS - NOT FOR CONSTRUCTION





1 - PROFILE
LEACHATE TRANSMISSION HEADER- WEST

HORIZONTAL SCALE: 1" = 80'
VERTICAL SCALE: 1" = 20'

LEGEND

- EXISTING MINOR GRADE CONTOUR
- EXISTING MAJOR GRADE CONTOUR
- EXISTING TREE LINE
- PROPERTY LINE
- PROPOSED MINOR GRADE CONTOUR
- PROPOSED MAJOR GRADE CONTOUR

REV	DATE	DESCRIPTION	DRN	APP

Geosyntec consultants
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TOLSON AND ASSOCIATES, LLC
24024 FREDERICK ROAD
CLARKSBURG, MARYLAND 20871

TITLE: LEACHATE TRANSMISSION HEADER PROFILE

PROJECT: **VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL**

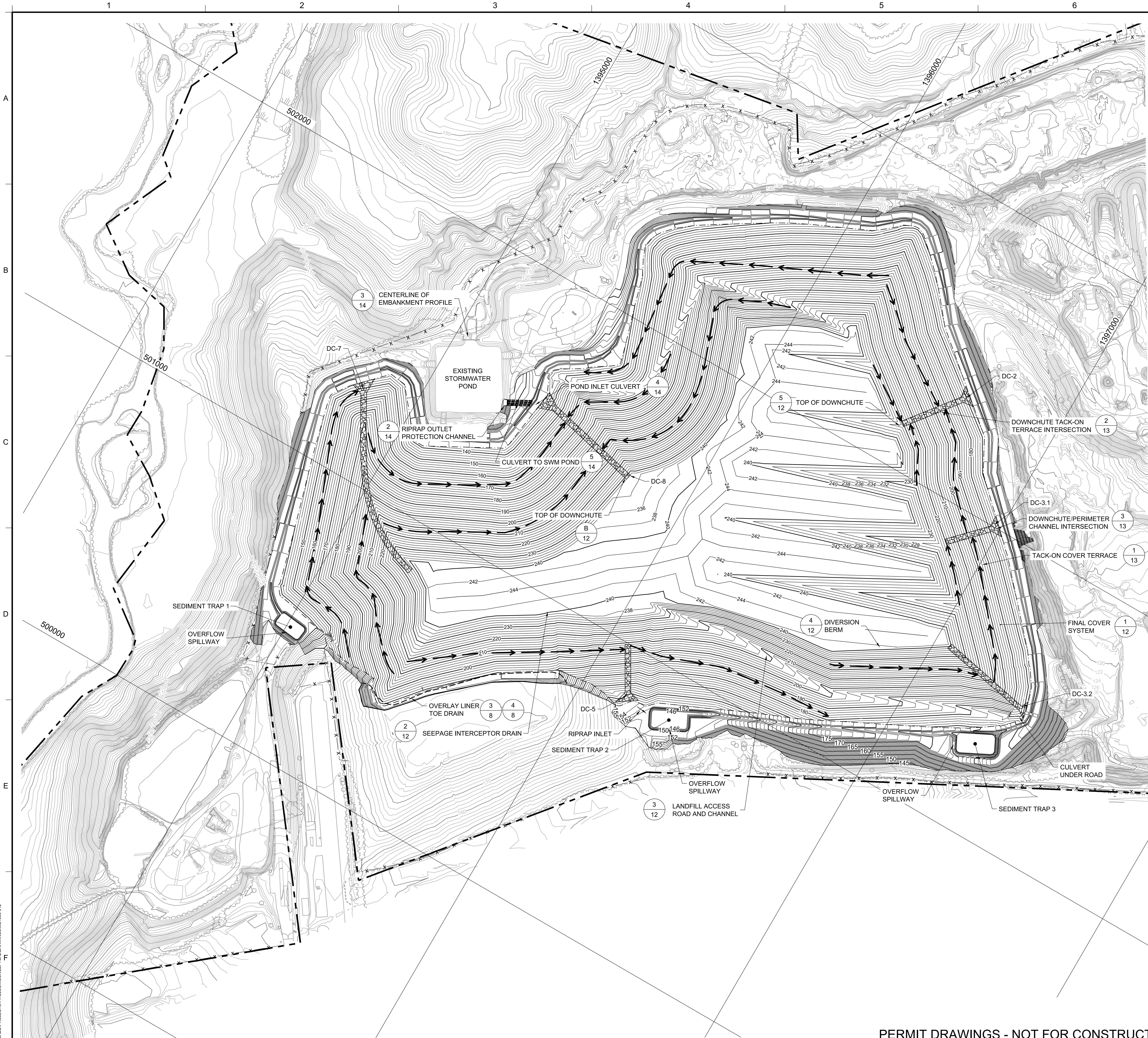
SITE: **TOLSON RUBBLE LANDFILL**

C.H. Pendleton
SIGNATURE
11-06-2020
DATE

STATE OF MARYLAND CARRIE H. PENDLETON 32252 PROFESSIONAL ENGINEER

DESIGN BY:	SS	DATE:	JULY 2020
DRAWN BY:	ANA	PROJECT NO.:	ME1606
CHECKED BY:	SS	FILE:	ME1606-009
REVIEWED BY:	---	DRAWING NO.:	
APPROVED BY:	CHP	10 OF 18	

PERMIT DRAWINGS - NOT FOR CONSTRUCTION



LEGEND

- EXISTING CONTOURS (FEET, MSL)
- EXISTING TREE LINE
- EXISTING FENCE
- EXISTING ELECTRIC POLES
- EXISTING ELECTRIC LINE
- EXISTING UNDERGROUND ELECTRIC LINE
- EXISTING ROAD
- PROPOSED CONTOUR GRADE (FEET, MSL)
- PROPERTY BOUNDARY
- PROPOSED DRAINAGE TERRACE
- PROPOSED DOWNCHUTE
- LIMITS OF FINAL COVER GRADING
- OVERLAY LINER TOE DRAIN

NOTES:

1. CONTOURS SHOWN REPRESENT TOP OF FINAL COVER GRADE.

PERMIT DRAWINGS - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DRN	APP
1	NOV 2020	UPDATED PER MDE COMMENTS	AM/TJ	CHP

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TOLSON AND ASSOCIATES, LLC
24024 FREDERICK ROAD
CLARKSBURG, MARYLAND 20871

TITLE: FINAL COVER GRADING AND STORMWATER MANAGEMENT SYSTEM

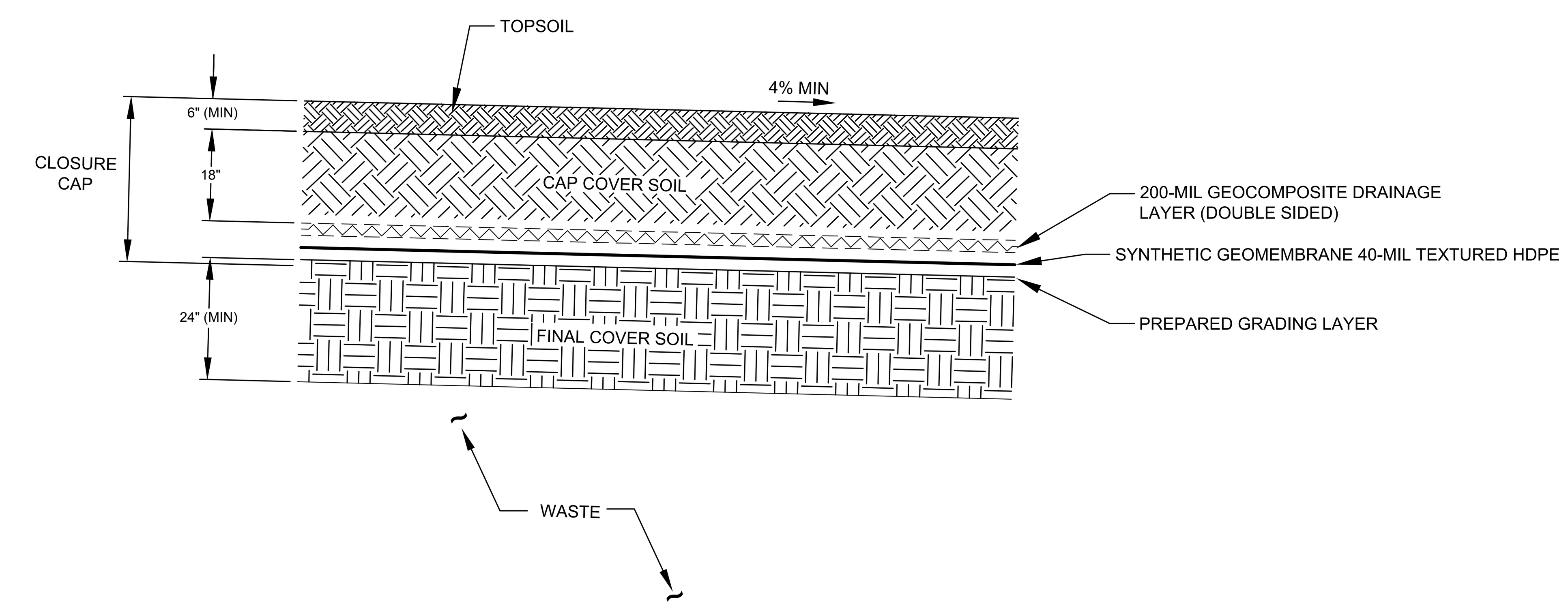
PROJECT: **VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL**

SITE: **TOLSON RUBBLE LANDFILL**

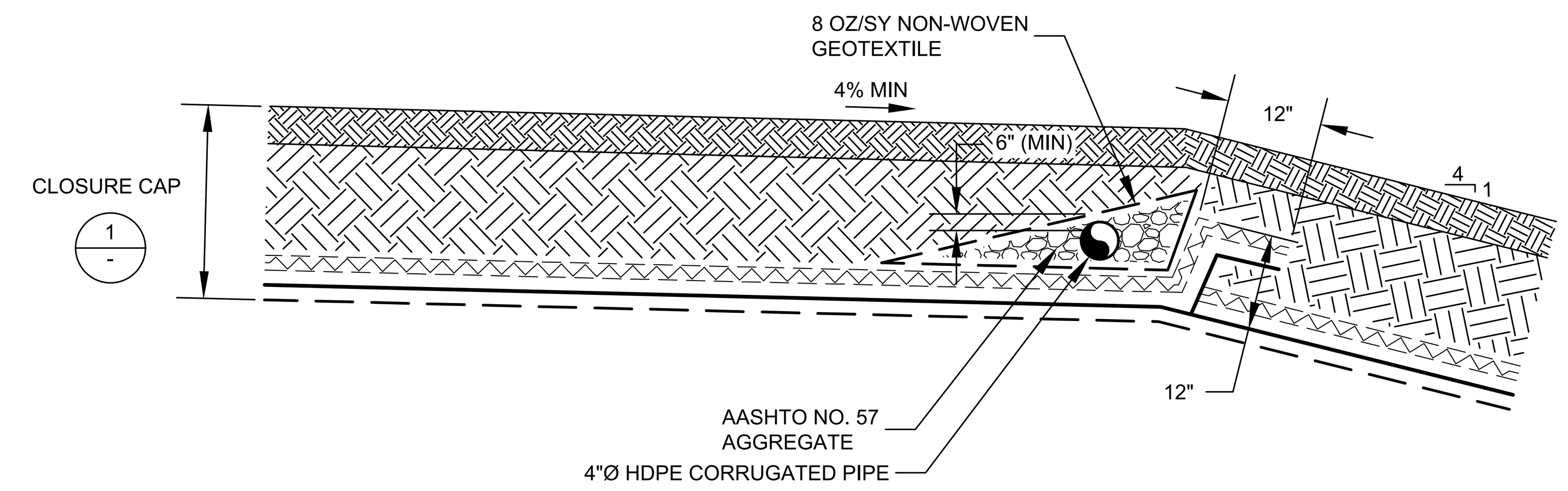
C.H. Pendleton
SIGNATURE
11-06-2020
DATE

STATE OF MARYLAND CARRIE H. PENDLETON 32252 PROFESSIONAL ENGINEER

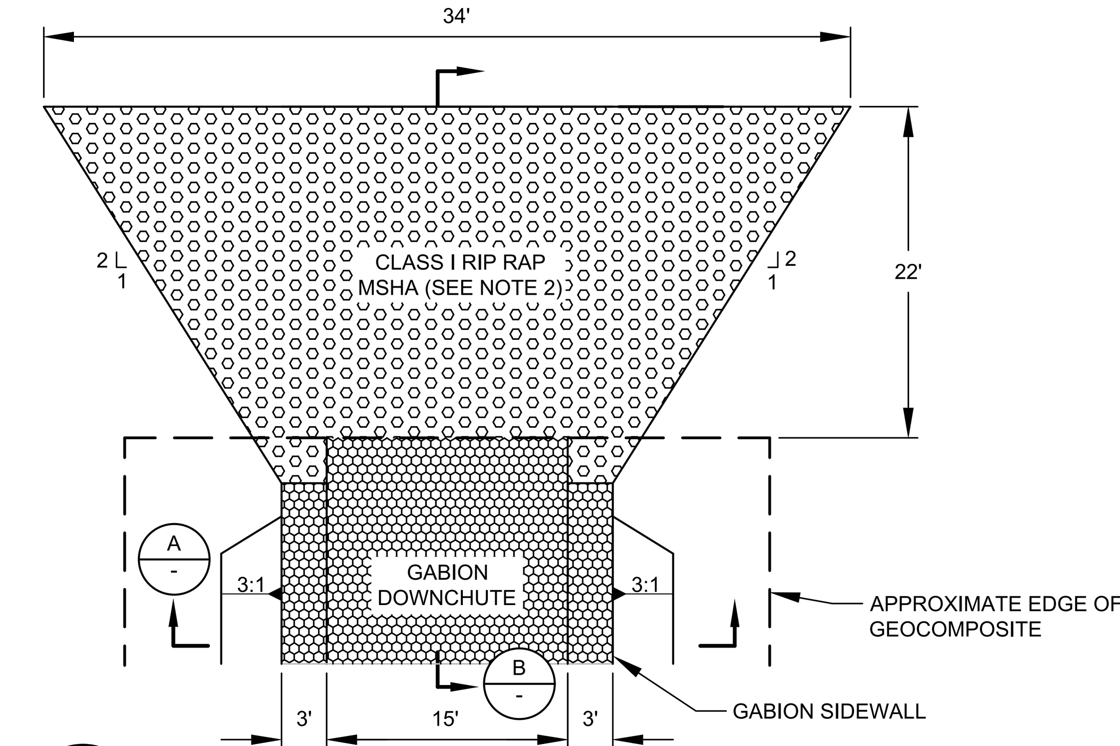
DESIGN BY:	SS	DATE:	JULY 2020
DRAWN BY:	ANA	PROJECT NO.:	ME1606
CHECKED BY:	SS	FILE:	ME1606-012
REVIEWED BY:	---	DRAWING NO.:	
APPROVED BY:	CHP	11 OF 18	



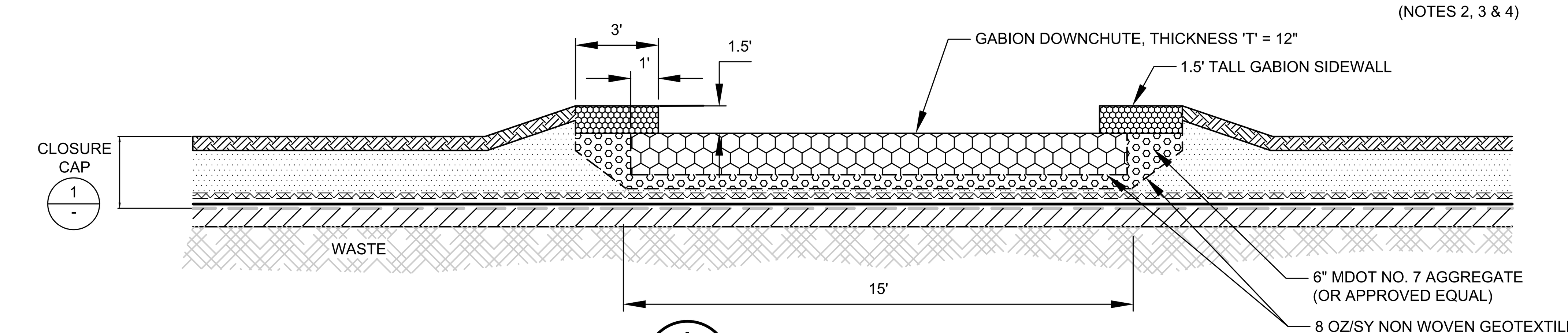
1 / 11 DETAIL
FINAL COVER SYSTEM
SCALE: 1"=2'



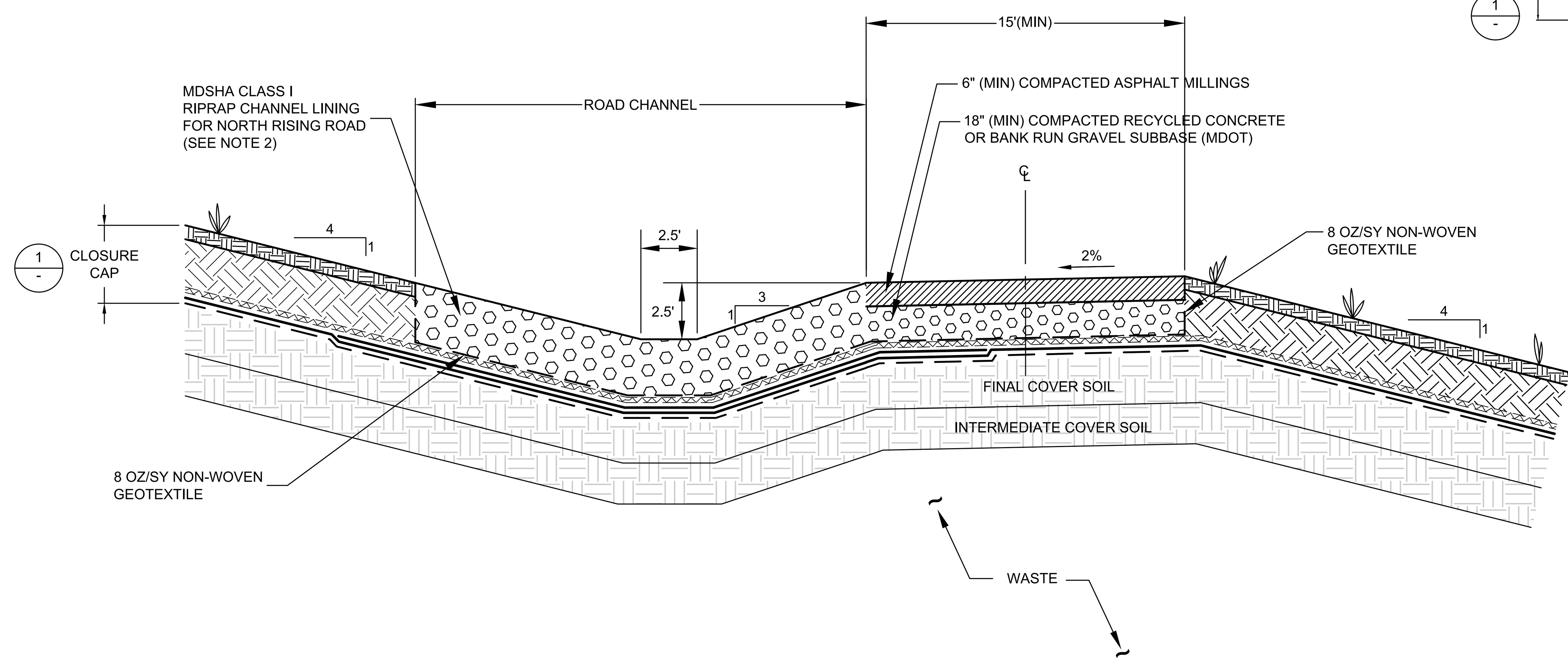
2 / 11 DETAIL
SEEPAGE INTERCEPTOR DRAIN
SCALE: NTS



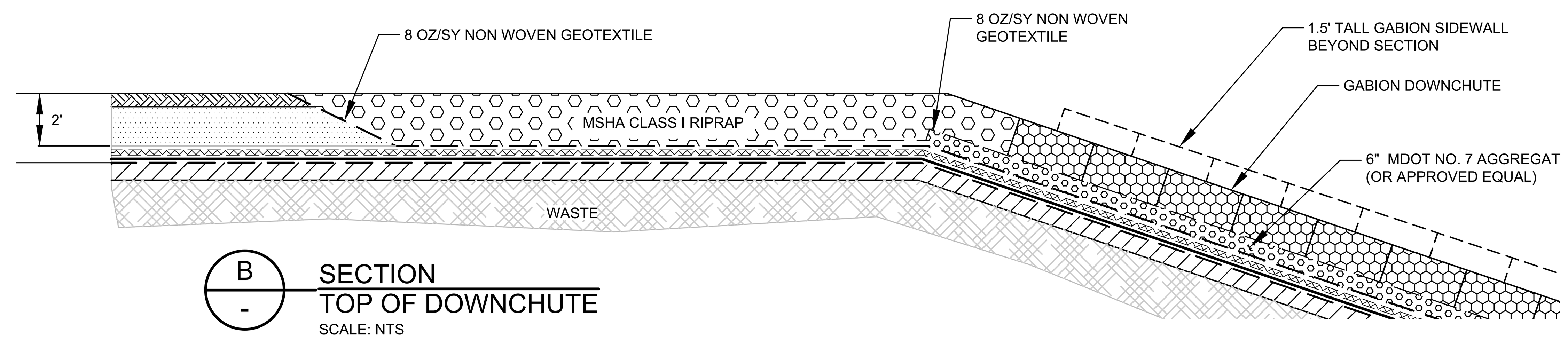
5 / 11 DETAIL
TOP OF DOWNCHUTE
SCALE: NTS
(NOTES 2, 3 & 4)



A / - SECTION
DOWNCHUTE
SCALE: NTS
(NOTES 1 & 6)



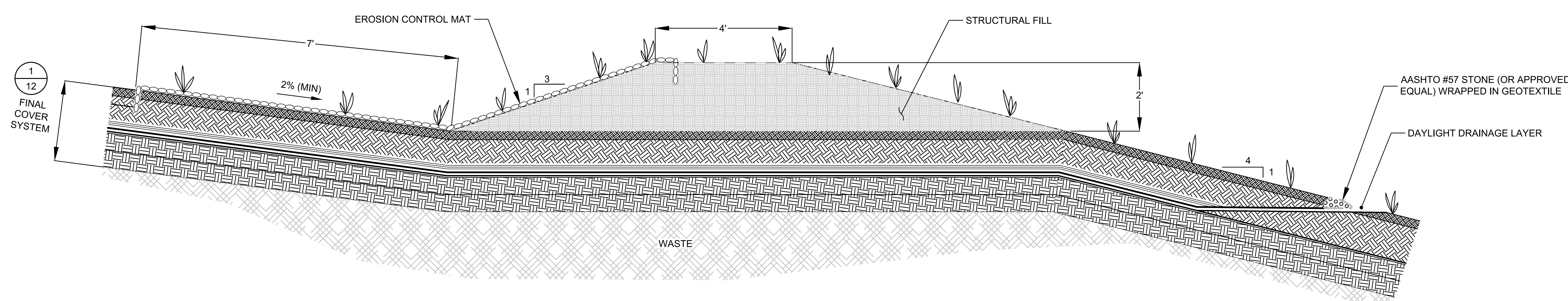
3 / 11 DETAIL
LANDFILL ACCESS ROAD AND CHANNEL
SCALE: NTS



B / - SECTION
TOP OF DOWNCHUTE
SCALE: NTS
(NOTES 1)

NOTES:

1. GEOTEXTILE SHALL BE MDOT CLASS C OR APPROVED EQUAL.
2. VEGETATED FINAL COVER MAY BE USED IN PLACE OF RIPRAP AS ROAD CHANNEL LINING FOR SOUTH RISING ROAD.
3. GABION DOWNCHUTES AND SIDEWALLS SHALL BE BACKFILLED WITH MSHA CLASS I RIPRAP.
4. CLASS I RIPRAP SHALL BE PLACED MANUALLY OR USING A PIECE OF EQUIPMENT APPROVED BY ENGINEER. MAXIMUM DROP HEIGHT SHALL BE 18 INCHES.
5. OVERLAP BETWEEN GEOTEXTILES SHALL BE MINIMUM 12 INCHES.
6. DOWNCHUTE WIDTH IS 15 FEET EXCEPT FOR DC-8 WHICH IS 22 FEET.



4 / 11 DETAIL
DIVERSION BERM
SCALE: NTS

PERMIT DRAWINGS - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DRN	APP
1	NOV 2020	UPDATED PER MDE COMMENTS	BGF	CHP

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PHONE: (410) 381-4333

TOLSON AND ASSOCIATES, LLC
24024 FREDERICK ROAD
CLARKSBURG, MARYLAND 20871

TITLE:
FINAL COVER SYSTEM AND STORMWATER MANAGEMENT DETAILS

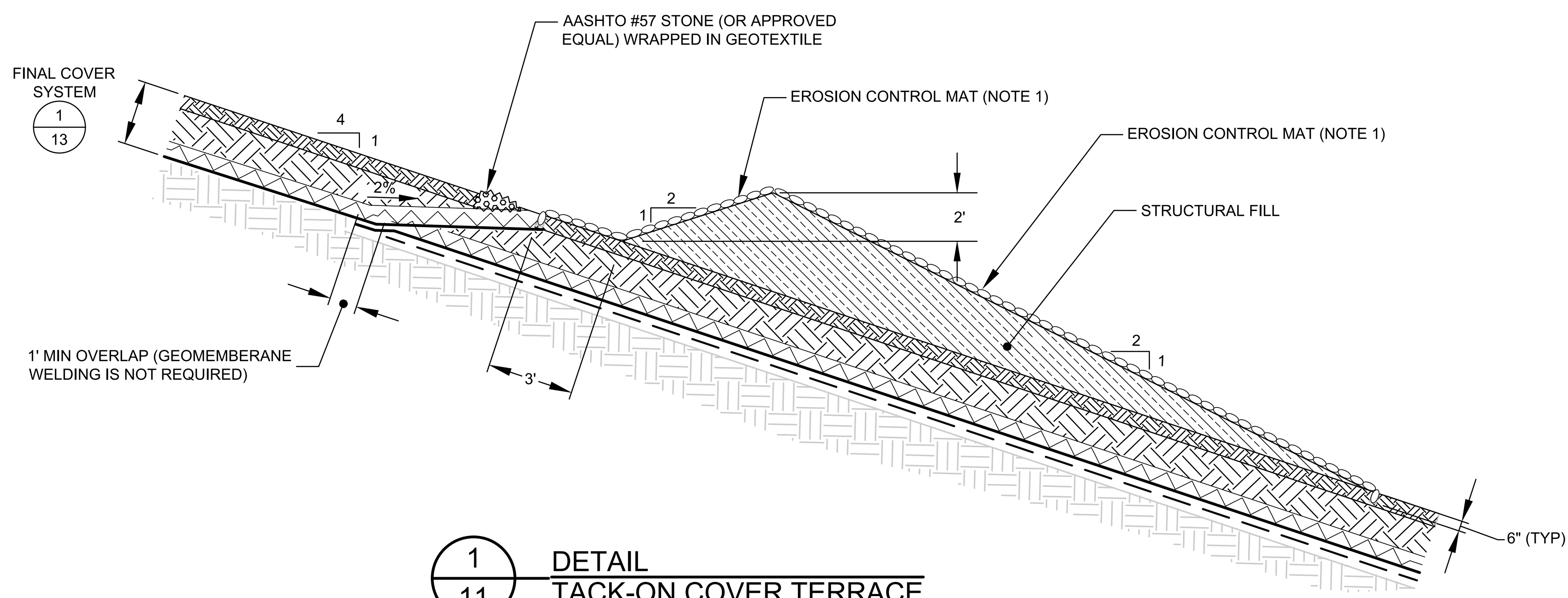
PROJECT:
VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL

SITE:
TOLSON RUBBLE LANDFILL

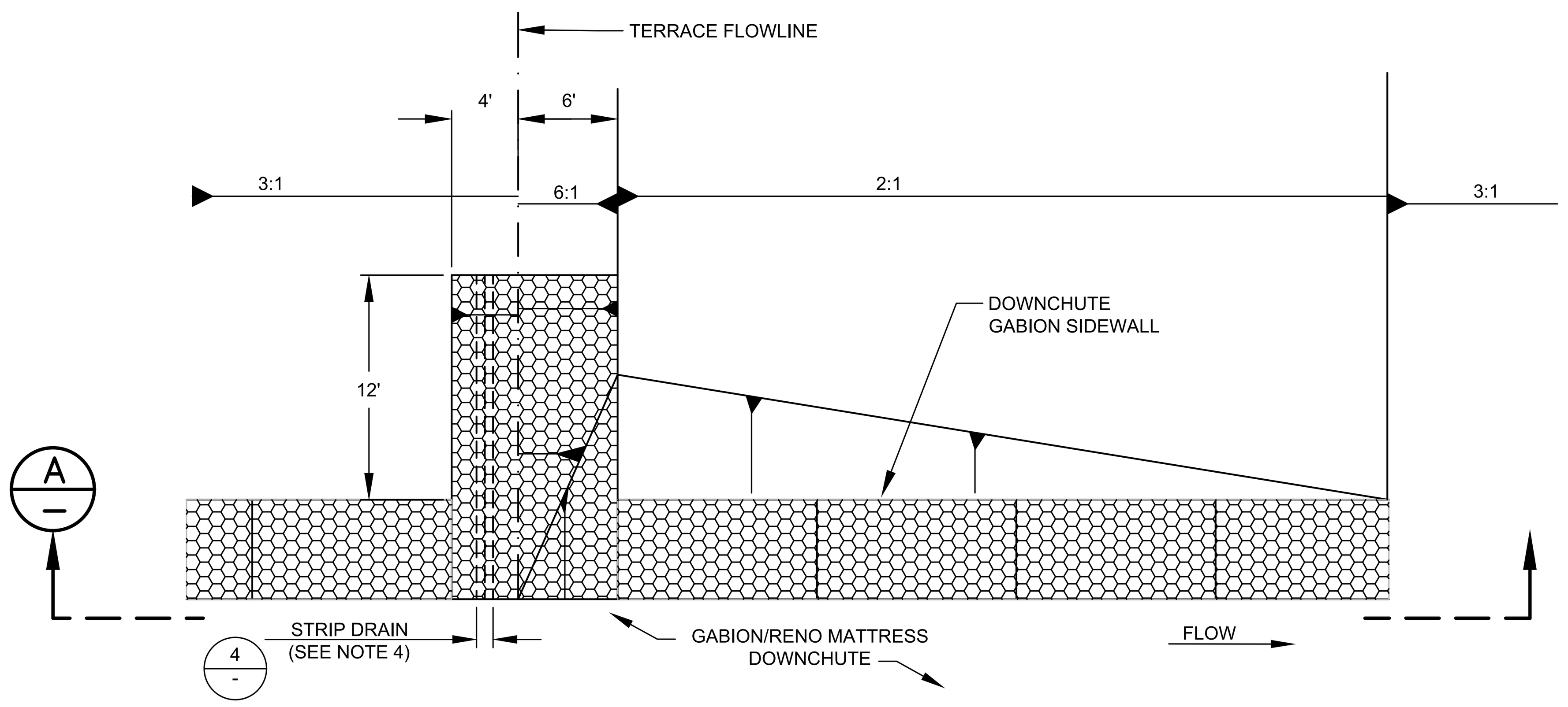
C. H. Pendleton
SIGNATURE
11-06-2020
DATE

STATE OF MARYLAND
CARRIE H. PENDLETON
32252
PROFESSIONAL ENGINEER

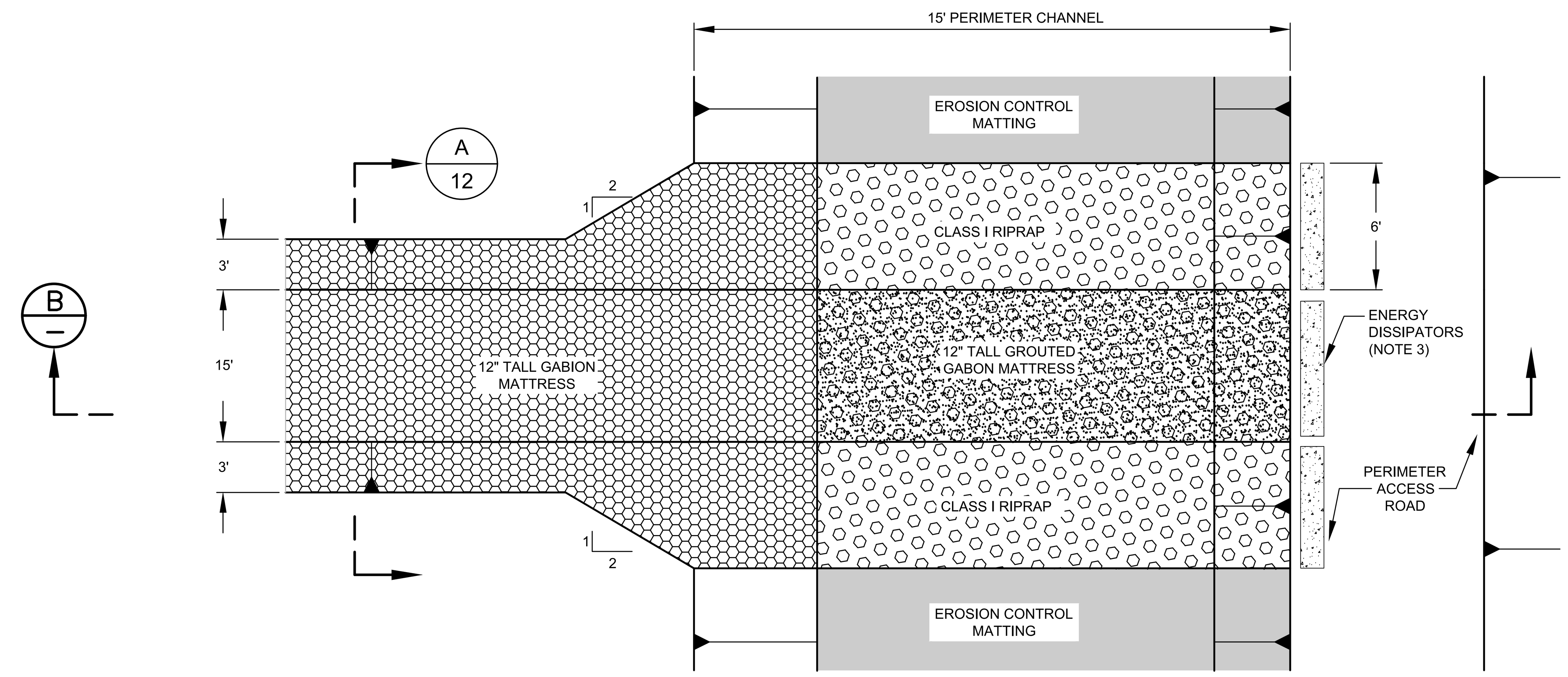
DESIGN BY:	SS	DATE:	JULY 2020
DRAWN BY:	ANA	PROJECT NO.:	ME1606
CHECKED BY:	SS	FILE:	ME1606-014
REVIEWED BY:	---	DRAWING NO.:	
APPROVED BY:	CHP	12 OF 18	



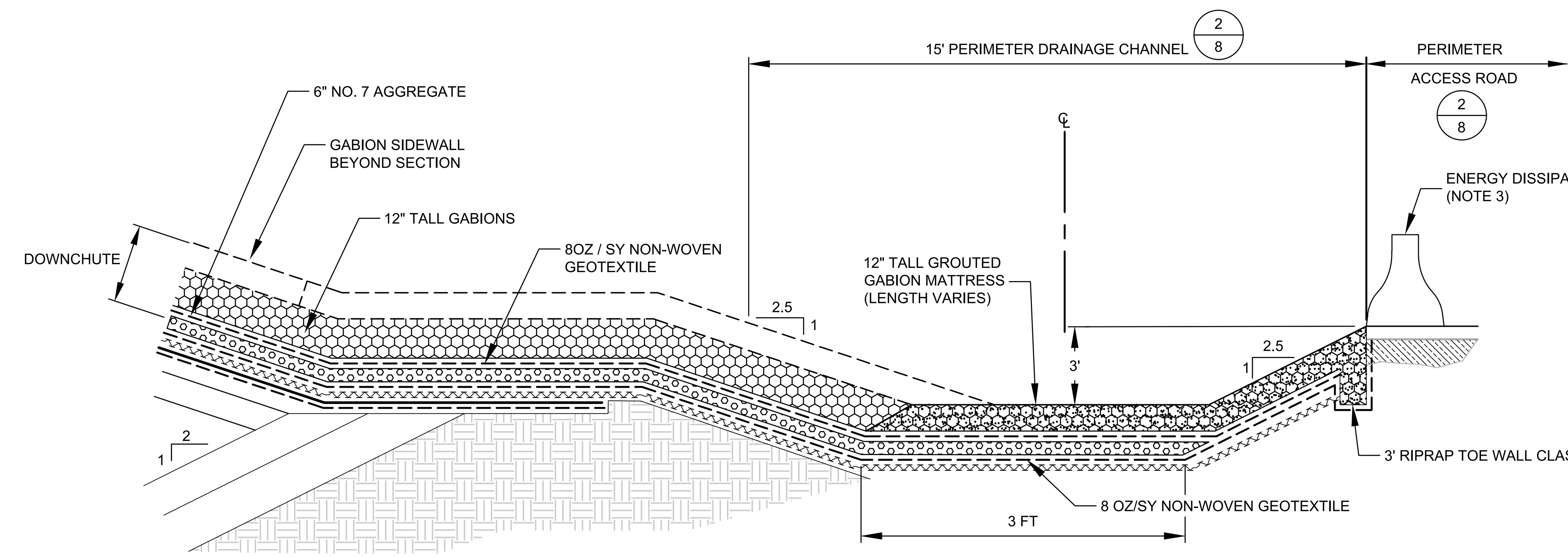
1
11
DETAIL
TACK-ON COVER TERRACE
SCALE: NTS



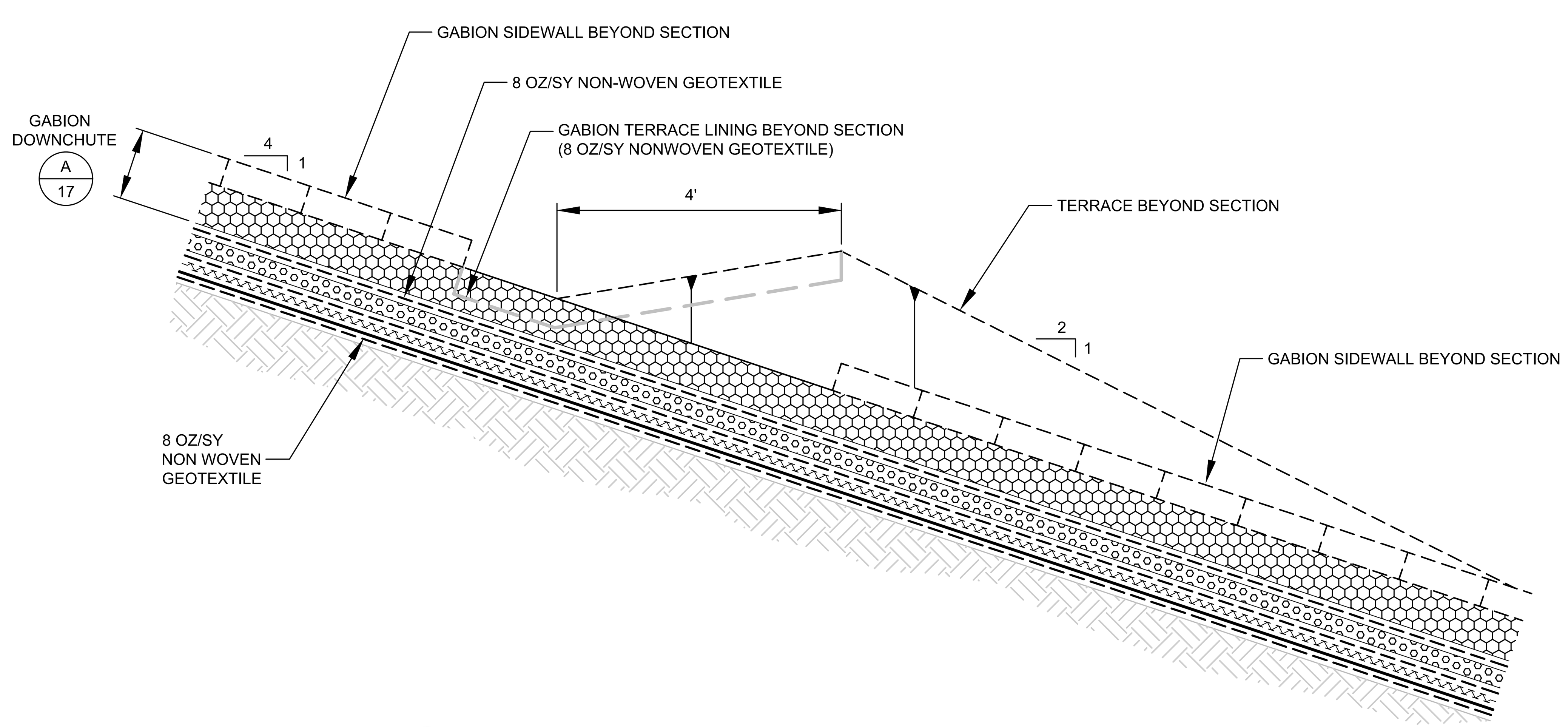
2
11
DETAIL
DOWNCHUTE/TERRACE INTERSECTION
SCALE: NTS



3
11
DETAIL
DOWNCHUTE/PERIMETER CHANNEL INTERSECTION
SCALE: NTS



B
-
DETAIL
DOWNCHUTE/PERIMETER CHANNEL INTERSECTION
SCALE: NTS



A
-
DETAIL
DOWNCHUTE/TACK-ON COVER TERRACE INTERSECTION
SCALE: NTS

NOTES:

1. ALL TERRACES SHALL BE LINED WITH TEMPORARY EROSION CONTROL MATTING MEETING THE FOLLOWING CRITERIA:
A) LONGEVITY GREATER THAN 6 MONTHS
B) MAXIMUM FLOW VELOCITY GREATER THAN 6 FT/S
C) MAXIMUM SHEAR STRESS GREATER THAN 1.5 PSF

2. SEE SHEET 12 FOR DOWNCHUTE DIMENSIONS.

3. ENERGY DISSIPATORS SHALL BE 6' INTERLOCKED JERSEY BARRIERS

PERMIT DRAWINGS - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DRN	APP

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10211 WINCOPIN CIRCLE, FLOOR 4
COLUMBIA, MARYLAND 21044
PHONE: (410) 381-4333

TOLSON AND ASSOCIATES, LLC
24024 FREDERICK ROAD
CLARKSBURG, MARYLAND 20871

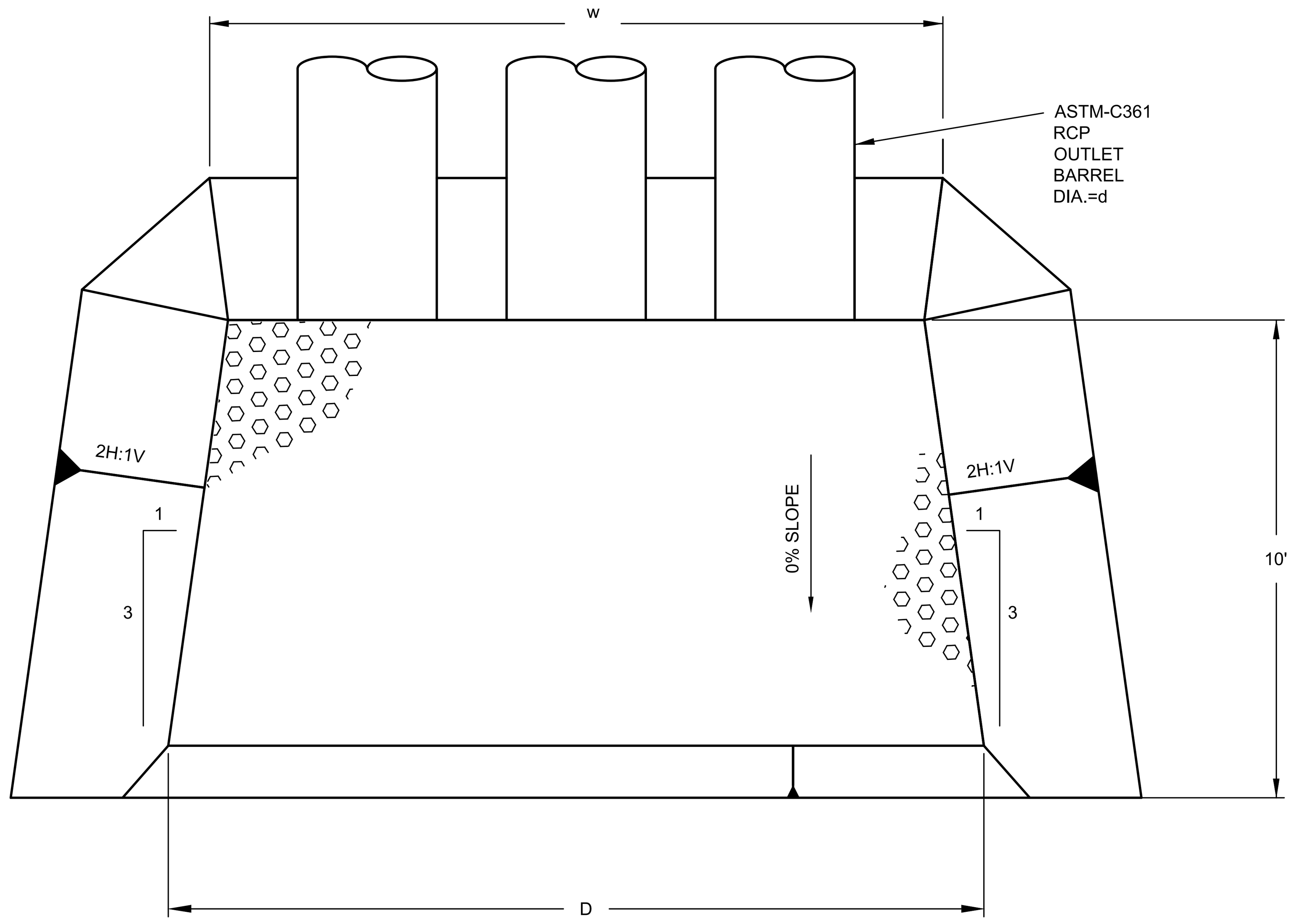
TITLE: STORMWATER MANAGEMENT DETAILS I

PROJECT: VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL

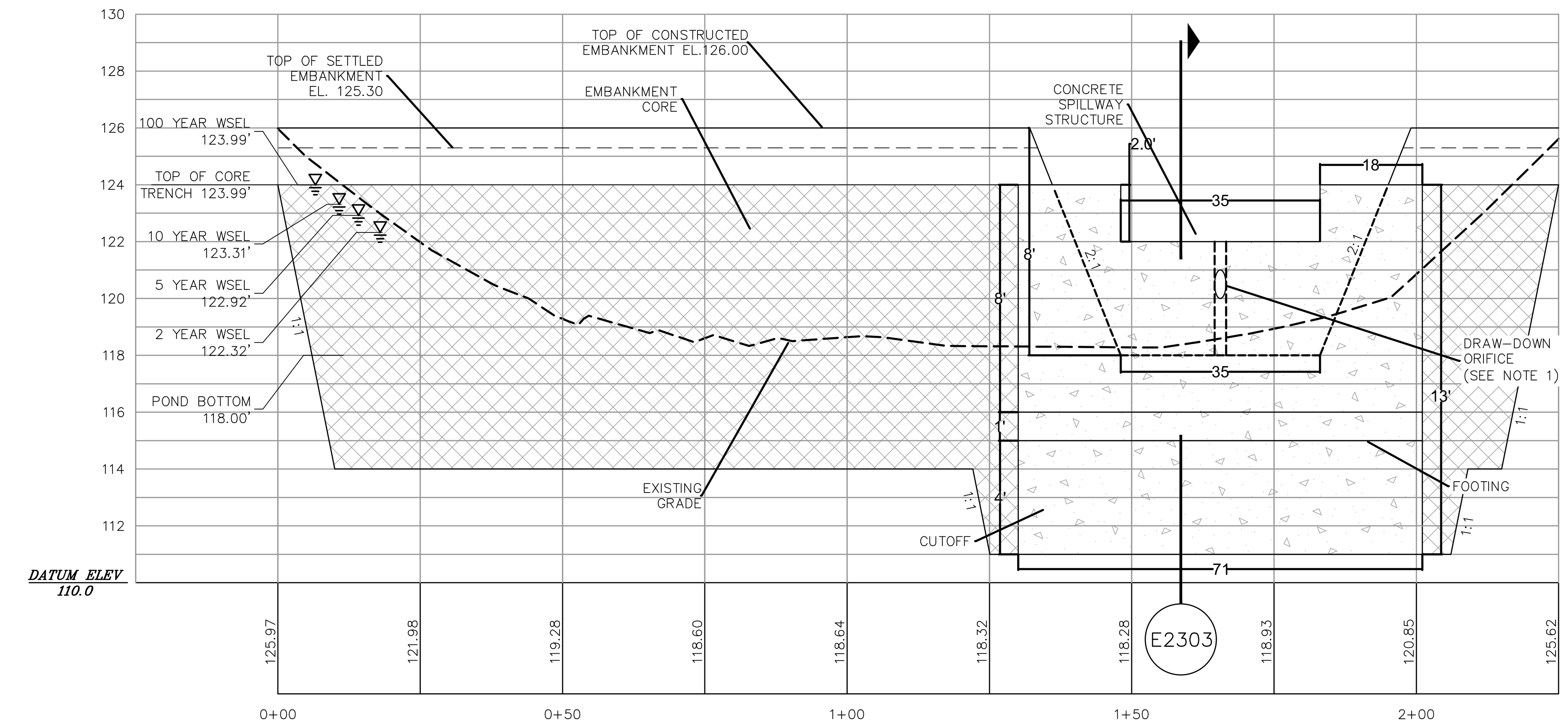
SITE: TOLSON RUBBLE LANDFILL

C.H. Pendleton
SIGNATURE
11-06-2020
DATE

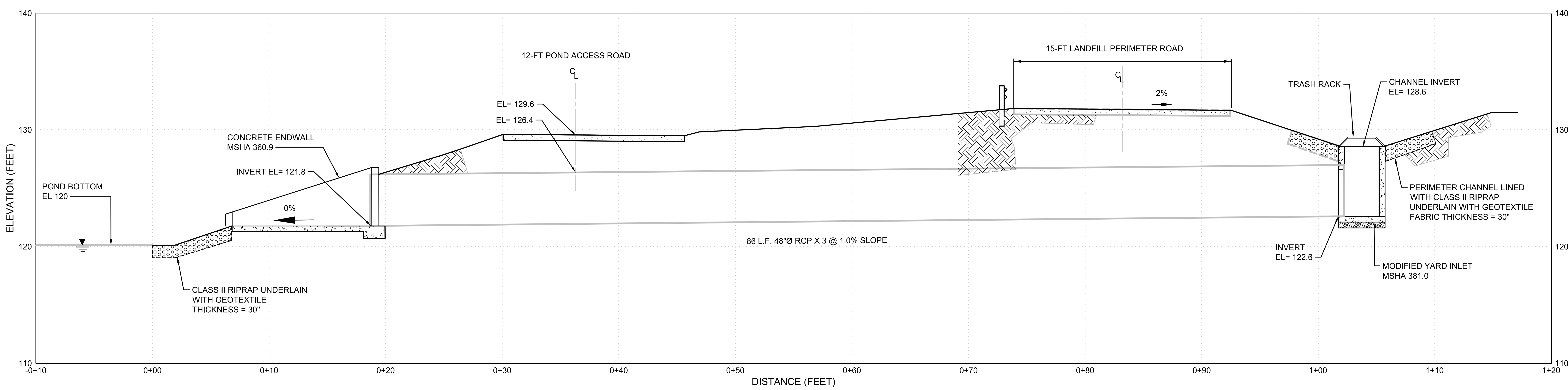
DESIGN BY:	SS	DATE:	JULY 2020
DRAWN BY:	ANA	PROJECT NO.:	ME1606
CHECKED BY:	SS	FILE:	ME1606-016
REVIEWED BY:	---	DRAWING NO.:	13 OF 18
APPROVED BY:	CHP		



2 / 9,11 DETAIL
RIPRAP OUTLET PROTECTION CHANNEL
SCALE: SEE NOTE 4
(NOTES 1 & 2)

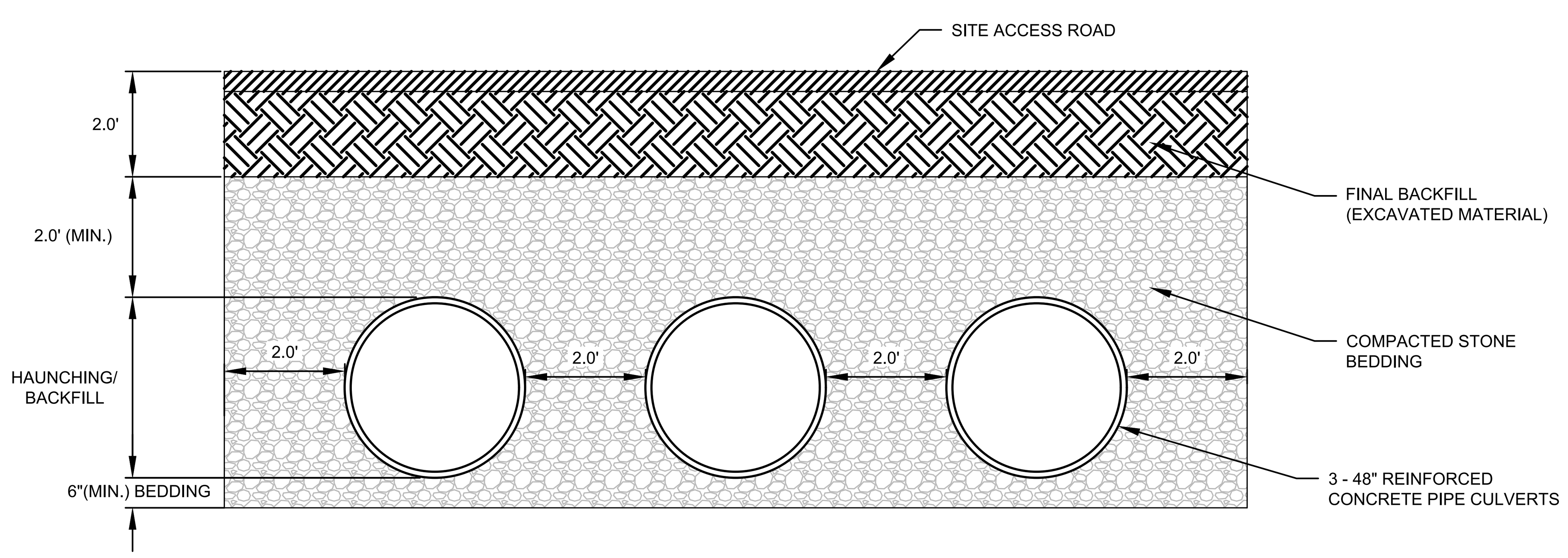


3 / 11 DETAIL
CENTERLINE OF EMBANKMENT PROFILE
SCALE: SEE NOTE 4
(NOTE 1)



CULVERT PROFILE

5 / 9 DETAIL
CULVERT TO SWM POND
SCALE: AS SHOWN
(NOTES 1 & 2)



4 / 11 DETAIL
POND INLET CULVERT
SCALE: NTS
(NOTES 1 & 2)

NOTES:

1. POND EMBANKMENT PROFILE OBTAINED FROM EROSION CONTROL AND STORMWATER MANAGEMENT PLAN FOR TOLSON RUBBLE LANDFILL, CROFTON, MARYLAND, ENVIRONMENTAL RESOURCES MANAGEMENT, INC. (ERM) OCTOBER 2014, AND REVISED BY BAY ENGINEERING INC., OCTOBER 2019.
2. GABION DOWNCHUTES AND SIDEWALLS SHALL BE BACKFILLED WITH MSHA CLASS I RIPRAP.
3. CLASS I RIPRAP SHALL BE PLACED MANUALLY OR USING A PIECE OF EQUIPMENT APPROVED BY ENGINEER. MAXIMUM DROP HEIGHT SHALL BE 18 INCHES.
4. DOWNCHUTE WIDTH IS 15-FT EXCEPT FOR DC-8 WICH IS 22-FT.

PERMIT DRAWINGS - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DRN	APP

Geosyntec consultants
10211 WINCOPIN CIRCLE, FLOOR 4
COLUMBIA, MARYLAND 21044
PHONE: (410) 381-4333

TOLSON AND ASSOCIATES, LLC
24024 FREDERICK ROAD
CLARKSBURG, MARYLAND 20871

TITLE: STORMWATER MANAGEMENT DETAILS II

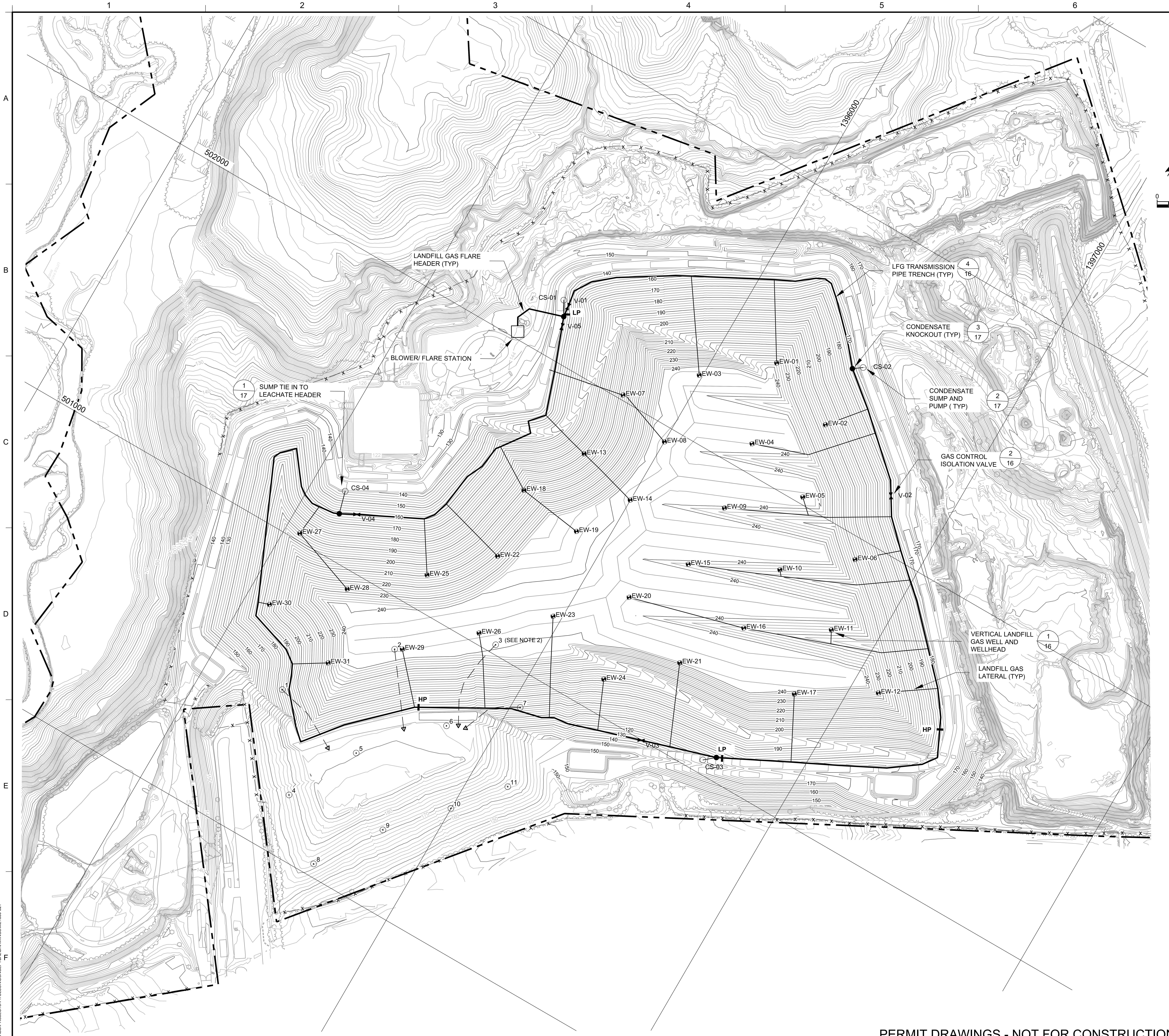
PROJECT: VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL

SITE: TOLSON RUBBLE LANDFILL

C.H. Pendleton
SIGNATURE
11-06-2020
DATE

STATE OF MARYLAND · CARRIE H. PENDLETON · 32252 · PROFESSIONAL ENGINEER

DESIGN BY:	SS	DATE:	JULY 2020
DRAWN BY:	ANA	PROJECT NO.:	ME1606
CHECKED BY:	SS	FILE:	ME1606-017
REVIEWED BY:	---	DRAWING NO.:	
APPROVED BY:	CHP	14 OF 18	



LEGEND

55	EXISTING MINOR GRADE CONTOUR
50	EXISTING MAJOR GRADE CONTOUR
	EXISTING TREE LINE
x — x — x	EXISTING FENCE
	EXISTING ROAD
	PROPERTY LINE
118	PROPOSED MINOR GRADE CONTOUR
120	PROPOSED MAJOR GRADE CONTOUR
	LANDFILL GAS HEADER
	LANDFILL GAS LATERAL
EW-12	LANDFILL GAS EXTRACTION WELL
CS-02	CONDENSATE SUMP
LP	LOW POINT
HP	HIGH POINT
●	CONDENSATE KNOCKOUT
	GAS CONTROL/ ISOLATION VALVE
⊙	CUNNINGHAM GAS VENTS
	RELOCATED CUNNINGHAM GAS VENTS

NOTES:

1. CONTOURS SHOWN REPRESENT TOP OF WASTE GRADES.
2. A TOTAL OF FOUR GAS VENTS (1, 2, 3, AND 7) IN THE EXISTING CUNNINHAM LANDFILL WILL BE RELOCATED.

REV	DATE	DESCRIPTION	DRN	APP
1	NOV 2020	UPDATED GRADING AND ADDITION OF CUNNINGHAM GAS VENTS	AM	CHP

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TOLSON AND ASSOCIATES, LLC
24024 FREDERICK ROAD
CLARKSBURG, MARYLAND 20871

TITLE: LANDFILL GAS MANAGEMENT SYSTEM PLAN

PROJECT: **VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL**

SITE: **TOLSON RUBBLE LANDFILL**

C.H. Pendleton
SIGNATURE
11-06-2020
DATE

STATE OF MARYLAND CARRIE H. PENDLETON 32252 PROFESSIONAL ENGINEER

DESIGN BY:	SS	DATE:	JULY 2020
DRAWN BY:	ANA	PROJECT NO.:	ME1606
CHECKED BY:	SS	FILE:	ME1606-021
REVIEWED BY:	----	DRAWING NO.:	
APPROVED BY:	CHP	15 OF 18	

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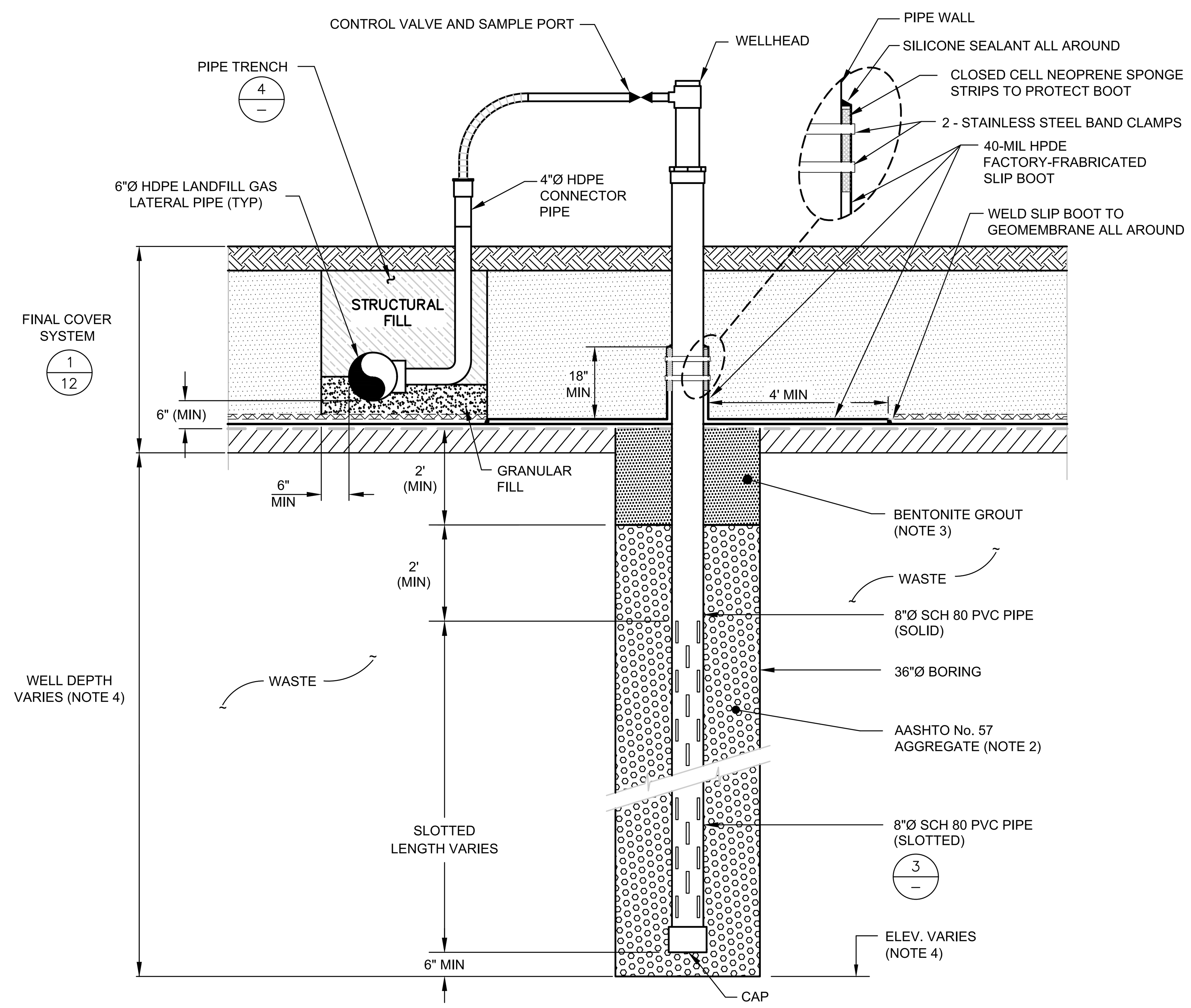
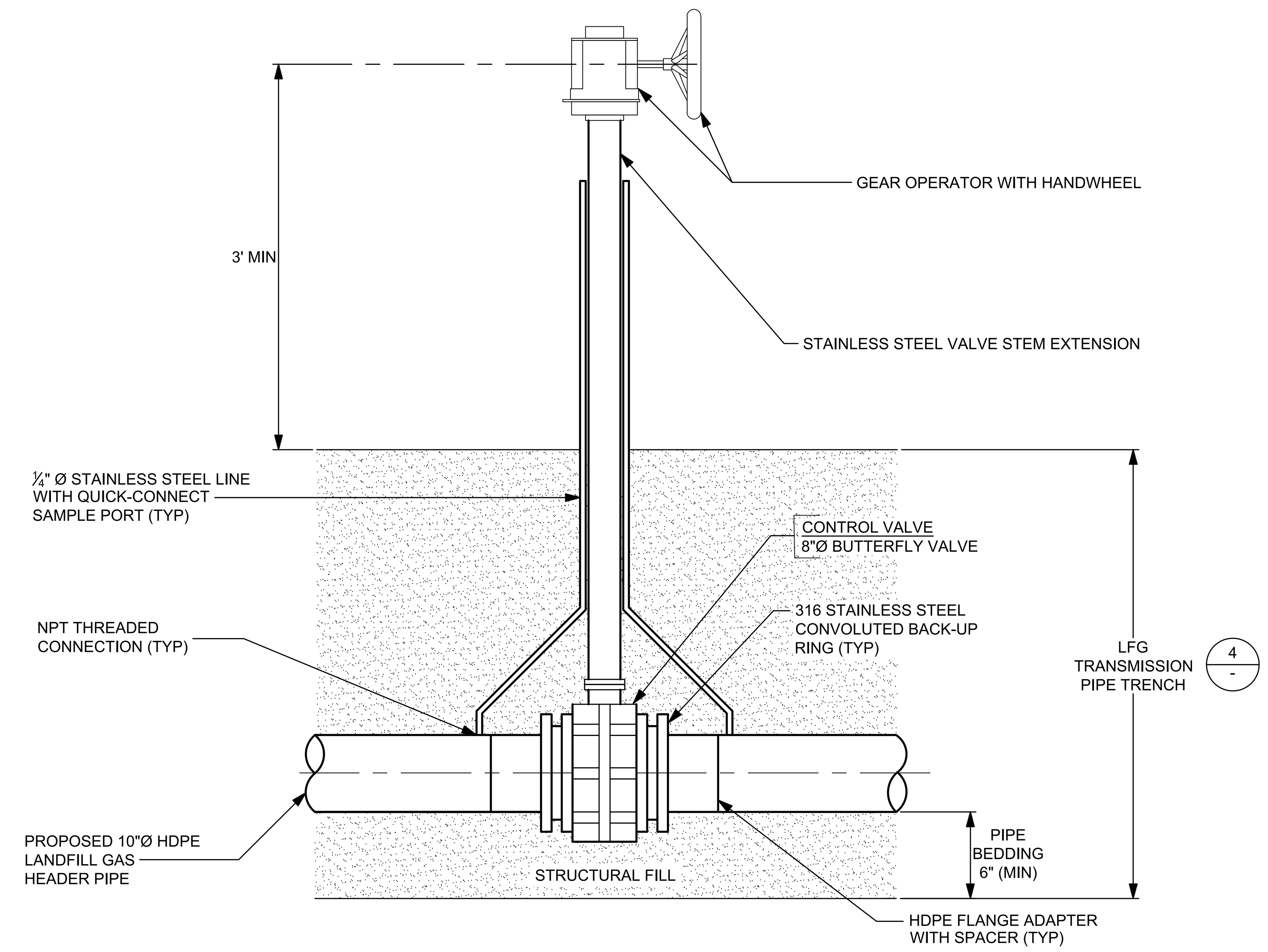
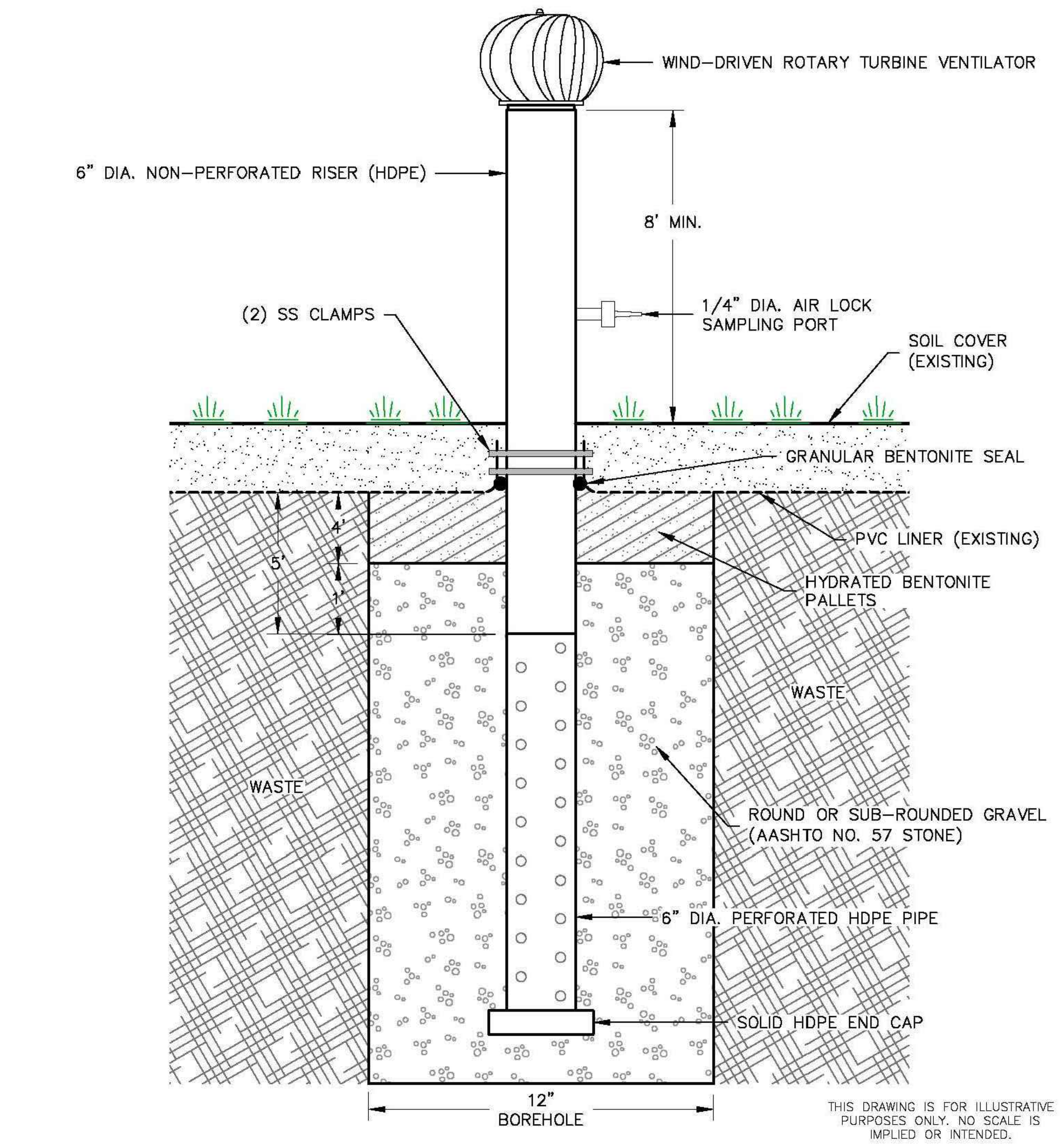


1
15
DETAIL
VERTICAL LANDFILL GAS WELL AND WELLHEAD
SCALE: NONE
(NOTE 1)



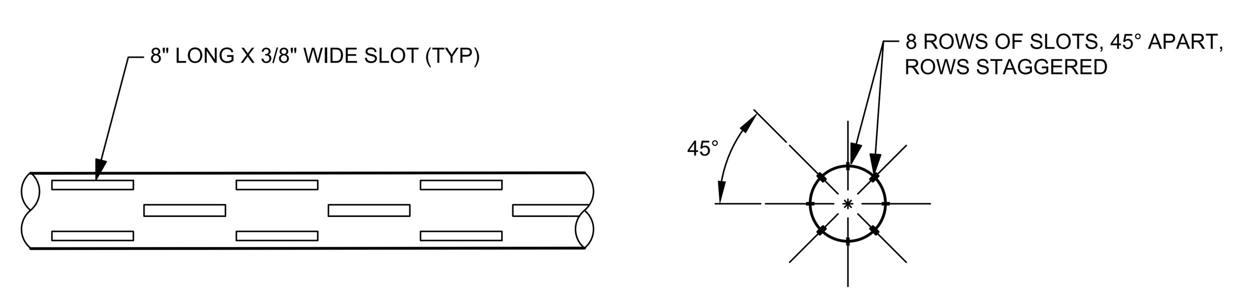
2
15
DETAIL
GAS CONTROL ISOLATION VALVE
SCALE: NONE
(NOTE 1)



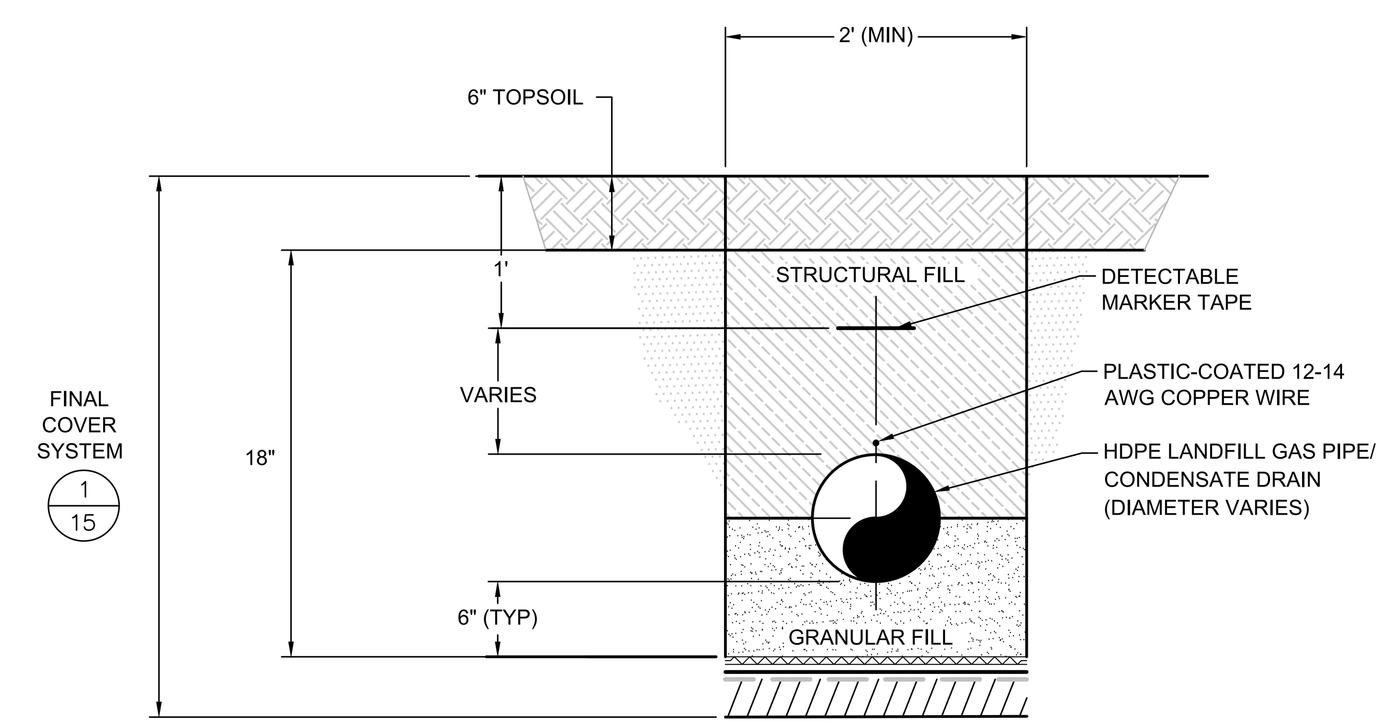
5
15
DETAIL
CUNNINGHAM GAS VENT DETAIL
SCALE: NONE
(NOTE 5)

NOTES:

1. MINIMUM 6" GRANULAR FILL MATERIAL BETWEEN ALL BURIED COMPONENTS OF LANDFILL GAS TRANSMISSION SYSTEM AND GEOSYNTHETIC COMPONENTS OF FINAL COVER SYSTEM. IF ANY LFG SYSTEM COMPONENTS ARE INSTALLED PRIOR TO FINAL CLOSURE, LFG PIPING MAY SIT DIRECTLY ON INTERMEDIATE COVER UNTIL FINAL CLOSURE.
2. AASHTO No. 57 AGGREGATE OR ALTERNATIVE ENGINEER-APPROVED INERT GRANULAR MEDIA THAT SUPPORTS SUFFICIENT PORE SIZES MAY BE USED (E.G. SCRAP TIRE CHIPS OR CRUSHED GLASS).
3. BENTONITE CHIPS SHALL BE HYDRATED PER MANUFACTURER'S RECOMMENDATIONS IN 6" LIFTS.
4. WELL TERMINATES A MINIMUM OF 15-FT ABOVE TOP OF DRAINAGE/PROTECTION LAYER IN LINER SYSTEM.
5. CUNNINGHAM GAS VENT DETAIL OBTAINED FROM ERM FIGURE "TYPICAL GAS VENT DETAIL" DATED 10/16/17.



3
15
DETAIL
PIPE SLOTTING
SCALE: NONE
(NOTE 1)



4
15
DETAIL
LFG TRANSMISSION PIPE TRENCH (TYP)
SCALE: NONE
(NOTE 1)

REV	DATE	DESCRIPTION	DRN	APP
1	NOV 2020	ADDITION OF CUNNINGHAM GAS VENT DETAIL	BGF	CHP

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TOLSON AND ASSOCIATES, LLC
24024 FREDERICK ROAD
CLARKSBURG, MARYLAND 20871

TITLE: LANDFILL GAS MANAGEMENT SYSTEM DETAILS I

PROJECT: VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL

SITE: TOLSON RUBBLE LANDFILL

C.H. Pendleton
SIGNATURE
11-06-2020
DATE

STATE OF MARYLAND
CARRIE H. PENDLETON
32252
PROFESSIONAL ENGINEER

DESIGN BY:	SS	DATE:	JULY 2020
DRAWN BY:	ANA	PROJECT NO.:	ME1606
CHECKED BY:	SS	FILE:	ME1606-022
REVIEWED BY:	---	DRAWING NO.:	
APPROVED BY:	CHP		16 OF 18

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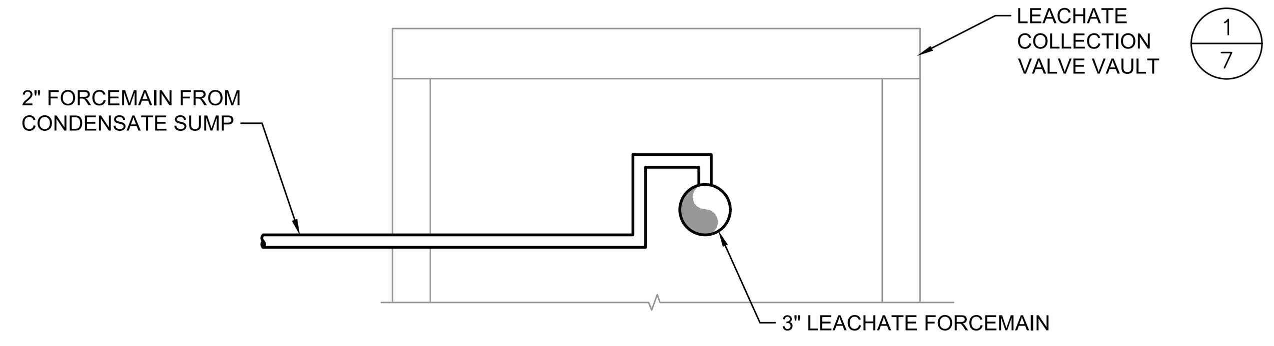
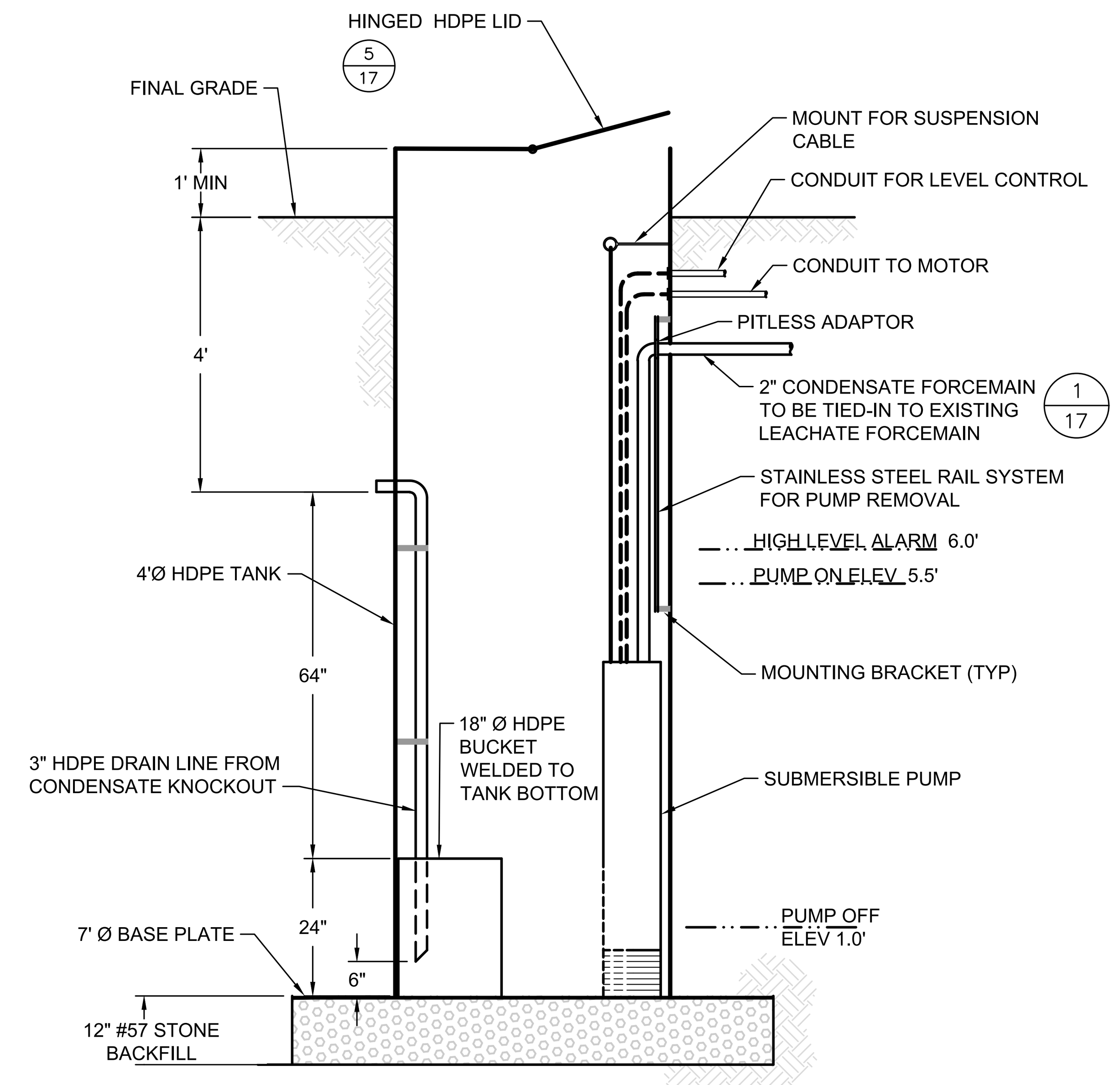
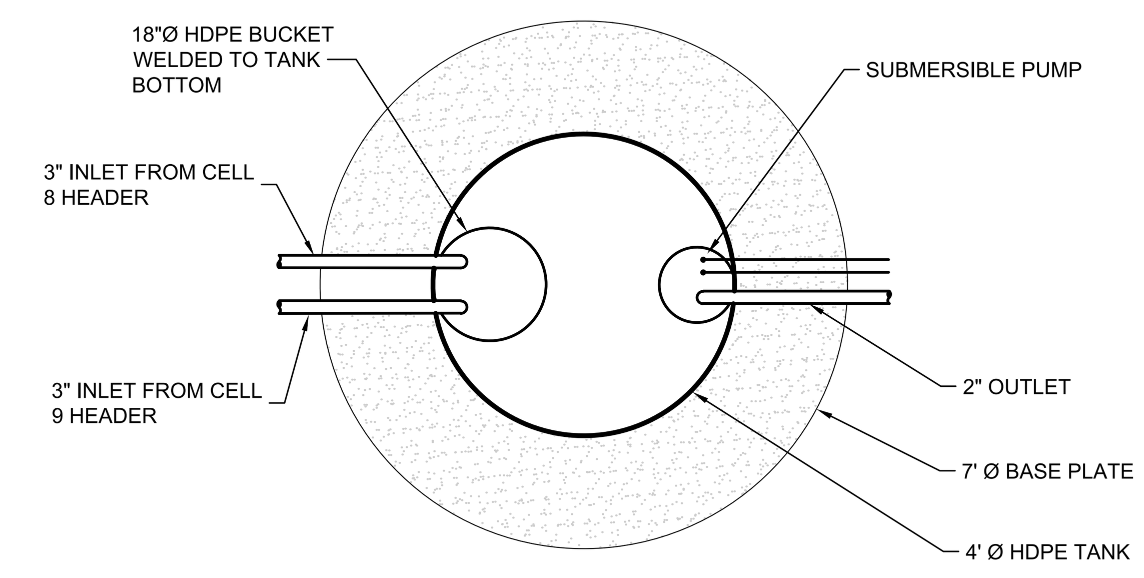
BFERRICK - 10-Nov-20 - 6:14 PM
P:\CADD\PROJECTS\TOLSON\CONCEPTUAL\DRAWINGS\ME1606-022



1 / 15 DETAIL
SUMP TIE-IN TO LEACHATE PIPE
SCALE: 1" = 2'

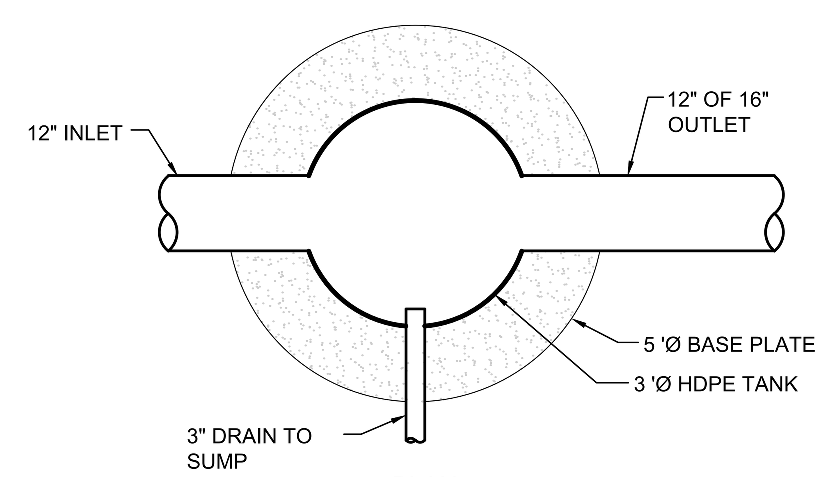


SECTION

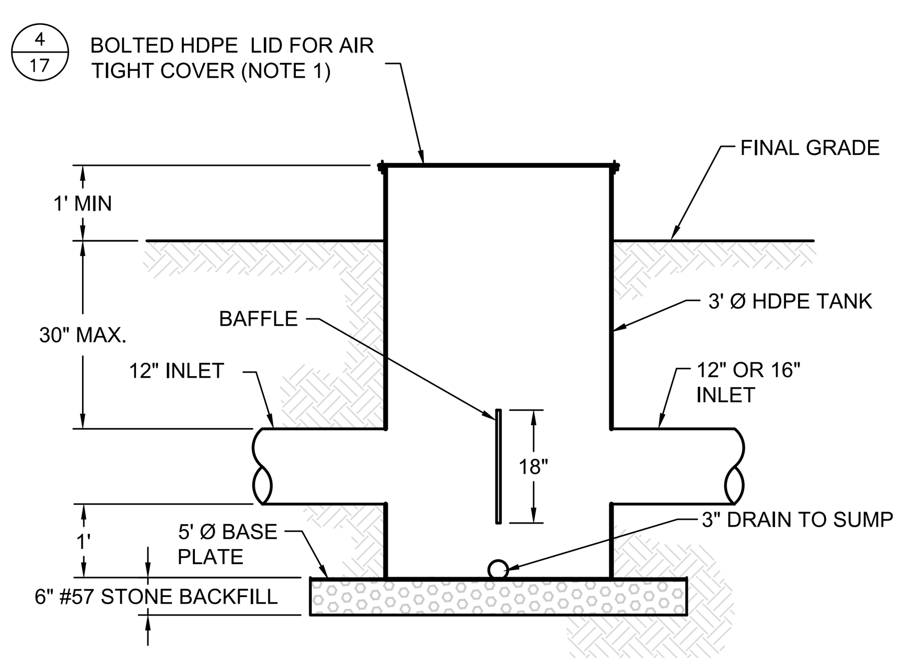


PLAN

2 / 15 DETAIL
CONDENSATE SUMP AND PUMP
SCALE: 1" = 2'

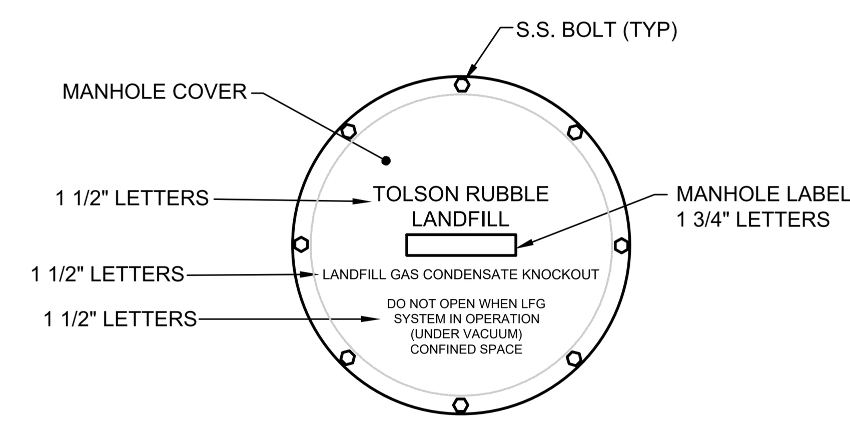


PLAN

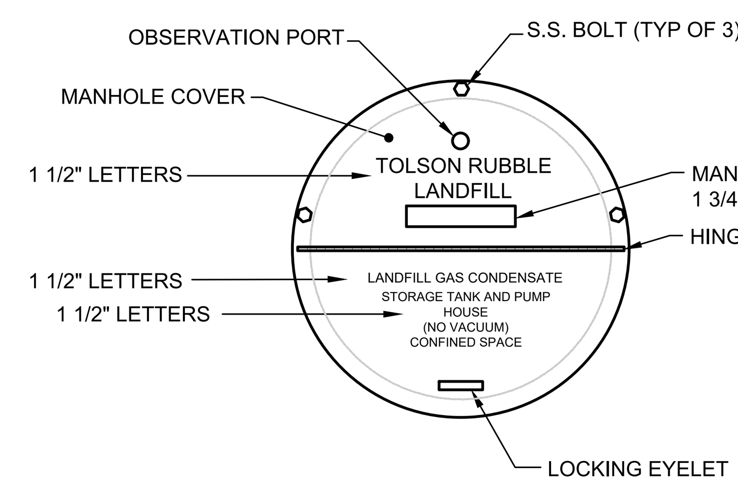


SECTION

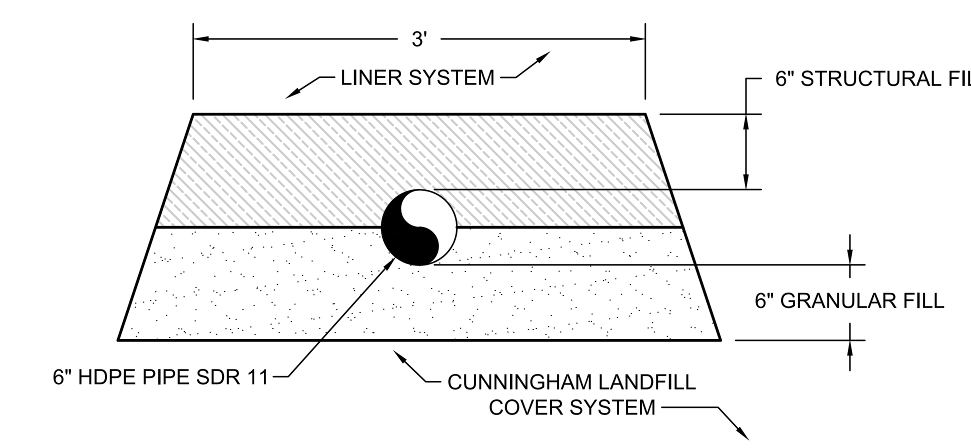
3 / 15 DETAIL
CONDENSATE KNOCKOUT
SCALE: 1" = 2'



4 / - DETAIL
CONDENSATE KNOCKOUT COVER
SCALE: 1" = 2'



5 / - DETAIL
CONDENSATE SUMP COVER
SCALE: 1" = 2'



6 / 8 DETAIL
CUNNINGHAM LANDFILL GAS VENT OVERLAY PIPING
SCALE: 1" = 1'
(NOTE 2)

NOTES:

1. CONDENSATE KNOCKOUT COVER SHALL BE DESIGNED FOR OPERATION UNDER VACUUM.
2. GAS VENT OVERLAY NOT COVERED BY LINER SYSTEM TO BE VEGETATED UNTIL CLOSURE.

REV	DATE	DESCRIPTION	DRN	APP
1	NOV 2020	ADDITION OF CUNNINGHAM LANDFILL GAS VENT OVERLAY SECTION	BGF	CHP

Geosyntec consultants
10211 WINCOPIN CIRCLE, FLOOR 4
COLUMBIA, MARYLAND 21044
PHONE: (410) 381-4333

TOLSON AND ASSOCIATES, LLC
24024 FREDERICK ROAD
CLARKSBURG, MARYLAND 20871

TITLE: LANDFILL GAS MANAGEMENT SYSTEM DETAIL II

PROJECT: **VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL**

SITE: **TOLSON RUBBLE LANDFILL**

C.H. Pendleton
SIGNATURE
11-06-2020
DATE

STATE OF MARYLAND · CARLIE H. PENDLETON · 32252 · PROFESSIONAL ENGINEER

DESIGN BY:	SS	DATE:	JULY 2020
DRAWN BY:	ANA	PROJECT NO.:	ME1606
CHECKED BY:	SS	FILE:	ME1606-023
REVIEWED BY:	---	DRAWING NO.:	
APPROVED BY:	CHP	17 OF 18	

PERMIT DRAWINGS - NOT FOR CONSTRUCTION

BFERRICK - 10-Nov-20 - 6:16 PM
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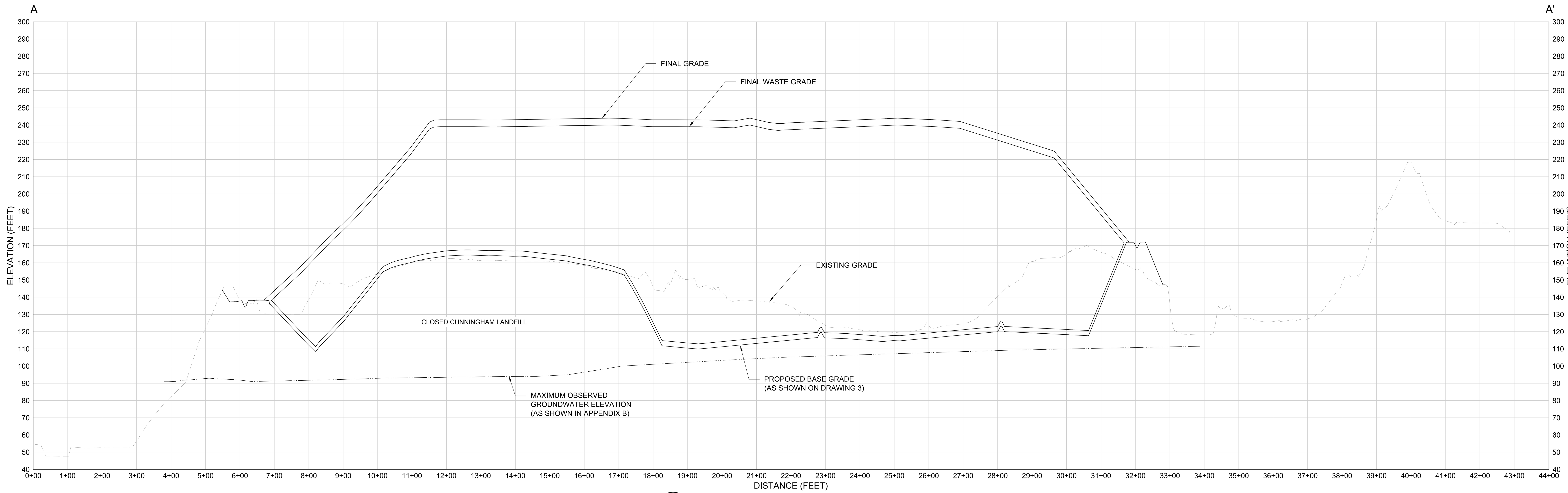
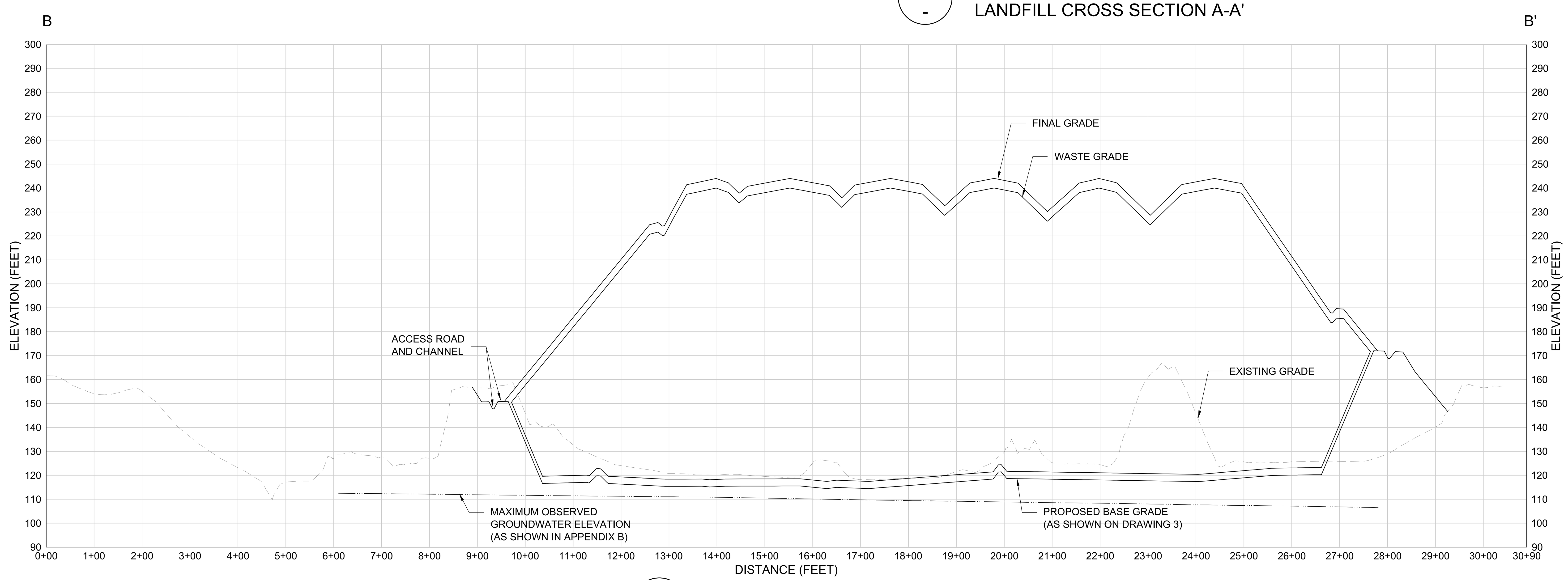


A-A'
-
LANDFILL CROSS SECTION A-A'



B-B'
-
LANDFILL CROSS SECTION B-B'

0 150 300
HORIZONTAL SCALE: 1" = 150'

0 5 10
VERTICAL SCALE: 1" = 5'

LEGEND

- EXISTING CONTOURS (FEET, MSL)
- PROPERTY BOUNDARY
- HIGHEST OBSERVED GROUNDWATER CONTOUR FROM PRIOR 18 MONTHS (FEET, MSL)
- 170 PROPOSED GRADE CONTOURS
- PERMITTED LIMIT OF WASTE

REV	DATE	DESCRIPTION	DRN	APP

Geosyntec consultants
10211 WINCOPIN CIRCLE, FLOOR 4
COLUMBIA, MARYLAND 21044
PHONE: (410) 381-4333

TOLSON AND ASSOCIATES, LLC
24024 FREDERICK ROAD
CLARKSBURG, MARYLAND 20871

TITLE: LANDFILL CROSS SECTIONS

PROJECT: **VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL**

SITE: **TOLSON RUBBLE LANDFILL**

C.H. Pendleton
SIGNATURE
11-06-2020
DATE

STATE OF MARYLAND
CARRIE H. PENDLETON
32252
PROFESSIONAL ENGINEER

DESIGN BY:	SS	DATE:	JULY 2020
DRAWN BY:	ANA	PROJECT NO.:	ME1606
CHECKED BY:	SS	FILE:	ME1606-020
REVIEWED BY:	---	DRAWING NO.:	
APPROVED BY:	CHP	18 OF 18	

PERMIT DRAWINGS - NOT FOR CONSTRUCTION

Appendix B: Groundwater Monitoring and Phase II Geology (ERM, 2006)

APPENDIX B. GROUNDWATER MONITORING 2019-2020

COMAR 26.04.07.15 requires that a Phase II Report be prepared and that it include information on 12 specific items in sufficient detail to permit a comprehensive review of a proposed project. The existing Phase II Geologic report is still applicable to the Tolson Rubble Landfill because the proposed expansion is within the existing permitted footprint. The expansion is vertical and includes lowering the base grades from the currently permitted minimum elevation of 122 ft-msl to a minimum elevation of 95 ft-msl. This appendix contains the following additional information related to Site topography and groundwater levels:

- Table B-1 – Monthly Groundwater Levels;
- Figure B-1 – Deep Potentiometric Surface Maximum Water Level Measurements;
- Attachment B-1 – Key Map and Site Cross Sections A to D;
- Attachment B-2 – Hydrograph Time Trend Plots;
- Attachment B-3 – Phase II Geology Report (ERM, 2006) ELECTRONIC ONLY.

TABLES

TABLE B-1
MONTHLY GROUNDWATER ELEVATION DATA

Tolson Rubble Landfill
Crofton, Maryland

Monitoring Location	Reference Elevation [1] (ft above msl)	Revised Reference Elevation [4]	Screened Aquifer	Groundwater Elevation (Above msl)																					
				31-Jan-19	15-Feb-19	25-Mar-19	16-Apr-19	6-May-19	7-Jun-19	15-Jul-19	5-Aug-19	4-Sep-19	9-Oct-19	18-Nov-19	2-Dec-19	2-Jan-20	5-Feb-20	9-Mar-20	24-Apr-20	8-May-20	2-Jun-20	16-Jul-20	25-Aug-20	1-Sep-20	5-Oct-20
MW-1A	155.82		Shallow	NM	NM	81.94	82.28	82.73	83.19	83.35	83.39	83.05	82.80	82.54	82.31	81.92	81.59	81.36	81.17	81.16	81.02	80.97	81.09	81.08	81.31
MW-1B	154.59		Deep	NM	NM	73.68	75.15	75.97	76.76	77.25	77.45	77.32	75.91	76.75	76.67	75.93	76.27	76.02	74.89	75.36	75.36	75.55	75.64	75.67	74.29
MW-2A	145.41		Deep	55.76	56.23	56.52	56.17	57.11	56.35	55.14	54.61	54.34	53.89	54.43	55.12	54.97	55.02	55.02	56.08	55.59	54.21	53.55	54.10	53.98	54.35
MW-2B	147.33		Shallow	99.27	99.63	99.74	99.80	98.52	100.08	99.78	99.79	99.33	99.13	98.76	98.77	98.59	98.57	98.54	98.51	97.10	98.58	98.53	98.66	98.62	98.87
MW-4A	149.38		Shallow	95.79	95.76	95.77	95.71	95.72	95.76	95.74	95.74	95.71	95.67	95.57	95.67	95.73	95.73	95.61	95.69	95.73	95.65	95.66	95.72	95.70	95.69
MW-4B	151.17		Deep	53.13	53.62	53.79	53.35	54.64	53.12	52.40	51.93	51.54	51.22	51.75	52.55	52.31	52.41	52.33	53.78	53.10	51.82	51.34	52.02	51.94	51.96
MW-5A	80.01		Shallow	NM	NM	61.15	60.87	60.54	60.05	59.51	59.36	58.71	58.43	58.56	58.45	58.73	58.95	59.43	59.61	59.87	59.79	59.16	59.47	59.39	59.79
MW-5B	78.27		Deep	NM	NM	53.07	52.45	53.49	52.33	51.43	50.84	50.44	50.09	50.91	51.43	51.34	51.44	51.37	52.58	52.14	50.74	50.13	50.82	50.66	50.82
MW-6A	91.70		Shallow	NM	NM	70.16	70.39	70.25	70.21	70.06	69.98	69.72	69.51	69.48	69.43	69.39	69.38	69.36	69.50	69.55	69.54	69.22	69.32	69.28	69.21
MW-7A	96.12		Shallow	NM	NM	62.92	60.95	63.02	60.93	62.89	62.76	62.60	62.41	62.53	62.51	62.48	62.42	62.36	62.42	62.48	62.25	62.06	62.18	62.12	62.14
MW-7B	95.43		Deep	NM	NM	48.07	48.10	50.21	50.30	45.51	44.35	43.79	43.33	44.27	44.71	44.77	45.18	45.42	46.56	46.04	41.49	39.61	39.64	39.69	42.37
MW-8A	144.22		Shallow	100.69	101.03	101.81	102.06	102.26	102.60	102.32	102.16	101.62	101.05	100.55	100.40	100.08	99.72	99.67	99.55	99.71	99.72	99.46	100.26	100.31	100.27
MW-8B	148.50		Deep	58.67	59.42	59.68	59.51	60.58	60.35	58.37	57.81	57.55	57.04	57.62	58.17	58.01	58.12	58.10	58.99	58.17	56.81	55.89	56.20	56.09	56.68
MW-12AR	152.48		Shallow	108.07	107.98	108.06	107.71	107.35	107.78	107.47	107.11	106.41	105.80	106.28	105.98	106.18	106.43	106.67	106.88	107.34	107.01	106.88	109.10	108.65	108.31
MW-15A	143.59		Shallow	100.28	100.34	100.29	100.16	100.07	100.31	100.41	100.18	99.94	99.73	100.54	100.59	100.67	100.73	100.46	100.76	101.21	100.86	100.71	101.83	101.53	101.12
MW-15B	143.98		Deep	60.94	61.05	61.71	61.62	62.49	62.13	60.84	60.40	60.24	59.68	60.26	60.68	60.53	60.50	59.24	61.31	61.13	59.76	59.02	86.41*	59.28	59.81
MW-16A [2]	157.79	146.80	Shallow	93.34	93.35	93.40	93.33	93.43	93.42	93.31	93.41	93.22	93.06	93.15	93.09	93.08	92.99	NM	NM	NM	NM	92.26	92.40	92.39	92.48
MW-16B[2]	157.96	146.92	Deep	53.41	53.87	53.97	53.56	54.81	53.34	52.74	52.32	52.02	51.66	52.36	53.02	52.70	52.75	NM	NM	NM	NM	51.27	52.01	51.97	51.81
MW-17A	183.80		Shallow	115.67	116.03	116.41	116.35	116.47	117.02	109.04	117.22	108.61	109.55	109.55	116.44	116.18	116.06	115.96	107.64	108.32	115.82	110.79	116.76	111.82	116.95
MW-17B	185.40		Deep	72.43	73.24	73.49	73.49	74.23	74.45	72.95	72.55	72.59	71.93	72.41	72.72	72.55	72.64	72.45	73.14	73.14	71.60	69.55	70.97	70.88	71.60
MW-18A	186.90		Shallow	114.36	115.29	115.47	115.30	115.61	115.90	115.73	115.93	116.54	115.24	115.26	115.26	114.69	114.48	114.29	114.62	111.38	114.32	114.34	114.92	114.83	115.14
MW-18B	189.60		Deep	69.65	70.01	70.65	70.79	71.18	72.18	70.35	69.77	69.61	69.27	69.09	69.37	69.49	69.61	69.59	70.03	70.33	68.63	67.38	66.97	66.80	67.66
MW-19A	159.90		Shallow	NM	NM	90.66	90.89	91.22	91.64	91.77	91.90	91.67	91.41	91.19	91.60	90.88	90.62	90.50	90.37	90.40	90.41	90.37	90.44	90.42	90.46
MW-19B	159.50		Deep	NM	NM	54.13	53.67	54.63	53.56	52.68	52.14	51.84	51.49	52.25	52.72	52.56	52.64	52.64	53.84	53.37	51.86	51.35	52.00	51.94	52.09
MW-20A	158.70		Shallow	88.81	89.13	89.69	89.92	90.31	90.70	90.77	90.87	90.50	90.39	90.10	89.97	89.67	89.40	89.24	89.08	89.11	89.20	89.17	89.24	89.27	89.27
MW-20B	158.30		Deep	56.84	57.51	57.75	57.09	58.04	57.36	56.39	55.93	55.59	55.14	55.98	56.28	56.12	56.18	56.07	57.16	56.89	55.53	134.9*	55.57	55.78	55.63
MW-21A [3]	145.70	145.29	Shallow	103.37	103.58	103.71	103.75	103.90	104.20	104.27	104.36	104.09	NM	NM	NM	NM	NM	102.71	102.56	102.62	102.63	102.46	102.90	103.01	103.16
MW-21B	146.10		Deep	58.19	61.67	45.60	53.48	58.44	61.36	61.58	61.36	61.01	47.16	58.23	59.46	60.53	61.00	61.15	54.31	57.76	59.88	60.29	60.29	60.27	43.41
MW-23A	173.09		Shallow	116.19	116.34	116.67	115.47	116.45	116.89	117.12	116.82	116.13	115.32	116.00	115.79	115.68	115.60	115.50	115.73	116.50	115.70	115.85	118.23	117.91	117.54
MW-26A	151.92		Shallow	101.23	101.60	102.04	102.23	102.52	102.88	102.90	102.92	102.60	101.23	101.87	101.92	101.58	101.27	101.23	101.16	100.69	101.14	101.23	101.42	101.46	101.66
MW-27A	158.22		Shallow	92.56	92.73	92.85	92.90	93.01	93.21	93.31	93.44	93.32	93.12	92.98	93.09	92.97	92.84	92.79	92.72	92.78	92.70	92.75	92.69	92.71	92.81
MW-28A	160.77		Shallow	NM	NM	93.37	93.45	93.57	93.82	93.94	95.10	93.92	93.73	93.60	93.69	93.58	93.43	93.38	93.31	93.39	93.34	93.26	93.33	93.36	93.44
MW-29A	161.17		Shallow	93.41	93.72	93.86	93.92	94.07	94.34	94.52	94.67	94.50	94.28	94.16	94.23	94.11	93.87	93.87	93.80	93.83	93.82	93.71	93.81	93.80	93.90
MW-31A	158.11		Shallow	102.93	103.53	104.31	104.59	104.97	105.33	105.08	105.01	104.46	103.90	103.42	103.40	102.86	102.45	102.31	102.15	102.12	102.13	101.99	102.41	102.47	102.70
MW-32A	139.26		Shallow	NM	NM	108.16	108.38	108.57	109.05	108.84	108.61	108.13	107.31	107.26	107.14	106.75	106.36	106.31	106.17	106.35	106.25	106.07	107.51	107.38	106.30
MW-33A	198.89		Shallow	NM	NM	112.00	112.17	112.35	112.81	112.88	112.95	112.63	112.15	112.04	111.95	111.58	111.27	111.29	111.36	111.39	111.26	111.14	111.89	111.96	110.20
MW-34A	141.11		Shallow	NM	NM	121.74	121.65	121.59	121.69	121.57	121.22	120.48	119.66	120.10	119.92	119.83	119.79	119.67	120.00	120.39	120.03	119.79	121.29	121.18	121.19
MW-35A	132.08		Shallow	NM	NM	118.65	117.34	118.21	118.48	118.75	118.25	117.47	116.81	117.50	117.29	117.26	117.37	117.18	117.61	118.29	117.52	117.60	120.18	119.75	119.13
MW-36A	124.13		Shallow	NM	NM	112.44	112.07	111.94	111.75	111.62	111.27	110.91	110.65	111.10	111.12	111.27	111.37	111.35	111.82	111.97	111.45	111.22	112.24	112.02	111.83
MW-37A	125.54		Shallow	NM	NM	106.78	106.31	105.92	106.41	106.04	105.58	104.85	104.30	104.79	104.65	104.91	105.23	105.24	105.73	106.25	105.78	105.55	107.76	107.23	106.72
PW-01	154.07		Shallow	NM	NM	87.92	88.24	88.57	88.33	88.47	89.11	88.78	87.87	88.23	88.17	93.96	87.64	86.78	87.22	87.38	87.45	87.37	NM	87.46	87.49
PW-02	158.83		Deep	NM	NM	76.13	78.68	76.25	76.45	73.33	68.48	75.79	78.41	70.39	69.72	NM	74.89	74.29	77.65	78.33	76.01	76.12	77.02	76.48	78.22
PW-03	153.90		Shallow	NM	NM	86.94	88.66	87.74	88.81	88.63	87.21	87.90	87.49	87.27	86.99	87.56	86.90	87.24	87.22	86.71	86.45	86.79	86.65	86.75	86.37

Notes:

[1] The elevation reference point for each monitoring well is the top of PVC casing surveyed by William C. Craig on 15 August 2017.

[2] Monitoring wells were modified due to accessibility issues to match surrounding ground surface on 5 March 2020 and completed on 16 July 2020.

[3] Monitoring well was repaired due to damage on 5 March 2020.

[4] Monitoring wells MW-16A, MW-16B, and, MW-21A new elevation reference points surveyed by Pleasants Construction Inc. on 22 July 2020.

NM - Not measured

UNK - Unknown

N/A - Not applicable

ft - feet

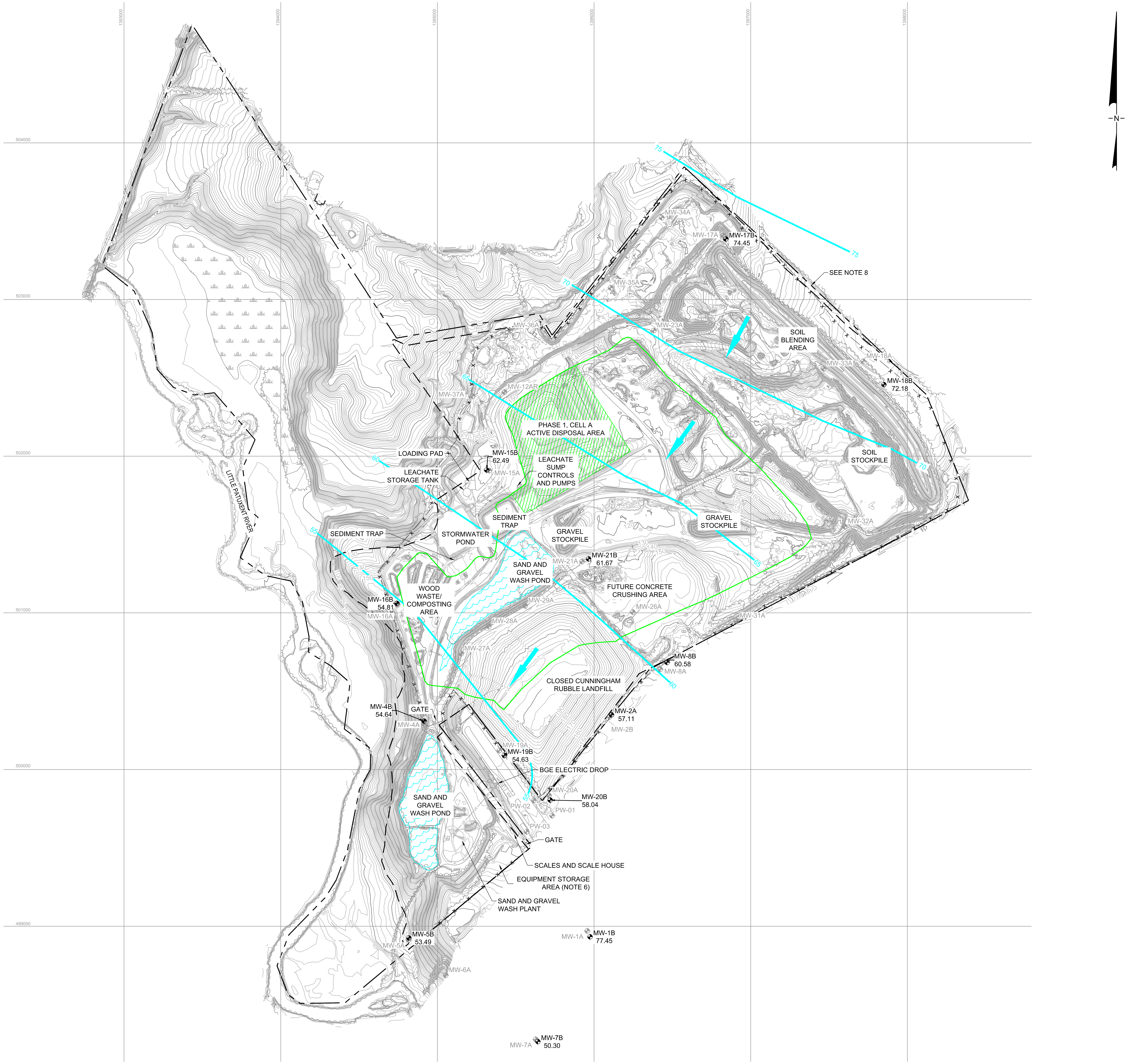
msl - Mean Sea Level

Grey shading indicates measured water level is maximum recorded.

* - erroneous measurement. Not included in site-wide maximums

Geosyntec consultants

FIGURES



LEGEND

- EXISTING CONTOURS (FEET, MSL)
- PROPERTY BOUNDARY
- MW-26B MONITORING WELL
- 115.93 GROUNDWATER ELEVATION, FEET ABOVE MEAN SEA LEVEL (FT AMSL)
- TREE LINE
- CURRENT PERMITTED WASTE BOUNDARY
- EXISTING WASH POND
- EXISTING WASTE DISPOSAL CELL
- SECURITY FENCE
- SECURITY FENCE AND GATE
- ELECTRIC POLES
- E — E — E ELECTRIC LINE
- UE UNDERGROUND ELECTRIC LINE
- SURFACE WATER
- 150 APPROXIMATE GROUNDWATER CONTOUR BASED ON MAXIMUM WATER LEVEL RECORDED BETWEEN JANUARY 2019 AND OCTOBER 2020
- GROUNDWATER FLOW DIRECTION

NOTES:

1. EXISTING TOPOGRAPHY IS FROM AN AERIAL SURVEY BY QUANTUM SPATIAL, DULLES, VA, PERFORMED ON 11 JANUARY 2019.
2. PROPERTY AND PARCEL BOUNDARIES FROM BAY ENGINEERING *"FILENAME TO GEOSYNTEC 06-01-2018 15-5132 EXHIBITS FOR ZONING 1-3"*.
3. LIMIT OF PHASE 1 CELL A BOUNDARY OBTAINED FROM CONSTRUCTION COMPLETION REPORT TOLSON RUBBLE LANDFILL PHASE I CELL A CROFTON, MARYLAND, 13 MARCH 2017, APPENDIX C, AS-BUILT DRAWINGS.
4. PIEZOMETER PW-02 IS UNDER AIR SPARGING PRESSURE AND NOT CONSIDERED IN THE INTERPOLATION OF THE SHOWN POTENTIOMETRIC SURFACE.

0 300 600
SCALE IN FEET

DEEP AQUIFER POTENTIOMETRIC SURFACE MAXIMUM RECORDED WATER LEVELS

TOLSON & ASSOCIATES RUBBLE LANDFILL
TOLSON AND ASSOCIATES, LLC
CAPITOL RACEWAY ROAD, CROFTON, MARYLAND

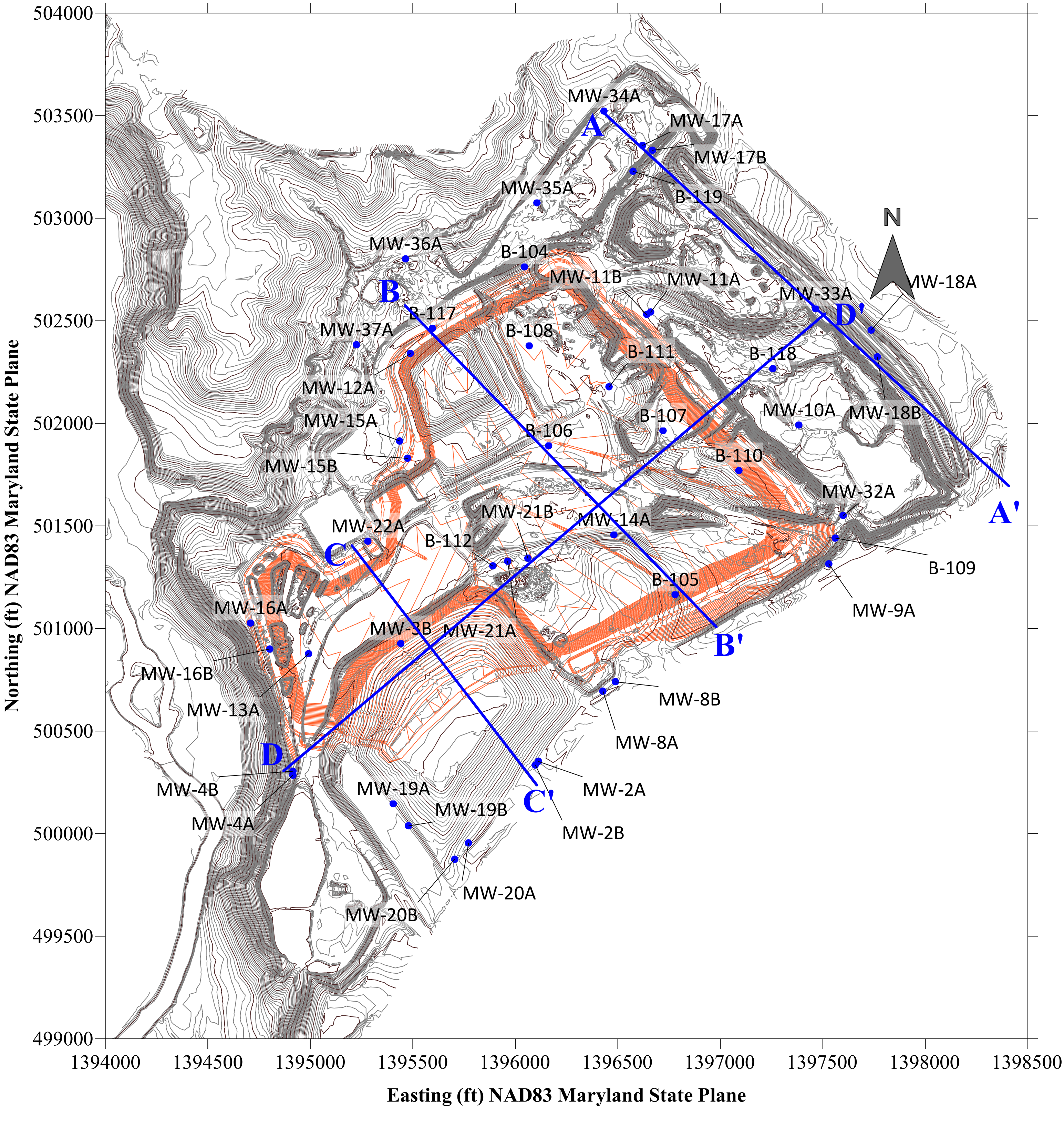
Geosyntec consultants

FIGURE B-1

PROJECT NO: ME1606B | OCTOBER 2020

P:\CADD\PROJECTS\TOLSON\CONCEPTUAL\FIGURES\ME1606F006A_OCT2020

Attachment B-1: Cross-Sections



Symbol	Description
	Ground Surface 2-ft Contour Intervals
	Base Grades
MW-20B	Wells/Boreholes

CROSS SECTION PLAN VIEW

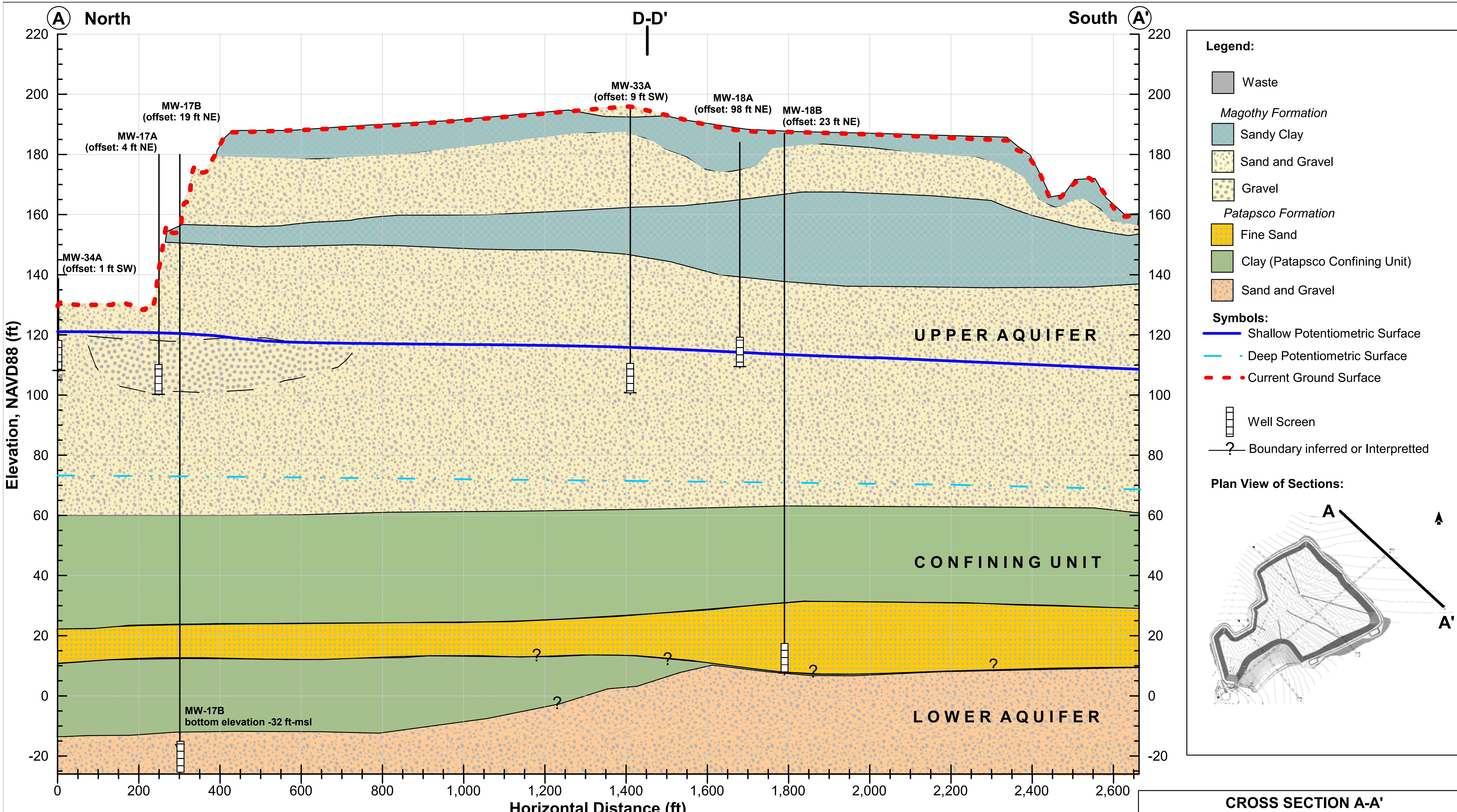
Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Geosyntec consultants

FIGURE 1

Columbia, Maryland

OCTOBER 2020



Notes:

1. Soil profiles shown are generalizations based on available drawings, boring logs, and related information.
2. Soil profiles shown between boreholes involve extrapolations and interpolations.Variations from the profile depicted in this section should be expected.
3. Shallow and deep groundwater elevations are the maximum measured between January 2019 and October 2020. The shallow potentiometric surface is inferred from maximum measured groundwater levels in the shallow wells.
4. The deep potentiometric surface is inferred from maximum measured groundwater levels in the deep wells.

CROSS SECTION A-A'

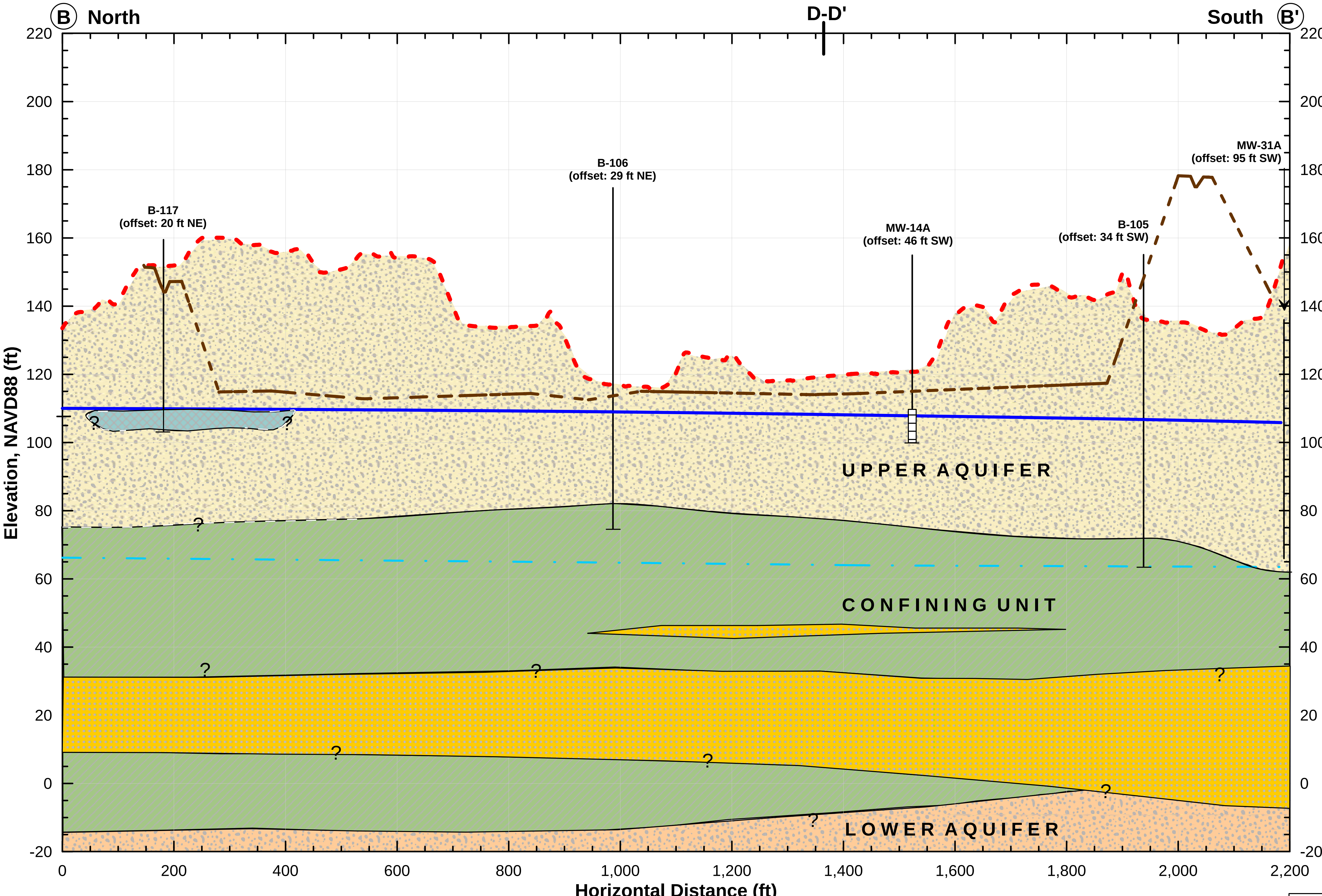
Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Geosyntec consultants

FIGURE 2

Columbia, Maryland | October 2020

\\columbia-01\data\PRJ1\MDENG\PROJECT\ME1606 - Tolson Landfill Permitting\Phase III Permit 2018-19 OLD DO NOT USE\Analysis\Phase II\Cross Section Data\A-A'_October2020.grf



Legend:

Waste

Magothy Formation

Sandy Clay

Sand and Gravel

Gravel

Patapsco Formation

Fine Sand

Clay (Patapsco Confining Unit)

Sand and Gravel

Symbols:

Shallow Potentiometric Surface

Deep Potentiometric Surface

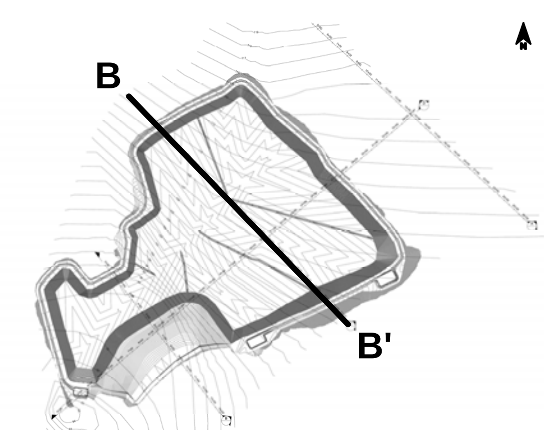
Current Ground Surface

Proposed Base Grade

Well Screen

? Boundary inferred or Interpretted

Plan View of Sections:



Notes:

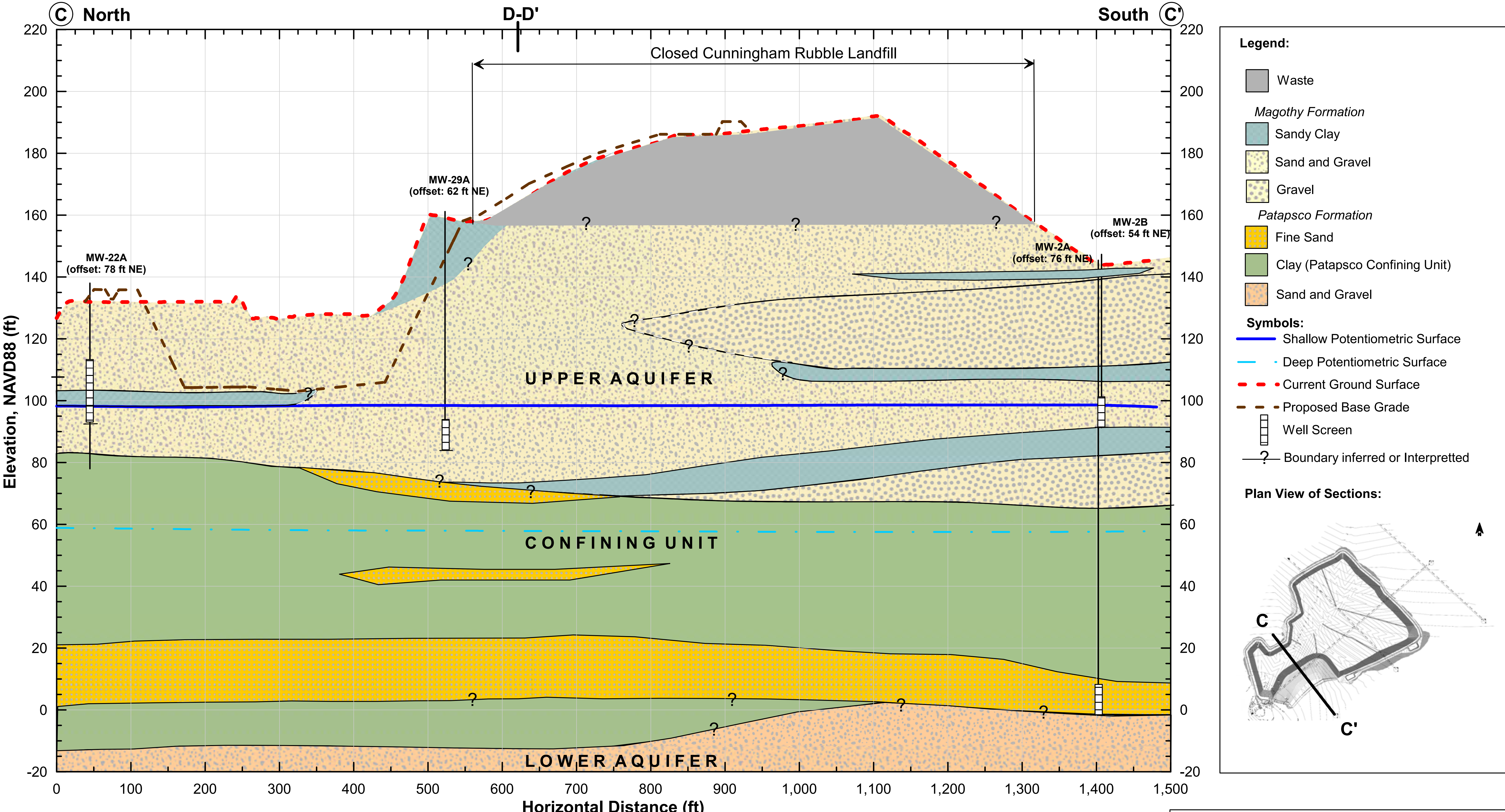
1. Soil profiles shown are generalizations based on available drawings, boring logs, and related information.
2. Soil profiles shown between boreholes involve extrapolations and interpolations.Variations from the profile depicted in this section should be expected.
3. Shallow and deep groundwater elevations are the maximum measured between January 2019 and October 2020. The shallow potentiometric surface is inferred from maximum measured groundwater levels in the shallow wells.
4. The deep potentiometric surface is inferred from maximum measured groundwater levels in the deep wells.

CROSS SECTION B-B'

Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Columbia, Maryland	October 2020	**FIGURE** 3

\\columbia-01\data\PRJ1\MDENG\PROJECT\ME1606 - Tolson Landfill Permitting\Phase III Permit 2018-19 OLD DO NOT USE\Analysis\Phase II\Cross Section Data\C-C'_October2020.grf



Notes:

1. Soil profiles shown are generalizations based on available drawings, boring logs, and related information.
2. Soil profiles shown between boreholes involve extrapolations and interpolations.Variations from the profile depicted in this section should be expected.
3. Shallow and deep groundwater elevations are the maximum measured between January 2019 and October 2020. The shallow potentiometric surface is inferred from maximum measured groundwater levels in the shallow wells.
4. The deep potentiometric surface is inferred from maximum measured groundwater levels in the deep wells.

CROSS SECTION C-C'

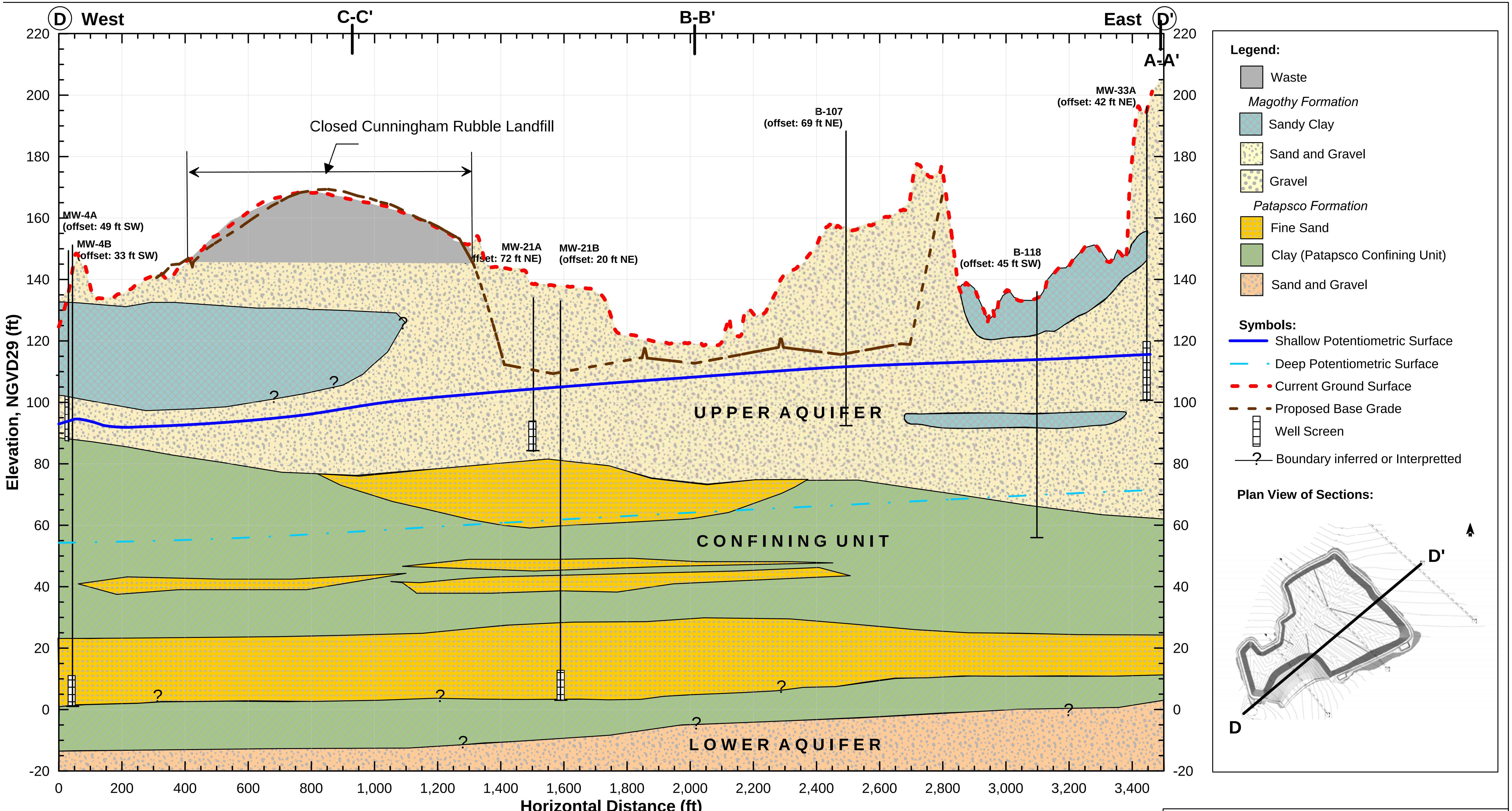
Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Geosyntec consultants

Columbia, Maryland | October 2020

FIGURE 4

\\columbia-01\data\PRJ1\MDENG\PROJECT\ME1606 - Tolson Landfill Permitting\Phase III Permit 2018-19 OLD DO NOT USE\Analysis\Phase II\Cross Section Data\B-B'_October2020.grf



Notes:

1. Soil profiles shown are generalizations based on available drawings, boring logs, and related information.
2. Soil profiles shown between boreholes involve extrapolations and interpolations.Variations from the profile depicted in this section should be expected.
3. Shallow and deep groundwater elevations are the maximum measured between January 2019 and October 2020. The shallow potentiometric surface is inferred from maximum measured groundwater levels in the shallow wells.
4. The deep potentiometric surface is inferred from maximum measured groundwater levels in the deep wells.

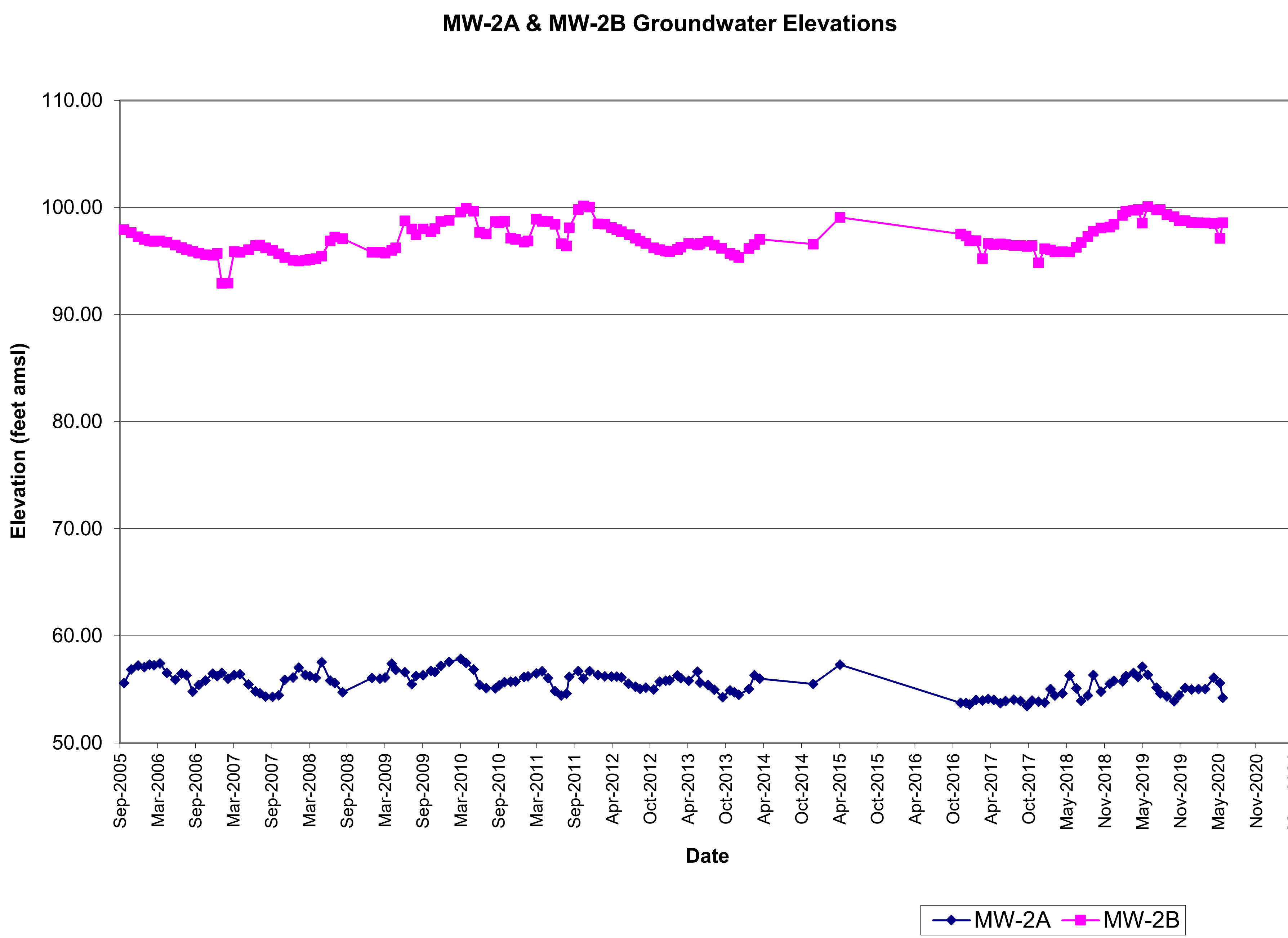
CROSS SECTION D-D'

Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Columbia, Maryland	October 2020	FIGURE 5

\\columbia-01\data\PRJ1\MDENG\PROJECT\ME1606 - Tolson Landfill Permitting\Phase III Permit 2018-19 OLD DO NOT USE\Analysis\Phase II\Cross Section Data\D-D'_October2020.grf

Attachment B-2: Hydrographs


MW-2A & MW-2B Groundwater Elevations
Elevation (feet amsl)
110.00
100.00
90.00
80.00
70.00
60.00
50.00
Sep-2005
Mar-2006
Sep-2006
Mar-2007
Sep-2007
Mar-2008
Sep-2008
Mar-2009
Sep-2009
Mar-2010
Sep-2010
Mar-2011
Sep-2011
Apr-2012
Oct-2012
Apr-2013
Oct-2013
Apr-2014
Oct-2014
Apr-2015
Oct-2015
Apr-2016
Oct-2016
Apr-2017
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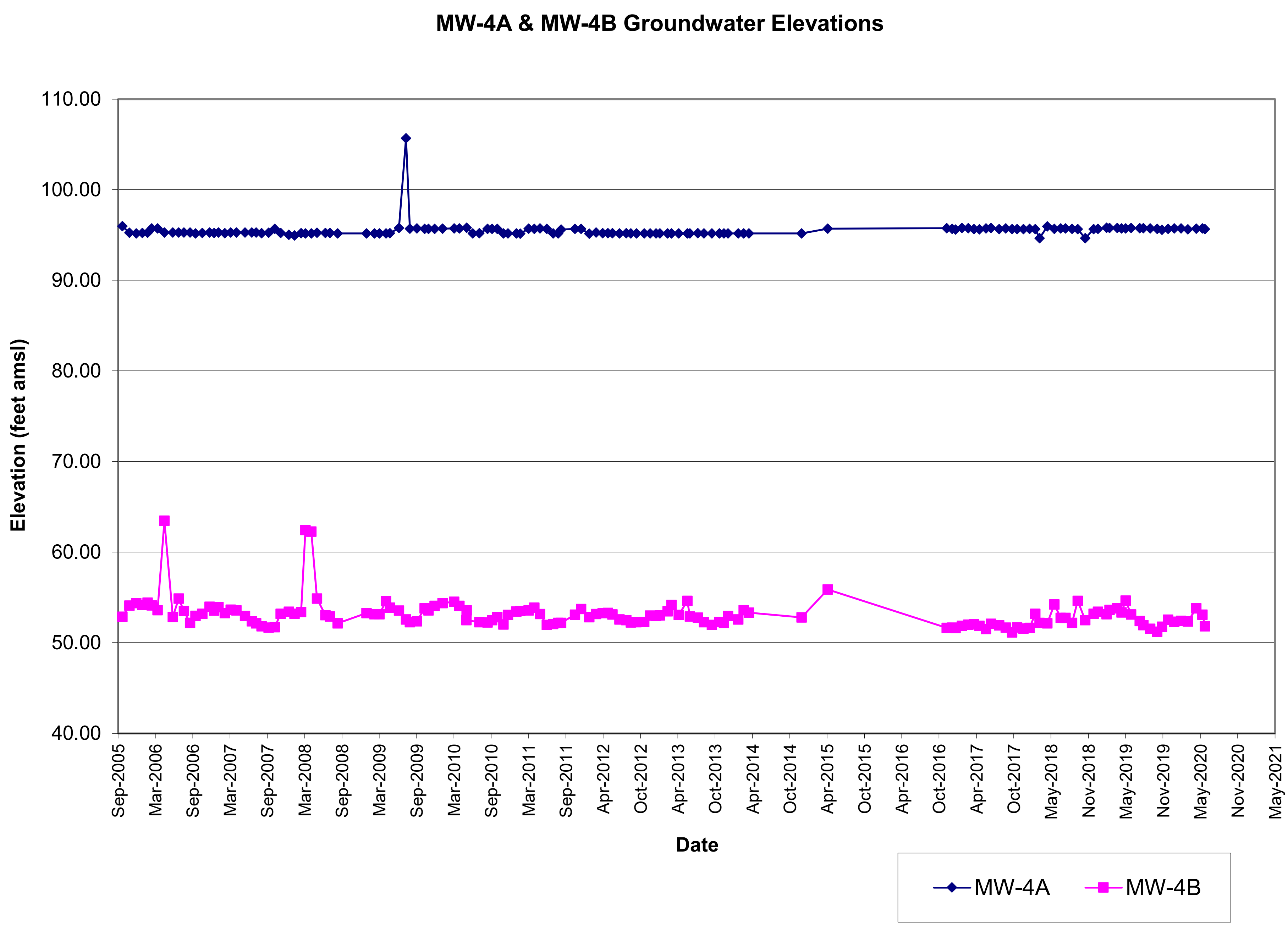
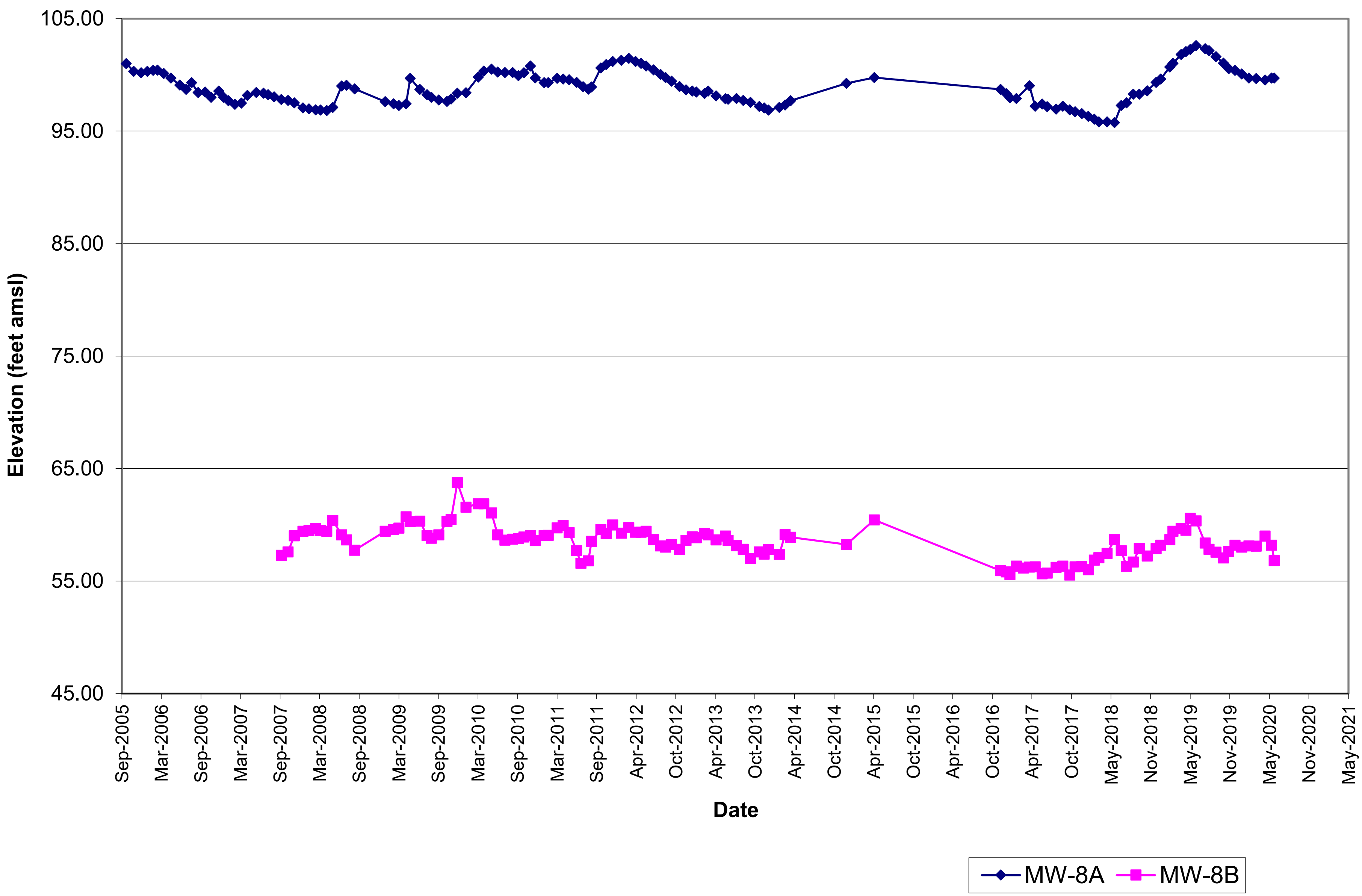
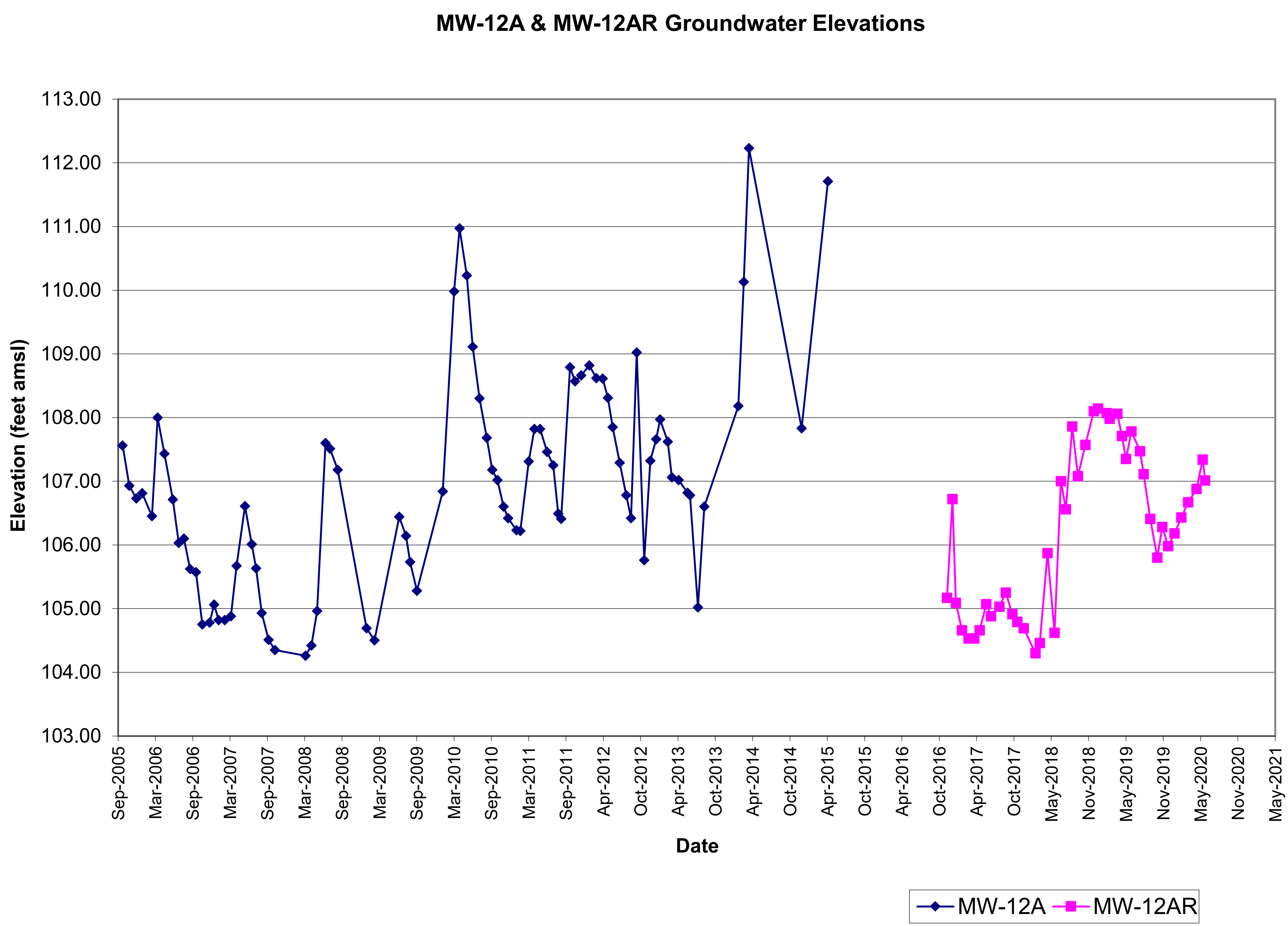
Nov-2018
May-2019
Nov-2019
May-2020
Nov-2020
May-2021
Date
MW-2A
MW-2B



MW-4A & MW-4B Groundwater Elevations
Elevation (feet amsl)
110.00
100.00
90.00
80.00
70.00
60.00
50.00
40.00
Sep-2005
Mar-2006
Sep-2006
Mar-2007
Sep-2007
Mar-2008
Sep-2008
Mar-2009
Sep-2009
Mar-2010
Sep-2010
Mar-2011
Sep-2011
Apr-2012
Oct-2012
Apr-2013
Oct-2013
Apr-2014
Oct-2014
Apr-2015
Oct-2015
Apr-2016
Oct-2016
Apr-2017
Oct-2017
May-2018
Nov-2018
May-2019
Nov-2019
May-2020
Nov-2020
May-2021
Date
MW-4A
MW-4B

MW-8A & MW-8B Groundwater Elevations




MW-12A & MW-12AR Groundwater Elevations
Elevation (feet amsl)
113.00
112.00
111.00
110.00
109.00
108.00
107.00
106.00
105.00
104.00
103.00
Sep-2005
Mar-2006
Sep-2006
Mar-2007
Sep-2007
Mar-2008
Sep-2008
Mar-2009
Sep-2009
Mar-2010
Sep-2010
Mar-2011
Sep-2011
Apr-2012
Oct-2012
Apr-2013
Oct-2013
Apr-2014
Oct-2014
Apr-2015
Oct-2015
Apr-2016
Oct-2016
Apr-2017
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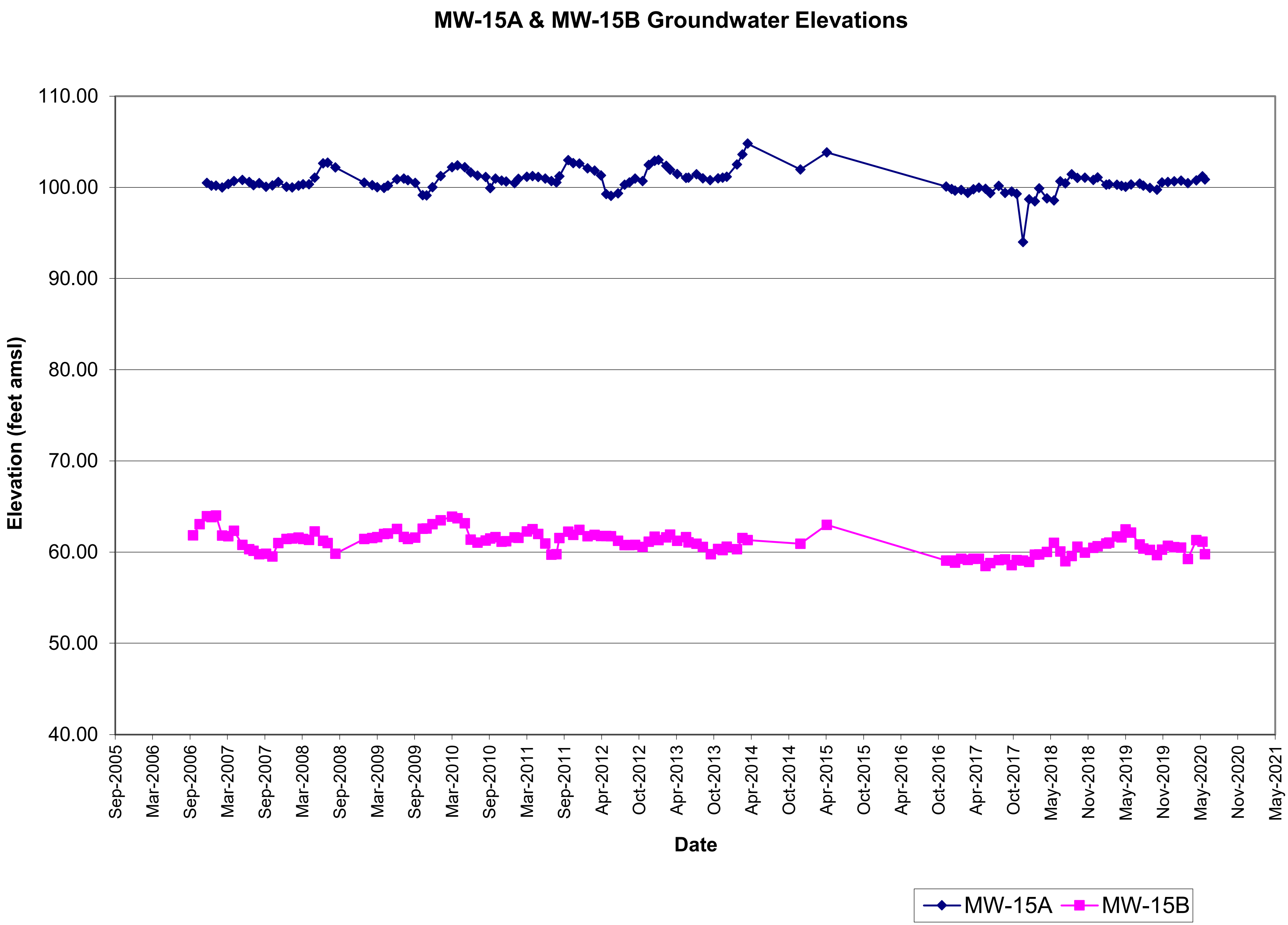
May-2020
Nov-2020
May-2021
Date
MW-12A
MW-12AR



MW-15A & MW-15B Groundwater Elevations
110.00
100.00
90.00
80.00
70.00
60.00
50.00
40.00
Elevation (feet amsl)
Sep-2005
Mar-2006
Sep-2006
Mar-2007
Sep-2007
Mar-2008
Sep-2008
Mar-2009
Sep-2009
Mar-2010
Sep-2010
Mar-2011
Sep-2011
Apr-2012
Oct-2012
Apr-2013
Oct-2013
Apr-2014
Oct-2014
Apr-2015
Oct-2015
Apr-2016
Oct-2016
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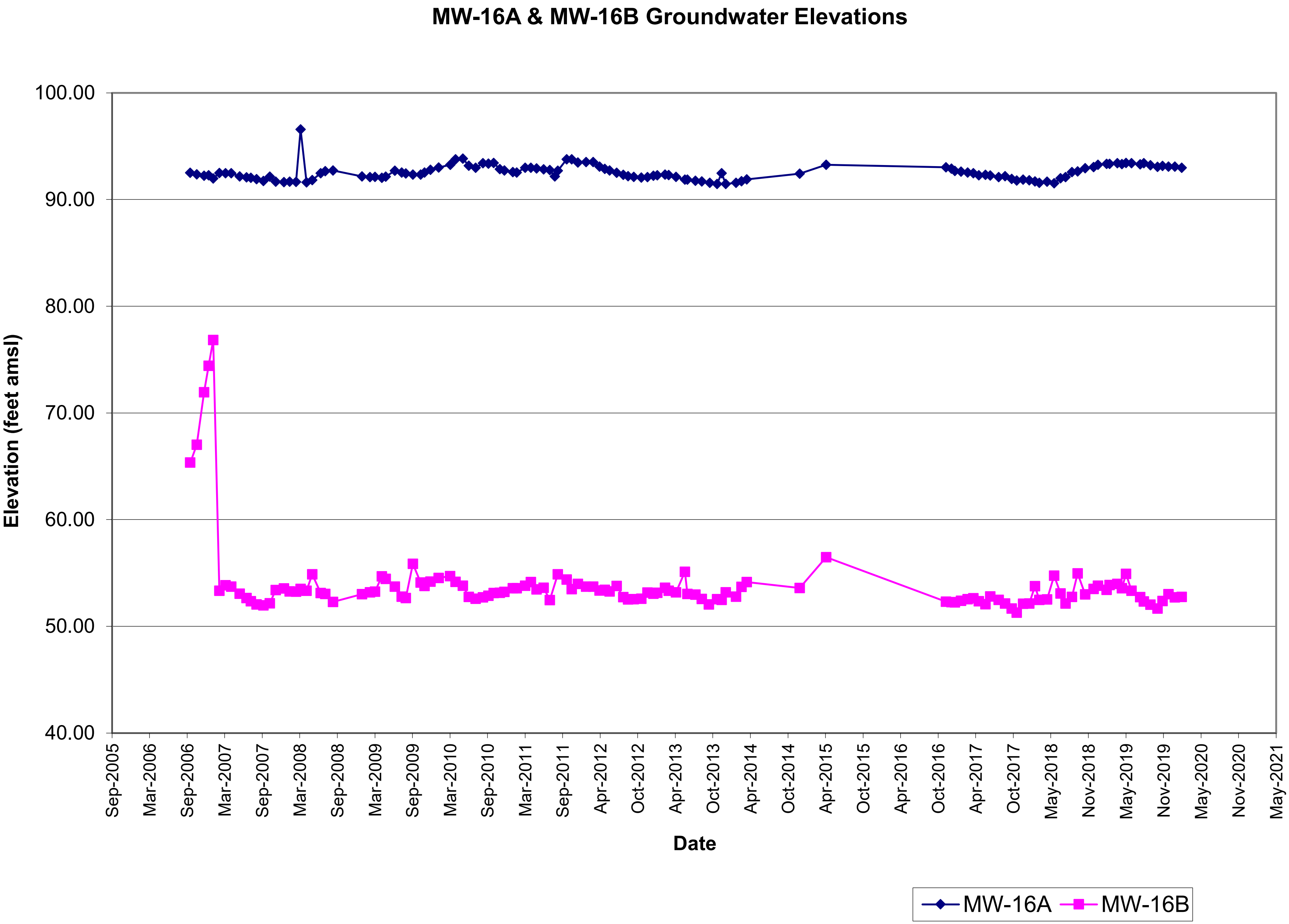
Nov-2020
May-2021
Date
MW-15A
MW-15B


MW-16A & MW-16B Groundwater Elevations
Elevation (feet amsl)
100.00
90.00
80.00
70.00
60.00
50.00
40.00
Sep-2005
Mar-2006
Sep-2006
Mar-2007
Sep-2007
Mar-2008
Sep-2008
Mar-2009
Sep-2009
Mar-2010
Sep-2010
Mar-2011
Sep-2011
Apr-2012
Oct-2012
Apr-2013
Oct-2013
Apr-2014
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Apr-2015
Oct-2015
Apr-2016
Oct-2016
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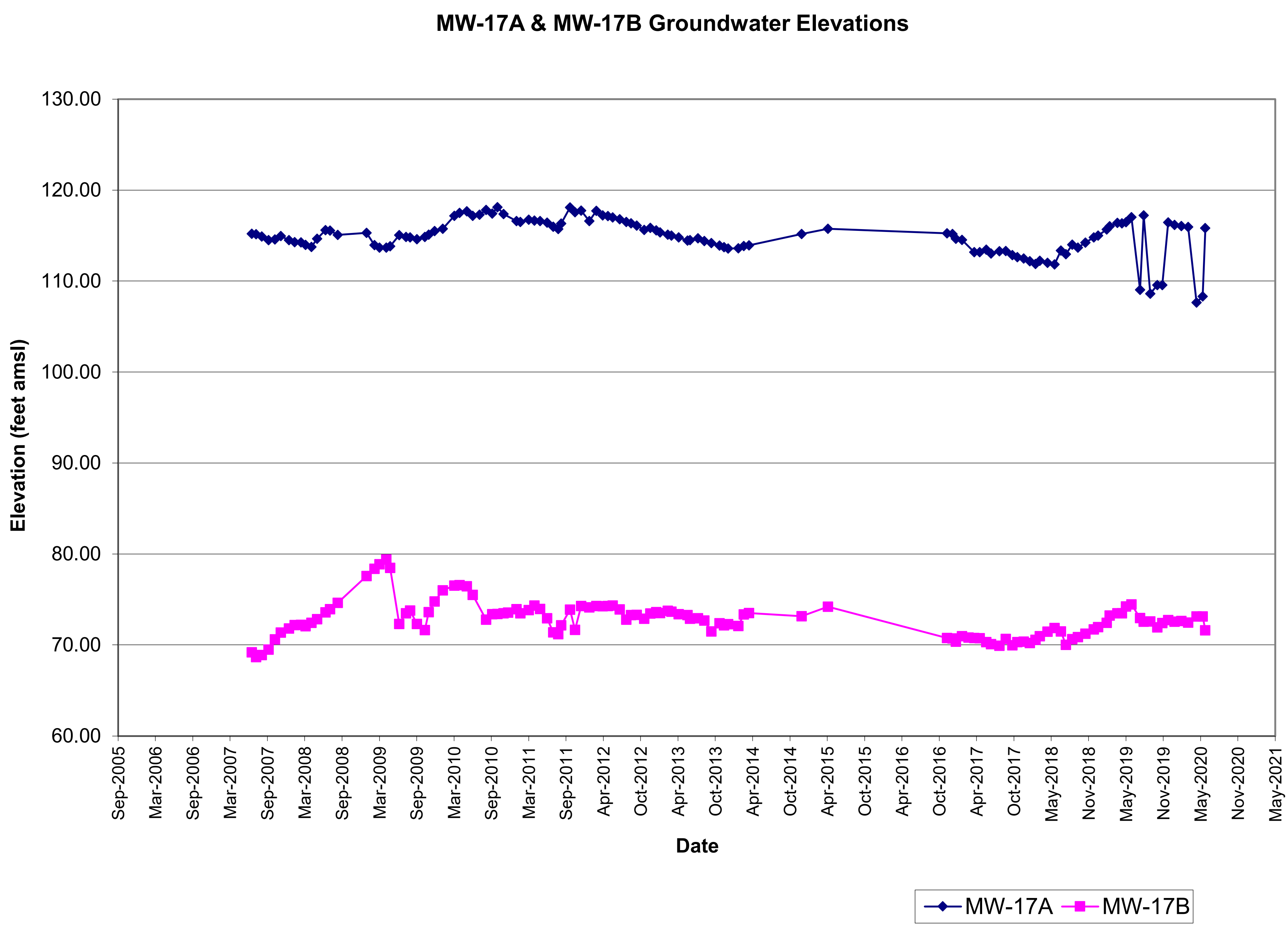
Nov-2020
May-2021
Date
MW-16A
MW-16B



MW-17A & MW-17B Groundwater Elevations
Elevation (feet amsl)
130.00
120.00
110.00
100.00
90.00
80.00
70.00
60.00
Sep-2005
Mar-2006
Sep-2006
Mar-2007
Sep-2007
Mar-2008
Sep-2008
Mar-2009
Sep-2009
Mar-2010
Sep-2010
Mar-2011
Sep-2011
Apr-2012
Oct-2012
Apr-2013
Oct-2013
Apr-2014
Oct-2014
Apr-2015
Oct-2015
Apr-2016
Oct-2016
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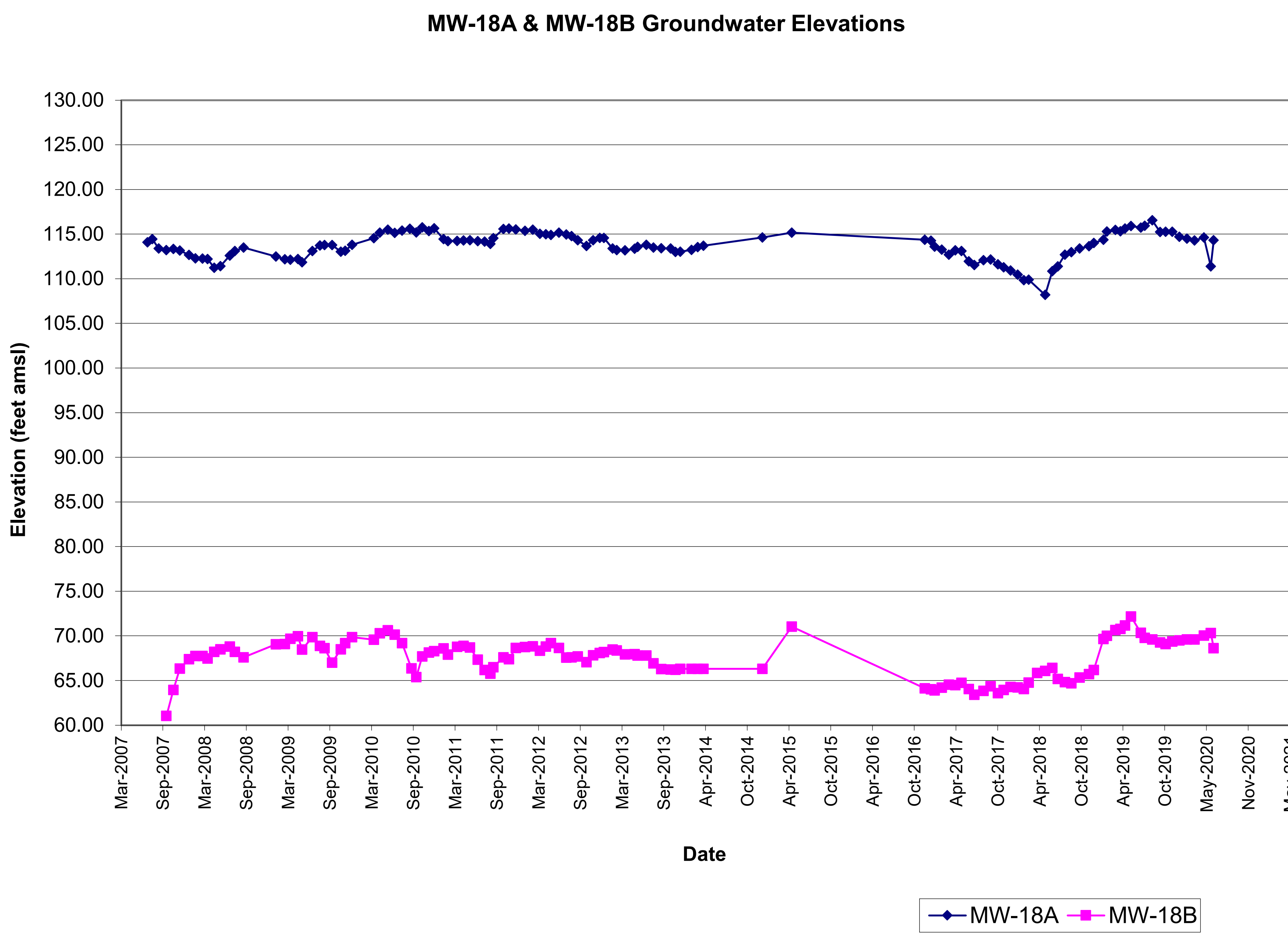
May-2019
Nov-2019
May-2020
Nov-2020
May-2021
Date
MW-17A
MW-17B



MW-18A & MW-18B Groundwater Elevations
Elevation (feet amsl)
130.00
125.00
120.00
115.00
110.00
105.00
100.00
95.00
90.00
85.00
80.00
75.00
70.00
65.00
60.00
Mar-2007
Sep-2007
Mar-2008
Sep-2008
Mar-2009
Sep-2009
Mar-2010
Sep-2010
Mar-2011
Sep-2011
Mar-2012
Sep-2012
Mar-2013
Sep-2013
Apr-2014
Oct-2014
Apr-2015
Oct-2015
Apr-2016
Oct-2016
Apr-2017
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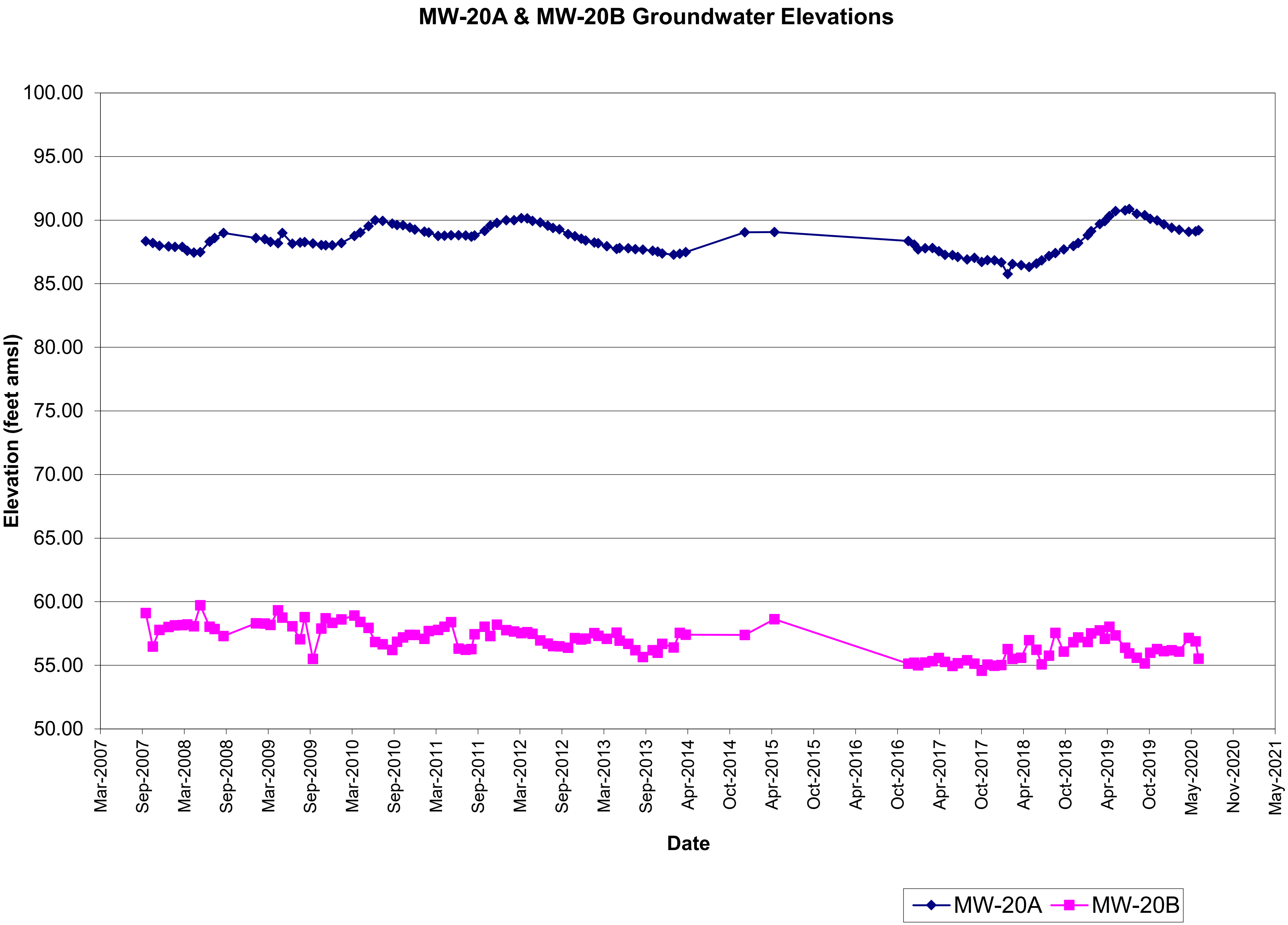
Apr-2018
Oct-2018
Apr-2019
Oct-2019
May-2020
Nov-2020
May-2021
Date
MW-18A
MW-18B


MW-20A & MW-20B Groundwater Elevations
Elevation (feet amsl)
100.00
95.00
90.00
85.00
80.00
75.00
70.00
65.00
60.00
55.00
50.00
Mar-2007
Sep-2007
Mar-2008
Sep-2008
Mar-2009
Sep-2009
Mar-2010
Sep-2010
Mar-2011
Sep-2011
Mar-2012
Sep-2012
Mar-2013
Sep-2013
Apr-2014
Oct-2014
Apr-2015
Oct-2015
Apr-2016
Oct-2016
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Oct-2018
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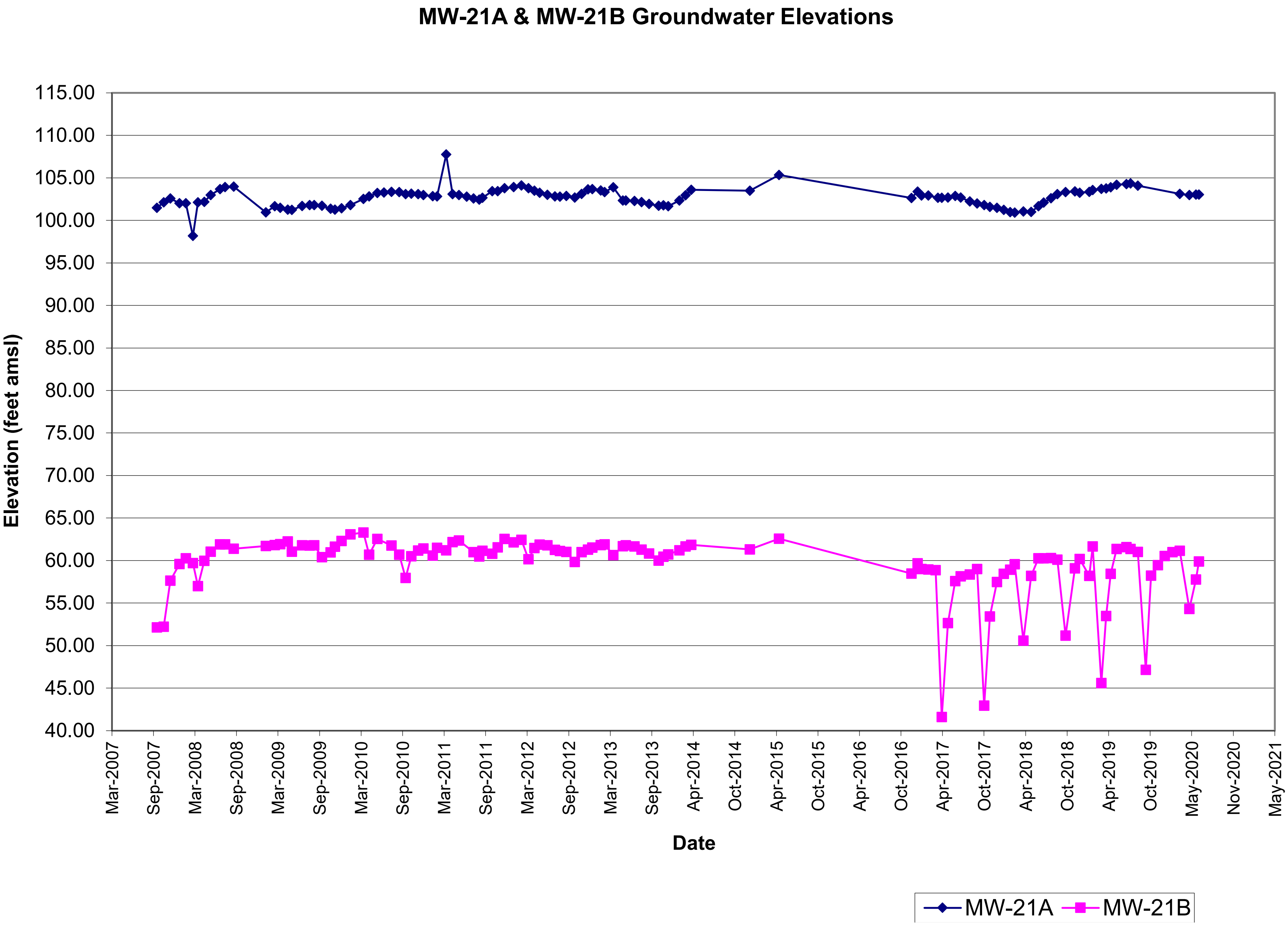
Oct-2019
May-2020
Nov-2020
May-2021
Date
MW-20A
MW-20B


MW-21A & MW-21B Groundwater Elevations
Elevation (feet amsl)
115.00
110.00
105.00
100.00
95.00
90.00
85.00
80.00
75.00
70.00
65.00
60.00
55.00
50.00
45.00
40.00
Mar-2007
Sep-2007
Mar-2008
Sep-2008
Mar-2009
Sep-2009
Mar-2010
Sep-2010
Mar-2011
Sep-2011
Mar-2012
Sep-2012
Mar-2013
Sep-2013
Apr-2014
Oct-2014
Apr-2015
Oct-2015
Apr-2016
Oct-2016
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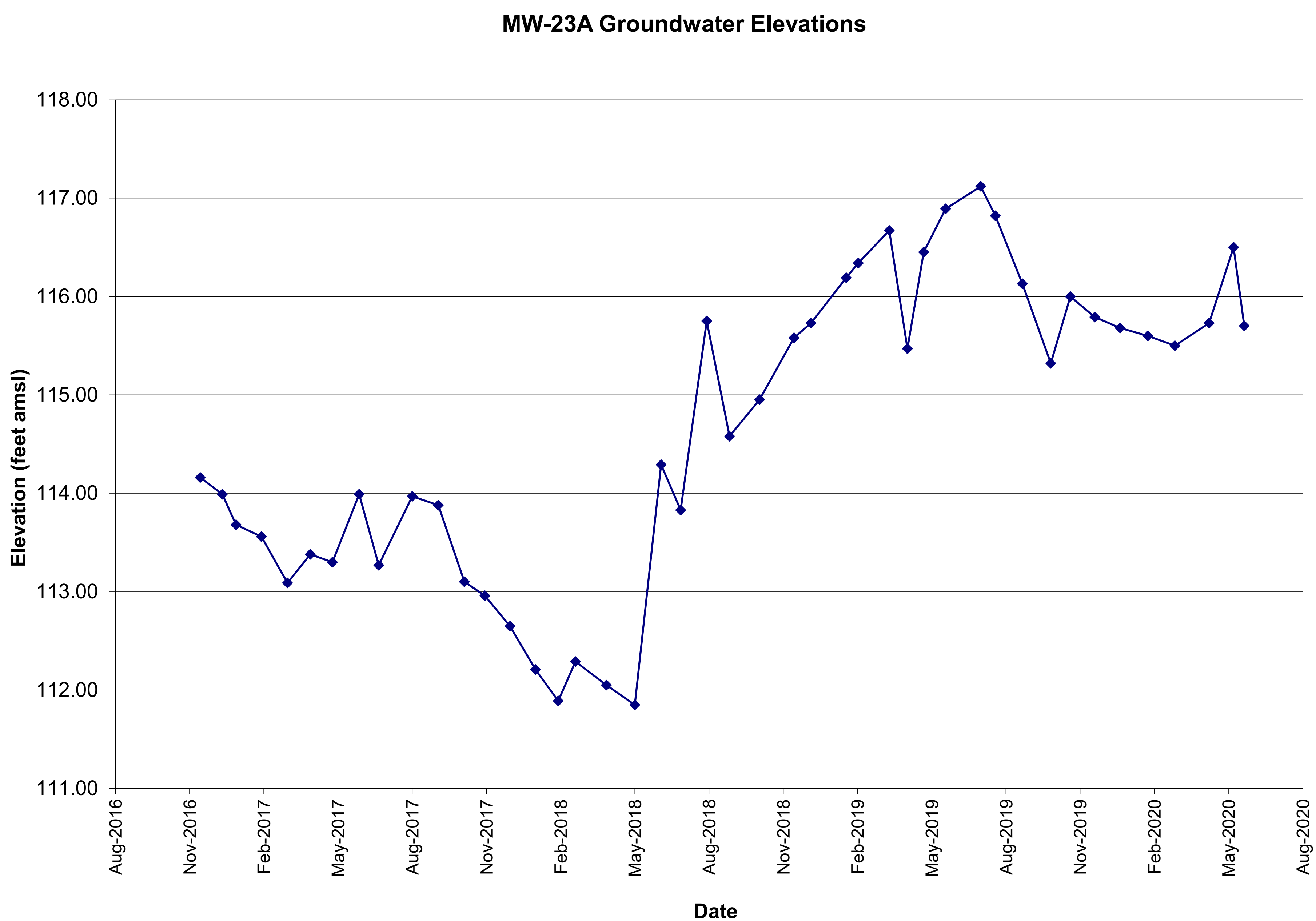
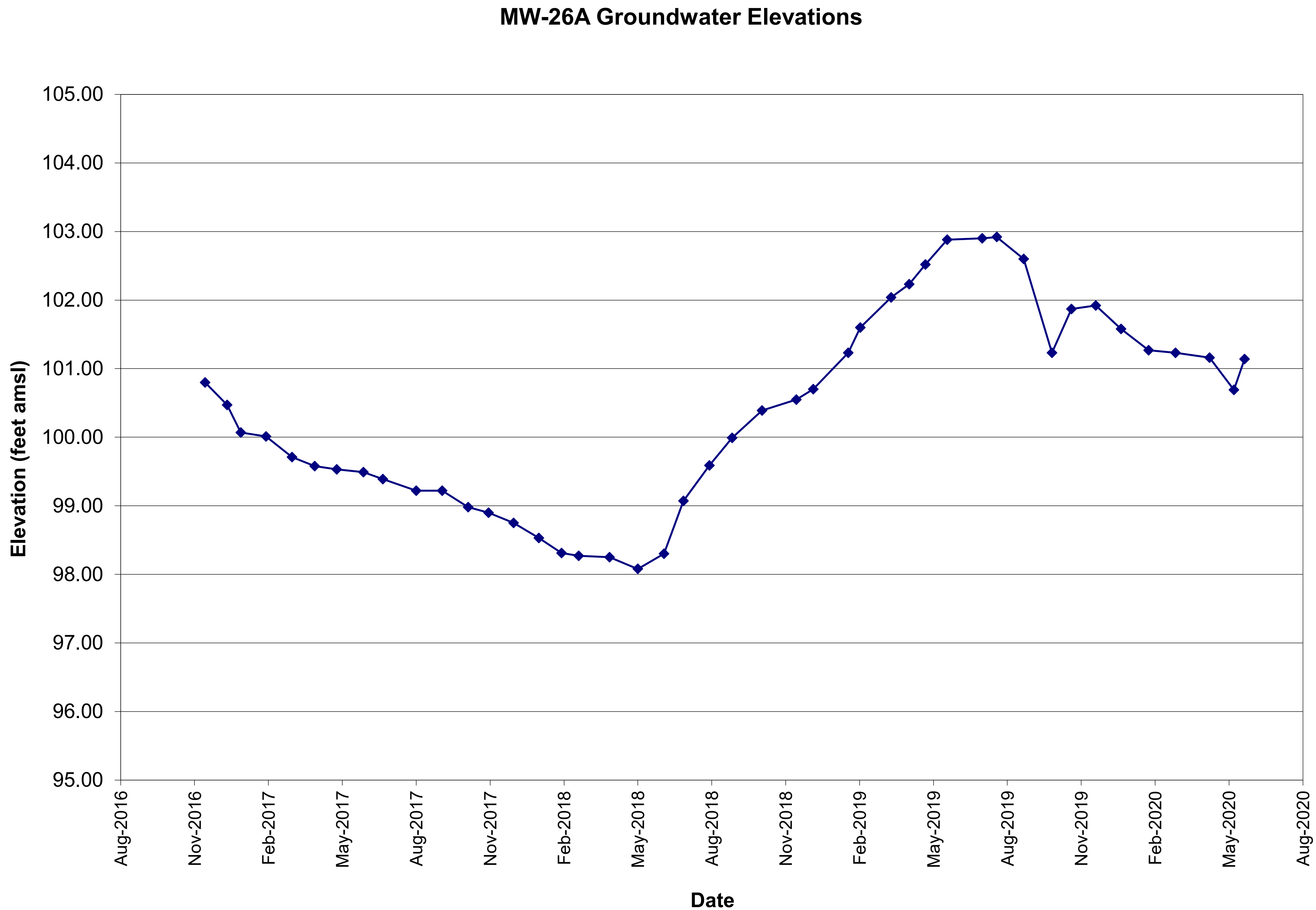
Oct-2018
Apr-2019
Oct-2019
May-2020
Nov-2020
May-2021
Date
MW-21A
MW-21B



MW-23A Groundwater Elevations
118.00
117.00
116.00
115.00
114.00
113.00
112.00
111.00
Elevation (feet amsl)
Aug-2016
Nov-2016
Feb-2017
May-2017
Aug-2017
Nov-2017
Feb-2018
May-2018
Aug-2018
Nov-2018
Feb-2019
May-2019
Aug-2019
Nov-2019
Feb-2020
May-2020
Aug-2020
Date


MW-26A Groundwater Elevations
Elevation (feet amsl)
105.00
104.00
103.00
102.00
101.00
100.00
99.00
98.00
97.00
96.00
95.00
Aug-2016
Nov-2016
Feb-2017
May-2017
Aug-2017
Nov-2017
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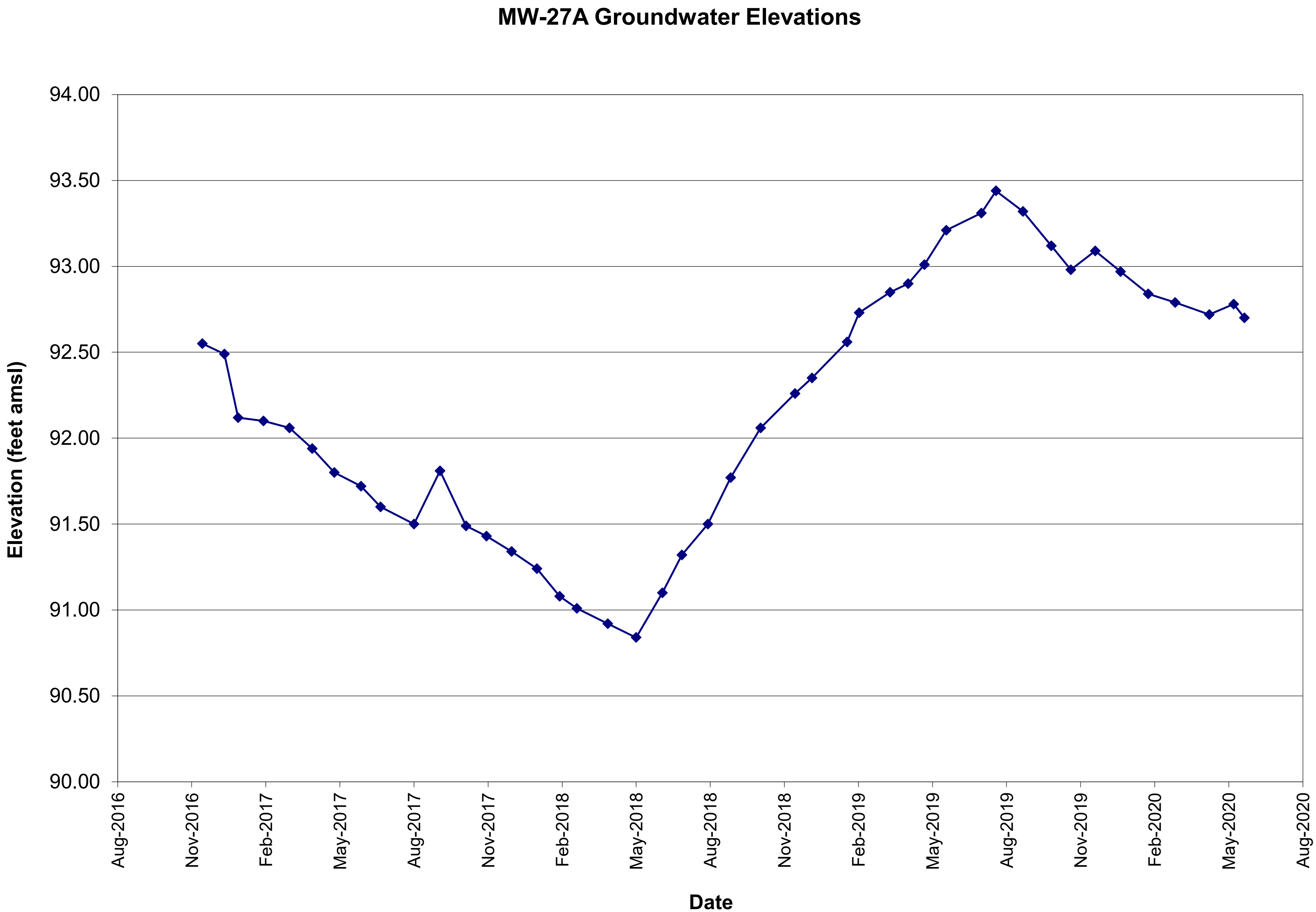
May-2020
Aug-2020
Date


MW-27A Groundwater Elevations
Elevation (feet amsl)
94.00
93.50
93.00
92.50
92.00
91.50
91.00
90.50
90.00
Aug-2016
Nov-2016
Feb-2017
May-2017
Aug-2017
Nov-2017
Feb-2018
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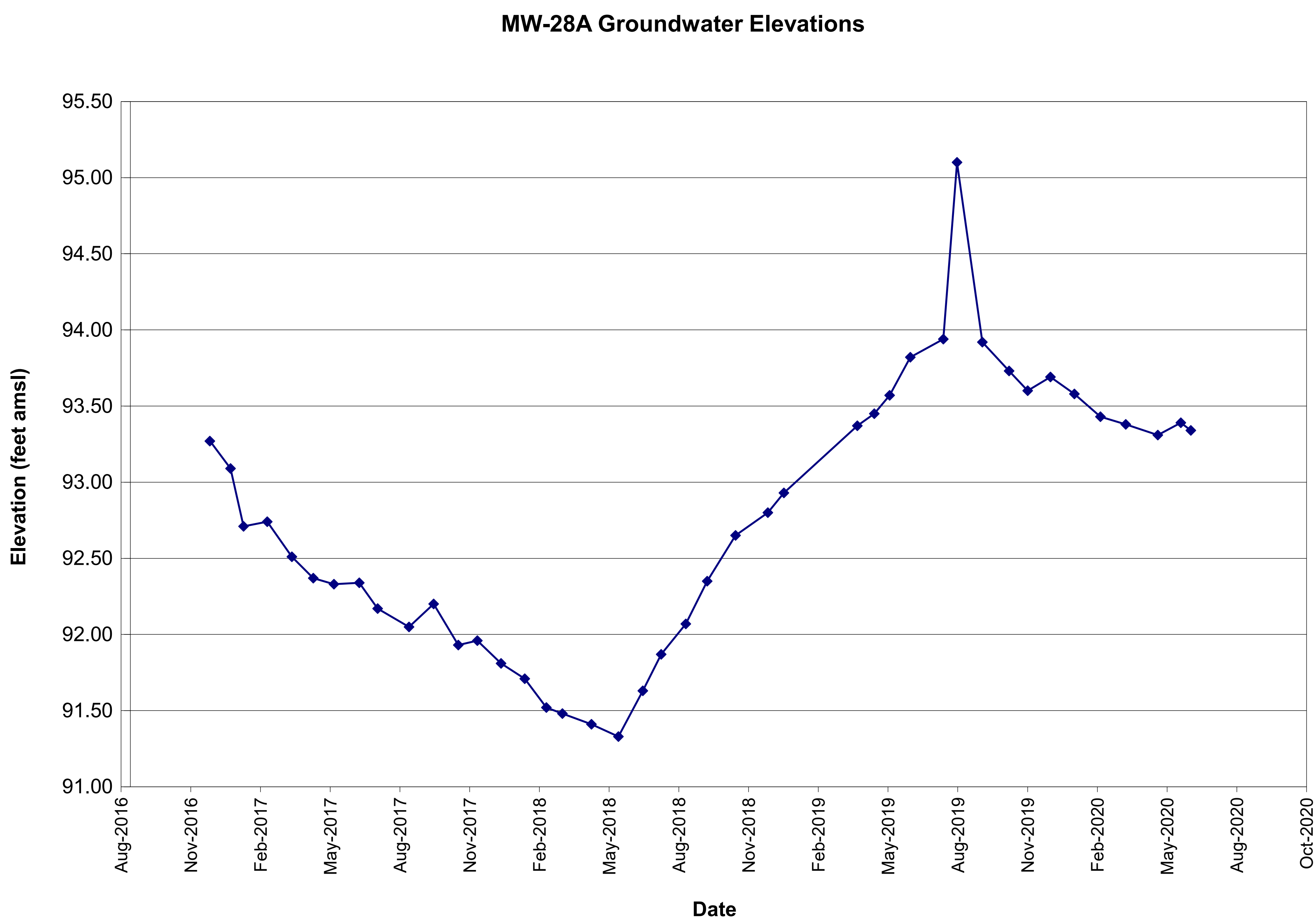
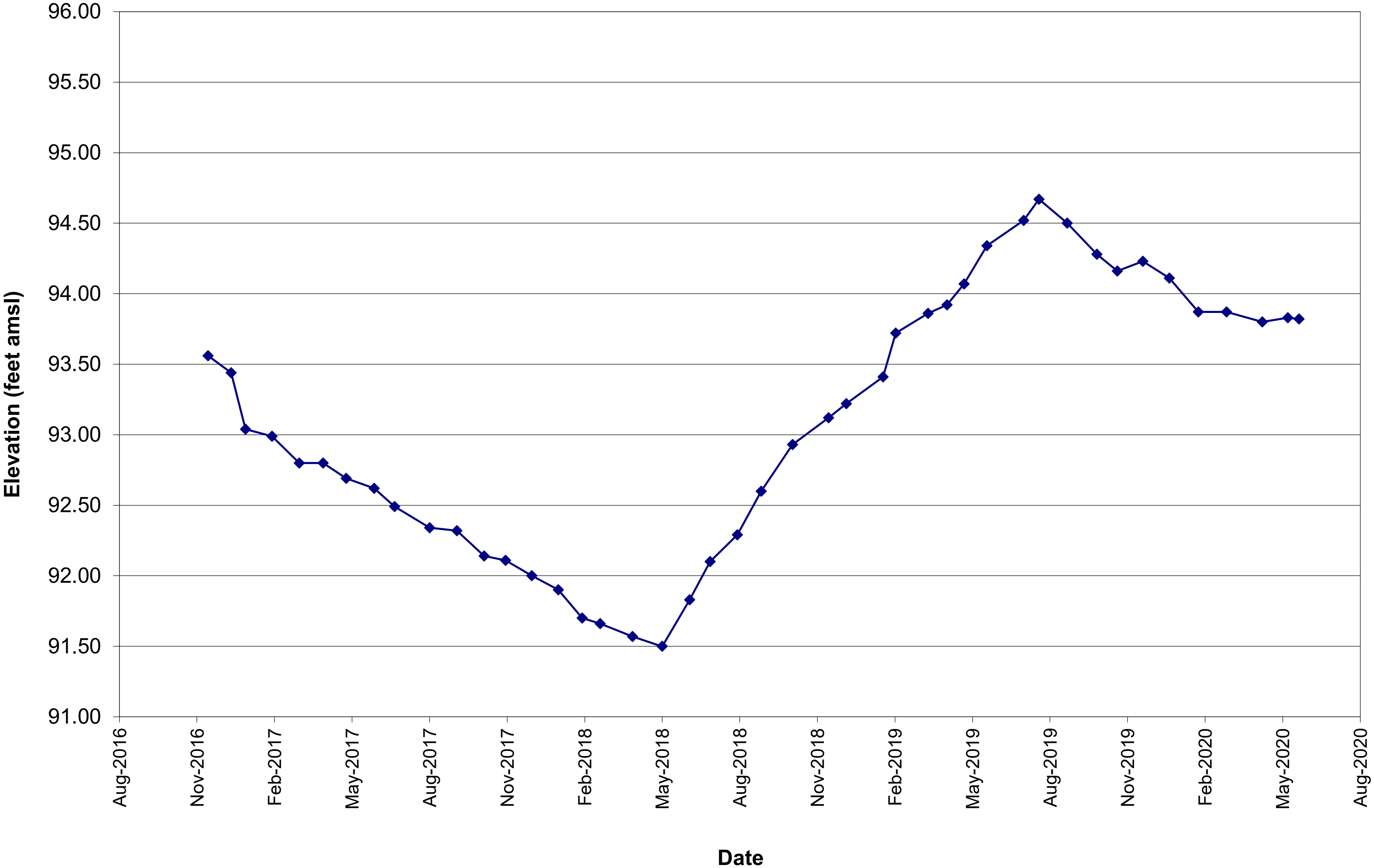
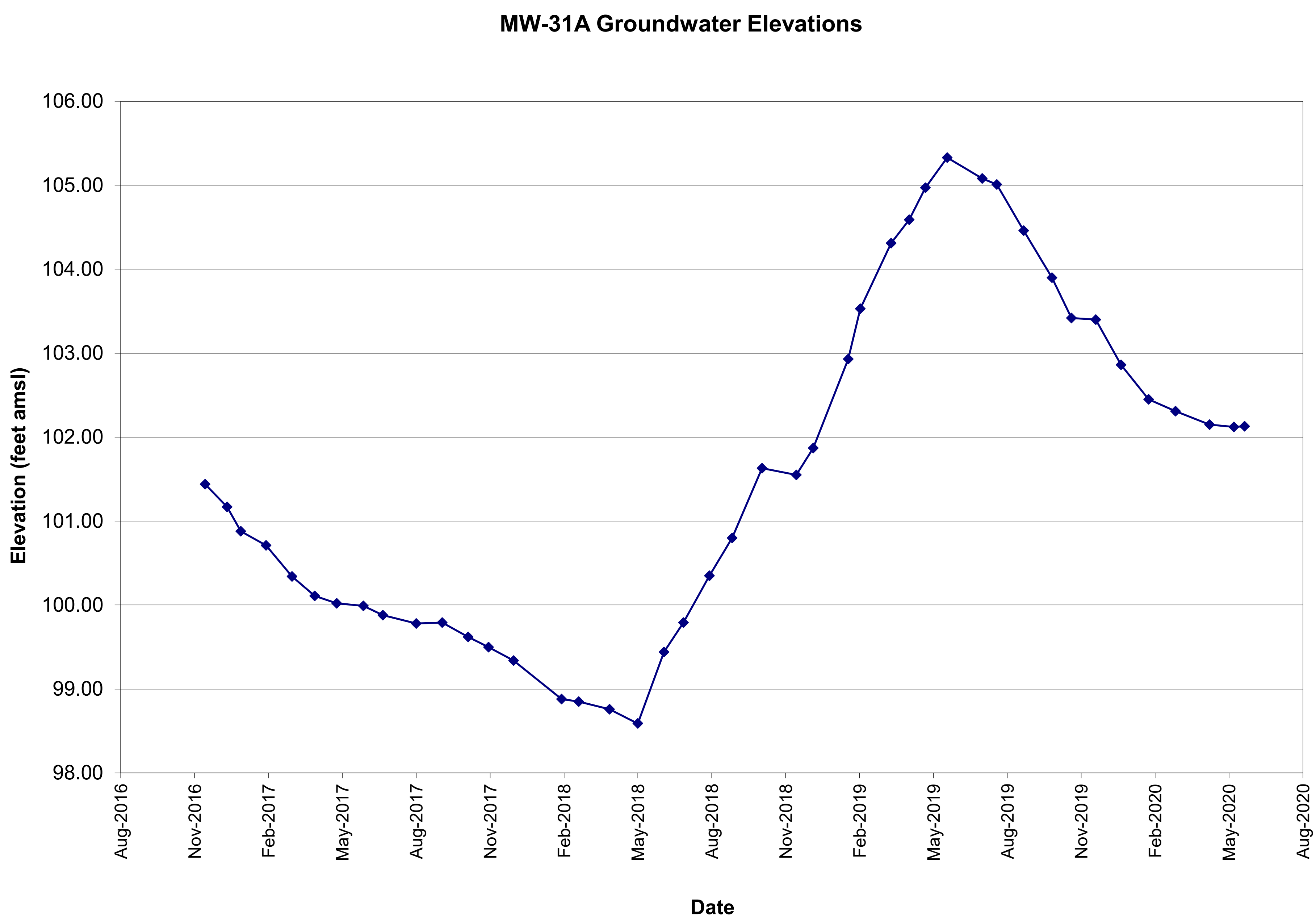
May-2019
Aug-2019
Nov-2019
Feb-2020
May-2020
Aug-2020
Date


MW-28A Groundwater Elevations
Elevation (feet amsl)
95.50
95.00
94.50
94.00
93.50
93.00
92.50
92.00
91.50
91.00
Aug-2016
Nov-2016
Feb-2017
May-2017
Aug-2017
Nov-2017
Feb-2018
May-2018
Aug-2018
Nov-2018
Feb-2019
May-2019
Aug-2019
Nov-2019
Feb-2020
May-2020
Aug-2020
Oct-2020
Date

MW-29A Groundwater Elevations





MW-31A Groundwater Elevations
Elevation (feet amsl)
106.00
105.00
104.00
103.00
102.00
101.00
100.00
99.00
98.00
Aug-2016
Nov-2016
Feb-2017
May-2017
Aug-2017
Nov-2017
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May-2018
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Feb-2019
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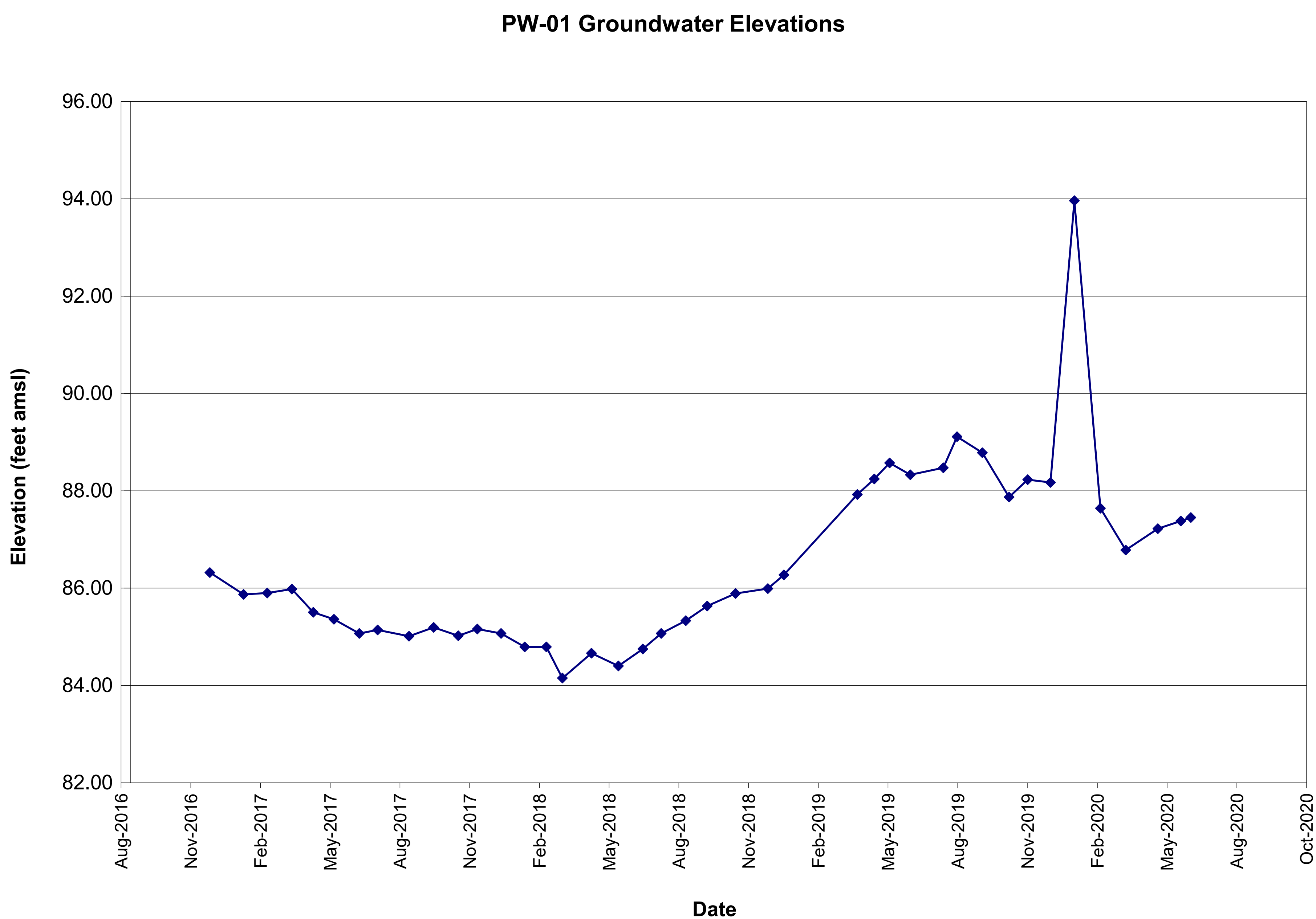
Feb-2020
May-2020
Aug-2020
Date



PW-01 Groundwater Elevations
Elevation (feet amsl)
96.00
94.00
92.00
90.00
88.00
86.00
84.00
82.00
Aug-2016
Nov-2016
Feb-2017
May-2017
Aug-2017
Nov-2017
Feb-2018
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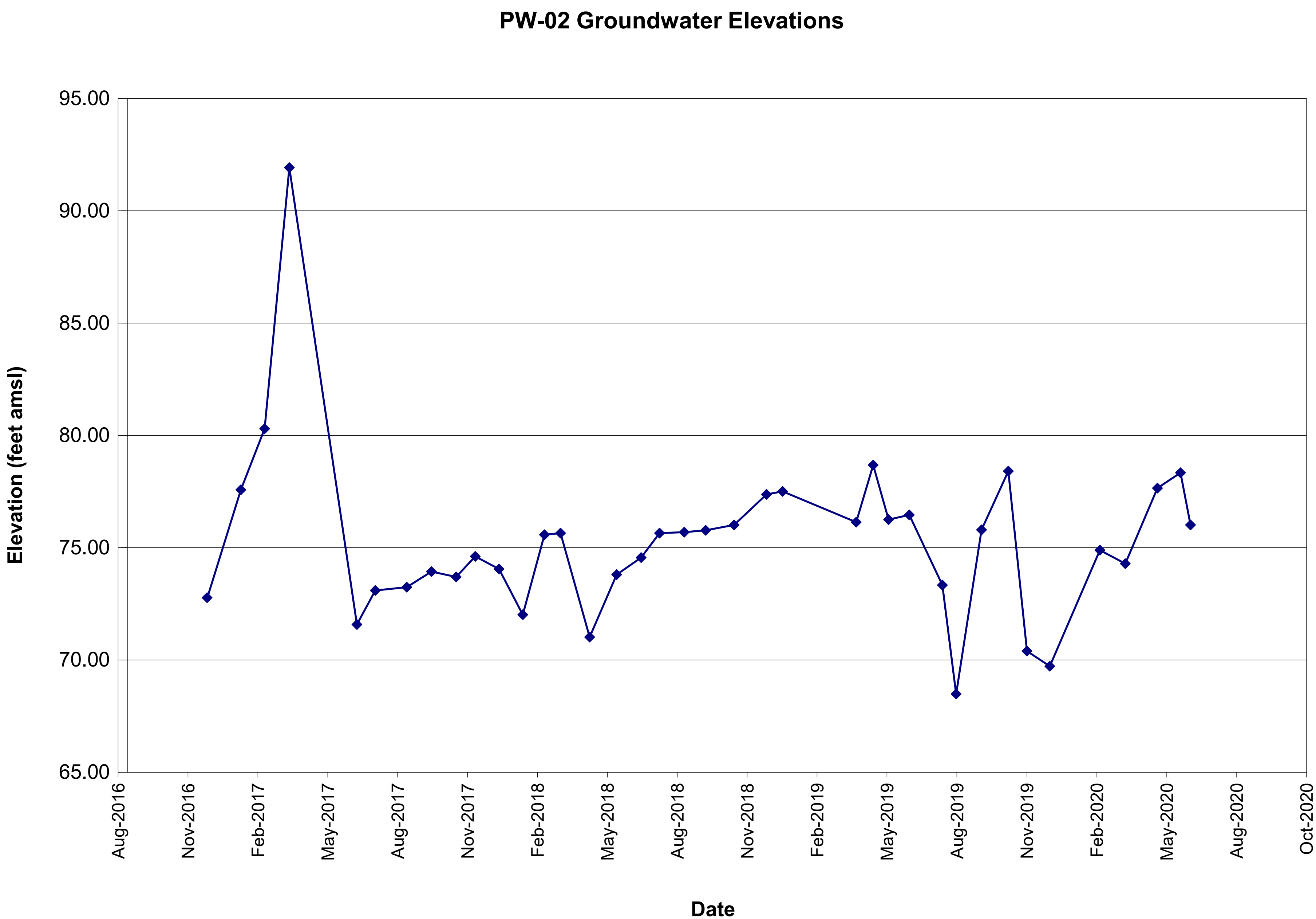
Aug-2019
Nov-2019
Feb-2020
May-2020
Aug-2020
Oct-2020
Date


PW-02 Groundwater Elevations
Elevation (feet amsl)
95.00
90.00
85.00
80.00
75.00
70.00
65.00
Aug-2016
Nov-2016
Feb-2017
May-2017
Aug-2017
Nov-2017
Feb-2018
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Aug-2018
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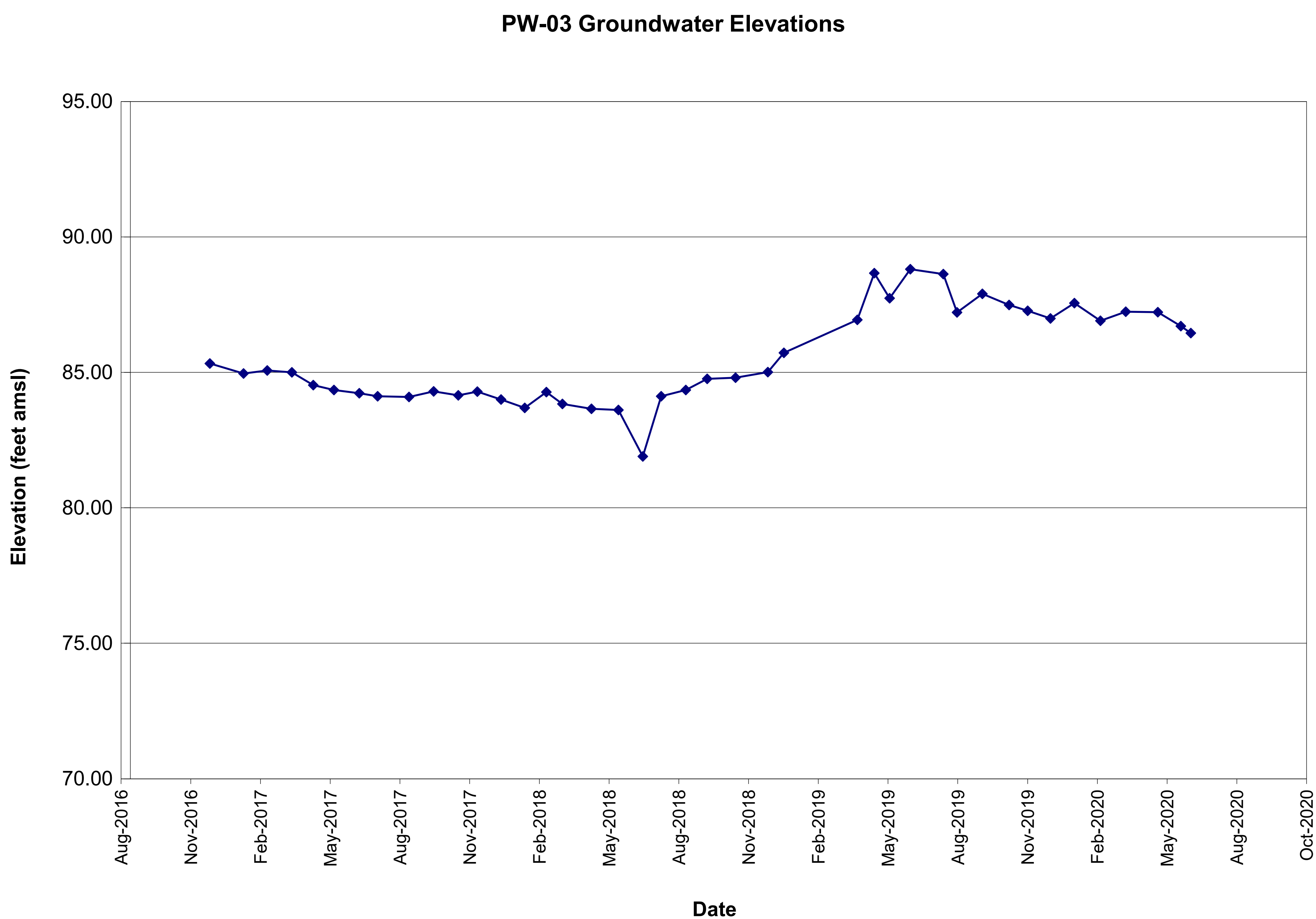
Aug-2020
Oct-2020
Date


PW-03 Groundwater Elevations
95.00
90.00
85.00
80.00
75.00
70.00
Elevation (feet amsl)
Aug-2016
Nov-2016
Feb-2017
May-2017
Aug-2017
Nov-2017
Feb-2018
May-2018
Aug-2018
Nov-2018
Feb-2019
May-2019
Aug-2019
Nov-2019
Feb-2020
May-2020
Aug-2020
Oct-2020
Date

Geosyntec
consultants

Attachment B-3:
Phase II Geology Report
ERM, 2006

Tolson & Associates, LLC

Phase II Site Geology Report
Tolson Rubble Landfill
Crofton, Maryland

November 1, 2006

Reference: 2003-WRF-0580

Environmental Resources Management
200 Harry S. Truman Parkway
Suite 400
Annapolis, Maryland 21401

Tolson & Associates, LLC

Phase II Site Geology Report
Tolson Rubble Landfill
Crofton, Maryland

November 1, 2006

Reference: 2003-WRF-0580

ERM Project No.: 0052940

Nathaniel R. Warner
Project Geologist

J. Lawrence Hosmer, P.E.
Project Manager
Maryland P.E. No. 10245

TABLE OF CONTENTS

LIST OF FIGURES

TABLE OF CONTENTS (CONTINUED)

LIST OF TABLES

LIST OF APPENDICES

1.0 INTRODUCTION

1.1 PURPOSE

Environmental Resources Management, Inc. (ERM) was retained by Tolson & Associates, LLC (Tolson & Associates) to prepare a consolidated Phase II Site Geology Report as a component of a permit application for a new rubble landfill in Crofton, Anne Arundel County, Maryland. The Phase II Site Geology Report presented herein is compliant with the permit application process requirements annotated in the Code of Maryland Regulations (COMAR) 26.04.07.15., and discussions with Maryland Department of the Environment (MDE) staff. Further, this Phase II of the permit application process follows, and is based upon a Phase I General Information Report, dated March 20, 2003, submitted to the MDE; the permit application hearing on the Phase I was held on July 14, 2004. Among the data provided at that time, the Phase I report included documentation that the proposed landfill conforms to the Anne Arundel County Solid Waste Management Plan, as confirmed in correspondence dated August 28, 2002 from the Anne Arundel County Department of Public Works (Appendix A).

This Phase II Site Geology Report was prepared in accordance with the specific technical requirements of COMAR 26.04.07.15, and provides comprehensive descriptions of the geology, soils, and hydrology of the proposed site presented in a systematic manner to respond directly to the regulatory requirements. The information and data presented in this report are based on a thorough evaluation of data developed and submitted to the MDE in three previous Phase II documents prepared by Marshall Engineering, Inc. (January 1995), Environmental Technical Services, Inc. (March 1995), and KCI Technologies Inc. (September 2005), as well as supplemental field investigations and data generated for this study. These prior submittals were deemed deficient by the MDE in several respects; specific comments by the MDE are annotated in correspondence dated March 30, 2006 (Appendix B).

Responses to specific MDE comments, and references to the sections of this report where supporting information may be located, are presented in Appendix B. A bibliography of the reports previously submitted to the MDE regarding this site is provided in Section 7.0; it should be noted, however, that the information presented in the referenced reports has been incorporated herein. The compilation of data has addressed the comments issued by the MDE, resulting in a complete and comprehensive permit application that is intended to supersede the previous reports and serve as a new and complete Phase II Site Geology Report.

1.2 BACKGROUND

The Phase I General Information Report, dated March 20, 2003, met the requirements of COMAR 26.04.07.06, and included a general description of site soils, topography, and zoning for the proposed landfill based on existing information. This Phase II Site Geology Report fulfills the requirements of COMAR 26.04.07 in that it integrates data relative to site-specific geology based on field investigations with the existing background information presented in the Phase I General Information Report. The specific areas of COMAR 26.04.07.15 addressed, along with a reference to the section of this report in which the information is presented, include:

- Current topography — Section 2.1
- Geologic understanding — Sections 3.0 and 4.0
- Well survey — Section 5.2
- Groundwater contours — Section 5.1
- Stratigraphic cross-sections — Section 4.3
- Isopach map — Section 2.1
- Chemical quality of groundwater — Section 6.0
- Potential vertical and horizontal movement — Section 5.3
- Preliminary concept design — Section 2.1

It should be noted that COMAR Sections 26.04.07.15(6) (bedrock contours) and COMAR Sections 26.04.07.15(10) (fracture trace analysis) are not applicable to this site because the site is located within a coastal plain deposit environment, not a residual bedrock environment.

In addition to providing specific baseline data as required by the regulations, an interpretation of the data is provided to assess the potential of the proposed site to comply with the intent of the technical requirements as well as provide, in conjunction with proper engineering design, an operating landfill which affords environmental protection. Subsequent to the review and approval of the Phase II Site Geology Report, a Phase III Engineering Report will be prepared and submitted to the MDE detailing the specific facility design plans, operating manuals, contingency plans, and monitoring plans for the proposed landfill. The design elements required under COMAR 26.04.07.18 will be incorporated into this facility during the Phase III report preparation, and have therefore been assumed during this analysis of site performance.

2.0 SITE DESCRIPTION

The proposed landfill (i.e., designated as the "Tolson Rubble Landfill") is located on Tax Map 36, Parcels 9, 10, and 239, which comprise the "site" for purposes of this study (see Figure 1). The site property is currently occupied by an operating sand and gravel mining, washing and distribution quarry and a previously closed, approximately 20-acre rubble landfill (Maryland State Permit 89-02-04-09A). The site is remotely located at the end of Capital Raceway Road off Maryland Route 3 in the northwestern sector of Crofton, Maryland (Figure 1). The landfill footprint will occupy approximately 60-acres of the site, centered on coordinates: 39° 02′ 35″North, 76° 42′ 20″ West. The site is bounded by undisturbed vegetated and treed buffer area to the north and northwest, and undeveloped land to the northeast; the Little Patuxent River valley to the west and southwest; Capital Raceway Park and Evergreen Road to the south; and the Reliable Contracting Disposal Facility and open land to the east (see the aerial photograph presented as Figure 2). Beyond the buffer areas to the north and northeast and along Evergreen Road are residential communities.

The specific portion of the site to be developed as the Tolson Rubble Landfill is currently a quarry where sand and gravel deposits have been extracted for commercial use, in conformance with a mineral extraction permit issued by the Maryland Department of Natural Resources (MDNR) (Permit No. 78-SP-0087-F), effective on April 21, 1978. The quarry has removed overburden as well as commercial sand and gravel, stockpiling the overburden on-site for future use at the landfill. An average floor elevation of approximately 120 feet, ranging from approximately 113 feet to 126 feet above mean sea level (amsl) datum, has been achieved. This floor elevation will be adjusted to meet the subgrade configuration to be designed during Phase III, but will retain the minimum required separation above the expected unconfined water table aquifer at all locations. In general, this separation will range from a minimum of three (3) feet to approximately 15 feet (see Figure 4). The mining operations will continue at the site concurrent with disposal operations in the approved landfill to achieve the final floor configuration. The landfill will ultimately be closed with an approximate peak final elevation of 230 feet amsl, no more than 30 feet above the highest surrounding natural grade elevation.

The Tolson Rubble Landfill will be restricted to receiving only rubble waste (e.g., construction debris, land clearing debris, demolition debris), in conformance with COMAR 26.04.07.13B, the Refuse Disposal Permit Application filed for the site dated July 30, 2002, and any final permit issued for the facility.

2.1 TOPOGRAPHY

The site is located in rolling terrain which ranges in topographic elevation from approximately 60 feet amsl in the Little Patuxent River valley to 200 feet amsl near the northern quarry boundary. The center of the site has been disturbed through the mining operations, achieving an average floor elevation of approximately 120 feet amsl.

The present ground surface topography; surface features (i.e., tree lines, fence lines, pavement, structures and well locations) at the proposed landfill site were surveyed using aerial photogrammetry methods in August 2006. Mapping was completed with a 5-foot contour interval, and the results integrated into existing topographic mapping available from Anne Arundel County (Figure 3). This topography served as the base map for this report and will be utilized for the subsequent Phase III Engineering Report. Twenty-four (24) monitoring wells (Table 1) were also surveyed to establish horizontal and vertical control in August-September 2006 (Figure 3); twenty of these wells were associated with previous investigations, and were primarily sited along the permitted periphery of the footprint of the quarry, and therefore the Tolson Rubble Landfill. The remaining four wells (termed the “new” monitoring wells) were installed as part of this Phase II investigation.

2.1.1 Current Conditions

The ground surface elevations in undisturbed areas surrounding the current quarry configuration range from 150 feet (amsl) to 200 feet amsl, and the surface slopes gently to the southeast until descending to the elevation of the Little Patuxent River at approximately 60 feet amsl along the southwestern boundary of the site. Elevations in areas that have been quarried extend to a minimum elevation of 113 feet amsl, but typically range from 120 to 145 feet amsl (Figure 3). Figure 3 also presents all surface waters and natural drainage features, the 100-year floodplain, property lines, on-site buildings and structures, forested and other vegetated areas, and the location of utilities and storage tanks, as required by COMAR 26.04.07.15 (1).

2.1.2 *Conceptual Cell Floor Elevation*

The topographic mapping was used to create an isopach map of the subsurface stratigraphy and hydrogeology (Figure 4). This figure illustrates the soil/sediment overburden thickness between the proposed cell floor surface elevation and the elevation of the saturated groundwater table of the upper, unconfined aquifer. It should be noted that these isopach contours were created only within the footprint of the proposed landfill cells, and represent the final prepared subgrade conditions. Previously extracted materials are not indicated on this isopach. The resulting data were used in calculations to determine the appropriate final elevation for the proposed cell floor to assure that an adequate separation distance can be maintained. The regulatory requirement between the cell floor elevation and the highest reported groundwater elevation is a minimum of three (3) feet at all locations. It was previously noted by the MDE that the existing quarry floor elevation does not provide the appropriate separation in the vicinity of monitoring wells MW-12A (117.58 feet amsl) and MW-11A (116.86 feet amsl). While close, the existing quarry floor in the areas surrounding MW-12A and MW-11A will nevertheless be raised to a minimum of 120.58 and 119.86 feet amsl, respectively, as depicted on Figure 4, to assure maintaining the proper separation. The Phase III Engineering Report will reflect these changes to the quarry floor.

The proposed landfill cells will cover a total area of 57.7 acres. This acreage is divided into three cells designated as Cells A, B, and C that lie northeast, north, and northwest, respectively, of the closed rubble landfill (Figure 5). This location is hydraulically upgradient of the closed rubble landfill. Further, the cell floor of the proposed landfill is topographically higher than that of the closed landfill. Design documents will be presented in the Phase III Engineering Report which documents the size, relationship and final configuration of each of the cells. The landfill will be operated in ascending cell order: Cell A, Cell B and then Cell C.

3.0 GEOLOGY

3.1 REGIONAL GEOLOGY

The site lies within the Coastal Plain Physiographic Province. The sediments of the Coastal Plain consist of interbedded sands, silts, and gravels deposited unconformably over crystalline basement rock that dips in an eastwardly direction. These Coastal Plain sediments begin at the “fall-line”, located approximately 20 miles to the west, and generally thicken to the east at a low angle. At the surface in the area of the site are Upper Cretaceous sediments of the Magothy Formation and Lower Cretaceous sediments of the Patapsco, Arundel Clay and Patuxent Formations of the Potomac Group. There are also Pleistocene Age Patuxent River Terrace deposits near the Patuxent River that lie unconformably on top of the Cretaceous sediments. A generalized lithology and the hydrologic characteristics of these geologic formations within Anne Arundel County are summarized in Table 2.

3.2 SITE-SPECIFIC GEOLOGY

As presented in the Phase I, the geologic map of Anne Arundel County illustrates that the western portion of the site contains surficial Quaternary sediments characterized by inter-stratified deposits of sands and gravels referred to in previous reports as the Patuxent River Terrace. These sediments lie unconformably above the Cretaceous sediments described below. However, most of these coarse sands and gravels, on the order of 20 to 70 feet in thickness at the site, have been removed during the mining activities at the site. On the northeastern third of the site are surficial deposits of the Magothy Formation, some of which have also been removed during mining activities. The lower area of the Magothy Formation are characterized by interbedded layers of sand and white to light gray clay, with some coarse gravel. Underlying both the Magothy Formation and the Patuxent River Terrace deposits are the Patapsco, Arundel, and Patuxent Formations of the Potomac Group. The Patapsco Formation contains alternating aquifers and confining units, whereas the Arundel Formation is a thick confining bed of clay and the Patuxent Formation consists of interbedded sands and clays.

Photographs 1 and 2 below depict the side walls created within the quarry, and indicate the various units penetrated and the materials encountered. The white and yellow-orange sands, as well as the reddish brown silts, sands and gravel materials may be observed on Photograph 1. The base of the slope, indicated by the white line, on Photograph 2 represents the approximate location of the proposed cell floor (approximately elevation 124 feet amsl) in the northeastern portion of Cell B.

Photograph 1. View North at the Northeast High Wall of the Sand and Gravel Quarry.

Photograph 2. View Northeast at the High Wall.

4.0 SITE INVESTIGATION ACTIVITIES

4.1 SOIL BORING AND MONITORING WELL INSTALLATION

To determine subsurface conditions at the site, eight (8) soil borings (B-101 through B-108) were installed to depths of up to 100 feet in 1991 (Figure 3). An additional eight (8) soil borings; i.e., B-109 through B-116, were installed to a minimum depth of 43 feet during the current investigation to complete the delineation of the subsurface stratigraphy at the site. Four of these latter borings; i.e., B-113 through B-116, were completed as 2-inch nominal diameter monitoring wells and re-designated MW-15A, MW-15B, MW-16A, and MW-16B (Figure 3). The soil borings were advanced using mud-rotary drilling methods. Soil samples were collected and logged at 5-foot intervals to the final depth of penetration using split-spoon samplers in accordance with ASTM D-1586 Standard Penetration Test (SPT) Procedures. For the two soil borings (borings B-115 and B-116) that penetrated the lower confined aquifer, creating "deep" monitoring wells MW-15B and MW-16B, sediments were sampled at intervals of 15 feet to the completion depth of the boring.

The boring program was designed to delineate the vertical and lateral extent of the subsurface materials encountered, specifically the thick confining clay unit underlying the near-surface unconfined aquifer. Six of the new borings; i.e., B-109 through B-112, MW-15A, and MW-16A, were completed to the top of the confining unit, confirming its presence across the site. MW-15B and MW-16B penetrated the confining unit, which was demonstrated to be greater than 30 feet thick in each of these borings. These borings were then completed as deep monitoring wells as described below. Boring logs from this field investigation are included in Appendix C; the boring logs from previous investigations at the site are also included in Appendix C for reference, including the boring logs for the 20 existing monitoring wells. The boring logs include the results of Standard Penetration Tests and lithologic descriptions of the various soil deposits encountered.

The four new monitoring wells were completed with a 2-inch diameter Schedule 40 polyvinyl chloride (PVC) riser and slotted well screen placed in a 6-inch diameter open borehole. The well screen annulus was backfilled with a silica sand filter pack to two (2) feet above the well screen followed by a 2-foot thick bentonite plug to prevent water from infiltrating the borehole, and Portland cement grout to the ground surface. Monitoring wells MW-15A, MW-15B, MW-16A, and MW-16B were finished with a protective steel well casing and cover, and set in a 2-foot by 2-foot concrete pad. Subsequent to well installation, the top of each well casing was surveyed to an accuracy of 0.01 feet relative to an on-site benchmark (Table 1). Well construction logs for all four new monitoring wells are included in Appendix C.

In general, the shallow soils at the Site are comprised of medium to coarse sands with some gravel and silt material, classified in the laboratory as SP-SM and ML under the Unified Soil Classification System (USCS). These soils were saturated at approximately 100 feet amsl; i.e., 10 to 15 feet below the proposed cell floor elevation in most areas, as described in Section 2.1.2. These saturated sediments create an unconfined aquifer above the thick confining unit of silt and clay that exists below the entire site. The confining unit soils were classified in the laboratory as CL, ML-CL, and CL-ML according to the USCS. The boring logs from previous investigations, as well as those from this investigation were used to create five stratigraphic cross sections to graphically depict the materials and deposits encountered (Figures 6 through 10). The locations of the cross sections are indicated on Figure 11.

4.2 SAMPLING ACTIVITIES AND ANALYSIS

Soil samples of the upper aquifer material as well as the silt and clay confining unit were collected from selected split-spoon samples for geotechnical laboratory testing. These samples were composited and analyzed for particle-size distribution, natural moisture content, and where appropriate, Atterberg limits for soil classification and correlation purposes. A summary of the laboratory results is presented in Table 3.

Generally, the upper deposits at the site that compose the unconfined aquifer (designated UA-1 and UA-2) are fine to coarse sands with some silt, underlain by a thick confining unit of silt and clay (designated CU-1, CU-2, and CU-3). The confining unit is present at elevations ranging from 70 to 90 feet amsl beneath the proposed landfill cell floor, but thins and descends in surface elevation toward the southwest, near the Little Patuxent River. Complete results of the geotechnical testing are presented in Appendix D.

4.3 *STRATIGRAPHIC CROSS SECTIONS*

Using the results of the visual observations during drilling; i.e., boring logs, the Standard Penetration Test results, and the geotechnical analytical results from this investigation, and in conjunction with monitoring well information and borehole logs from previous investigations, five cross sections were developed that transect the site in a grid pattern. Three cross sections transect the site from northwest to southeast (A-A′, B-B′, and C-C′) and two cross sections from northeast to southwest (D-D′ and E-E′). Figure 11 depicts the orientation of the cross sections in plan; the cross sections are presented as Figures 6 through 10.

The stratigraphic units encountered are consistent across the site, as depicted on the cross sections. The upper sediments represent deposits associated with the Patuxent River Terrace, as well as some similar deposits of the Magothy Formation and the Potomac Group. These silts, sands, and gravels compose the upper unconfined aquifer in the area. The extensive continuous confining unit underlies the entire site, and is interpreted as a confining bed of the Potomac Group. Below this confining unit are several alternating layers of confined aquifers and confining units (aquitards).

5.0 HYDROGEOLOGY

Groundwater at the site exists in two aquifers, the upper, unconfined aquifer and a deeper, confined aquifer beneath a dense confining layer that is continuous across the site. The upper, unconfined aquifer lies above the low-permeability silt and clay sediments that are a hydrologic confining unit for the deeper aquifer. Table 1 indicates the monitoring wells installed at the site, many of which are part of the current groundwater-monitoring program for the closed rubble landfill. Monitoring wells MW-1A, MW-2B, MW- 4A, MW-5A, MW-7A, MW-8A, MW-9A, MW-10A, MW-11A, MW-12A, MW-13A, MW-14A, and new wells MW-15A and MW-16A are all screened in the shallow, unconfined aquifer above the confining unit (Figure 3). Groundwater in the shallow aquifer generally flows regionally southeast, and locally southwest toward, and discharges to the Little Patuxent River (Figures 12, 13 and 14).

Table 1 also includes the monitoring wells that are screened in the deeper, confined aquifer: monitoring wells MW-1B, MW-2A, MW-3B, MW-4B, MW-5B, MW-7B, MW-11B, and new wells MW-15B, and MW-16B (Figure 3). Groundwater in the deeper aquifer also flows to the south-southwest beneath the site.

It should be noted that the site also contains random pockets, lenses and thin layers of clays and silts within the upper profile of sediments, above the silt and clay confining unit. These sediments occasionally trap infiltrating precipitation and create isolated "perched" conditions that are not laterally extensive, but could indicate localized areas of elevated "groundwater" above the unconfined aquifer. These locations are discontinuous, are not a source of groundwater available for extraction, and rapidly dissipate during the mining operations. Therefore, this perched water does not represent an aquifer.

5.1 GROUNDWATER MOVEMENT

As stipulated in COMAR 26.04.07.15A(4), any aquifers less than 50 feet below the cell floor elevation of the proposed landfill require creation of three separate groundwater contour maps for: 1.) a month with elevated groundwater conditions; 2.) a month with depressed groundwater conditions; and, 3.) the highest observed or predicted groundwater condition. These groundwater potentiometric surface contours were created for the unconfined aquifer from monthly depth to water measurements obtained in each of the existing 20 monitoring wells from 2000 to 2006. Three separate groundwater conditions are presented which represent groundwater under depressed conditions in July 2002 (Figure 12), elevated conditions in January 2004 (Figure 13), and maximum recorded conditions; i.e., the maximum groundwater elevations recorded between 2000 and 2006 (Figure 14). These data do not, however, include water level measurements from the four monitoring wells installed in 2006 because these new wells have not been operational for a sufficient period for the wells to be reflective of subsurface hydraulic conditions. Nevertheless, while not necessarily reliable indicators of historic groundwater levels, the data derived from the new monitoring wells are consistent with the current depth to water data.

To evaluate the appropriateness of the selected depressed and elevated conditions from a historic perspective, United States Geological Society (USGS) monitoring wells in the vicinity of the site were examined for both the Patapsco and the Patuxent Aquifers. Piezometric data is generally maintained for USGS wells over an extended period of time, and the site data was therefore correlated with such a well to confirm historic groundwater fluctuations. The historic depth to water measurements for the identified wells are included in Appendix E and provide over 45 years of groundwater monitoring data. The wells indicate graphically that January 2004 was one of the highest recorded elevated conditions for both aquifers and that July 2002 was one of the most depressed aquifer conditions over the same period, confirming the selection of these data.

5.2 PRODUCTION WELLS

A survey of all production wells, including residential wells, within ½ mile of the site boundary was conducted in 2006. A total of 119 wells are reported within the ½-mile radius; of these, thirty-three (33) are residential drinking water wells, one (1) a farm well, three (3) industrial wells, and eighty-two (82) test/monitoring wells. The survey includes well reports in the possession of the Maryland Department of Health and the MDE, and is reasonably expected to represent all of the wells within the vicinity. This information was nevertheless confirmed by a count of residences and other structures in the area from satellite imagery. While it is possible that certain older wells, or non-residential wells are not included, these wells, if any, would generally be expected to be shallow. A summary of well characteristics is provided in Table 4, which includes well depth, screen type, productivity, lithology, and water level, as stipulated in COMAR 26.04.07.15A(3). The well completion reports available for these wells are included in Appendix E. The drinking well locations as reported by MDE are displayed in Figure 1; it should be noted that these locations are only grid specific, as maintained by MDE, and slight locational variations should be expected.

Approximately 65 percent of the wells were determined to be screened between 80 and 150 feet bgs, into various Patapsco aquifers. These aquifers represent the deeper aquifer identified at the site, or lower. Only two (2) wells were interpreted to be screened in the near-surface unconfined aquifer, and these are generally located west (upgradient) of the site. The remainder are screened in the deeper aquifers of the Patapsco and the Patuxent Formations. The closest approach drinking water well is located approximately 1,200 feet to the south of the site boundary, and is screened in the deeper aquifer. The well records available for residential drinking water wells along Evergreen Road south of the site all indicate the presence of at least 30 feet of clay confining unit(s) overlying the aquifer.

5.3 POTENTIAL CONTAMINANT MIGRATION

In order to project the potential for any contaminant migration to reach possible human receptors, the subsurface conditions for groundwater movement were evaluated using the hydraulic gradients calculated from the potentiometric surface maps and the hydraulic conductivity of the aquifer units. The hydraulic conductivity for the shallow aquifer was calculated using two methods, as described below. From these calculations vertical movement was approximated.

5.3.1 Shallow Aquifer Hydraulic Conductivity from Slug Test Data

General

The first method for determining the shallow aquifer hydraulic conductivity was developed by Bouwer and Rice (1976). Field data was collected through tests by either placing or removing a slug of water into the wetted well casing. The drawdown (or rise) was then measured over time until the water level returned to equilibrium. The results were then used to calculate the hydraulic conductivity of the well using the Bouwer and Rice Method of slug test analysis:

$$K = \frac{(r_c)^2 \ln(R_e/R)}{2L_e} \times \frac{(1/t)}{} \ln(H_o/H_t)$$

where:

- K = the hydraulic conductivity,
- r_c = the radius of the well casing,
- R = the radius of the gravel envelop,
- R_e = the effective radial distance over which dissipated,
- L_e = the length of the screen,
- H_o = the drawdown at time t = 0,
- H_t = the drawdown at time t = t, and,
- T = the time since $H = H_o$.

While it is not possible to accurately calculate R_e for any given well, Bouwer and Rice present a method for estimating ln (R_e/R) using the following equation:

$$\ln(R_e/R) = [1.1/(\ln(L_w/R) + [(A + B \ln(h-L_w)/R)/(L_e/R)]]^{-1}$$

where A, B, and C are dimensionless numbers that are determined using the method described in Bouwer and Rice (1976), and as depicted on the graphs in Appendix F. The drawdown data and calculations are also provided in Appendix F.

The hydraulic conductivity values calculated from the slug tests ranged from 0.5 to 20 feet/day. The geometric mean of these values was 2.86 feet/day (Table 5). This calculated value is well within the accepted range of hydraulic conductivity values for fine sand, 0.05 to 20 feet/day, and for silt from 0.0001 to 6 feet/day (Domenico and Schwartz, 1990 and Bouwer, 1978).

Groundwater Velocities Beneath the Site

The results of the hydraulic conductivity testing were used to calculate the average groundwater flow velocity using the following equation:

$$V = (K \times i)/n,$$

where:

- K = the hydraulic conductivity,
- i = the hydraulic gradient, and,
- n = the effective porosity.

The hydraulic conductivity measurements and the projection of groundwater flow velocity provide a means of evaluating the potential for vertical and horizontal movement of possible contaminants, as required under COMAR 26.04.07.15.A(9).

Unconfined aquifer groundwater gradients in the vicinity of the site are generally reflective of the topography. The gradient in the immediate vicinity of the proposed landfill is therefore expectedly relatively uniform and low. The average horizontal gradient, calculated across the proposed landfill site is:

(120 feet – 95 feet)/3200 feet = 0.0078.

A conservative estimate for porosity (25 percent) was used. These calculations produce a projected groundwater velocity of 0.09 feet/day, which indicates that groundwater flows approximately 33 feet/year laterally in the shallow aquifer beneath the site (Table 6).

5.3.2 *Shallow Aquifer Hydraulic Conductivity from Particle-Size Distribution Data*

A second method to project the migration time for groundwater beneath the site is based on the particle-size distribution data derived from soil samples collected in the upper aquifer deposits during the field explorations. The composite samples from the upper aquifer (UA-1 and UA-2) indicate that the aquifer material is generally a silty-fine sand aquifer (Table 3). Reported (Domenico and Schwartz, 1990 and Bouwer, 1978) hydraulic conductivity values for a fine sand range from 0.05 to 20 feet/day, and for a silt from 0.0001 to 6 feet/day. While these ranges are broad, they provide some guidance for use in verifying groundwater velocities derived through other means.

Groundwater Velocities Beneath the Site

Assuming the most conservative hydraulic conductivity value (20 feet/day), a conservative standard porosity of 25 percent, and the hydraulic gradient previously developed for across the site (0.0078), and then applying the equation reported above:

$$V = (K \times i)/n ,$$

a very conservative velocity for the shallow groundwater beneath the site of 0.62 feet/day (228 feet/year) is projected.

5.3.3 *Vertical Movement*

Another significant consideration for any contaminant pathway analysis is the potential for the vertical migration of a contaminant into the deeper aquifer, particularly since this aquifer is the source of groundwater for downgradient drinking water wells, and therefore represents the pathway to the nearest human receptor. This pathway was evaluated using the particle-size distribution analysis and the hydraulic gradient established between the shallow aquifer wells and deep aquifer wells.

The average vertical gradient calculated between wells MW-11A and MW-11B in January 2004 was determined by subtracting the difference in the elevation of the groundwater divided by the difference in vertical distance between the well screens, as:

(GW Elevation X – GW Elevation Y) / (Screen Elevation X – Screen Elevation Y)
= Vertical Hydraulic Gradient

For MW-11A and MW-11B, this results in:

(116.20 feet – 70.12 feet) /(157 feet – 80 feet) = 0.59

This calculation was also performed for monitoring wells MW-2A and MW-2B, yielding:

(101.43 feet – 57.76 feet) /(148 feet – 58 feet) = 0.48

Applying the more conservative hydraulic gradient value and the extremely conservative hydraulic conductivity value for silty clay (0.001 ft/day) (Domenico and Schwartz, 1990 and Wolff, 1982), the predicted groundwater velocity is 0.0014 ft/day = 0.53 ft/year, assuming 40 percent porosity in the clay. Over the thinnest section of the confining unit (30 feet) encountered at the site, the migration of contaminants would require an estimated 57 years to penetrate the confining unit and enter the deeper confined aquifer. This is a very conservative projection; the actual time period would likely be much greater.

Using the closest human receptor (1,200 feet south) for groundwater flowing beneath the site, the mean hydraulic conductivity values determined for the site, and the resultant horizontal groundwater velocity calculated above for movement across the site (33 feet/year), a projected time period for any contaminant to exit the proposed landfill via a catastrophic failure of the anticipated liner system and migrate to the nearest human receptor is therefore projected to be a total of 93 years. Using the most conservative numbers derived from the literature value, particle-size distribution results yields a worst-case scenario projection of 62 years. The groundwater velocity calculations are summarized in Table 6.

6.0 GROUNDWATER QUALITY

6.1 BACKGROUND

The chemical water quality of the upper and lower aquifers has been measured periodically over the past sixteen (16) years (from 1989 to the present) as part of the Groundwater Management Plan for the closed rubble landfill. Field parameters, including pH, specific conductance, temperature, dissolved oxygen, and turbidity, were measured semi-annually. Standard water quality parameters, including alkalinity, total dissolved solids, hardness, chloride, sulfate, total organic carbon, chemical oxygen demand, ammonia, nitrate, and nitrite, were analyzed in the laboratory. Volatile organic compounds (VOCs) and twenty-two target analyte list (TAL) metals (excluding aluminum) were also analyzed in the laboratory. For the purposes of this Phase II report, the groundwater data from the most recent six years (2000 to 2005) was examined as representing the current condition. All of the data collected over the past 16 years is nevertheless available in Appendix G.

6.2 TREND ANALYSIS

The most recent six years of groundwater quality data at the proposed landfill provide an excellent basis for conducting a trend analysis of the groundwater quality beneath the site. The groundwater data were evaluated for seasonal and/or temporal changes, and graphic depictions of the data were visually interpreted for any trends during the groundwater monitoring period. Concentrations were compared to the national primary drinking water standards (NPDWS) and secondary drinking water standards (NSDWS). Any concentrations of constituents that exceeded the NPDWS were further investigated for any apparent trends in the data using linear regression analysis. Appendix H provides the visual interpretation of the groundwater quality data along with the statistical analysis for select groundwater parameters that exceeded the NPDWS or NSDWS over the data evaluation period.

6.2.1 *Metals*

Two metals, iron and manganese, consistently exceeded the NSDWS. The NSDWS are non-enforceable guidelines regulating contaminants that may cause a cosmetic or aesthetic effect in drinking water. The elevated levels of these contaminants in nearly all of the monitoring wells on-site are most likely part of the natural groundwater system in the area and are due to the background composition of the sediments and soils in the area.

Five metals, antimony, arsenic, cadmium, chromium, and thallium, each exhibited at least one detection that was above their NPDWS: 6, 50, 5, 100, and 2 ug/L, respectively.

- Antimony was reported in samples collected in March 2003 from four wells: MW-10A, MW-12A, MW-13A, and MW-14A at concentrations between 6 and 7.5 ug/L, immediately above the NPDWS of 6 ug/L. Antimony has not been detected in subsequent sampling events (detection limit 2 ug/L).

- Arsenic was only detected in two groundwater samples from MW-8A and MW-13A prior to 2003. These elevated concentrations may have been associated with sediment that was incorporated in the groundwater sample prior to a change in methodology. Groundwater samples are currently collected using low-flow protocol (EPA/540/S-95/504) that in most cases reduces the likelihood of incorporating sediment into the groundwater samples.

- Cadmium has been detected above the NPDWS in five monitoring wells: MW-2A, MW-7B, MW-8A, MW-11B, and MW-14A. With the exception of MW-14A, these detections were in samples from 2002 to 2003; cadmium has not been detected in subsequent sampling events from those wells. MW-14A, however, has indicated consistent concentrations of cadmium between 3.3 and 62 ug/L since 2000, above the NPDWS of 5 ug/L. MW-14A has also exhibited frequent elevated turbidity concentrations. The elevated cadmium values are most likely associated with sediments in the vicinity of MW-14A that are included in the samples of the highly turbid water.

- Chromium has been detected above the NPDWS in four monitoring wells: MW-4A, MW-8A, MW-13A, and MW-14A. Similar to cadmium, with the exception of MW-14A, all of these detections were in samples from 2002 to 2003; chromium has not been detected in subsequent sampling events from those wells. MW-14A, however, has exhibited consistent detections of chromium between 10 and 177 ug/L since 2000, and on three occasions was detected above the NPDWS of 100 ug/L. Therefore the elevated chromium and cadmium values are most likely associated with sediments in the vicinity of MW-14A that are included in the samples of the highly turbid water.

- Thallium was only detected in one groundwater sample from MW-8A in 2000.

Antimony, arsenic, cadmium, chromium, and thallium all exhibited at least one detection that was above their NPDWS, however a statistical analysis was not performed because the detections have all been followed by subsequent non-detections.

Therefore, a trend analysis using linear regression was conducted on monitoring wells MW-1A through MW-14A for only iron and manganese. The regression was conducted on iron concentrations versus time using the most recent six years of data that has exhibited consistent concentrations of iron above the NSDWS. The analysis revealed no statistically-significant relationships (p value < 0.05, which corresponds to a 95 percent confidence limit) for any wells with the exceptions of MW-2B and MW-7A. Both of these monitoring wells indicated an increase in concentrations of iron over time with R^2 values of 0.71 and 0.44 and p-values of 0.004 and 0.049, respectively. For manganese monitoring wells MW-2B, MW-11B, and MW-13A all indicated an increase in concentrations of manganese over time with R^2 values of 0.52, 0.67, and 0.50 and p-values of 0.03, 0.007, and 0.033, respectively.

6.2.2 *Volatile Organic Compounds*

No VOCs were detected above their respective detection limits with the exception of acetone and chloroethane. Acetone has been detected in seven monitoring wells: MW-1A, MW-2A, MW-2B, MW-4A, MW-5A, MW-8A, and MW-13A since 2002. With the exception of MW-5A, all of the detections were between 2002 and 2004; acetone has not been detected in subsequent sampling events from those wells. MW-5A has had only one detection (2.5 ug/L) of acetone, in February 2006. This concentration is qualified as an estimated value because it is below the detection limit of the analytical method. Acetone is a typical laboratory contaminant and the samples may be reflective of laboratory contamination.

Chloroethane has been consistently detected at or near the detection limit (1-5 ug/L) since 2002 in monitoring well MW-8A.

7.0 CONCLUSIONS

This Phase II Site Geology Report summarizes the site geology and hydrology for the Tolson Rubble Landfill site in response to COMAR 26.04.07.15. Past and recent field investigation findings are compiled and summarized in order to present a clear and comprehensive summary of the site geology in a single report. The key findings of this report are:

- The cell floor of the proposed landfill will meet the three-foot separation standard between the base of the landfill and the maximum high groundwater table for the upper aquifer. The highest reported groundwater elevation for monitoring wells on-site provides the required separation standard in all locations except the northern section of the Cell A of the proposed landfill. This location will be raised with clean fill to the appropriate elevation (approximately 121 feet amsl) prior to landfill development.

- Groundwater beneath the site exists in two aquifers. The near-surface, phreatic upper aquifer (i.e., composed of sands with some silt) is unconfined and lies atop a thick (approximately 30 to 50 feet) continuous confining unit of silt and clay. The second aquifer is confined at depths exceeding 50 feet, beneath the continuous confining unit that provides an aquitard.

- Contaminants identified in the groundwater regime above the NPDWS and NSDWS over the most recent six years of data collection are few, with no trends indicating a degrading condition:

    - Acetone and chloromethane were detected in previous sampling events between 2002 and 2004; however, more recent sampling has shown no concentrations above detection limits.

    - Antimony, arsenic, cadmium, chromium, and thallium were detected above their respective NPDWS between 2002 and 2004; however, recent sampling has indicated no concentrations above detection limits and therefore no upward trends in their concentrations.

- The only apparent trends in concentrations of groundwater contaminants beneath the site appear to be increasing concentrations of iron in MW-2A and MW-7A and manganese in MW-2B, MW-11B, and MW13A. All other wells did not indicate any statistically-significant relationship between iron or manganese concentrations over time.

- Groundwater beneath the site in the shallow aquifer flows to the southwest toward the Little Patuxent River; groundwater in the deeper aquifer also flows to the south-southwest. Groundwater use downgradient of the site is from the deeper aquifer.

- In the event that a hypothetical catastrophic failure of the proposed liner system was to occur, contaminants would most likely not reach the nearest human receptor for a minimum period of 62 years. This projection represents very conservative assumptions with respect to hydrogeologic parameters for groundwater flow direction, hydraulic conductivity, and groundwater velocity calculated from the hydrogeologic properties of sediments and groundwater at the site.

8.0 *BIBLIOGRAPHY*

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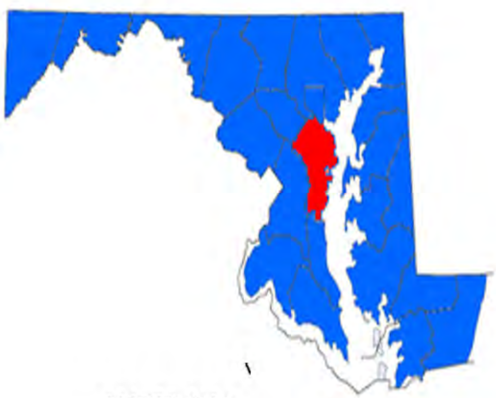
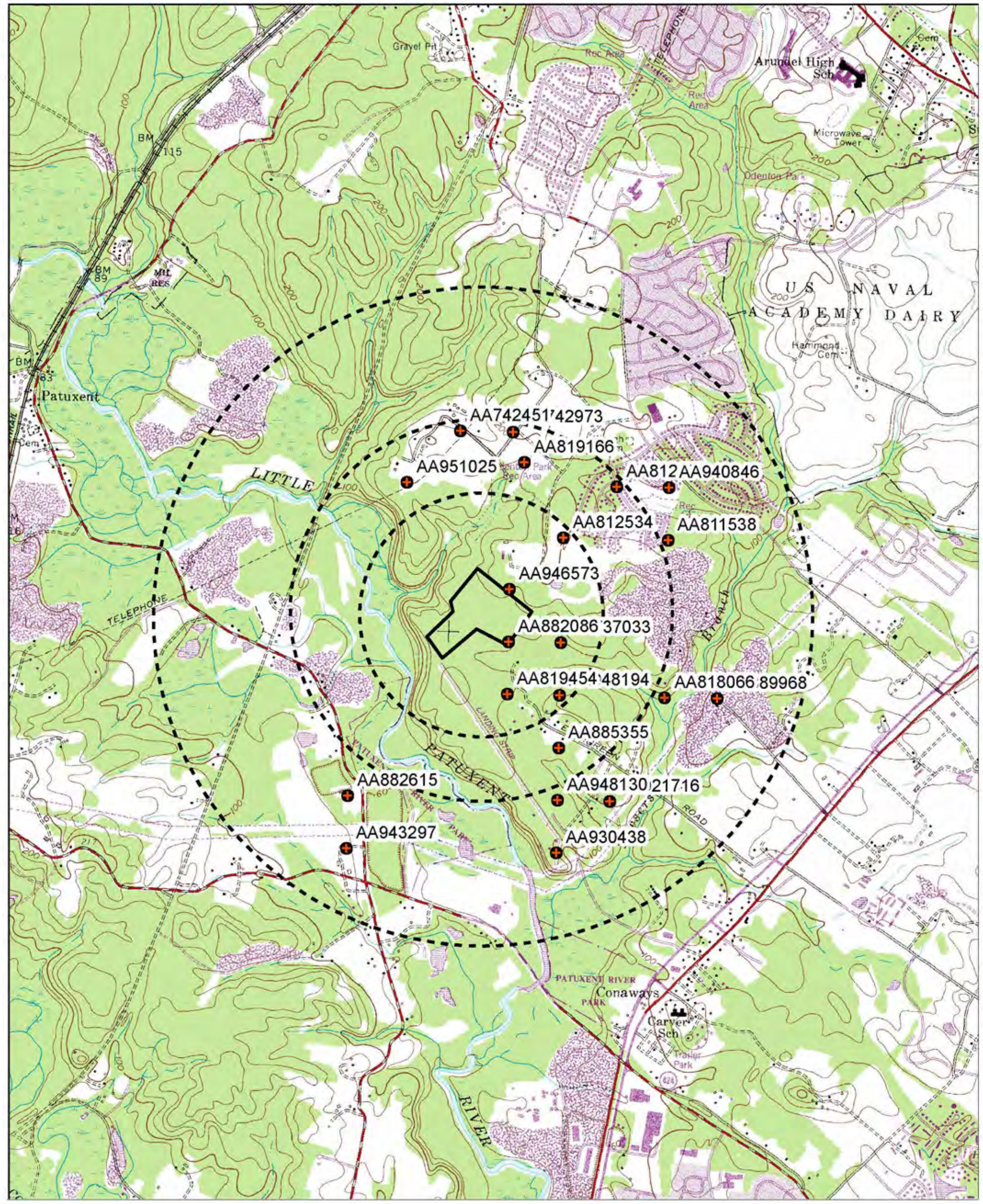
Figures



MARYLAND



Adapted From USGS - Odenton Quadrangle

ENVIRONMENTAL RESOURCES MANAGEMENT, INC.

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N

0 1,750 3,500

Scale in Feet
1" = 3,500'

FIGURE 1
SITE LOCATION MAP
TOLSON RUBBLE LANDFILL
PHASE II SITE GEOLOGY REPORT
CROFTON, MARYLAND

ENVIRONMENTAL RESOURCES MANAGEMENT, INC.

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N

1000 500 0 1000

SCALE IN FEET

FIGURE 2
SITE AERIAL
TOLSON RUBBLE LANDFILL
PHASE II SITE GEOLOGY REPORT
CROFTON, MARYLAND

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N

300 150 0 300

SCALE IN FEET

LEGEND:

PROPERTY LINE	MONITORING WELL
LIMIT LINE (OF AUG. 2006 SURVEY)	SOIL BORING - MARSHALL ENGINEERING
EDGE OF TREES	SOIL BORING - ERM
FEMA 100 YEAR FLOOD LINE	MONITORING WELL - ERM

FIGURE 3
SITE TOPOGRAPHIC MAP
TOLSON RUBBLE LANDFILL
PHASE II SITE GEOLOGY REPORT
CROFTON, MARYLAND

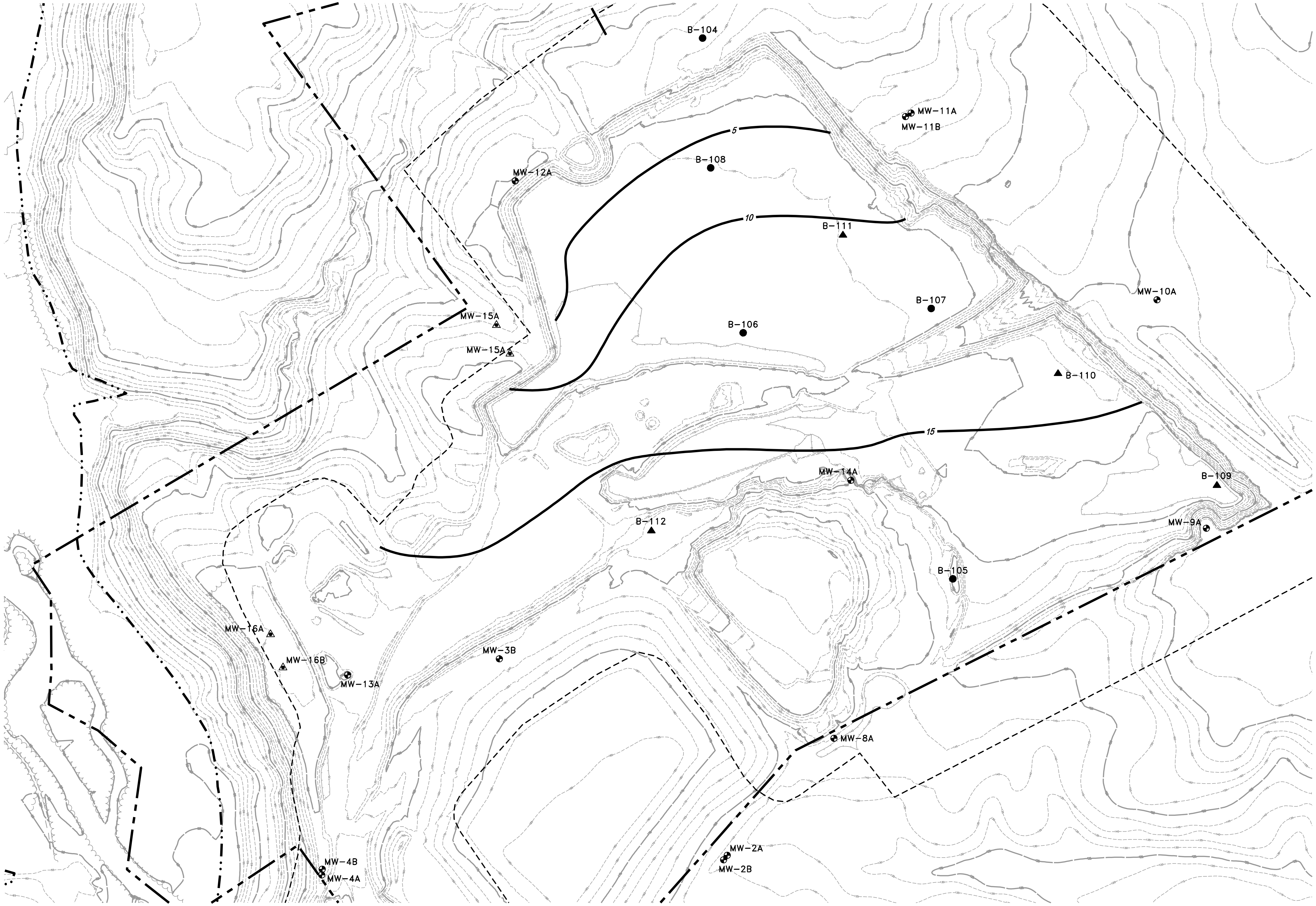

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FIGURE 4

GENERALIZED ISOPACH THICKNESS OF SEDIMENT ABOVE GROUNDWATER TABLE AND BELOW THE PROPOSED CELL FLOOR

TOLSON RUBBLE LANDFILL
PHASE II SITE GEOLOGY REPORT
CROFTON, MARYLAND

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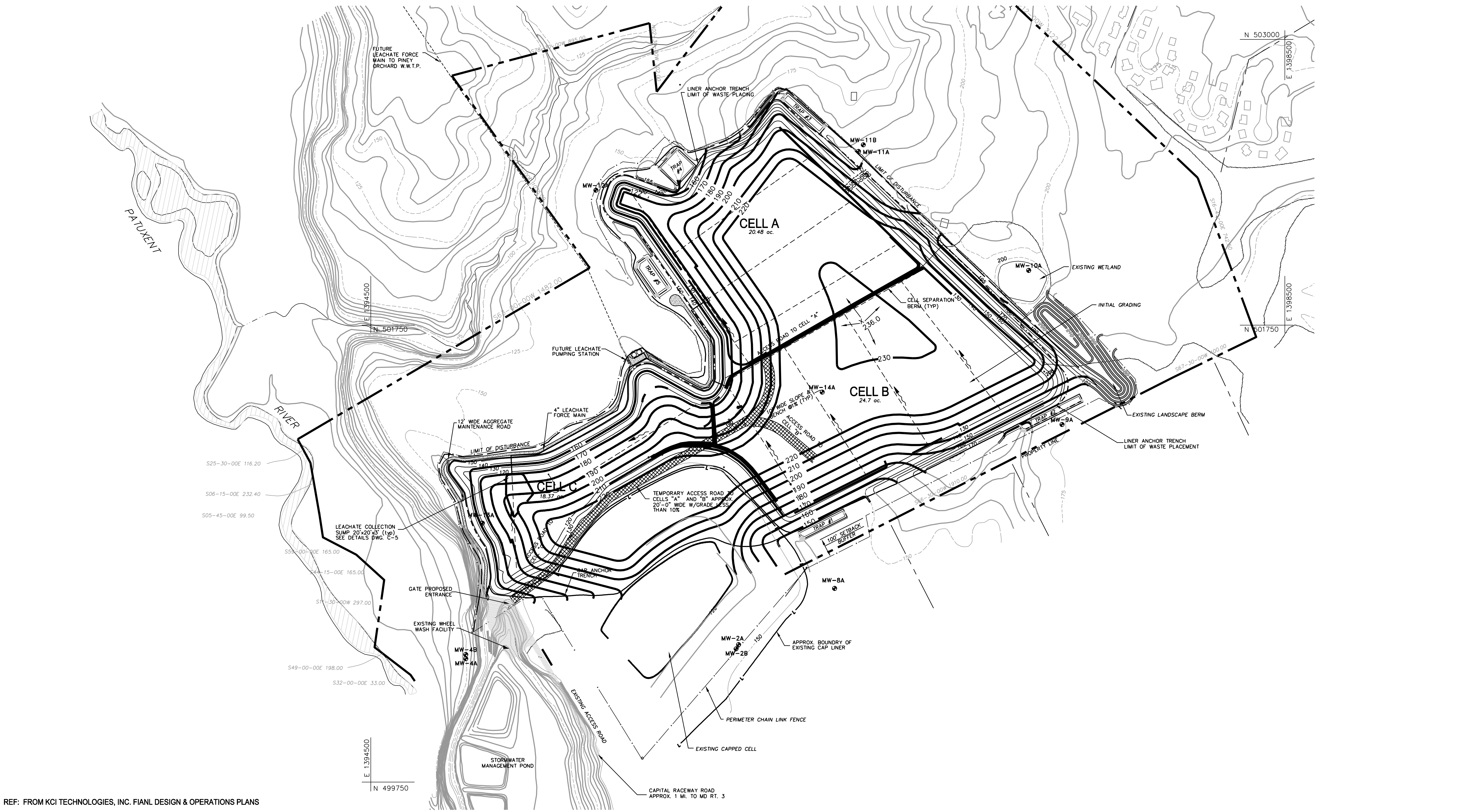

REF: FROM KCI TECHNOLOGIES, INC. FIANL DESIGN & OPERATIONS PLANS

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N

400 200 0 400

SCALE IN FEET

LEGEND:

- PROPERTY LINE
- EDGE OF TREES
- MONITORING WELL
- TEMPORARY/ACCESS ROAD
- APPROXIMATE BOUNDAYR OF EXISTING CAP LINER
- PERIMETER CHAIN LINK FENCE

FIGURE 5
SITE CELL CONCEPTUAL DESIGN
TOLSON RUBBLE LANDFILL
PHASE II PERMIT APPLICATION
CROFTON, MARYLAND

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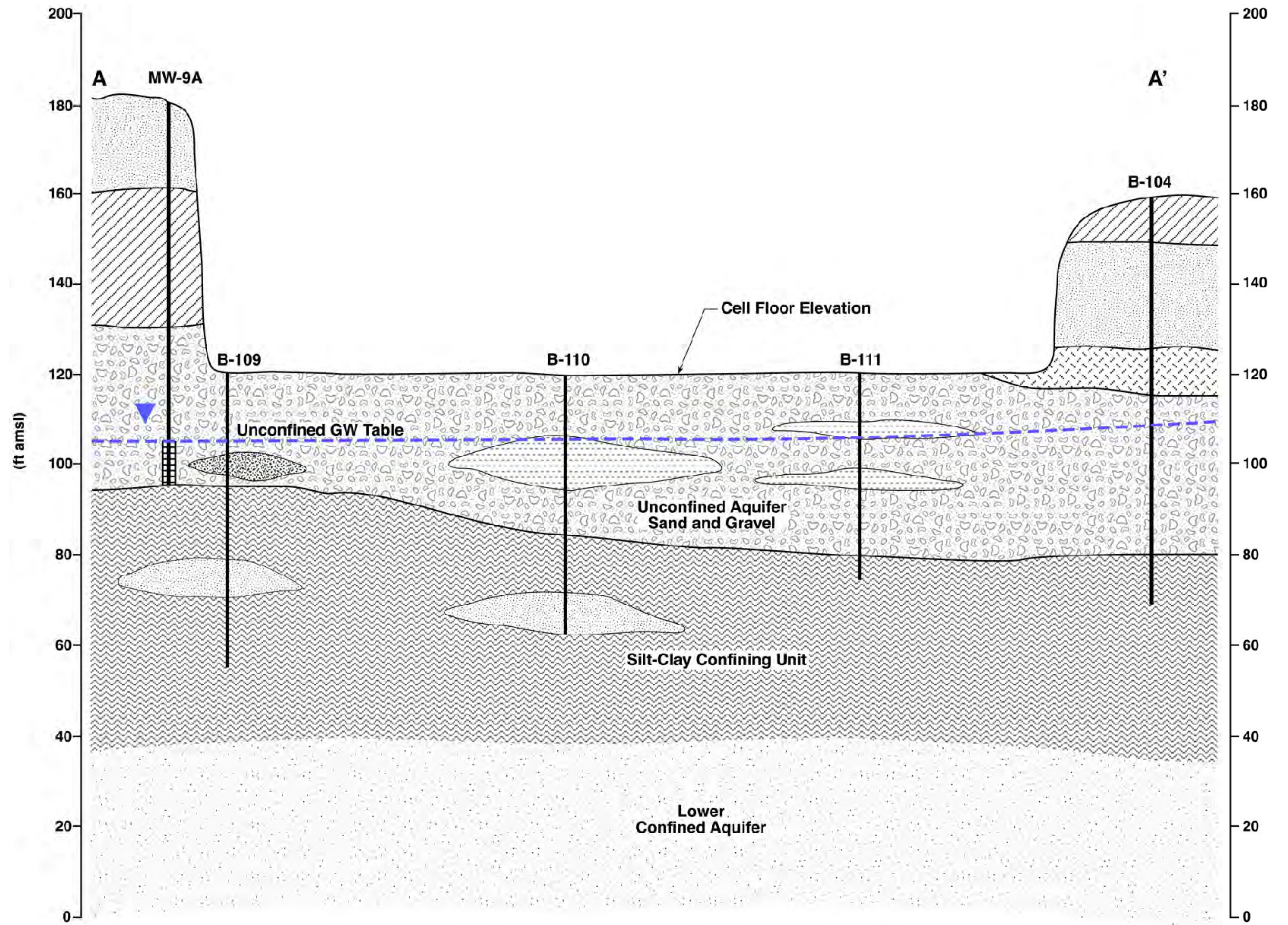

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N

300 150 0 300

SCALE IN FEET

VERTICAL SCALE = 10x EXAGGERATION

LEGEND:

- UNCONFINED WATER TABLE
- CLAY
- SAND
- SAND AND CLAY
- SILT-CLAY
- SILT-SAND
- SAND AND GRAVEL
- SILT
- COARSE SAND

FIGURE 6
CROSS-SECTION A-A'
TOLSON RUBBLE LANDFILL
PHASE II SITE GEOLOGY REPORT
CROFTON, MARYLAND

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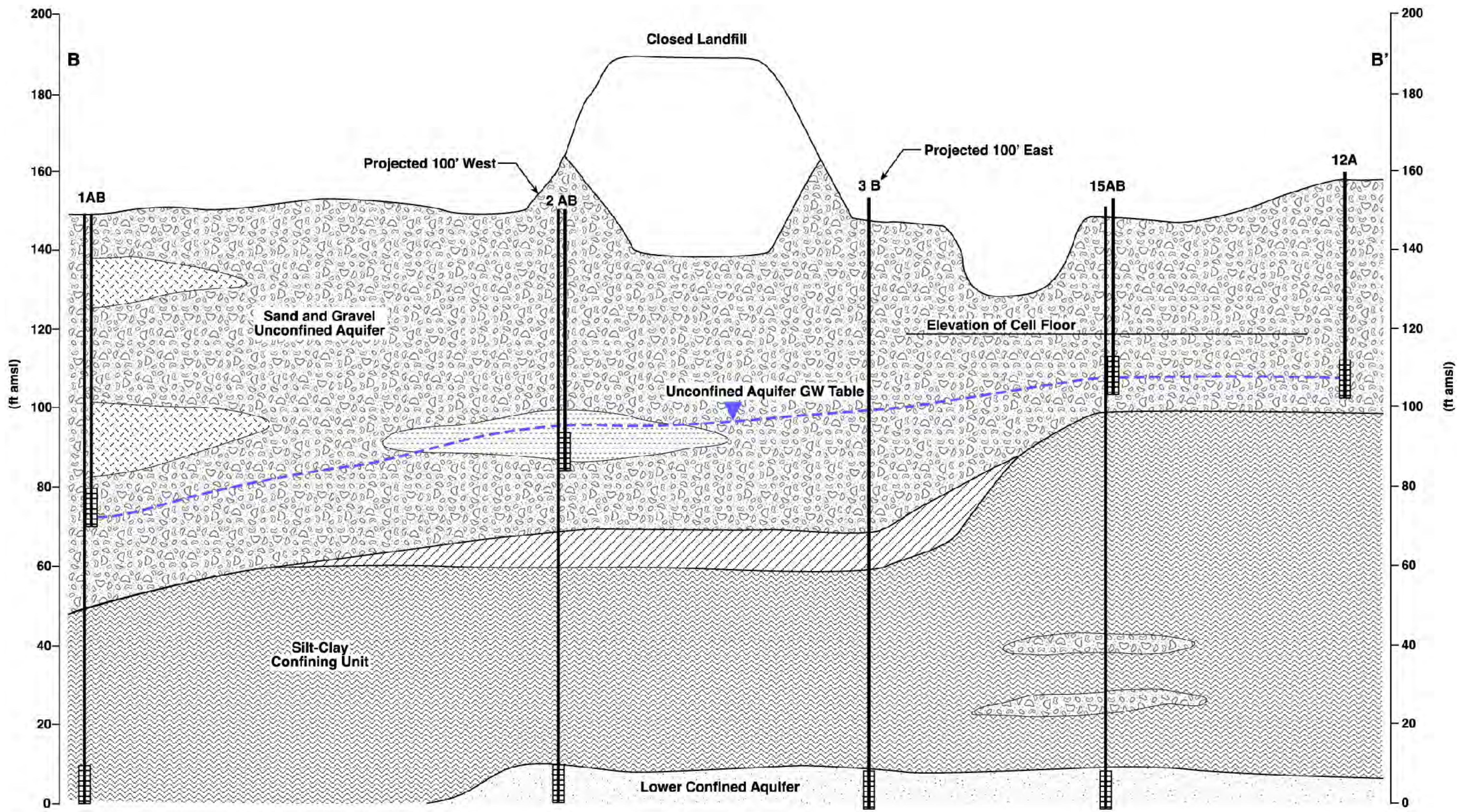

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N

300 150 0 300

SCALE IN FEET

VERTICAL SCALE 10X EXAGGERATION

LEGEND:

- UNCONFINED WATER TABLE
- CLAY
- SILT-CLAY
- SILT-SAND
- SAND AND GRAVEL
- SILT
- COARSE SAND

FIGURE 7
CROSS-SECTION B-B'
TOLSON RUBBLE LANDFILL
PHASE II SITE GEOLOGY REPORT
CROFTON, MARYLAND

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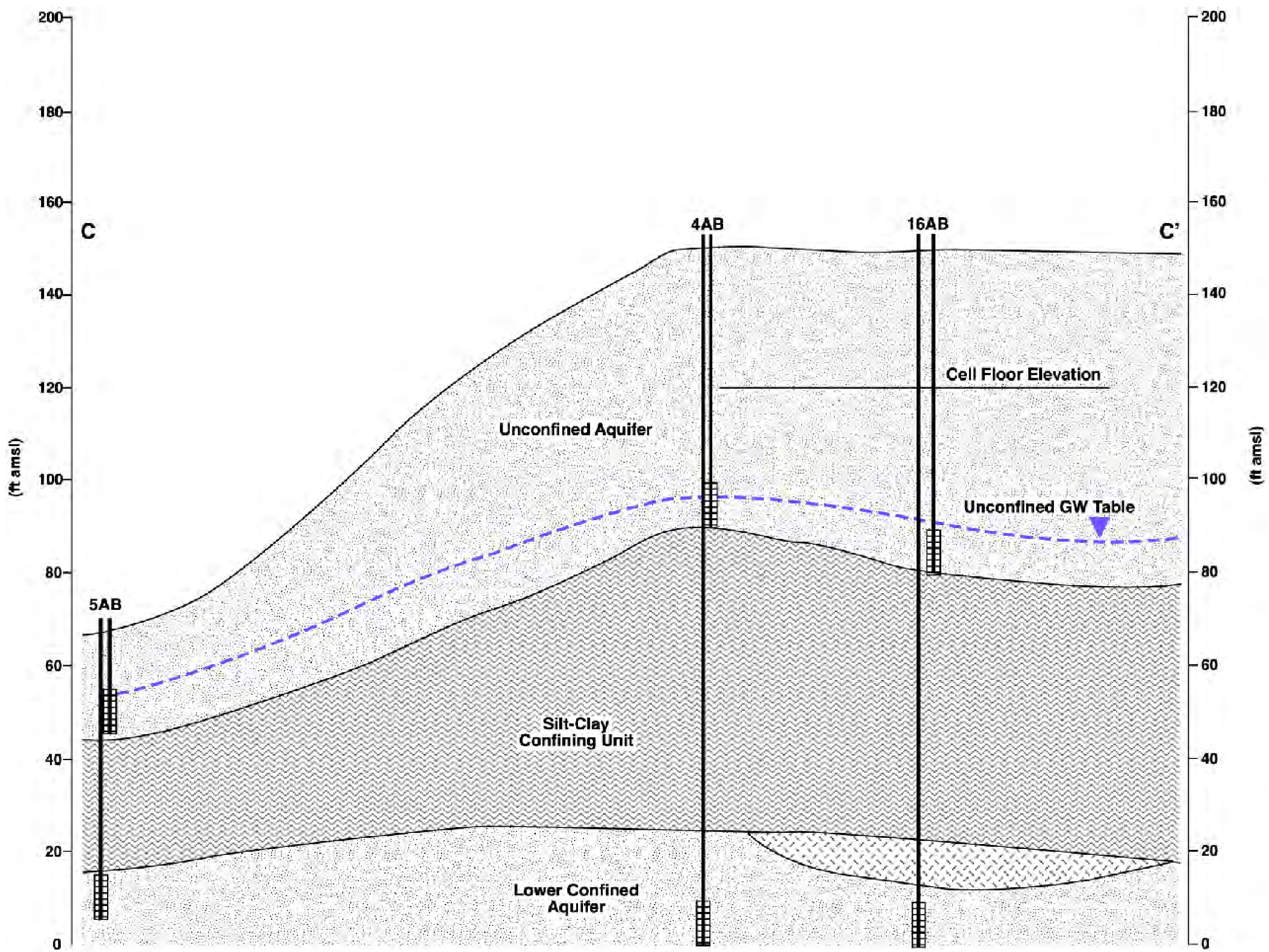

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NOVEMBER 1, 2006

N

300 150 0 300

SCALE IN FEET

VERTICAL SCALE 10X EXAGGERATION

LEGEND:

- UNCONFINED WATER TABLE
- COARSE SAND
- SILT-CLAY
- SILT-SAND

FIGURE 8
CROSS-SECTION C-C'
TOLSON RUBBLE LANDFILL
PHASE II SITE GEOLOGY REPORT
CROFTON, MARYLAND

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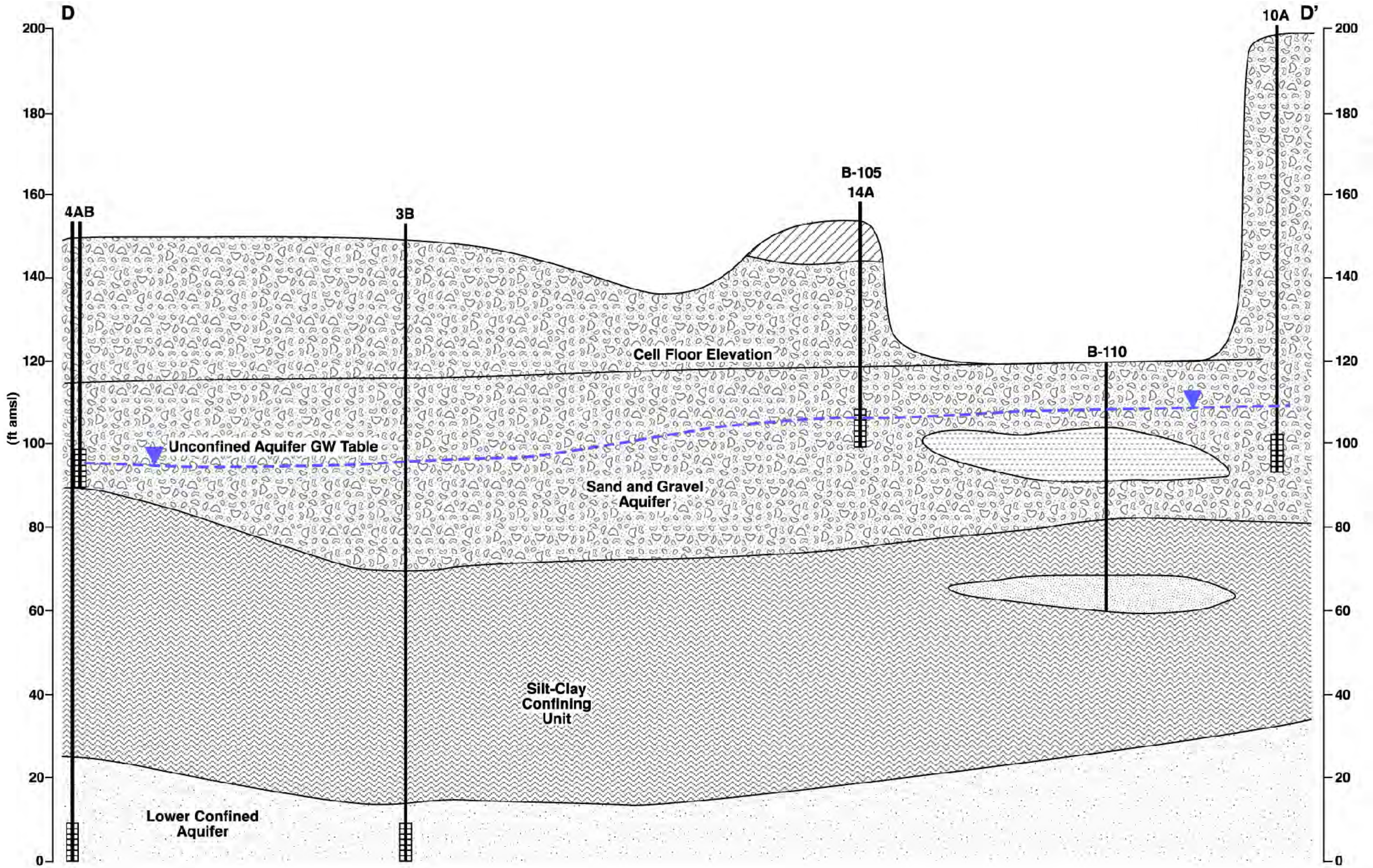

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NOVEMBER 1, 2006

N

300 150 0 300

SCALE IN FEET

VERTICAL SCALE = 10x EXAGGERATION

LEGEND:

UNCONFINED WATER TABLE

CLAY

SAND

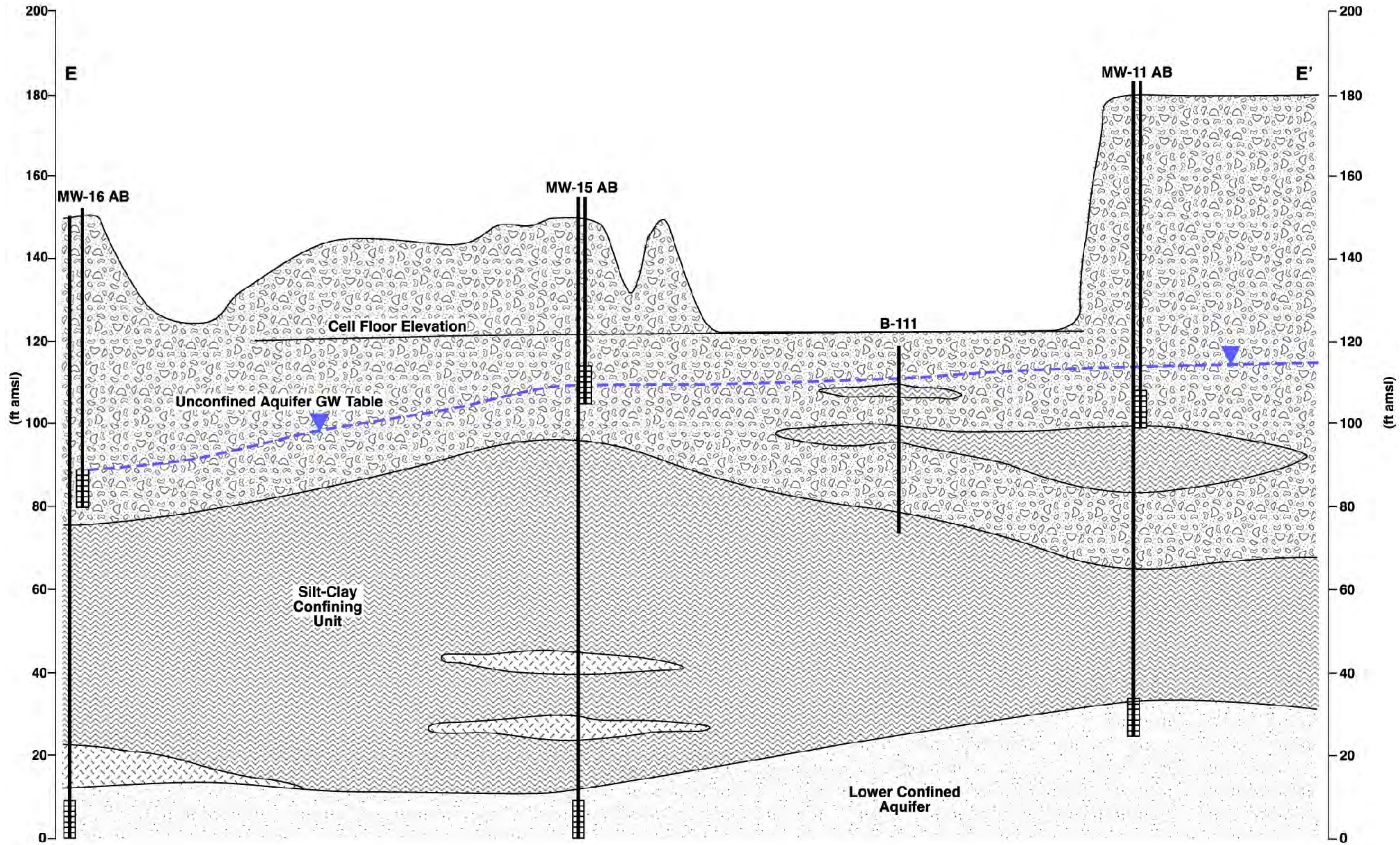
SILT-CLAY

SAND AND GRAVEL

SILT

COARSE SAND

FIGURE 9
CROSS-SECTION D-D'
TOLSON RUBBLE LANDFILL
PHASE II SITE GEOLOGY REPORT
CROFTON, MARYLAND



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ERM

NOVEMBER 1, 2006

N

300 150 0 300

SCALE IN FEET

VERTICAL SCALE = 10x EXAGGERATION

LEGEND:

UNCONFINED WATER TABLE

SILT-CLAY

SILT-SAND

SAND AND GRAVEL

COARSE SAND

FIGURE 10

CROSS-SECTION E-E'

TOLSON RUBBLE LANDFILL

PHASE II SITE GEOLOGY REPORT

CROFTON, MARYLAND

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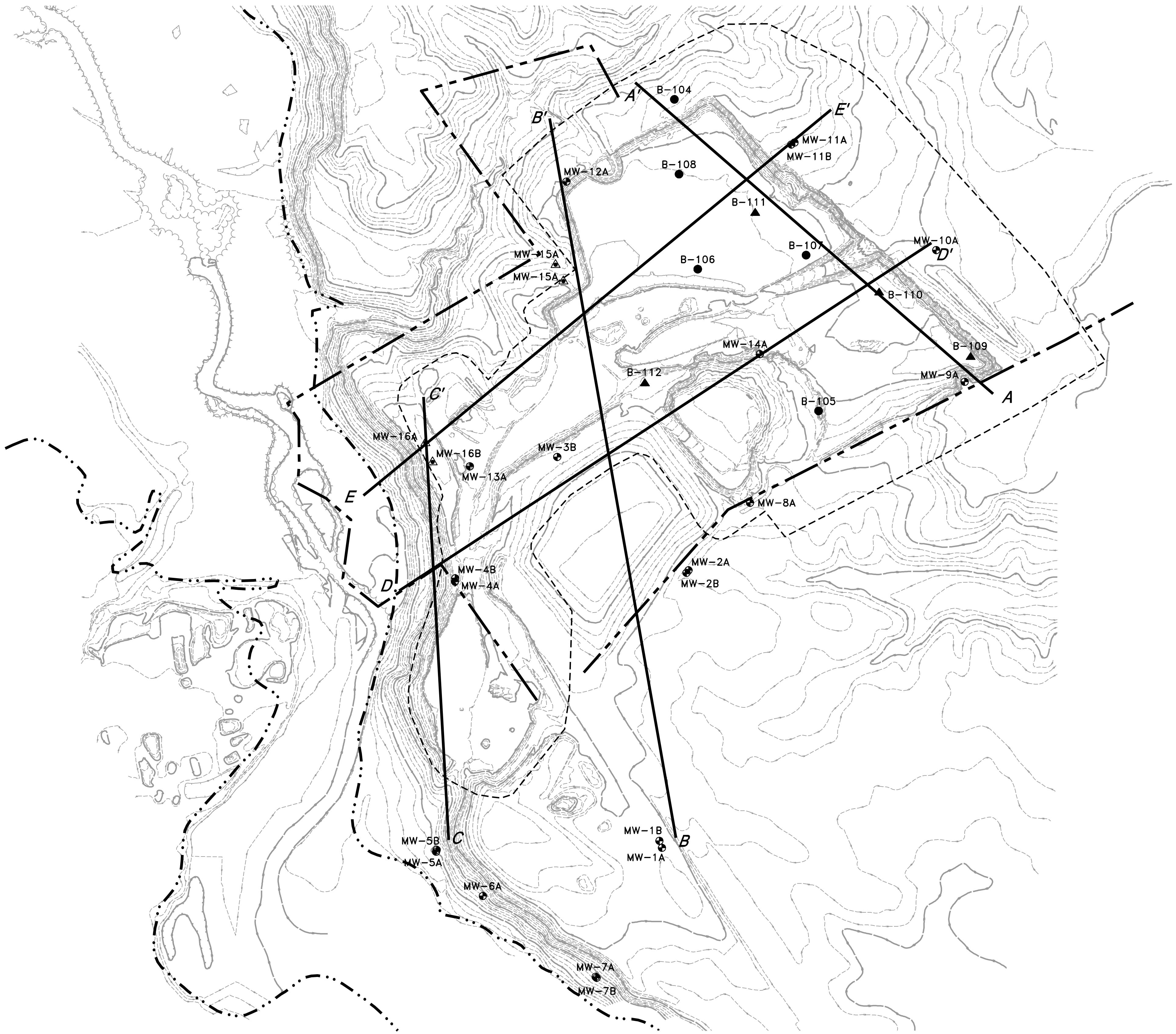

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ENVIRONMENTAL RESOURCES MANAGEMENT, INC.

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NOVEMBER 1, 2006

N

300 150 0 300

SCALE IN FEET

LEGEND:

PROPERTY LINE

LIMIT LINE (OF AUG. 2006 SURVEY)

EDGE OF TREES

FEMA 100 YEAR FLOOD LINE

MONITORING WELL

SOIL BORING - MARSHALL ENGINEERING

SOIL BORING - ERM

MONITORING WELL - ERM

A — A' CROSS SECTIONS

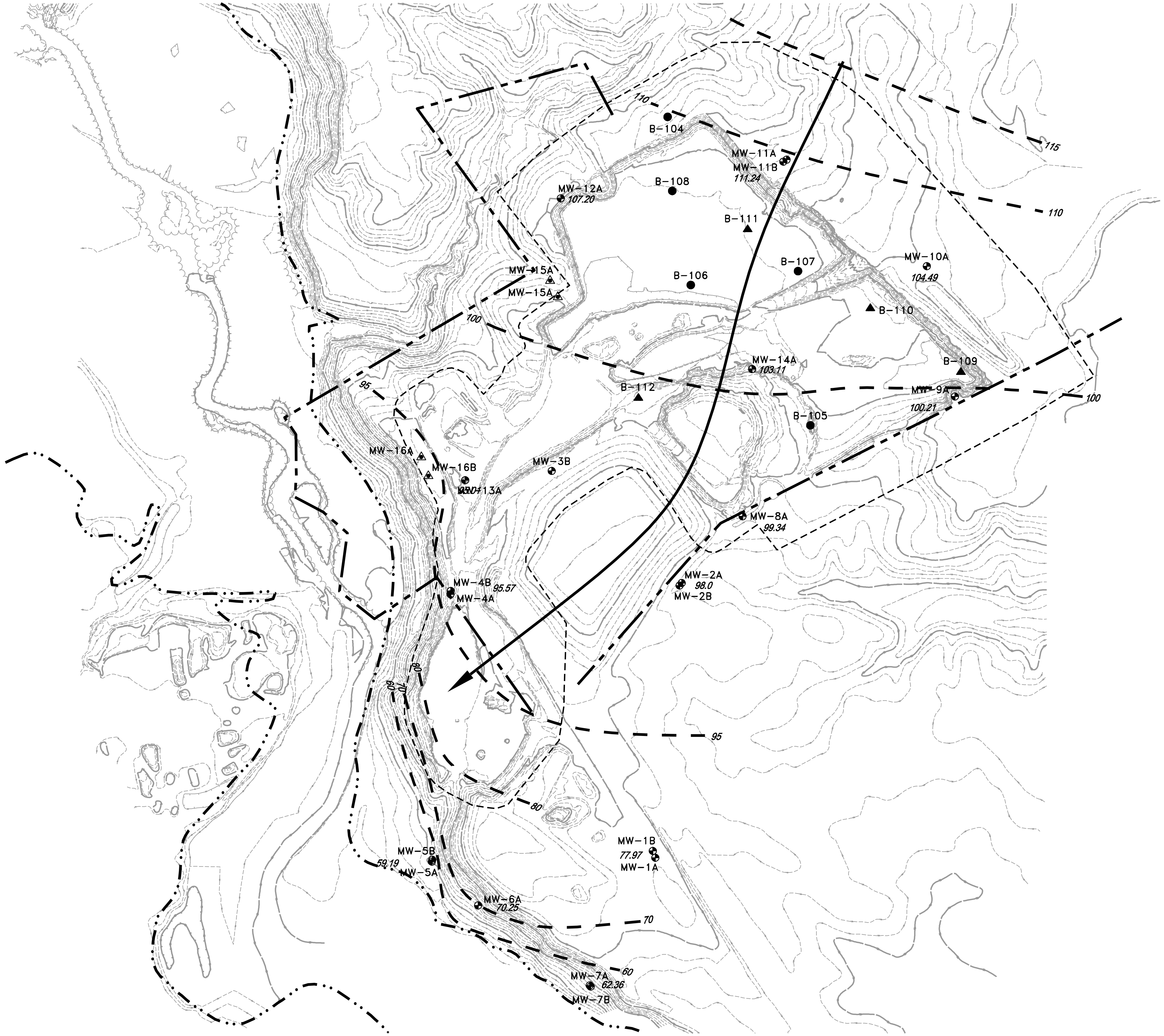
FIGURE 11

TOPOGRAPHIC MAP WITH CROSS SECTION LOCATIONS

TOLSON RUBBLE LANDFILL

PHASE II SITE GEOLOGY REPORT

CROFTON, MARYLAND



ENVIRONMENTAL RESOURCES MANAGEMENT, INC.

ERM

NOVEMBER 1, 2006

N

300 150 0 300

SCALE IN FEET

LEGEND:

PROPERTY LINE	MONITORING WELL
LIMIT LINE (OF AUG. 2006 SURVEY)	SOIL BORING - MARSHALL ENGINEERING
EDGE OF TREES	SOIL BORING - ERM
FEMA 100 YEAR FLOOD LINE	MONITORING WELL - ERM
	95 INFERRED GROUNDWATER CONTOUR (FEET)
	99.34 GROUNDWATER ELEVATION (FEET)
	GROUNDWATER FLOW DIRECTION

FIGURE 12
GROUNDWATER POTENTIOMETRIC SURFACE (DEPRESSED CONDITIONS) - JULY 2002
TOLSON RUBBLE LANDFILL
PHASE II SITE GEOLOGY REPORT
CROFTON, MARYLAND

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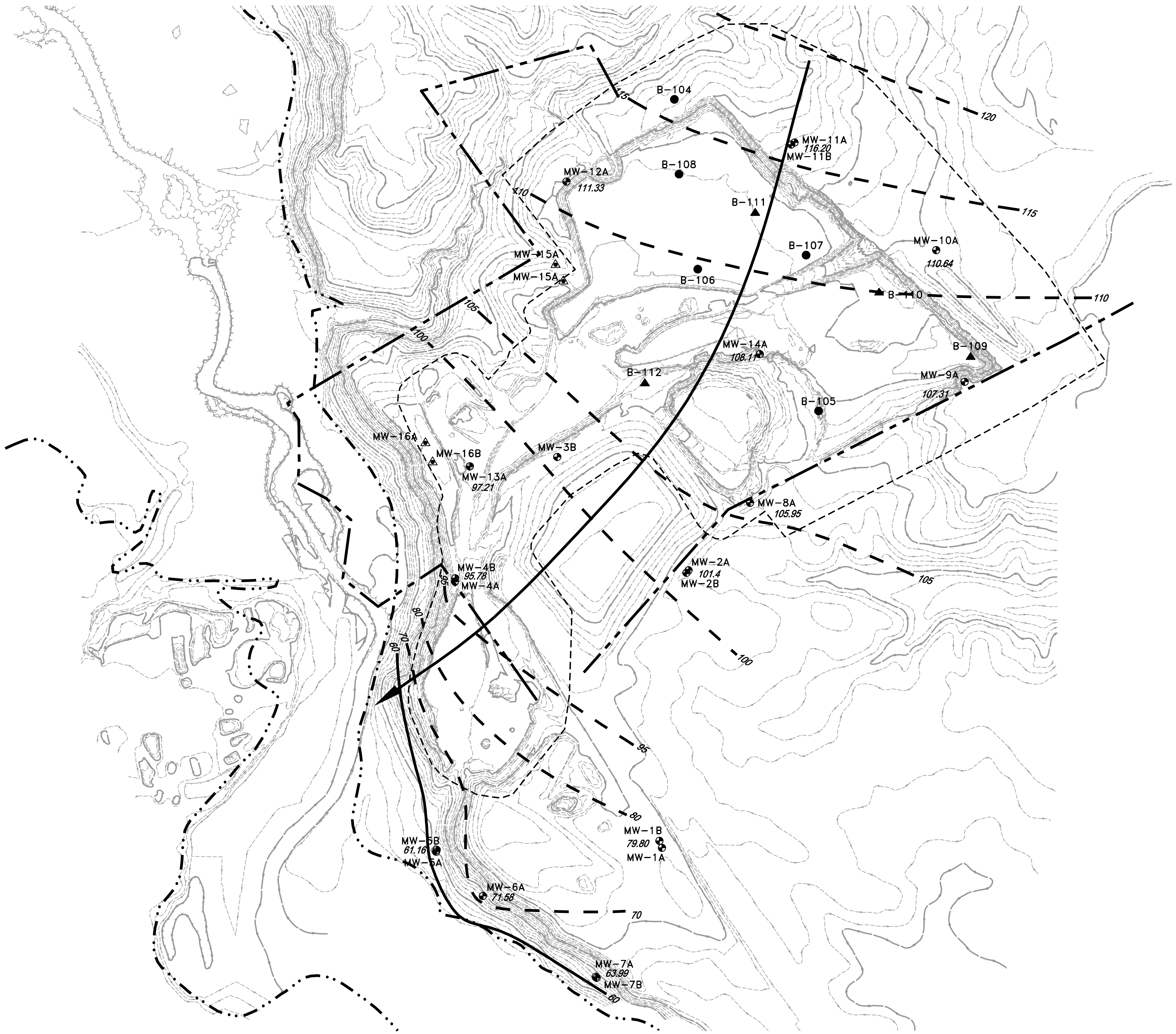

ENVIRONMENTAL RESOURCES MANAGEMENT, INC.

ERM

NOVEMBER 1, 2006

N

300 150 0 300

SCALE IN FEET

LEGEND:

PROPERTY LINE

LIMIT LINE (OF AUG. 2006 SURVEY)

EDGE OF TREES

FEMA 100 YEAR FLOOD LINE

MONITORING WELL

SOIL BORING - MARSHALL ENGINEERING

SOIL BORING - ERM

MONITORING WELL - ERM

95 INFERRED GROUNDWATER CONTOUR (FEET)

63.99 GROUNDWATER ELEVATION (FEET)

GROUNDWATER FLOW DIRECTION

FIGURE 13
GROUNDWATER POTENTIOMETRIC SURFACE (ELEVATED CONDITIONS) - JANUARY 2004
TOLSON RUBBLE LANDFILL
PHASE II SITE GEOLOGY REPORT
CROFTON, MARYLAND

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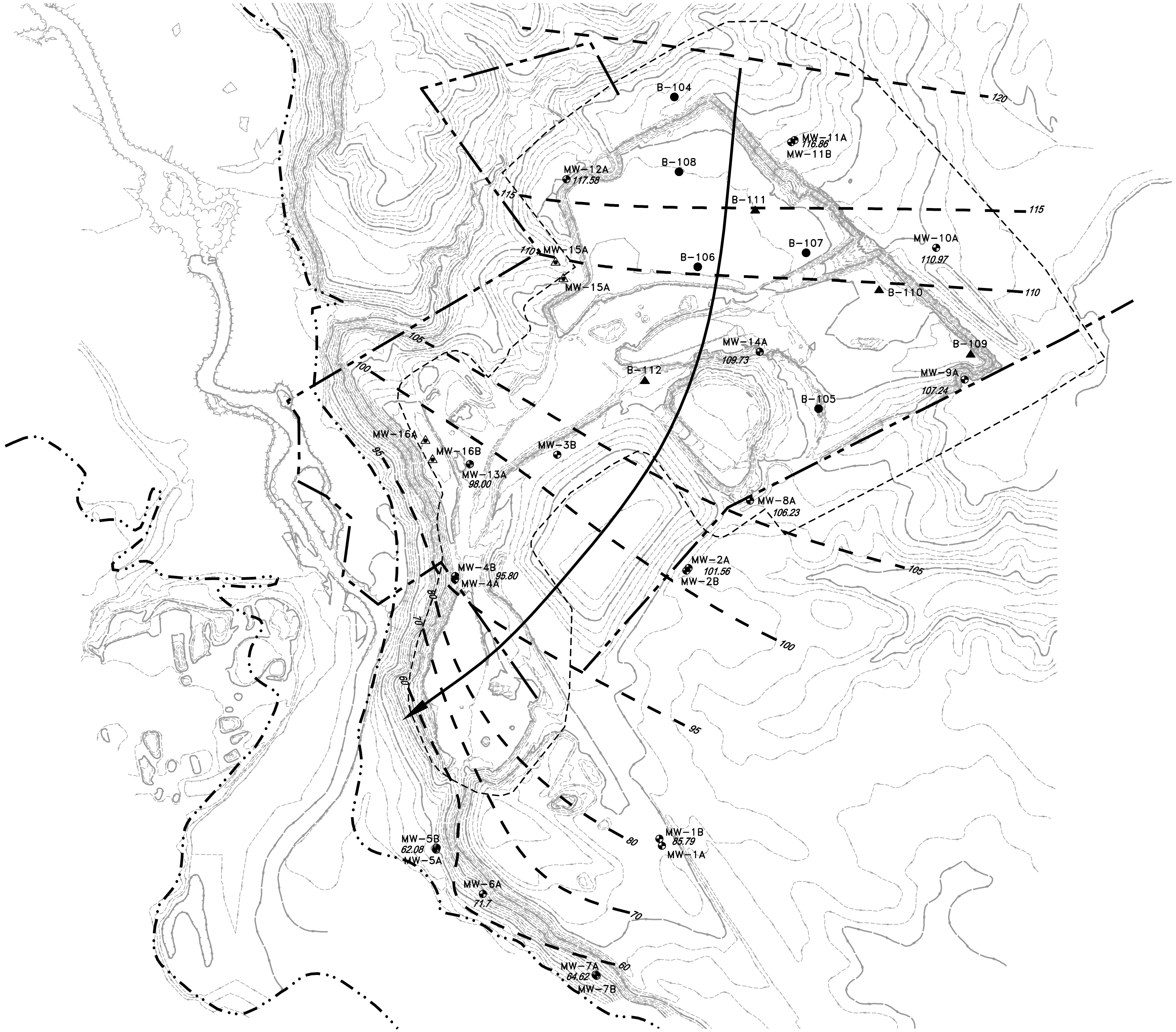


ENVIRONMENTAL RESOURCES MANAGEMENT, INC.

ERM

NOVEMBER 1, 2006

N

300 150 0 300

SCALE IN FEET

LEGEND:

	PROPERTY LINE
	LIMIT LINE (OF AUG. 2006 SURVEY)
	EDGE OF TREES
	FEMA 100 YEAR FLOOD LINE
	MONITORING WELL
	SOIL BORING - MARSHALL ENGINEERING
	SOIL BORING - ERM
	MONITORING WELL - ERM
95	INFERRED GROUNDWATER CONTOUR (FEET)
85.79	GROUNDWATER ELEVATION (FEET)
	GROUNDWATER FLOW DIRECTION

FIGURE 14
GROUNDWATER POTENTIOMETRIC SURFACE (MAXIMUM CONDITIONS) - 2002-2004

TOLSON RUBBLE LANDFILL
PHASE II SITE GEOLOGY REPORT
CROFTON, MARYLAND

G:\CAD\Drawings\Tolson Landfill\0052940\A210.dwg

Tables

Table 1. Comprehensive Monitoring Well List

Reference Well Number	Anne Arundel County Assigned Well Number	Alternative Well Number	Total Depth (feet bgs)	Date Installed	Gradient	Aquifer	Elevation (feet amsl)	July 2002 Depth to Groundwater (DTGW)	July 2002 Groundwater Elevation (feet amsl)	February 2004 DTGW	January 2004 Groundwater Elevation (feet amsl)	Lowest Recorded Depth to Water (DTW) (2002-2004)	Highest Reported Elevation (feet amsl)
MW-1A	AA-81-5756		83	1/6/1986	upward	Shallow	155.82	77.97	77.85	76.02	79.80	70.68	85.79
MW-1B	AA-81-5779		148	1/20/1986	upward	Deep	154.59	73.97	80.62	70.05	84.54		
MW-2A	AA-88-8130		148	12/30/1985	upward	Deep	145.41	90.18	55.23	87.65	57.76		
MW-2B	AA-88-9051		58	1/14/1986	upward	Shallow	147.33	49.42	97.91	45.90	101.43	45.77	101.56
MW-3A	AA-81-5757		142	1/15/1986	cross	Deep							
MW-3B [1.]	AA-81-5452			Abandoned									
MW-3B [2.]	AA-94-2905		150	8/6/1998	cross	Deep	159.75	104.30	55.45	102.08	57.67		
MW-4A	AA-81-5755		61	12/30/1985	downward	Shallow	149.38	53.81	95.57	53.60	95.78	53.58	95.97
MW-4B	AA-81-5780		146	1/13/1986	downward	Deep	151.17	98.95	52.22	96.74	54.43		
MW-5A	AA-81-5831		25	1/15/1986	downward	Shallow	80.01	20.82	59.19	18.85	61.16	17.93	62.08
MW-5B	AA-81-5454		60	1/15/1986	downward	Deep	78.27	26.65	51.62	24.58	53.69		
MW-6A	AA-81-5832		35	12/24/1995	cross	Shallow	91.70	21.45	70.25	20.12	71.58	19.99	71.71
MW-6B [3.]													
MW-7A	AA-81-5830		48	1/22/1986	cross	Shallow	96.12	33.76	62.36	32.13	63.99	31.50	64.62
MW-7B	AA-81-5453		112	1/22/1986	cross	Deep	95.43	46.71	48.72	41.60	53.83		
MW-8A	AA-93-0268	57	50	1/4/1995	upward	Shallow	144.22	44.88	99.34	38.27	105.95	37.99	106.23
MW-9A	AA-93-0265	55	85	1/4/1995	upward	Shallow	180.86	80.65	100.21	73.55	107.31	73.62	107.24
MW-10A	AA-93-0266	54	100	1/4/1995	upward	Shallow	198.22	93.73	104.49	87.58	110.64	87.25	110.97
MW-11A	AA-93-0264	53	80	1/3/1995	upward	Shallow	185.22	74.98	110.24	69.02	116.20	68.36	116.86
MW-11B [4.]	AA-92-1985		157	2/3/1995	upward		185.50	118.61	66.89	115.38	70.12		
MW-12A	AA-93-0262	52	53.5	12/26/1994	upward	Shallow	151.73	44.53	107.20	40.40	111.33	34.15	117.58
MW-13A	AA-93-0263	51	67.5	12/23/1994	downward	Shallow	158.06	63.05	95.01	60.85	97.21	60.06	98.00
MW-14A	AA-93-0267	56	58		upward	Shallow	154.96	51.85	103.11	46.85	108.11	45.23	109.73
MW-15A [5.]			**45**	**9/5/2006**	**downward**	**Shallow**	**140 [6.]**	**30.52**	110 [7.]				
MW-15B			**160**	**9/8/2006**	**downward**	**Deep**	**140 [6.]**	**70.00**	70 [7.]				
MW-16A			**68**	**8/29/2006**	**downward**	**Shallow**	**150 [6.]**	**65.27**	85 [7.]				
MW-16B			**150**	**8/31/2006**	**downward**	**Deep**	**152 [6.]**	**95.60**	57 [7.]				

Notes:

1. Former well abandoned on 8/4/1998; water well abandonment sealing report provided in Appendix C.
2. Replacement well for AA-81-5442, installed on 8/6/1998; well completion report provided in Appendix C.
3. Well not installed.
4. Well re-drilled deeper, formerly MW-11B installed on 10/05/1994; both well completion reports provided in Appendix C.
5. Items in **BOLD** are newly-installed wells.
6. Estimated elevations; awaiting final survey data.
7. Estimated elevations based on depth to water measurements from 9/21/2006.

Table 2. Generalized Lithology in Anne Arundel County [1]

System	Series	Group	Formation	Lithology	Hydrologic Character	General Character
Quaternary	Pleistocene	Columbia			Confining bed in most places. Poor aquifer in some places.	Sand, gravel, silt, and clay.
Tertiary	Miocene	Chesapeake	Calvert		Poor aquifer in places.	Sandy clay and fine sand, fossiliferous; diatomaceous earth.
	Eocene	Pamunkey	Nanjemoy		Confining bed	Sand, with clayey layers, glauconitic.
			Marlboro Clay 1/		Confining bed	Clay, plastic, pale-red.
	Paleocene		Aquia		Aquifer	Glauconitic, greenish to brown sand with indurated or "rock" layers in middle and basal parts.
			Brightseat		Confining bed in most places. Poor aquifer in some places.	Sand, silt, and clay, olive gray to black, glauconitic.
Cretaceous	Upper Cretaceous		Monmouth		Poor aquifer in places.	Sand, silty to fine, with some glauconite.
			Matawan		Confining bed	Silt and fine sand, clayey, dark gray to black, glauconitic.
			Magothy		Aquifer	Sand, light gray to white, with interbedded thin layers of organic black clay. Contains pyrite and lignite. Lower part composed of interbedded layers of sand and white to light gray clay. Layers of coarse sand and gravel near the base.
	Lower Cretaceous	Potomac	Patapsco		Confining bed Aquifer Confining bed Aquifer Confining bed Aquifer	Sand layers interbedded with thick clay layers. Color variegated but chiefly hues of red and yellow.
			Arundel Clay		Confining bed	Clay, red brown, and gray, contains some ironstone nodules and plant remains.
			Patuxent		Aquifer ? Confining bed Aquifer ?	Sand, gray and yellow, with interbedded clay; kaolinized feldspar and lignite common. Locally clay layers predominate.
Lower Paleozoic (?) or Precambrian			Basement complex		Confining bed	Probably gneiss, granite, gabbro, metagabbro, quartz diorite, and granitized schist.

Notes:

1. From *Anne Arundel County Groundwater Information, United States Geological Survey,* 1976.

Table 3. Summary of Soil Physical Properties

Sample Number	Boring and Sample Depth (feet)	USCS Classification	Atterberg Limits			Particle Size (percentage)					
			PL	LL	PI	Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay
CU-1	B-112: 30 MW-12B: 55	CL	19	38	19	0.9	0.4	1.3	2.3	24.5	70.6
CU-2	B-112: 65 B-111: 40	ML-CL	14	21	7	0.0	0.2	2.1	19.3	27.0	51.4
CU-3	B-109: 55-65	CL-ML	17	25	8	0.0	0.1	1.1	13.6	33.0	52.2
UA-1	B-110: 40 B-111: 25	ML				2.8	0.5	9.8	50.3	20.2	16.4
UA-2	B-109: 50 B-112: 25-50	SP-SM				0.3	0.8	37.0	54.0	7.9	0.0
LA-1	MW-12B: 155	SM				0.0	0.2	6.2	74.3	19.3	0.0

Notes:
CU = Confining Unit
UA = Upper Aquifer
LA = Lower Aquifer

Table 4. Summary of Well Physical and Performance Data

Anne Arundel County Assigned Permit Number	Coordinates Northing GRID 27	Easting GRID 27	Nearest Street Address	Side of the Road	Distance from Roadway (feet)	Total Depth of Well (feet amsl)	Pumping Rate (gallons per minute)	Water Level Prior to Pumping (feet)	Water Level during Pumping (feet)	Screen Type	Top of Screen Elevation (feet amsl)	Bottom of Screen Elevation (feet amsl)	Lot Number	Well Use [1.]	Well Completion Date
AA943297	436,000	881,000	1250 PATUXENT RD	E	400	37	15	15	20	PL	32	37		DW	11/4/1998
AA818761	436,000	881,000	1196 PATUXENT RD	W	140	125	10	25	40	PL	120	125	1	DW	7/30/1987
AA942136	436,000	881,000	1198 PATUXENT RD	W	200	115	15	30	40	PL	110	115		DW	11/10/1997
AA930438	436,000	885,000	1072 MD RTE 3 SOUTH	W	75	108	10	66	80	PL	98	108	2	DW	7/24/1995
AA882615	437,000	881,000	1200 PATUXENT RD	W	105	114	20	40	50	PL	109	114		DW	5/11/1989
AA948622	437,000	881,000	1293 MEYERS STATION	E	203	231	25	35	45	ST	226	231	4	DW	11/8/2002
AA948130	437,000	885,000	2633 EVERGREEN RD	E	15	275	40	68	95	PL	268	275	C	DW	7/23/2002
AA948131	437,000	885,000	2637 EVERGREEN RD	E	15	245	50	82	115	PL	238	245	A	DW	7/23/2002
AA811817	437,000	885,000	JACKSON RD	E	55	85	15	50	60	PL	80	85		DW	6/15/1983
AA921716	437,000	886,000	2647 EVERGREEN RD	W	170	80	20	55	60	PL	75	80	13	DW	8/22/1994
AA942345	437,000	886,000	1427 JACKSON RD	E	30	180	25	60	80	PL	170	180		DW	2/9/1998
AA885355	438,000	885,000	EVERGREEN RD		15	152	20	75	95	PL	145	152	14	DW	11/15/1990
AA819454	439,000	884,000	EVERGREEN RD	W	75	200	45	90	110	PL	193	200		DW	10/2/1987
AA948194	439,000	885,000	2635 EVERGREEN RD	E	15	235	50	82	110	PL	228	235	B	DW	8/13/2002
AA882086	440,000	884,000	637 ROBEY LA	S	15	135	15	95	115	PL	128	135		DW	3/1/1989
AA737033	440,000	885,000	WAUGH CHAPEL RD	W	120	122	15	65	75	PL	117	122		DW	3/15/1977
AA942922	440,000	885,000	JACKSON RD	N	300	170	15	77	100	PL	160	170	7-10	DW	8/18/1998
AA730911	440,000	885,000	WAUGH CHAPEL RD	S	350	110	15	65	70	PL	105	110		DW	3/8/1973
AA720031	440,000	885,000	TIMBER RIDGE DR	S	15	85	12	50	55	PL	80	85		DW	7/12/1971
AA736875	440,000	885,000	TIMBER RIDGE DR	S	70	75	20	35	40	PL	70	75	97	DW	1/12/1977
AA720703	440,000	885,000	WAUGH CHAPEL RD	N	50	125	14	40	68	PL	118	125	5	DW	4/4/1972
AA946573	441,000	884,000	2664 EVERGREEN RD		310	180	30	100	120	PL	170	180	7-10	DW	5/5/2001
AA812534	442,000	885,000	MAYTIME DR	E	50	235	20	150	165	PL	225	235		DW	11/14/1983
AA742451	444,000	883,000	FRANCIS STA RD	N	150	145	15	100	105	PL	140	145		DW	10/17/1980
AA742973	444,000	884,000	FRANCIS STATION RD	S	50	225	15	125	135	PL	220	225		DW	4/23/1981
AA811538	442,000	887,000	HAWKINS DR	W	45	95	10	64	73	PL	88	95	63	DW	4/28/1983
AA817886	444,000	884,000	FRANCIS STATION RD	W	200	220	15	120	140	PL	215	220		DW	1/21/1987
AA818066	439,000	887,000	BRICKHEAD RD	W	1,000	122	10	60	75	PL	117	122		DW	3/5/1987
AA882086	440,000	884,000	637 ROBEY LA	S	15	135	15	95	115	PL	128	135		DW	3/1/1989
AA889968	439,000	888,000	2542 BRICKHEAD RD	N	600	105	10	52	80	PL	100	105		DW	7/21/1993
AA940846	443,000	887,000	1182 PATUXENT RD	W	100	196	15	20	30	PL	191	196	4	DW	9/16/1996
AA948194	439,000	885,000	2635 EVERGREEN RD	E	15	235	50	82	110	PL	228	235	B	DW	8/13/2002
AA951025	443,000	882,000	1600 MEYERS STATION	N	135	249	30	10	25	ST	244	249		DW	4/14/2005
AA813858	438,000	885,000	MAYTIME DR	E	15	195	35	105	125	PL	188	195		F	6/3/1985
AA812053	443,000	886,000	DORSEY RD	W	15	82	20	42	60	PL	75	82		I	8/9/1983
AA819166	443,427	884,227	FRANCIS STATION RD	E	30	216	1	105	105	PL	196	216		I	10/26/1987
AA889363	439,000	887,000	BRICKHEAD RD	N	15	170	50	70	120	PL	163	170		I	3/22/1993
AA930277	436,000	883,000	CONWAY RD	N	300	20				PL	10	20		T	1/9/1995
AA948958	436,000	885,000	CONWAY RD	N	30	40				PL	30	40		T	3/25/2003
AA948957	436,000	885,000	CONWAY RD	N	650	23				PL	13	23		T	4/24/2003
AA815454	437,000	882,000	CAPITOL RACEWAY RD	N	1,000	60	1	1	1	PL	50	60		T	1/16/1986
AA815452	437,000	883,000	CAPITOL RACEWAY RD	N	1,000	142	1	1	1	PL	132	142		T	1/24/1986
AA815453	437,000	883,000	CAPITOL RACEWAY RD	N	1,000	112	1	1	1	PL	87	97		T	1/16/1986
AA811315	437,000	883,000	CAPITAL RACEWAY RD	W	1,000	38	1	28	35	PL	28	38		T	1/28/1983
AA815780	437,000	884,000	CAPITAL RACEWAY RD	N	1,000	146	1	1	1	PL	136	146		T	1/23/1986

Table 4. Summary of Well Physical and Performance Data

Anne Arundel County Assigned Permit Number	Coordinates		Nearest Street Address	Side of the Road	Distance from Roadway (feet)	Total Depth of Well (feet amsl)	Pumping Rate (gallons per minute)	Water Level Prior to Pumping (feet)	Water Level during Pumping (feet)	Screen Type	Top of Screen Elevation (feet amsl)	Bottom of Screen Elevation (feet amsl)	Lot Number	Well Use [1.]	Well Completion Date
	Northing GRID 27	Easting GRID 27													
AA813857	438,000	882,000	CAPITAL RACEWAY RD	W	1,500									T	
AA815832	438,000	882,000	EVERGREEN RD	W	2,000	50	1	1	1	PL	40	50		T	1/6/1986
AA815831	438,000	882,000	EVERGREEN RD	W	2,000	25	1	1	1	PL	15	25		T	12/30/1985
AA815830	438,000	882,000	EVERGREEN RD	W	2,000	35	1	1	1	PL	25	35		T	12/24/1985
AA888130	438,000	882,000	CAPITAL RACEWAY RD	E	15	147	20	88	110	PL	140	147		T	12/31/1992
AA815451	438,000	882,000	CAPITAL RACEWAY RD	N	1,000	148	1	1	1	PL	138	148		T	1/24/1986
AA810182	438,000	883,000	EVERGREEN RD	W	1,600	55	1	1	1	PL	50	55		T	2/26/1982
AA815779	438,000	883,000	CAPITAL RACEWAY RD	N	1,000	150	1	1	1	PL	140	150		T	1/23/1986
AA815756	438,000	883,000	EVERGREEN RD	W	800	83	1	1	1	PL	73	83		T	1/6/1986
AA810185	438,000	884,000	EVERGREEN RD	W	1,100	76	1	1	1	PL	71	76		T	3/10/1982
AA810186	438,000	884,000	EVERGREEN RD	W	1,000	77	1	1	1	PL	72	77		T	3/12/1982
AA810183	438,000	885,000	EVERGREEN RD	W	1,700	65	1	1	1	PL	60	65		T	3/10/1982
AA810184	438,000	885,000	EVERGREEN RD	W	1,500	80	1	1	1	PL	75	80		T	3/8/1982
AA815755	439,000	882,000	EVERGREEN RD	W	1,000	61	1	1	1	PL	51	61		T	12/30/1985
AA811314	439,000	882,000	CAPITAL RACEWAY RD	W	1,500	60	1	45	50	PL	45	55		T	1/28/1983
AA811313	439,000	883,000	EVERGREEN RD	N	500	34	1	25	30	PL	22	32		T	1/28/1983
AA815758	439,000	884,000	EVERGREEN RD	W	100	58	1	1	1	PL	48	58		T	12/30/1985
AA811316	439,000	884,000	EVERGREEN RD	W	200	35	1	27	34	PL	25	35		T	1/29/1983
AA815757	439,000	884,000	EVERGREEN RD	W	600	49	1	1	1	PL	39	49		T	12/31/1985
AA930417	439,000	884,000	EVERGREEN RD	N	500									T	
AA888929	439,000	885,000	MD ROUTE 3	N	35	25	1	1	1					T	1/13/1993
AA811469	439,000	886,000	BRICKHEAD RD	S	600	20	1	8	8	PL	15	20		T	2/22/1983
AA944482	439,000	886,000	BRICKHEAD RD	N	700									T	
AA889051	440,000	882,000	CAPITAL RACEWAY RD	W	15	56	1	51	56	PL	46	56		T	12/31/1992
AA942905	440,000	883,000	CAPITAL RACEWAY RD	N	15	130	20	104	125	PL	140	150		T	8/6/1998
AA735838	440,000	885,000	WAUGH CHAPEL RD	S	60	980	200	118	155	ST	748	758		T	10/29/1976
AA735837	440,000	885,000	WAUGH CHAPEL RD	S	60	985	250	114	160	ST	730	755		T	10/29/1976
AA930262	441,000	884,000	MAYTIME DR	W	3,228	55				PL	45	55		T	1/3/1995
AA930266	441,000	884,000	MAYTIME DR	W	528	103				PL	90	100		T	1/4/1995
AA930265	441,000	884,000	MAYTIME DR	S	2,112	88				PL	75	85		T	1/4/1995
AA930264	441,000	884,000	MAYTIME DR	W	528	83				PL	70	80		T	1/3/1995
AA930267	441,000	884,000	MAYTIME DR	W	3,228	58				PL	45	55		T	1/3/1995
AA930268	441,000	884,000	MAYTIME DR	W	3,228	51				PL	38	48		T	1/4/1995
AA930263	441,000	884,000	MAYTIME DR	W	4,224	70				PL	58	68		T	1/4/1995
AA944486	441,000	886,000	WAUGH CHAPEL RD	S	60								MW-17	T	
AA940852	441,000	886,000	PATUXENT RD	N	380								MW3	T	
AA940858	441,000	886,000	PATUXENT RD	N	175								MW7	T	
AA940856	442,000	886,000	PATUXENT RD	N	275								MW5	T	
AA811314	439,000	882,000	CAPITAL RACEWAY RD	W	1,500	60	1	45	50	PL	45	55		T	1/28/1983
AA811466	439,000	888,000	BRICKHEAD RD	N	400	20	1	1	1	PL	15	20		T	2/22/1983
AA818380	439,000	888,000	BRICKHEAD RD	N	175	39	1	1	1	PL	29	39		T	5/1/1987
AA818381	439,000	888,000	BRICKHEAD RD	N	150	41	1	1	1	PL	31	41		T	5/5/1987
AA818382	439,000	888,000	BRICKHEAD RD	N	100	43	1	1	1	PL	33	43		T	5/6/1987
AA818383	439,000	888,000	BRICKHEAD RD	S	120									T	
AA818384	439,000	888,000	BRICKHEAD RD	S	150									T	

Table 4. Summary of Well Physical and Performance Data

Anne Arundel County Assigned Permit Number	Coordinates: Northing GRID 27	Coordinates: Easting GRID 27	Nearest Street Address	Side of the Road	Distance from Roadway (feet)	Total Depth of Well (feet amsl)	Pumping Rate (gallons per minute)	Water Level Prior to Pumping (feet)	Water Level during Pumping (feet)	Screen Type	Top of Screen Elevation (feet amsl)	Bottom of Screen Elevation (feet amsl)	Lot Number	Well Use [1.]	Well Completion Date
AA883008	442,000	888,000	PATUXENT RD	E	1,130									T	
AA883009	442,000	888,000	PATUXENT RD	E	1,130									T	
AA883010	443,000	888,000	PATUXENT RD	E	1,200									T	
AA883011	442,000	887,000	PATUXENT RD	E	1,200									T	
AA883012	442,000	888,000	PATUXENT RD	E	10									T	
AA883013	443,000	887,000	PATUXENT RD	E	10									T	
AA883014	443,000	886,000	PATUXENT RD	E	5									T	
AA883016	442,000	888,000	PATUXENT RD	E	1,100									T	
AA883017	442,000	887,000	PATUXENT RD	E	2									T	
AA883018	443,000	887,000	PATUXENT RD	E	2									T	
AA883019	443,000	887,000	PATUXENT RD	E	1,100									T	
AA883020	443,000	888,000	PATUXENT RD	E	2,000									T	
AA883021	442,000	888,000	PATUXENT RD	E	2,500									T	
AA889051	440,000	882,000	CAPITAL RACEWAY RD	W	15	56	1	51	56	PL	46	56		T	12/31/1992
AA930263	441,000	884,000	MAYTIME DR	W	4,224	70				PL	58	68		T	1/4/1995
AA930416	439,000	887,000	EVERGREEN RD	N	500	58				PL	43	58		T	2/25/1995
AA940852	441,000	886,000	PATUXENT RD	N	380								MW3	T	
AA940853	443,000	886,000	W B & A RAILROAD BED	E	135								MW1	T	
AA940854	444,000	886,000	WB & A RAILROAD BED	E	190								MW2	T	
AA940855	442,000	887,000	PATUXENT RD	N	145								MW4	T	
AA940857	442,000	887,000	PATUXENT RD	N	425								MW6	T	
AA940859	442,000	887,000	PATUXENT RD	N	230								MW8	T	
AA940860	441,000	887,000	PATUXENT RD	N	370								MW9	T	
AA940861	442,000	887,000	PATUXENT RD	N	520								MW10	T	
AA940862	442,000	888,000	PATUXENT RD	N	645								MW11	T	
AA940863	442,000	888,000	PATUXENT RD	N	915								MW12	T	
AA944483	439,000	887,000	BRICKHEAD RD	N	1,250									T	
AA944484	439,000	887,000	BRICKHEAD RD	S	550	64				PL	54	64		T	8/31/1999
AA944485	440,000	887,000	WAUGH CHAPEL RD	S	700									T	

Notes:

1. Abbreviations:
   - DW= Drinking water well for domestic or public use.
   - I= Industrial, commercial, state and federal government (require appropriations permit).
   - F= Farm (livestock watering and agricultural irrigation) well.
   - T = Test, observation, or monitoring well.
   - PL = Plastic Screen.
   - ST = Steel Screen.

Table 5. Results of Hydraulic Conductivity Tests

Reference Well Number	Anne Arundel County Assigned Well Number	Total Depth (feet bgs)	Date Installed	Gradient	Aquifer	Hydraulic Conductivity Slug-Test 1 (feet/day)	Hydraulic Conductivity Slug-Test 2 (feet/day)
MW-1A	AA-81-5756	83	1/6/1986	upward	Shallow	0.7	
MW-2B	AA-88-9051	148	1/14/1986	upward	Shallow	0.5	0.9
MW-5A	AA-81-5831	25	1/15/1986	downward	Shallow	1	1
MW-6A	AA-81-5832	35	12/24/1995	cross	Shallow	3	3
MW-9A	AA-93-0265	85	1/4/1995	upward	Shallow	8	10
MW-11A	AA-93-0264	80	1/3/1995	upward	Shallow	10	20
MW-12A	AA-93-0262	53.5	12/26/1994	upward	Shallow	3	4
MW-15A [1.]		45	9/5/2006	downward	Shallow	4	
		Shallow Aquifer Geometric Mean Hydraulic Conductivity (feet/day)					**2.8360**

Notes:

1. Newly-installed well.

Table 6. Projected Groundwater Velocities and Travel Time to Receptor

Geologic Formation	Hydraulic Conductivity (feet/day)	Gradient	Porosity	Velocity (feet/day)	Travel Time to Human Receptor [1.]	Source of Hydraulic Conductivity in Calculation
Shallow Aquifer	1	0.0078	25	0.031	105	Intermediate Estimate of Hydraulic Conductivity Based on Particle-Size Distribution (Shallow Aquifer)
Shallow Aquifer	2.86	0.0078	25	0.09	36	On-site Slug Tests
Shallow Aquifer	20	0.0078	25	0.62	5.2	Conservative Estimate of Hydraulic Conductivity Based on Particle-Size Distribution (Shallow Aquifer)
Confining Unit	0.001	0.59	40	0.0014	57	Conservative Estimate of Hydraulic Conductivity Based on Particle-Size Distribution (Confining Unit)

Notes:

[1.] 1,200-foot lateral migration pathway through unconfined aquifer and 30-foot vertical migration through confining unit.

Appendices

Appendix A
Anne Arundel County
Letter

ANNE
ARUNDEL
COUNTY
MARYLAND
County Executive Janet S. Owens

DEPARTMENT OF PUBLIC WORKS
2662 RIVA ROAD
ANNAPOLIS, MARYLAND 21401

August 28, 2002

Edward M. Dexter, II
Chief, Field Operations and Compliance Division
Solid Waste Program, MDE/WAS
2500 Broening Highway
Baltimore, Maryland 21224

RE: Refuse Disposal Permit Application Documents

Dear Mr. Dexter:

The purpose of this letter is to respond to Mr. Gorski's request for information (see enclosure) about the proposed rubble landfill formerly known as the Cunningham Excavation Rubble Landfill, Inc. (CEI)

As indicated, Mr. Gorski represents Tolson and Associates, L.L.C. the current legal entity seeking a Refuse Disposal Permit from the Maryland Department of the Environment. It is our understanding that the application previously submitted by CEI has not changed in size or scope, and the facility is to be located on the same parcel of land occupied by CEI. Accordingly, all the operating conditions specified in the County Solid Waste Management Plan that applied to CEI in the past, will now automatically apply to Tolson and Associates, L.L.C. Any updates to the Solid Waste Management Plan will reflect the ownership change, as indicated in his letter.

Therefore, this letter serves as confirmation that Tolson and Associates, L.L.C. proposed Rubble Landfill in the Crofton Area of Anne Arundel County meets all applicable zoning requirements and conforms to the current Solid Waste Management Plan.

Mr. Edward M. Dexter, II
August 29, 2002
Page 2

If you require additional information or have any questions please call either Ronald Bowen at 410-222-7092 or Denis Canavan at 410-222-7450.

Sincerely,

Ronald E. Bowen

Ronald E. Bowen, P.E.
Director
Department of Public Works

Denis D. Canavan

Denis Canavan
Planning and Zoning Officer
Office of Planning and Zoning

TMS:emg

Enclosure

cc: Anthony Gorski, Schaller & Gorski L.L.P.

Appendix B
MDE March 2006 Letter
With Phase II Comments

MARYLAND DEPARTMENT OF THE ENVIRONMENT
1800 Washington Boulevard • Baltimore MD 21230-1719
MDE 410-537-3000 • 1-800-633-6101

Robert L. Ehrlich, Jr.
Governor

Michael S. Steele
Lt. Governor

Kendl P. Philbrick
Secretary

Jonas A. Jacobson
Deputy Secretary

March 30, 2006

Mr. William N. Tolson
Tolson & Associates, LLC
7 Willow Street
Annapolis MD 21401

Dear Mr. Tolson:

The Maryland Department of the Environment (the "Department") has completed its review of the reports entitled "Groundwater Monitoring Data Analysis and Supplemental Phase II Site Geology Report" and "Groundwater Monitoring Data Analysis" consisting of Part I of 2 and 2 of 2 for the proposed Tolson and Associates Rubble Landfill. The proposed rubble landfill is contiguous to the closed Cunningham Excavating Rubble Landfill located at the end of Capital Raceway Road in Crofton, Anne Arundel County, Maryland

The following comments are presented based on our review of the available information and discussions during the Phase II joint plan review meeting held on Tuesday, March 7, 2006. The Phase II Report will not be considered complete until all of the following comments are addressed and submitted to us for review and approval:

1. The revised report lacked a clear, current topographic map of the site depicting all pertinent features that are relevant to the site, a discussion of the geologic formations directly underlying the site, adequate bore logs to define the groundwater table and movement across the site, hydrologic relationship between the formations and characterization of each water bearing unit at the site. This is also true for the old Phase II Report prepared by Marshal Engineering. The topographic map must reflect existing conditions at the site.

2. A survey of all production wells including residential wells, within ½ mile of the site boundary must be included and each well located on the current topographic map, with a table developed that specifies all pertinent information such as well depth, screen type, productivity, lithology penetrated and water level as required under COMAR 26.04.07.15A(3).

3. An inventory of the wells on the site, including well abandonment reports for wells that no longer exist or an explanation of their status.

4. To determine groundwater elevations and stratigraphic correlations, the ground surface elevation of each boring and monitoring well as well as the elevation of the top of the well casing on each monitoring well must be established to provide a constant reference point for future water level measurements. The surveyed point at the top of each well casing must be permanently marked,

and the elevations surveyed must be measured to 0.01-foot precision and referenced to mean sea level datum. All wells and borehole locations need to be shown on the groundwater contour maps.

5. On page 4 of the previous Phase II Report received on January 17, 1995, it states that "the thickness of clay is estimated to be at least 50-feet based on all information available at this time this report was prepared". This clay layer is noted as being continuous on page 5 of the "Groundwater Monitoring Data Analysis and Supplemental Phase II Site Geology Report" under "Isopach Map Thickness of Soil Above the Perched Groundwater". The thickness and continuity of the clay soil across the site was not demonstrated in the previous or current report with geologic cross sections based on well logs.

6. The site investigation lacked complete lithology documentation through the entire borehole depths, sample analysis for varying depths that includes geotechnical test samples, summary of hydrogeologic tests conducted to evaluate the distribution of hydraulic conductivity and summary of test results.

7 The report should include aquifer test simulation using hydraulic conductivity tests from the geometric mean slug tests to determine the distribution of constituents.

8. The "Groundwater Monitoring Data Analysis and Supplemental Phase II Site Geology Report" lacks well-defined geologic cross sections in sufficient detail, orientation and number to clearly identify the subsurface conditions at the site. These cross sections should be based on available well data and accurately surveyed in the field.

9. Groundwater collected from the wells at the site must have interpretative analysis of the data with trend analysis of all the historic and current data. The interpretive trend analysis data should be evaluated and discussed individually for any MCL exceedances for contaminants in each well and the potential cause or reason that contributed to the exceedances.

10. Additional sampling is required to properly assess existing water quality at the site and sampling techniques should be evaluated to reduce turbidity.

11 Shop drawings figures 1 through 5 must be 24 inches wide and 36 inches long. The plans must be neatly folded and inserted in plastic covers so that the title of each plan can be read in place and incorporated into a ring binder fitting size 8.5 inch by 11 inch paper. The engineering plans and specifications for the proposed design must be prepared, signed, and sealed by a registered professional engineer.

12 Groundwater Elevation Table 1 lacks a column for highest observed or predicted water elevations. Please revise this column accordingly.

13. On Figure 5, monitoring well MW 12-A shows the liner system bottom at elevation 117.5' and the maximum recorded perched water elevation at 117.78' and monitoring well MW-11A with less than a 3-foot buffer to the highest observed groundwater table. MW 12-A looks to be

located within the footprint of Cell A, even though page 6 of the report says that "only monitoring well 14-A is situated in the proposed Rubble Landfill area". Figure 4 indicates three wells drilled within the footprint of the proposed fill area, not enough to accurately predict the groundwater elevations beneath the proposed site, especially since the northeast corner of the proposed footprint might lack the required 3-foot buffer to the groundwater.

14. The report lacks evaluation of all water bearing zones within 50 feet of the anticipated lowest elevation of the cell floor, and a discussion of the potential for horizontal and vertical movement of pollutants beneath the proposed site, based on hydraulic conductivity test results and existing water quality (COMAR 26.04.07.15A(9)). In addition, COMAR 26.04.07.15A(4) requires three separate groundwater contour maps for each distinct water bearing formation within 50 feet of the anticipated lowest elevation of the cell floor. The report should include a discussion and evaluation of the three water bearing zones mentioned in the report.

15. The groundwater chemistry report lacked discussion and hypothetical solute transport simulation for the three water bearing zones to predict down gradient movement of contaminants. The simulation must assume constant horizontal and vertical migration of contaminants within the aquifer using the geometric mean of slug tests conducted at the boreholes. Simulating the movement of volatile organic compounds is preferable since they are more mobile than other potentially harmful constituents.

16. All revised reports and drawings must reflect the name Tolson & Associates Rubble Landfill, not Cunningham Rubble Landfill.

Please refer to the document control number **2003-WRF-0580** when writing the Department regarding this application. If you have any questions concerning this matter, please contact Mr. Kassa Kebede, Head of the Construction and Maintenance Section, at (410) 537-3424.

Sincerely,

Martha Hynson

Martha Hynson, Chief
Field Operations & Projects Division

MH:KK.sm

cc: Mr. Tom Sprehe
Mr. James Pittman
Mr. Horacio Tablada

Appendix B
Response to MDE Comments
March 30, 2006

The MDE issued comments on the prior Phase II Site Geology Report on March 30, 2006. Direct responses to these comments and references to the location of the same information in this document, is addressed below in a question/answer format.

Comment No.1:

The revised report lacked a clear, current topographic map of the site depicting all pertinent features that are relevant to the site, a discussion of the geologic formations directly underlying the site, adequate bore logs to define the groundwater table and movement across the site, hydrologic relationship between the formations and characterization of each water bearing unit at the site. This is also true for the old Phase II Report prepared by Marshal Engineering. The topographic map must reflect existing conditions at the site.

Response:

Figure 3 presents the topography at the Tolson Rubble Landfill Site on August 2006. Sections 2 and 3 provide a description of the site as well as the underlying geology in both a regional and a site-specific context. Figures 6 through 10 provide a geologic interpretation through stratigraphic cross sections taken across the site.

Comment No. 2:

A survey of all production wells including residential wells, within ½ mile of the site boundary must be included each well located on the current topographic map, with a table developed that specifies all pertinent information such as well depth, screen type, productivity, lithology penetrated and water level as required under COMAR 26.04.07.15A(3).

Response No. 2:

A survey of all production wells is summarized on Table 4. The wells are plotted as reported by the MDE database search on Figure 1. The actual locations may be slightly different due to the scale resolution on the MDE database.

Comment No. 3:

An inventory of the wells on the site, including well abandonment reports for wells that no longer exist or an explanation of their status.

Response No. 3:

An inventory of all known on-site wells is included in Table 1. Appendix C provides boring logs and abandonment reports (if appropriate) for all wells located on the site.

Comment No. 4:

To determine groundwater elevations and stratigraphic correlations, the ground surface elevation of each boring and monitoring well as well as the elevation of the tope of the well casing on each monitoring well must be established to provide a constant reference point for future water level measurements. The surveyed point at the top of each well casing must be permanently marked and the elevations surveyed must be measured to 0.01-foot precision and referenced to mean sea level datum. All wells and borehole locations need to be shown on the groundwater contour maps.

Response No. 4:

All wells are plotted on the groundwater contour maps Figures 12-14. The well elevations were surveyed in August-September 2006 and are included in Table 1.

Comment No. 5:

On page 4 of the previous Phase II Report received on January 17, 1995, it states that "the thickness of clay is estimated to be at least 50-feet based on all information available at this time this report was prepared." This clay layer is noted as being continuous on page 5 of the "Groundwater Monitoring Data Analysis and Supplemental Phase II Site Geology Report" under "Isopach Map Thickness of Soil Above the Perched Groundwater". The thickness and continuity of the clay soil across the site was not demonstrated in the previous or current report with geologic cross sections based on well logs.

Response No. 5:

Cross sections through the site are provided on Figures 6 through 10. The clay layer is interpreted as continuous across/beneath the site, but thins to the southwest near the Little Patuxent River to a thickness of approximately 30 feet. Areas beneath the site further northeast exceed a thickness of 50 feet.

Comment No. 6:

The site investigation lacked complete lithology documentation through the entire borehole depths, sample analysis for varying depths that includes geotechnical test samples, summary of hydrogeologic tests conducted to evaluate the distribution of hydraulic conductivity and summary of test results.

Response No. 6:

A summary of hydraulic conductivity tests is provided in Table 5. Geotechnical analytical results are summarized in Table 3. Complete boring logs for the newly installed wells (MW-15A, MW-15B, MW-16A, and MW-16B, as well as borings B-109 through B-112, are included in Appendix C. All logs from previous investigations (i.e., Marshall Engineering) are also provided for reference.

Comment No. 7:

The report should include aquifer test simulation using hydraulic conductivity tests from the geometric mean slug tests to determine the distribution of constituents.

Response No. 7:

The geometric mean of the slug test hydraulic conductivity values is provided in Table 5. A summary of the projected groundwater velocities beneath the site are also included in Table 6. A narrative explanation is provided in Section 5.3.

Comment No. 8:

The "Groundwater Monitoring Data Analysis and Supplemental Phase II Site Geology Report" lacks well-defined geologic cross sections in sufficient detail, orientation and number to clearly identify the subsurface conditions at the site. These cross sections should be based on available well data and accurately surveyed in the field.

Response No. 8:

Five cross sections are provided on Figures 6 through 10 based on available well and soil boring data. These are consistent and provide a basis of understanding for the subsurface geologic ands hydrologic conditions. The cross sections reflect an interpretation of the boring logs as recorded by drillers and field consultants. In this case, geotechnical particle-size distribution analyses of the samples extracted from the shallow aquifer reveal that the unconfined sand and gravel aquifer, at the depth that transmits water, is composed of finer grained sediments, primarily fine sand with some silt.

Comment No. 9:

Groundwater collected from the wells at the site must have interpretative analysis of the data with trend analysis of all the historic and current data. The interpretive trend analysis data should be evaluated and discussed individually for any MCL exceedances for contaminants in each well and the potential cause or reason that contributed to the exceedances.

Response No. 9:

A trend analysis for any wells that exceeded MCLs is provided in narrative form in Section 6. Supporting documentation (including documentation of the trend analysis) is provided in Appendices G and H.

Comment No. 10:

Additional sampling is required to properly assess existing water quality at the site and sampling techniques should be evaluated to reduce turbidity.

Response No. 10:

Until the Fall of 2005, groundwater was sampled after withdrawing 3 well volumes with either high speed pumps or bailers. Since the Fall of 2005, groundwater is sampled using low-flow sampling techniques. This most recent data should reduce turbidity in the samples and thereby eliminate some of the anomalous detections that might have resulted from the inclusion of sediment material in the past. The most recent data has been utilized in the assessment of water quality

Comment No. 11:

Shop drawings figures 1 through 5 must be 24 inches wide and 36 inches long. The plans must be neatly folded and inserted in plastic covers so that the title of each plan can be read in place and incorporated into a ring binder fitting size 8.5 inch by 11 inch paper. The engineering plans and specifications for the proposed design must be prepared, signed, and scaled by a registered professional engineer.

Response No. 11:

Figure 3 is provided as a 24 x 36 inch site map. Additional engineering drawings for the Phase III Engineering Report will be included as noted above utilizing standard D-size (24 x 36 inch) drawing format.

Comment No. 12:

Groundwater Elevation Table 1 lacks a column for highest observed or predicted water elevations. Please revise this column accordingly.

Response No. 12:

Table 1 has been revised to include a column for the highest recorded groundwater elevation. This information is also included in Appendix G.

Comment No. 13:

On Figure 5, monitoring well MW 12-A shows the liner system bottom at elevation 117.5′ and the maximum recorded perched water elevation at 117.78′ and monitoring well MW-11A with less than 3-foot buffer to the highest observed groundwater table. MW 12-A looks to be located within the footprint of Cell A, even though page 6 of the report says that "only monitoring well 14-A is situated in the proposed Rubble Landfill area". Figure 4 indicates three wells drilled within the footprint of the proposed fill area, not enough to accurately predict the groundwater *elevations beneath the proposed site, especially since the northeast corner of the proposed footprint might lack the required 3-foot buffer to the groundwater.*

Response No 13:

The northeast corner of the proposed liner system will reflect a change in bottom elevation (to approximately 121 feet amsl) to ensure that the minimum 3-foot separation distance is met.

Comment No. 14:

The report lacks evaluation of all water bearing zones within 50 feet of the anticipated lowest elevation of the cell floor, and a discussion of the potential for horizontal and vertical movement of pollutants beneath the proposed site, based on hydraulic conductivity test results and existing water quality (COMAR 26.04.07.15A(9)). In addition, COMAR 26.04.07.15A(4) requires three separate groundwater contour maps for each distinct water bearing formation within 50 feet of the anticipated lowest elevation of the cell floor. The report should include a discussion and evaluation of the three water bearing zones mentioned in the report.

Response No. 14:

This Phase II report includes a narrative description (Section 5.1) of the observed three water bearing zones (i.e., shallow perched water, unconfined aquifer, and deep confined aquifer) beneath the site. The shallow perched water has been removed during excavation of the quarry deposits. Three potentiometric surface maps are provided in Figures 12 through 14 for the unconfined aquifer, as requested. The potentiometric surface of the deeper aquifer is greater than 50 feet below the proposed cell floor and therefore is only described in narrative. A discussion of the potential for horizontal and vertical movement of contaminants is included in Section 5.3.

Comment No. 15:

The groundwater chemistry report lacked discussion and hypothetical solute transport simulation for the three water bearing zones to predict down gradient movement of contaminants. The simulation must assume constant horizontal and vertical migration of contaminants within the aquifer using the geometric mean of slug tests conducted at the boreholes. Simulating the movement of volatile organic compounds is preferable since they are more mobile than other potential harmful constituents.

Response No. 15:

A simulation of a possible catastrophic release of contaminants from the landfill was explored using the geometric mean of the hydraulic conductivity values calculated from the on-site slug tests. The simulation included analysis of the contaminant migration to the nearest human receptor through the shallow and deep aquifers. This

involved an analysis of the vertical migration from the shallow aquifer, through the clay confining unit and into the deeper aquifer (Section 5.3 and Tables 5 and 6) as well as lateral migration.

Comment No. 16:

All revised reports and drawings must reflect the name Tolson & Associates Rubble Landfill, not Cunningham Rubble Landfill.

Response No. 16:

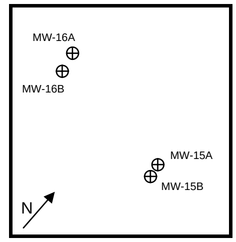
This report reflects the proper name for the facility: the Tolson Rubble Landfill, and the correct ownership: Tolson & Associates, LLC.

Appendix C
Boring Logs

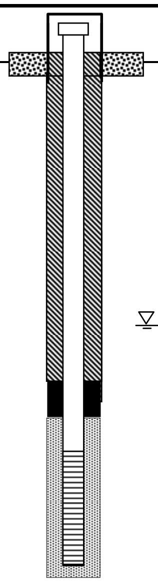
Environmental Resources Management

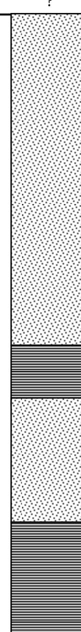
MW-15A

WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment		
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham		
Completed	29-Aug-06	Boring Depth (feet)	56.5	Diameter	4 inches
Northing	na	Surface Elevation	na	feet, site datum	
Easting	na	Riser Elevation	na	feet, site datum	
Screen	Sch. 40 PVC	Length (feet)	10	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	24	feet BGS	
Riser	Sch. 40 PVC	Length (feet)	37	Diameter	2 inches
Drilling Method		Driller(s)	Bill Kimes	Geologist	Nat Warner
Drillng Company	Summit Site Services			Well Permit #	



Location Sketch Map





Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment	Sample Description/Classification	
	na				?	* See log ERM-X for detailed unsaturated soil characterization.	
			3-3-7-10	10		0 - 13	Dry, orange & tan medium to fine SAND with pebble sized quartz minerals (fill)
5	#VALUE!		50/4	8			
10	#VALUE!		11-16-20	13		13 - 30	Moist, orange & tan silty SAND & fine SAND
15	#VALUE!		9-11-12	12			
20	#VALUE!		8-9-10	12			
25	#VALUE!		3-4-5	16		30 - 36	Grey CLAY & grey/tan clayey SAND
30	#VALUE!		9-11-15	15			
35	#VALUE!		8-9-8	15		37 - 45	Tan, moist moving to a wet, medium moving to a coarse, SAND
40	#VALUE!		50/4	5			
45	#VALUE!		13-18-22	14		46 - 56.5	Dense, red and grey CLAY
50	#VALUE!		8-16-22	0			Lab Sample MW-15A-50/55
55	#VALUE!		10-16-19	14			Lab Sample MW-15A-55
60	#VALUE!						

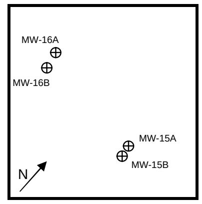
Monitoring Well Construction Specifications

Surface completion is a above grade protective casing (6 inches round X 4 foot long) with lock anchored into the cement collar and surface pad. The well is equipped with a PVC top cap.

	(Feet BGS)		(Feet BGS)
6" Outer Steel Casing		Portland Cement	
Top	-2.5	Top	0.0
Bottom	1.5	Bottom	29.0
PVC Riser Interval		Hydrated Bentonite Chip Seal	
Top	-2.0	Top	29.0
Bottom	35.1	Bottom	32.0
PVC Screen Interval		Filter Sand	
Top	35.1	Top	32.0
Bottom	45.1	Bottom	46.0

Environmental Resources Management **MW-15B**

WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment		
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham		
Completed	31-Aug-06	Boring Depth (feet)	160	Diameter	4 inches
Northing	na	Surface Elevation	na feet, site datum		
Easting	na	Riser Elevation	na feet, site datum		
Screen	Sch. 40 PVC	Length (feet)	10	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	feet BGS		
Riser	Sch. 40 PVC	Length (feet)	152	Diameter	2 inches
Drilling Method		Driller(s)	Bill Kimes	Geologist	Nat Warner
Drillng Company	Summit Site Services			Well Permit #	



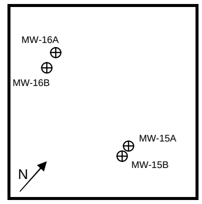
Location Sketch Map

Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment		Sample Description/Classification
	na						
			3-3-7-10	10		0 - 13	Dry, orange & tan medium to fine SAND with pebble sized quartz minerals (fill)
5	#VALUE!		50/4	8			
10	#VALUE!		11-16-20	13		13 - 30	Moist, orange & tan silty SAND & fine SAND
15	#VALUE!		9-11-12	12			
20	#VALUE!		8-9-10	12			
25	#VALUE!		3-4-5	16			
30	#VALUE!		9-11-15	15		30 - 36	Grey CLAY & grey/tan clayey SAND
35	#VALUE!		8-9-8	15		37 - 45	Tan, moist moving to a wet, medium moving to a coarse, SAND
40	#VALUE!		50/4	5			
45	#VALUE!		13-18-22	14		46 - 95	Very hard, dense, red-maroon and grey-dark grey CLAY Lab Sample MW-15A-50/55
50	#VALUE!		8-16-22	0			
55	#VALUE!		10-16-19	14			
60	#VALUE!		14-16-17	6			
65	#VALUE!		NA				
70	#VALUE!		NA				
75	#VALUE!		50/5	4			
80	#VALUE!		NA				
85	#VALUE!		NA				
90							

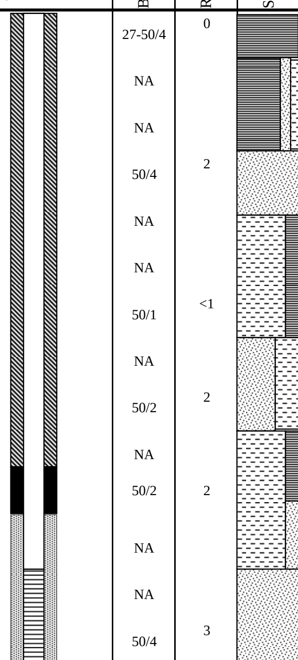
Environmental Resources Management

MW-15B

WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment		
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham		
Completed	31-Aug-06	Boring Depth (feet)	160	Diameter	4 inches
Northing	na	Surface Elevation	na feet, site datum		
Easting	na	Riser Elevation	na feet, site datum		
Screen	Sch. 40 PVC	Length (feet)	10	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	feet BGS		
Riser	Sch. 40 PVC	Length (feet)	152	Diameter	2 inches
Drilling Method		Driller(s)	Bill Kimes	Geologist	Nat Warner
Drillng Company	Summit Site Services			Well Permit #	



Location Sketch Map



Depth (feet BGS)	Elevation (feet, MSL)	Blow Counts	Recovery (inches)	Sample Description/Classification
90		27-50/4	0	
95	#VALUE!	NA		96 - 105 Dry, tan silty-sandy mixture with grey CLAY
100	#VALUE!	NA		
105	#VALUE!	50/4	2	106 - 112 Suspected loose SAND layer (quick drilling)
110	#VALUE!	NA		113 - 125 Dark grey, wet, clayey SILT
115	#VALUE!	NA		
120	#VALUE!	50/1	<1	
125	#VALUE!	NA		126 - 135 Wet silty SAND
130	#VALUE!	50/2	2	
135	#VALUE!	NA		136 - 143 Off-white, dry, clayey SILT
140	#VALUE!	50/2	2	143 - 145 Suspected loose SAND layer (quick drilling)
145	#VALUE!	NA		146 - 149 Sandy SILT from slurry cuttings
150	#VALUE!	NA		150 - 160 Grey, moist medium to fine SAND
155	#VALUE!	50/4	3	Lab Sample MW-15B-155
160	#VALUE!			
165	#VALUE!			

Monitoring Well Construction Specifications

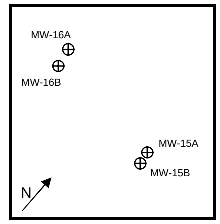
Surface completion is a above grade protective casing (6 inches round X 4 foot long) with lock anchored into the cement collar and surface pad. The well is equipped with a PVC top cap.

6" Outer Steel Casing	(Feet BGS)	Portland Cement	(Feet BGS)
Top	-2.5	Top	0.0
Bottom	1.5	Bottom	139.0
PVC Riser Interval	(Feet BGS)	Hydrated Bentonite Chip Seal	(Feet BGS)
Top	-2.0	Top	139.0
Bottom	150.0	Bottom	144.0
PVC Screen Interval	(Feet BGS)	Filter Sand	(Feet BGS)
Top	150.0	Top	144.0
Bottom	160.0	Bottom	160.0

Environmental Resources Management

MW-16A

WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment				
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham				
Completed	29-Aug-06	Boring Depth (feet)		75		Diameter	4 inches
Northing	na	Surface Elevation		na	feet, site datum		
Easting	na	Riser Elevation		na	feet, site datum		
Screen	Sch. 40 PVC	Length (feet)		10		Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW			feet BGS		
Riser	Sch. 40 PVC	Length (feet)		68		Diameter	2 inches
Drilling Method		Driller(s)	Bill Kimes			Geologist	Nat Warner
Drillng Company	Summit Site Services					Well Permit #	



Location Sketch Map

Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment	Sample Description/Classification
	na				?	* See log ERM-X for detailed unsaturated soil characterization.
			2-3-4	6		0-27 Dry fine, medium, coarse sand (larger sized grains at lower depths), tan/white SAND with 1/8 to 1/4 inch gravel and quartz minerals
5	#VALUE!		5-7-10	11		
10	#VALUE!		9-14-22	16		
15	#VALUE!		50/2	2		
20	#VALUE!		18-11-14	12		
25	#VALUE!		10-17-38	8		28 - 32 Moist, dense, dark tan medium SAND
30	#VALUE!		50/2	4		33 - 37 Moist, light tan medium to coarse SAND
35	#VALUE!		28-23-32	7		38 - 44 Moist to wet, tan silty fine SAND, somewhat consolidated
40	#VALUE!		22-25-23	15		45 - 46 Hard dry white CLAY
45	#VALUE!		30-50/4	12		47 - 67 Moist to wet, dense medium to coarse, tan, SAND with some quartz minerals
50	#VALUE!		50/2	3		
55	#VALUE!		50/2	9		
60	#VALUE!		50/2	1		
65	#VALUE!		32-32-29			68 - 75 Hard grey and red CLAY
70	#VALUE!		13-25-32	3		
75	#VALUE!		30-23-27			
80	#VALUE!					

Monitoring Well Construction Specifications

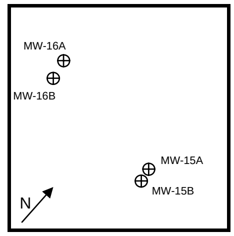
Surface completion is a above grade protective casing (6 inches round X 4 foot long) with lock anchored into the cement collar and surface pad. The well is equipped with a PVC top cap.

6" Outer Steel Casing	(Feet BGS)	Portland Cement	(Feet BGS)
Top	-3.0	Top	0.0
Bottom	1.0	Bottom	50.0
PVC Riser Interval	(Feet BGS)	Hydrated Bentonite Chip Seal	(Feet BGS)
Top	-2.5	Top	50.0
Bottom	57.0	Bottom	54.0
PVC Screen Interval	(Feet BGS)	Filter Sand	(Feet BGS)
Top	57.0	Top	54.0
Bottom	67.0	Bottom	67.0

Environmental Resources Management

MW-16B

WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment				
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham				
Completed	31-Aug-06	Boring Depth (feet)	150	Diameter	4 inches		
Northing	na	Surface Elevation	na	feet, site datum			
Easting	na	Riser Elevation	na	feet, site datum			
Screen	Sch. 40 PVC	Length (feet)	10	Diameter	2 inches		
Slot Size	0.01 inches	Stabilized DTW		feet BGS			
Riser	Sch. 40 PVC	Length (feet)	141.5	Diameter	2 inches		
Drilling Method		Driller(s)	Bill Kimes	Geologist	Nat Warner		
Drillng Company	Summit Site Services			Well Permit #			

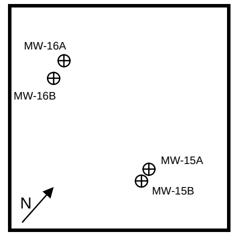


Location Sketch Map

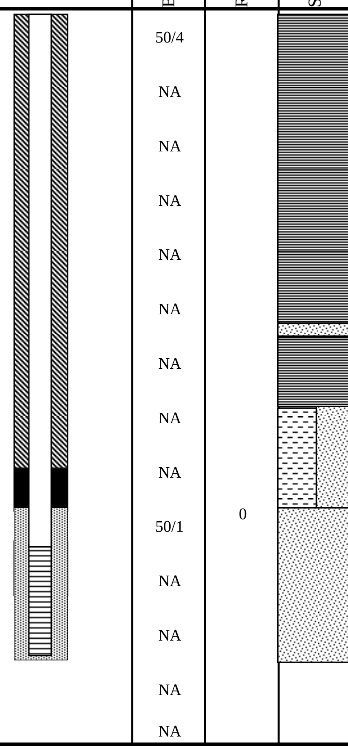
Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment	Sample Description/Classification
	na					
			2-3-4	6	0-27	Dry fine, medium, coarse sand (larger sized grains at lower depths), tan/white SAND with 1/8 to 1/4 inch gravel and quartz minerals
5	#VALUE!					
			5-7-10	11		
10	#VALUE!					
			9-14-22	16		
15	#VALUE!					
			50/2	2		
20	#VALUE!					
			18-11-14	12		
25	#VALUE!					
			10-17-38	8		
					28 - 32	Moist, dense, dark tan medium SAND
30	#VALUE!					
			50/2	4		
					33 - 37	Moist, light tan medium to coarse SAND
35	#VALUE!					
			28-23-32	7		
					38 - 44	Moist to wet, tan silty fine SAND, somewhat consolidated
40	#VALUE!					
			22-25-23	15		
					45 - 46	Hard dry white CLAY
45	#VALUE!					
			30-50/4	12		
					47 - 67	Moist to wet, dense medium to coarse, tan, SAND with some quartz minerals
50	#VALUE!					
			50/2	3		
55	#VALUE!					
			50/2	9		
60	#VALUE!					
			50/2	1		
65	#VALUE!					
			32-32-29			
					68 - 118	Hard grey and red CLAY Lab Sample MW-16B-90
70	#VALUE!					
			13-25-32	3		
75	#VALUE!					
			30-23-27			
80	#VALUE!					
			NA			
85	#VALUE!					
			NA			
90						

Environmental Resources Management **MW-16B**

WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment				
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham				
Completed	31-Aug-06	Boring Depth (feet)	150		Diameter	4 inches	
Northing	na	Surface Elevation	na	feet, site datum			
Easting	na	Riser Elevation	na	feet, site datum			
Screen	Sch. 40 PVC	Length (feet)	10		Diameter	2 inches	
Slot Size	0.01 inches	Stabilized DTW		feet BGS			
Riser	Sch. 40 PVC	Length (feet)	141.5		Diameter	2 inches	
Drilling Method		Driller(s)	Bill Kimes		Geologist	Nat Warner	
Drillng Company	Summit Site Services				Well Permit #		



Location Sketch Map



Depth (feet BGS)	Elevation (feet, MSL)	Blow Counts	Recovery (inches)		Sample Description/Classification
90					
		50/4			
95	#VALUE!				
		NA			
100	#VALUE!				
		NA			
105	#VALUE!				
		NA			
110	#VALUE!				
		NA			
115	#VALUE!				
		NA			
				119	Small layer of easily breakable GRAVEL approximately 2 inches in thickness
120	#VALUE!				
		NA			
				120 - 127	Hard grey CLAY
125	#VALUE!				
		NA			
				128 - 136	Dense SILT or consolidated fine SAND (from slurry cuttings)
130	#VALUE!				
		NA			
135	#VALUE!				
			0	137 - 150	Medium to coarse, loose SAND (from slurry cuttings) Lab Sample MW-16B-145
		50/1			
140	#VALUE!				
		NA			
145	#VALUE!				
		NA			
150	#VALUE!				
		NA			
155	#VALUE!				
		NA			

Monitoring Well Construction Specifications

Surface completion is a above grade protective casing (6 inches round X 4 foot long) with lock anchored into the cement collar and surface pad. The well is equipped with a PVC top cap.

6" Outer Steel Casing	(Feet BGS)	Portland Cement	(Feet BGS)
Top	-3.0	Top	0.0
Bottom	1.0	Bottom	133.0
PVC Riser Interval	(Feet BGS)	Hydrated Bentonite Chip Seal	(Feet BGS)
Top	-2.5	Top	133.0
Bottom	139.0	Bottom	136.0
PVC Screen Interval	(Feet BGS)	Filter Sand	(Feet BGS)
Top	139.0	Top	136.0
Bottom	149.0	Bottom	150.0

Environmental Resources Management, Inc.
Boring Log

Boring Number: B-109

Site Name & Location Tolson Rubble Landfill, Crofton, MD	Project Number 0052940	Date & Time Started Date & Time Completed	8/24/06 1000 8/24/06 1530
Drilling Company Summit Site Services	Driller Bill Kimes	Sampler(s) Nat Warner & Matt Fortin	Sampler Depth 5 foot intervals
Drilling Equipment Truck mounted Hollow Stem Auger	Method Split Spoon	Elevation & Datum na	Completion Depth 65 feet; Rock Depth na
Bit Size 2 inch	Core Barrel (s) 2-foot soil core	North Coordinate na	
Geologist(s) Nat Warner		East Coordinate na	

DEPTH (ft below base of Concrete)	SAMPLES Sample Number	Recovery (inches)	Blow Counts	Sed-iment	SOIL DESCRIPTION	REMARKS
0	1	13.0	3 5 5 6		SAND (fill)	
5	2	14.0	3 4 4 4		SAND (fill)	
10	3	13.0	3 3 4 4		Clayey SAND	
15	4	8.0	2 2 3 4		Red to brown clayey SAND with some gravel	
20	5	8.0	4 4 5 4		Well sorted, native, clayey SAND with pebbles	
25	6	7.0	3 4 6 6		Well sorted clayey SAND with pebbles	
30	7	10.0	9 9 11 20		Grey soft CLAY	
35	8	4.0	50/1		Grey soft CLAY to a grey SILT	
40	9	3.0	50/2		Grey SILT with yellow streaks to orange/reddish grey SILT	
45	10	<1.0	50/2		Small amount of slurry saturated Gravel (Most likely dragged from above during sampling)	
50	11	3.0	50/1		Saturated medium SAND	Water Table @ ~49 feet Lab Sample B-109-50 submitted to ____ for analysis of moisture content and grain size.
55	12	8.0	19 26 30		Moist dark grey hard CLAY	Lab Sample B-109-55 submitted to ____ for analysis of moisture content, grain size, and atterburg limits.
60	13	8.0	29 50/4		Grey hard CLAY with some sand	
65	14		48 50/5		Grey clayey SAND End of boring at 65 feet bgs.	Lab Sample B-109-65 submitted to ____ for analysis of moisture content, grain size, and atterburg limits.
						Slow drilling from 60-65 feet

Environmental Resources Management, Inc.
Boring Log

Boring Number: B-110

Site Name & Location Tolson Rubble Landfill, Crofton, MD	Project Number 0052940	Date & Time Started Date & Time Completed	8/25/06 800 8/25/06 1200
Drilling Company Summit Site Services	Driller Bill Kimes	Sampler(s) Matt Fortin	Sampler Depth 5 foot intervals
Drilling Equipment Truck mounted Hollow Stem Auger	Method Split Spoon	Elevation & Datum na	Completion Depth 57 feet / Rock Depth na
Bit Size 2 inch	Core Barrel (s) 2-foot soil core	North Coordinate na	
Geologist(s) Nat Warner		East Coordinate na	

DEPTH (ft below base of Concrete)	SAMPLES: Sample Number	Recovery (inches)	Blow Counts	Sed-iment	SOIL DESCRIPTION	REMARKS
0	1	6.0	4 5 7 7		Fine SAND (fill)	
5	2		6 9 10 12		Dry, tan, fine SAND with pebbles	Difficulty augering to 10 feet
10	3	12.0	10 11 22 9		Dry, tan, dense, fine SAND to grey, moist clayey SAND	
15	4	15.0	12 16 19		Moist, maluable grey CLAY	
20	5	16.0	22 27 40		Grey to tan, moist, dense SILT with a red streak	
25	6	3.0	50/2		Saturated, medium SAND	Water Table @ ~24 feet Lab Sample B-110-25 submitted to ____ for analysis of moisture content and grain size.
30	7	3.0	50/2		Saturated, light brown, medium SAND	
35	8	5.0	50/5		Saturated, light brown, medium SAND to grey sandy CLAY	
40	9	16.0	50/3		Grey to tan, moist, dense, sandy/silty CLAY	First two sample attempts provided no recovery. Lab Sample B-110-40 submitted to ____ for analysis of moisture content, grain size, and atterburg limits.
45	10	3.0	50/1		Moist silty SAND	First two sample attempts provided no recovery.
50	11	6.0	50/1		Wet, coarse, dark, tan SAND	
55	12	8.0	50/1		Moist, grey, medium SAND End of boring at 57 feet bgs.	Slow drilling from 55 to 57 feet Refusal at 57 feet (very dense and consolidated/petrified sand)

Environmental Resources Management, Inc.
Boring Log

Boring Number: B-111

Site Name & Location	Project Number	Date & Time Started		
Tolson Rubble Landfill, Crofton, MD	0052940	Date & Time Completed	8/25/06 1330 8/25/06 1620	
Drilling Company Summit Site Services	Driller Bill Kimes	Sampler(s) Matt Fortin	Sampler Depth 5 foot intervals	
Drilling Equipment Truck mounted Hollow Stem Auger	Method Split Spoon	Elevation & Datum na	Completion Depth 43 feet	Rock Depth na
Bit Size 2 inch	Core Barrel (s) 2-foot soil core	North Coordinate na		
Geologist(s) Nat Warner		East Coordinate na		

DEPTH (ft below base of Concrete)	SAMPLES: Sample Number	Recovery (inches)	Blow Counts	Sed-iment	SOIL DESCRIPTION	REMARKS
0	1	14.0	3 5 6 5		Moist, fine, brown SAND with silt (fill)	Material was noted by Mr. Cunningham to have been deposited within the last year
5	2	3.0	2 2 6 11		Wet silty CLAY to orange brownish clayey SAND to 0.5" fine white SAND to orange brownish clayey SAND	
10	3	14.0	5 3 3 3		Light brown, fine sand to moist, clayey SAND	Refusal at 7 feet, hole reset 3 feet to the south
15	4	7.0	50/5		Wet coarse SAND	
20	5	4.0	50/4		Grey to orange, moist, sandy SILT	
25	6	8.0	50/3		Moist to wet, brown/orange, medium SAND with pebbles	Water Table @ ~ 27 feet Lab Sample B-111-25 submitted to ____ for analysis of moisture content and grain size.
30	7	9.0	50/3		Wet brown medium SAND	
35	8	4.0	50/3		Grey to brown, moist sand/silty CLAY	
40	9	10.0	50/5		Grey, moist CLAY End of boring at 43 feet bgs.	Lab Sample B-111-40 submitted to ____ for analysis of moisture content, grain size, and atterburg limits. Slow drilling from 40 to 43 feet Refusal at 43 feet (1 inch over 20 minutes)

Environmental Resources Management, Inc.
Boring Log

Boring Number: B-112

Site Name & Location Tolson Rubble Landfill, Crofton, MD	Project Number 0052940	Date & Time Started Date & Time Completed	8/28/06 830 8/28/06 1630	
Drilling Company Summit Site Services	Driller Bill Kimes	Sampler(s) Nat Warner & Matt Fortin	Sampler Depth 5 foot intervals	
Drilling Equipment Truck mounted Hollow Stem Auger	Method Split Spoon	Elevation & Datum na	Completion Depth 70 feet	Rock Depth na
Bit Size 2 inch	Core Barrel (s) 2-foot soil core	North Coordinate na		
Geologist(s) Nat Warner		East Coordinate na		

DEPTH (ft below base of Concrete)	SAMPLES Sample Number	Recovery (inches)	Blow Counts	Sed-iment	SOIL DESCRIPTION	REMARKS
0		na			Asphalt Medium, brown SAND	Asphalt layer ~ 3 inches
5	1	8.0	5 9 10 14		Moist, brown, medium, coarse SAND	
10	2	4.0	8 50/4		Silty CLAY with full wood fragments	Hole took entire bentonite slurry mixture. Hole reset with 15 feet of augers
15	3	3.0	7 2 2		Dry, medium, tan SAND with gravel to a moist tan, sandy CLAY	
20	4	8.0	8 9 10		Coarse to medium, brown, wet SAND to light grey, moist CLAY	
25	5	14.0	15 25 34		Tan, medium, moist SAND	Lab Sample B-112-25 submitted to ____ for analysis of moisture content and grain size.
30	6	16.0	18 28 32		Moist, grey CLAY	Lab Sample B-112-30 submitted to ____ for analysis of moisture content and grain size.
35	7	20.0	11 11 17		Moist brown/reddish CLAY	Clay was sealing hole around bit preventing slurry from reaching surface. Regular bit replaced with a bit designed for clay.
40	8	6.0	50/3		Tan, moist, coarse clayey SAND	
45	9	18.0	36 40 38		Wet, light brown, silty SAND to light grey moist sandy CLAY	300 gallons of water used between 30 and 45 feet
50	10	3.0	50/1		Coarse to medium, moist, tan SAND	
55	11	8.0	19 26 30		Wet coarse to medium, tan SAND	Water Table @ ~54 feet Lab Sample B-112-55 submitted to ____ for analysis of moisture content and grain size.
60	12		50/3		Wet coarse to medium, tan SAND	300 gallons of water used between 45 and 65 feet.
65	13	18.0	50/5 50/12		Dark, wet coarse SAND to Grey, dry to moist CLAY	Red clay observed in slurry at 66 feet. 250 gallons of water used between 65 and 70 feet.
70	14	4.0	50/4		Grey CLAY with a little red CLAY End of boring at 70 feet bgs.	Lab Sample B-112-70 submitted to ____ for analysis of moisture content, grain size, and atterburg limits.

1A

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED

COUNTY NUMBER: 02

PERMIT NO. FROM "PERMIT TO DRILL WELL"

DATE WELL COMPLETED

Depth of Well (TO NEAREST FOOT)

OWNER: CUNNINGHAM JAMES (First name)

TOWN: CROFTON

SECTION LOT

WELL LOG
STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION	FROM	TO	Water
Fine Brown SAND	0	18	
Coarse SAND	18	22	
Coarse Sand, gravel and weathered rk (lost circ.)	22	27	
Brown Sand	27	45	
[illegible]	45	[illegible]	
[illegible]	65	73	

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box) Y N

TYPE OF GROUTING MATERIAL: CEMENT CM BENTONITE CLAY BC

NO. OF BAGS NO. OF POUNDS

GALLONS OF WATER

DEPTH OF GROUT SEAL (to nearest foot)

(enter 0 if from surface)

CASING RECORD
casing types (insert appropriate code below): ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE: PL; Nominal diameter top (main) casing (nearest inch); Total depth of main casing (nearest foot)

OTHER CASING (if used): diameter inch; depth (feet) from to

SCREEN RECORD
screen type or open hole: ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

02

PL

DEPTH (nearest ft.)

SLOT SIZE

DIAMETER OF SCREEN (NEAREST INCH)

GRAVEL PACK from 65 to 73

IF WELL DRILLED WAS FLOWING WELL, INSERT F IN BOX

CIRCLE APPROPRIATE LETTER
A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED

ELECTRIC LOG OBTAINED

TEST WELL CONVERTED TO PRODUCTION WELL

DRILLERS LICENSE NO. MWD 231

DRILLER'S SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

SITE SUPERVISOR

PUMPING TEST
HOURS PUMPED (nearest hour)

PUMPING RATE (gal. per min. to nearest gal.)

METHOD USED TO MEASURE PUMPING RATE

WATER LEVEL (distance from land surface)

BEFORE PUMPING

WHEN PUMPING

TYPE OF PUMP USED (for test): A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

Pete Eatey

PUMP INSTALLED
DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO): YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX. SEE ABOVE.

CAPACITY: GALLONS PER MINUTE (to nearest gallon)

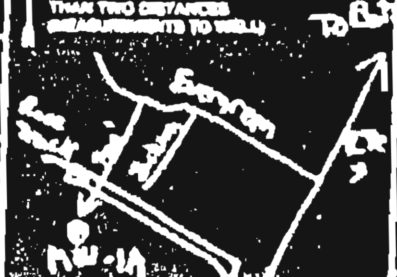
PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height)

+ above, − below LAND SURFACE

LOCATION OF WELL ON LOT
SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



OFFICE USE ONLY (NOT TO BE FILLED IN BY DRILLER)

TELESCOPE CASING; LOG INDICATOR; OTHER DATA

ORIGINAL

1B

AA 00220 (OEP USE ONLY)
THIS NUMBER IS TO BE PUNCHED IN COLS. 3-8 ON ALL CARDS)

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

DATE Received

DATE WELL COMPLETED 012396

Depth of Well 150 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-81-5779

OWNER Cunningham Excavating (last name / first name)

STREET OR RFD 1073 St. Stevens Rd. TOWN Crownsville, MD 21032

SUBDIVISION Capital Raceway SECTION LOT 1D monitoring well

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Fine Brown Sand	0	18	
Gray Silt & Sand	18	22	
Weather Limonite & Rock & Gravel	22	26	
Buff Sand	26	45	
Interbedded Silt & Sand	45	65	
Medium Coarse Sand	65	95	
Buff & Red Clay	95	110	
Red Clay	110	150	

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box) Y (yes) N (no)

TYPE OF GROUTING MATERIAL: CEMENT CM / BENTONITE CLAY BC

NO. OF BAGS 5 NO. OF POUNDS 250

GALLONS OF WATER 125

DEPTH OF GROUT SEAL (to nearest foot) from 0 ft. (TOP) to 105 ft. (BOTTOM) (enter 0 if from surface)

CASING RECORD
casing types insert appropriate code below: ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	4	130

EACH CASING — OTHER CASING (if used): diameter inch; depth (feet) from / to

SCREEN RECORD
screen type or open hole insert appropriate code below: ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C2

EACH SCREEN — DEPTH (nearest ft)

Type	From	To
PL	130	150

SLOT SIZE 1 .010 2 ___ 3 ___

DIAMETER OF SCREEN 4 (NEAREST INCH)

GRAVEL PACK from 125 to 150

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

C3

PUMPING TEST
HOURS PUMPED (nearest hour)

PUMPING RATE (gal. per min. to nearest gal.)

METHOD USED TO MEASURE PUMPING RATE

WATER LEVEL (distance from land surface) BEFORE PUMPING / WHEN PUMPING

TYPE OF PUMP USED (for test): A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

PUMP INSTALLED
DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX. SEE ABOVE.

CAPACITY: GALLONS PER MINUTE (to nearest gallon)

PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height): + above / - below LAND SURFACE 2 (nearest foot)

LOCATION OF WELL ON LOT
SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

N

See attached Drawing

CIRCLE APPROPRIATE LETTER

A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED

E ELECTRIC LOG OBTAINED

P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 10.17.13 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE

DRILLERS IDENT. NO. 288

DRILLERS SIGNATURE (MUST MATCH SIGNATURE OF APPLICATION)

OEP USE ONLY (NOT TO BE FILLED IN BY DRILLER)

T (E.R.O.S.) WQ

Jul-24-2006 12:35pm From-MDE WMA 410 537 3163 T-307 P 002/005 F-673

2A

(DENV USE ONLY)

THIS NUMBER IS TO BE PUNCHED COLS. 3-6 ON ALL CARDS)

WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

COUNTY NUMBER 02

ST/CO USE ONLY
DATE Received 33B

DATE WELL COMPLETED 1/23/92

Depth of Well 147 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-88-8130

OWNER Cunningham Excavating
last name first name
STREET OR RFD P.O. Box 3698 TOWN Crofton, Maryland 21114
SUBDIVISION SECTION LOT

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Top Soil	0	1	
Brown Sand & Clay	1	6	
Gravel	6	34	
White Clay	34	39	
Brown Sand & Gravel	39	52	
Gravel & White Clay	52	63	
Gravel	63	80	
[illegible] l white clay	80	137	
Brown Sand	137	147	X

CIRCLE APPROPRIATE LETTER
A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
E ELECTRIC LOG OBTAINED
D TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS IDENT. NO. 288

DRILLERS SIGNATURE
(MUST MATCH SIGNATURE ON APPLICATION)

DENTON J. WOLFORD
SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N
TYPE OF GROUTING MATERIAL
CEMENT CM BENTONITE CLAY BC
NO. OF BAGS 11 NO. OF POUNDS 550
GALLONS OF WATER 275
DEPTH OF GROUT SEAL (to nearest foot)
from 3 ft. to 135 ft.
TOP BOTTOM (enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below
ST STEEL CO CONCRETE PL PLASTIC OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	4	140

OTHER CASING (if used)
diameter inch depth (feet) from to

SCREEN RECORD

screen type or open hole insert appropriate code below
ST STEEL BR BRASS BRONZE HO OPEN HOLE PL PLASTIC OT OTHER

C 2

	Type	DEPTH (nearest ft.) from	to
1	PL	142	147
2			
3			

SLOT SIZE 1 .020 2 3
DIAMETER OF SCREEN 2 (NEAREST INCH)

GRAVEL PACK from 135 to 147
IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

DEP USE ONLY
(NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W Q
TELESCOPE CASING LOG INDICATOR OTHER DATA A

C 3

PUMPING TEST

HOURS PUMPED (nearest hour) 2
PUMPING RATE (gal. per min. to nearest gal.) 20
METHOD USED TO MEASURE PUMPING RATE Air
WATER LEVEL (distance from land surface)
BEFORE PUMPING 38
WHEN PUMPING 110
TYPE OF PUMP USED (for test)
A air P piston T turbine
C centrifugal R rotary O other (describe below)
J jet S submersible

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES NO
IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE
TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE:
CAPACITY: GALLONS PER MINUTE (to nearest gallon)
PUMP HORSE POWER
PUMP COLUMN LENGTH (nearest ft.)
CASING HEIGHT (circle appropriate box and enter casing height)
+ above
LAND SURFACE
− below
1 (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

N

X

ROAD

Jul-24-2006 12:35pm From-MDE WMA 410 537 3163 T-307 P.003/005 F-673

2B

(DENV USE ONLY)

THIS NUMBER IS TO BE PUNCHED IN COLS. 3-8 ON ALL CARDS)

WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

COUNTY NUMBER

ST/CO USE ONLY
DATE Received JUN 2 1993

DATE WELL COMPLETED 1 2 3 1 9 2

Depth of Well 56 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-88-9057

OWNER CUNNINGHAM EXCAVATING (last name / first name)

STREET OR RFD P.O. BOX 3698 TOWN CROFTON MD. 21114

SUBDIVISION CAPITAL RACEWAY SECTION WELL #2B LOT

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
? SOIL	0	1	
BROWN SAND & CLAY	1	6	
GRAVEL	6	33	
ITE CLAY	33	41	
AVEL & BROWN SAND	41	56	x

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N — Y circled

TYPE OF GROUTING MATERIAL: CEMENT CM; BENTONITE CLAY BC — BC circled

NO. OF BAGS 6 NO. OF POUNDS 300

GALLONS OF WATER 175

DEPTH OF GROUT SEAL (to nearest foot) from 3 ft. to 45 ft. (enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below: ST STEEL; CO CONCRETE; PL PLASTIC; OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	4	46

EACH CASING — OTHER CASING (if used): diameter inch; depth (feet) from to

SCREEN RECORD

screen type or open hole insert appropriate code below: ST STEEL; BR BRASS BRONZE; HO OPEN HOLE; PL PLASTIC; OT OTHER

C2

EACH SCREEN — DEPTH (nearest ft.)

Type	From	To
PL	46	56

SLOT SIZE .020 2 3

DIAMETER OF SCREEN 4 (NEAREST INCH)

GRAVEL PACK from 41 to 56

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 58

C3

PUMPING TEST

HOURS PUMPED (nearest hour) 2

PUMPING RATE (gal. per min. to nearest gal.) 1

METHOD USED TO MEASURE PUMPING RATE AIR

WATER LEVEL (distance from land surface)

BEFORE PUMPING 51

WHEN PUMPING 56

TYPE OF PUMP USED (for test): A air (circled); P piston; T turbine; C centrifugal; R rotary; O other (describe below); J jet; S submersible

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES NO — NO circled

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE:

CAPACITY: GALLONS PER MINUTE (to nearest gallon)

PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height) + above (circled) / − below LAND SURFACE 1 (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

SEE ATTACHED

CIRCLE APPROPRIATE LETTER

A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED (circled)

E ELECTRIC LOG OBTAINED

P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS IDENT NO 288

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

DENTON J. WOLFORD

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

DEP USE ONLY (NOT TO BE FILLED IN BY DRILLER)

T (E.R.O.S.) W.Q.

TELESCOPE CASING 70; LOG INDICATOR 72; OTHER DATA 74 75 76 A

Jul-24-2006 12:36pm From-MDE WMA 410 537 3163 T-307 P 005/005 F-673

3B

0170 (MDE USE ONLY)

S NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

COUNTY NUMBER 02

ST/CO USE ONLY DATE Received AUG 27 1998

DATE WELL COMPLETED 080698

Depth of Well 130 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-94-2905

OWNER Cunningham Excavating
STREET OR RFD Rt #3 Capital Raceway Road TOWN Odenton
SUBDIVISION Capital Raceway SECTION ____ LOT ____

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	check if water bearing
MONITORING WELL			
Sand Fine Silt & Gravel	0	50	
Sand Fine Medium	50	70	
Sand Med Course	70	80	
Sand Fine Course Silt	80	90	
Red Clay	90	130	
Gray Clay	130	133	
Sand Fine To Course	133	135	
Gray Clay/Fine To Course Sand	135	150	xx

NUMBER OF UNSUCCESSFUL WELLS: ____

WELL HYDROFRACTURED Y N

CIRCLE APPROPRIATE LETTER
A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
E ELECTRIC LOG OBTAINED
P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

TYPE MWD/MSD/MGD
DRILLERS LIC. NO. 288

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

LIC. NO. MWD 288

Denton J. Wolford

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) Y N
TYPE OF GROUTING MATERIAL (Circle one)
CEMENT CM BENTONITE CLAY BC
NO. OF BAGS 10 NO. OF POUNDS 500
GALLONS OF WATER 250
DEPTH OF GROUT SEAL (to nearest foot)
from 3 ft. to 122 ft. (enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below
ST STEEL CO CONCRETE
PL PLASTIC OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	4	140

OTHER CASING (if used)

	diameter inch	depth (feet) from	to

SCREEN RECORD

screen type or open hole insert appropriate code below
ST STEEL BR BRASS BRONZE HO OPEN HOLE
PL PLASTIC OT OTHER

C 2

EACH SCREEN		DEPTH (nearest ft.) from	to
1	PL	140	150
2			
3			

SLOT SIZE 1 .020 2 ____ 3 ____
DIAMETER OF SCREEN 2 (NEAREST INCH)

GRAVEL PACK from 135 to 150
IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W.Q.
TELESCOPE CASING LOG INDICATOR OTHER DATA

C 3

PUMPING TEST

HOURS PUMPED (nearest hour) 2
PUMPING RATE (gal. per min.) 20.
METHOD USED TO MEASURE PUMPING RATE AIR
WATER LEVEL (distance from land surface)
BEFORE PUMPING 104 ft
WHEN PUMPING 125 ft
TYPE OF PUMP USED (for test)
A air P piston T turbine
C centrifugal R rotary O other (describe below)
J jet S submersible

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES NO
IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS.
TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX 29.
CAPACITY: GALLONS PER MINUTE (to nearest gallon)
PUMP HORSE POWER
PUMP COLUMN LENGTH (nearest ft.)
CASING HEIGHT (circle appropriate box and enter casing height)
+ above
LAND SURFACE
− below
(nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND /OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

N

See attached drawing

4A

FROM : FAX NO. :4107930798 Jul. 25 2006 11:32AM P4

0421 (OEP USE ONLY) (THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)	WELL COMPLETION REPORT FILL IN THIS FORM COMPLETELY PLEASE PRINT OR TYPE		COUNTY NUMBER 02
DATE Received JAN 2 1986 — 1/2/85	DATE WELL COMPLETED 12/30/85	Depth of Well 61 (TO NEAREST FOOT) — 47	PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-81-5755

OWNER CUNNINGHAM (last name) JAMES (first name)
STREET OR RFD Rt 3 TOWN CROFTON
SUBDIVISION ______ SECTION ______ LOT ______

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Med. Brown Sand w/ gravel	0	17	
DK gray silt w/ clay, Moist	17	47	
Med.-Coarse brown Sand w/ gravel	47	60	✓
Buff clay w/ silt, some red streaks very cohesive, wet	60	62	

CIRCLE APPROPRIATE LETTER

- A — A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
- E — ELECTRIC LOG OBTAINED
- P — TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 10.17.13 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE

DRILLERS IDENT. NO. MWD-334

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

SITE SUPERVISOR (sign. of driller or journeyman responsible for all work if different from permittee)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) yes **Y** no N

TYPE OF GROUTING MATERIAL: CEMENT **CM** BENTONITE CLAY BC

NO. OF BAGS ______ NO. OF POUNDS ______

GALLONS OF WATER ______

DEPTH OF GROUT SEAL (to nearest foot) from 0 ~~0~~ ft. TOP to 44 ~~44~~ ft. BOTTOM (enter 0 if from surface)

CASING RECORD

casing types — Insert appropriate code below: ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	4	51 ~~51~~

EACH CASING — OTHER CASING (if used)

diameter inch	depth (feet) from	to

SCREEN RECORD

screen type or open hole — Insert appropriate code below: ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C 2

EACH SCREEN

	DEPTH (nearest ft.) Top	bottom
PL	51 ~~51~~	61 ~~61~~

SLOT SIZE 1 .01 2 ___ 3 ___

DIAMETER OF SCREEN 4 (NEAREST INCH)

GRAVEL PACK from 45 to 61

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

OEP USE ONLY (NOT TO BE FILLED IN BY DRILLER)

T TELESCOPE CASING — (E.R.O.S.) LOG INDICATOR — W O OTHER DATA

C 3

PUMPING TEST

HOURS PUMPED (nearest hour) 1

PUMPING RATE (gal. per min. to nearest gal.) 1

METHOD USED TO MEASURE PUMPING RATE ______

WATER LEVEL (distance from land surface)

BEFORE PUMPING 1

WHEN PUMPING 1

TYPE OF PUMP USED (for test): A air, P piston, T turbine, C centrifugal, R rotary, **O** other describe below), J jet, S submersible

Data Entry

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES **NO**

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE:

CAPACITY: GALLONS PER MINUTE (to nearest gallon)

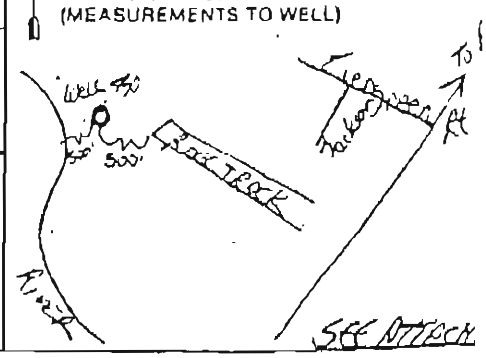
PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height) **+ above** / − below LAND SURFACE 2 ~~2~~ (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



4B

C1 00227 SEQUENCE NO. (OEP USE ONLY)
(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

STATE OF MARYLAND WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

DATE Received

DATE WELL COMPLETED 012386

Depth of Well 146 (TO NEAREST FOOT)

4B

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-81-3782

OWNER Cunningham Excavating (last name) (first name)

STREET OR RFD 1073 St. Stephens Rd. TOWN Crownsville, MD 21032

SUBDIVISION Capital Raceway SECTION ______ LOT 7-A monitoring well

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Sand & Gravel	0	18	
Gray Silt	18	51	
Sand	51	60	
Buff Silt w/clay & Sand	60	75	
Red Clay	75	125	
Sand	125	150	

CIRCLE APPROPRIATE LETTER

A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED

E ELECTRIC LOG OBTAINED

P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 10.17.13 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS IDENT. NO. 288

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) YES Y NO N

TYPE OF GROUTING MATERIAL
CEMENT CM BENTONITE CLAY BC

NO. OF BAGS 5 NO. OF POUNDS 250

GALLONS OF WATER 125

DEPTH OF GROUT SEAL (to nearest foot)
from 0 ft. to 105 ft. (enter 0 if from surface)

CASING RECORD

casing types Insert appropriate code below
ST STEEL CO CONCRETE PL PLASTIC OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	4	136

OTHER CASING (if used)
EACH CASING diameter inch — depth (feet) from — to

SCREEN RECORD

screen type or open hole Insert appropriate code below
ST STEEL BR BRASS BRONZE HO OPEN HOLE PL PLASTIC OT OTHER

C2

EACH SCREEN DEPTH (nearest ft.)

Type	From	To
PL	136	146

SLOT SIZE 1 .010 2 ___ 3 ___

DIAMETER OF SCREEN 4 (NEAREST INCH)

GRAVEL PACK from 131 to 146

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

OEP USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) WO

C3

PUMPING TEST

HOURS PUMPED (nearest hour)
PUMPING RATE (gal. per min. to nearest gal.)
METHOD USED TO MEASURE PUMPING RATE
WATER LEVEL (distance from land surface)
BEFORE PUMPING
WHEN PUMPING

TYPE OF PUMP USED (for test)
A air P piston T turbine
C centrifugal R rotary O other (describe below)
J jet S submersible

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX SEE ABOVE.

CAPACITY: GALLONS PER MINUTE (to nearest gallon)

PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height)
+ above LAND SURFACE
- below
2 (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

N

See attached drawing

5A

FROM : FAX NO. :4107930798 Jul. 25 2006 11:33AM P6

CT - U425 SEQUENCE NO. (OEP USE ONLY)

(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

STATE OF MARYLAND WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

DATE Received 012186

DATE WELL COMPLETED 122085

Depth of Well 25 (TO NEAREST FOOT)

5A

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-81-5831

OWNER CUNNINGHAM (last name) JAMES (first name)

STREET OR RFD RTe 3 TOWN CROFTON

SUBDIVISION ______ SECTION ______ LOT ______

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Fine brown sand w/trace silt And gravel	0	24	L Encountered water at 14'
Lt gray silt w/ some fine sand	24	30	
Interbbed silt And Fine sand	30	34	

CIRCLE APPROPRIATE LETTER

A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED

E ELECTRIC LOG OBTAINED

P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 10.17.13 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE

DRILLERS IDENT. NO. MWD-336

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION) [signature]

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) YES Y NO N

TYPE OF GROUTING MATERIAL

CEMENT CM BENTONITE CLAY BC

NO. OF BAGS ______ NO. OF POUNDS ______

GALLONS OF WATER ______

DEPTH OF GROUT SEAL (to nearest foot) from 0 ~~0~~ ft. (TOP) to 9 ~~5~~ ft. (BOTTOM) (enter 0 if from surface)

CASING RECORD

casing types — insert appropriate code below

ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	~~4~~ 4	13 ~~15~~

OTHER CASING (if used)

EACH CASING	diameter inch	depth (feet) from	to

SCREEN RECORD

screen type or open hole — insert appropriate code below

ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C2

EACH SCREEN		DEPTH (nearest ft.) Top	Bottom
1	PL	15 ~~15~~	25 ~~25~~
2			
3			

SLOT SIZE 1. 01 2. ______ 3. ______

DIAMETER OF SCREEN 4 ~~4~~ (NEAREST INCH)

GRAVEL PACK from 10 to 25

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

OEP USE ONLY (NOT TO BE FILLED IN BY DRILLER)

T (E.R.O.S.) W O

TELESCOPE CASING — LOG INDICATOR — OTHER DATA

C3

PUMPING TEST

HOURS PUMPED (nearest hour) 1

PUMPING RATE (gal. per min. to nearest gal.) 1

METHOD USED TO MEASURE PUMPING RATE ______

WATER LEVEL (distance from land surface)

BEFORE PUMPING 1

WHEN PUMPING 1

TYPE OF PUMP USED (for test)

A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

Data Entry

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE:

CAPACITY: GALLONS PER MINUTE (to nearest gallon)

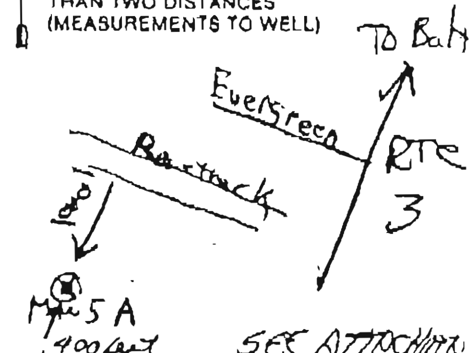
PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height) + above / - below LAND SURFACE 2 (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



SEE ATTACHED

5B

FROM : FAX NO. :4107930798 Jul. 25 2006 11:38AM P5

STATE OF MARYLAND WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER: 02

PERMIT NO. FROM "PERMIT TO DRILL WELL": AA-94-2194

WELL COMPLETED

Depth of Well: 60 (TO NEAREST FOOT)

Cunningham, James

Crownsville, Md.21032

St. Stevens Rd.

TOWN

Capital Raceway

SECTION

LOT: monitoring well #8

WELL LOG

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION	FEET FROM	FEET TO	Check if water bearing
Fine Brown sand	0	24	
Lt. Gray silt w/ fine sand	24	30	
Interbedded silt & fine sand	30	40	
Silt & fine sand orange & brown	40	53	
SAnd w/ trace of silt	53	60	X

CIRCLE APPROPRIATE LETTER

A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED

ELECTRIC LOG OBTAINED

TEST WELL CONVERTED TO PRODUCTION WELL

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box): Y N

TYPE OF GROUTING MATERIAL: CEMENT CM, BENTONITE CLAY BC

NO OF BAGS — NO OF POUNDS

GALLONS OF WATER

DEPTH OF GROUT SEAL (to nearest foot): from 0 ft. to 44 ft. (enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below: ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	4	50

OTHER CASING (if used): diameter inch, depth (feet) from to

SCREEN RECORD

screen type or open hole insert appropriate code below: ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C2

SCREEN TYPE	DEPTH (nearest ft) from	to
PL	50	60

SLOT SIZE .01

DIAMETER OF SCREEN: 4 (NEAREST INCH)

GRAVEL PACK: from 44 to 60

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX

DEP USE ONLY (NOT TO BE FILLED IN BY DRILLER)

T TELESCOPE CASING — (E.R.O.S.) LOG INDICATOR — WO OTHER DATA

PUMPING TEST

C3

HOURS PUMPED (nearest hour): 0

PUMPING RATE (gal. per min to nearest gal.): 0

METHOD USED TO MEASURE PUMPING RATE

WATER LEVEL (distance from land surface)

BEFORE PUMPING: 0

WHEN PUMPING: 0

TYPE OF PUMP USED (for test): A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

Data Entry

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO): YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX SEE ABOVE

CAPACITY GALLONS PER MINUTE (To nearest gallon)

PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft)

CASING HEIGHT (circle appropriate box and enter casing height): + above, − below LAND SURFACE: 2 (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

Auto Track

Tower

10'

(DRILLER'S SIGNATURE OR APPLICATION)

FROM : FAX NO. :4107930798 Jul. 25 2006 11:35AM P1

6A

6H

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY. PLEASE PRINT OR TYPE.

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED

COUNTY NUMBER: 02

PERMIT NO FROM "PERMIT TO DRILL WELL"

DATE WELL COMPLETED

DEPTH OF WELL: 50 (TO NEAREST FOOT)

OWNER: Cunningham (last name), James (first name) 5832

STREET OR RFD: Rt. 3 TOWN: Crofton

SUBDIVISION ___ SECTION ___ LOT ___

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION	FROM	TO	Check if water bearing
Red Brown Sand	0	18	
Fine Brown Sandy Silt	18	26	
Med Coarse Brown-Buff Sand	26	47	✓
Dark Gray-Brown Sand and Silt	47	50	

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box) Y N

TYPE OF GROUTING MATERIAL: CEMENT CM BENTONITE CLAY BC

NO. OF BAGS ___ NO. OF POUNDS ___

GALLONS OF WATER ___

DEPTH OF GROUT SEAL (to nearest foot): from 0 to 40 (enter 0 if from surface)

CASING RECORD
Casing type (insert appropriate code below): ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE: PL; Nominal diameter top (main casing) (nearest inch): 4; Total depth of main casing (nearest foot): 40

OTHER CASING (if used): diameter (inches), depth (feet) from, to

SCREEN RECORD
Screen type or open hole (insert appropriate code below): ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C2

PL 4 40 50

SLOT SIZE .01

DIAMETER OF SCREEN: 4 (NEAREST INCH)

GRAVEL PACK from 30 to 50

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX

C3 PUMPING TEST
HOURS PUMPED (nearest hour)

PUMPING RATE (gal. per min. to nearest gal.)

METHOD USED TO MEASURE PUMPING RATE

WATER LEVEL (distance from land surface)

BEFORE PUMPING

WHEN PUMPING

TYPE OF PUMP USED (for test): A Air, P Piston, T Turbine, C Centrifugal, R Rotary, O Other (none), J Jet, S Submersible

Data Entry

PUMP INSTALLED
DRILLER WILL INSTALL PUMP (CIRCLE YES or NO): YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX, SEE ABOVE

CAPACITY: GALLONS PER MINUTE (to nearest gallon)

PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height): + above, − below LAND SURFACE (nearest foot)

LOCATION OF WELL ON LOT
SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

Entrance

Residence

Rt 3 North

70'

50'

CIRCLE APPROPRIATE LETTER
A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED

E ELECTRIC LOG OBTAINED

P TEST WELL CONVERTED TO PRODUCTION WELL

DRILLERS LICENSE NO. 33

OFFICE USE ONLY
NOT TO BE FILLED IN BY DRILLER

TELESCOPE CASING ___ LOG INDICATOR ___ OTHER DATA ___

ORIGINAL

FROM : FAX NO. :4107930798 Jul. 25 2006 11:36AM P2

7A

C 1 0427 SEQUENCE NO. (OEP USE ONLY)

(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

STATE OF MARYLAND
WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

JAN 21 1985
DATE Received ~~[illegible]~~

DATE WELL COMPLETED 1 2 2 4 8 5

Depth of Well 35 (TO NEAREST FOOT)

7A

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-81-5830

OWNER CUNNINGHAM (last name) JAMES (first name)

STREET OR RFD RTe 3 TOWN CROFTON

SUBDIVISION ______ SECTION ______ LOT ______

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Med Sand, Silt And gravel Brown - Rust brown	0	8	
Fine - Med. Buff Sand + Silt	8	14	
Med Sand, Trace silt, well sorted, Moist	14	-18	
Coarse Sand + gravel / Tan Colored to Grey occasional Silt Lenses	18	33 ~~30~~ ~~33 41~~	✓
Fine Sand And Buff Silt	33	41	

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) **Y** (yes) N (no)

TYPE OF GROUTING MATERIAL
CEMENT **CM** BENTONITE CLAY BC

NO. OF BAGS ______ NO. OF POUNDS ______

GALLONS OF WATER ______

DEPTH OF GROUT SEAL (to nearest foot)
from 0 ~~0~~ ft. (TOP) to 11 ~~11~~ ft. (BOTTOM)
(enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below

ST STEEL CO CONCRETE PL PLASTIC OT OTHER

MAIN CASING TYPE: PL
Nominal diameter top (main) casing (nearest inch): ~~4~~
Total depth of main casing (nearest foot): 25 ~~25~~

OTHER CASING (if used) diameter inch, depth (feet) from ___ to ___

SCREEN RECORD

screen type or open hole insert appropriate code below

ST STEEL BR BRASS BRONZE HO OPEN HOLE PL PLASTIC OT OTHER

C 2

EACH SCREEN — DEPTH (nearest ft.)

Type	Top	Bottom
PL	25 ~~25~~	35 ~~35~~

SLOT SIZE 1 .01 2 ___ 3 ___

DIAMETER OF SCREEN 4 ~~4~~ NEAREST INCH)

GRAVEL PACK from 12 to 35

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

PUMPING TEST

C 3

HOURS PUMPED (nearest hour) 1

PUMPING RATE (gal. per min to nearest gal.) 1

METHOD USED TO MEASURE PUMPING RATE ______

WATER LEVEL (distance from land surface)
BEFORE PUMPING 1
WHEN PUMPING 1

TYPE OF PUMP USED (for test)
A air P piston T turbine C centrifugal R rotary **O** other (describe below) J jet S submersible

Data Entry

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES **NO**

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE:

CAPACITY: GALLONS PER MINUTE (to nearest gallon)

PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height) **+** above / − below LAND SURFACE 2 (nearest foot)

CIRCLE APPROPRIATE LETTER
A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
E ELECTRIC LOG OBTAINED
P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 10.17.13 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE

DRILLERS IDENT. NO. MWD-336

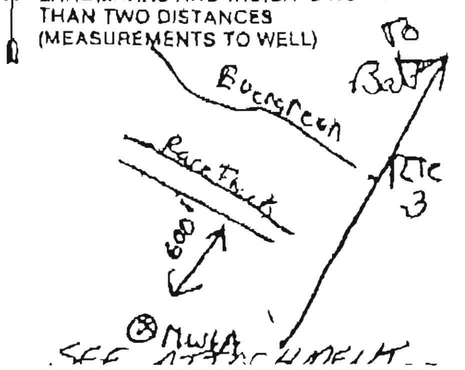
[signature]

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

SITE SUPERVISOR (sign. of driller or journeyman

OEP USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T TELESCOPE CASING (E.R.O.S.) LOG INDICATOR WO OTHER DATA

LOCATION OF WELL ON LOT
SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



SEE ATTACHMENT

STATE OF MARYLAND WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED

SEQUENCE NO (DEP USE ONLY)

COUNTY NUMBER 02

PERMIT NO FROM "PERMIT TO DRILL WELL" AA-81-3453

DATE WELL COMPLETED

Depth of Well 112 (TO NEAREST FOOT)

OWNER Cunningham, James
TOWN Crownsville, Md. 21032
STREET OR RFD 1073 St. Stephens Rd
SUBDIVISION Capital Raceway
SECTION
LOT monitoring well #5

C 3

WELL LOG

(Not required for driven wells)

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Med. Brown sand	0	18	
Fine brown sandy silt	18	26	
Med. coarse brown - buff sand	26	47	
Dark gray & brown sand & silt	47	60	
Red - Brown & buff sand & silt	60	90	
Interbedded buff & Red clay & Silty sand	90	108	
Tan sand	108	112	X

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) Y N

TYPE OF GROUTING MATERIAL
CEMENT CM BENTONITE CLAY BC
NO. OF BAGS NO. OF POUNDS
GALLONS OF WATER
DEPTH OF GROUT SEAL (to nearest foot) from 0 to 80 (enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below
ST STEEL CO CONCRETE PL PLASTIC OT OTHER

MAIN CASING TYPE PL | Nominal diameter top of main casing (nearest inch) 4 | Total depth of main casing (nearest foot) 87

OTHER CASING (if used) diameter (inch) depth (feet) from to

SCREEN RECORD

screen type or open hole insert appropriate code below
ST STEEL BR BRASS BRONZE HO OPEN HOLE PL PLASTIC OT OTHER

C 2

EACH SCREEN: PL 4 DEPTH (nearest ft) 87 97

SLOT SIZE

DIAMETER OF SCREEN (NEAREST INCH)

GRAVEL PACK from 80 to 110

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX

PUMPING TEST

HOURS PUMPED (nearest hour)
PUMPING RATE (gal. per min. to nearest gal.)
METHOD USED TO MEASURE PUMPING RATE
WATER LEVEL (distance from land surface)
BEFORE PUMPING
WHEN PUMPING
TYPE OF PUMP USED (for test)
A air P piston T turbine
C centrifugal R rotary O other (describe below)
J jet S submersible

Data Entry

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES NO
IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE
TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX SEE ABOVE
CAPACITY GALLONS PER MINUTE (to nearest gallon)
PUMP HORSE POWER
PUMP COLUMN LENGTH (nearest ft.)
CASING HEIGHT (circle appropriate box and enter casing height)
+ above
− below
LAND SURFACE (nearest foot)

CIRCLE APPROPRIATE LETTER
A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
E ELECTRIC LOG OBTAINED
P TEST WELL CONVERTED TO PRODUCTION WELL

DRILLER'S LICENSE NO. 2882

DRILLER'S SIGNATURE

LOCATION OF WELL ON LOT
SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

Race Track

DEP USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T TELESCOPE CASING
(E,R,O,S) LOG INDICATOR
W.O. OTHER DATA

ORIGINAL

8A

SEQUENCE NO. (DENV USE ONLY)
...S NUMBER IS TO BE PUNCHED ... COLS. 3-8 ON ALL CARDS)

STATE OF MARYLAND WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

45 DAYS AFTER WELL IS COMPLETED.
COUNTY NUMBER

...O USE ONLY Received

DATE WELL COMPLETED 01 ... 95

Depth of Well 22 51 26 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-93-0268

...R Cunningham Excavating

...ET OR RFD 1073 (last name) Stephens Church Rd (first name) TOWN Crownsville Md. 21032

...BDIVISION ______ SECTION 87-3 Capital Raceway LOT ... B-57-5

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, ...HICKNESS AND IF WATER BEARING

...PTION (Use ...al sheets if needed)	FEET FROM	TO	Check if water bearing
... Tan ... Sand ... a little ... ravel	0'	37'	
... Tan ... t, Sand	37'	50'	✓

...D ROCK AREAS, IDENTIFY SPECIFICALLY ... TURATED FRACTURES WERE OBSERVED.

...ELL HYDROFRACTURED yes Y no N

...RCLE APPROPRIATE LETTER
...VELL WAS ABANDONED AND SEALED
...EN THIS WELL WAS COMPLETED
...RIC LOG OBTAINED
...WELL CONVERTED TO PRODUCTION

...Y THAT THIS WELL HAS BEEN CONSTRUCTED IN ...ITH COMAR 26.04.04 "WELL CONSTRUCTION" ...ANCE WITH ALL CONDITIONS STATED IN THE ...ED PERMIT, AND THAT THE INFORMATION PRE... ...EIN IS ACCURATE AND COMPLETE TO THE BEST OF ...DG...

...ENT. NO. DWD-413

...NATURE
...SIGNATURE ON APPLICATION)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N

TYPE OF GROUTING MATERIAL

CEMENT CM BENTONITE CLAY BC

NO. OF BAGS 9 NO. OF POUNDS 846

GALLONS OF WATER 57

DEPTH OF GROUT SEAL (to nearest foot)

from 0 ft. to 35 ft. (enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below

ST STEEL CO CONCRETE PL PLASTIC OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	2	38

OTHER CASING (if used) diameter inch depth (feet) from to

SCREEN RECORD

screen type or open hole insert appropriate code below

ST STEEL BR BRASS BRONZE HO OPEN HOLE PL PLASTIC OT OTHER

C 2

	DEPTH (nearest ft.)	
PL	38	48

SLOT SIZE 1 ___ 2 ___ 3 ___

DIAMETER OF SCREEN ______ (NEAREST INCH)

GRAVEL PACK from 35 to 50'

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)

T (E.R.O.S.) W Q

C 3

PUMPING TEST

HOURS PUMPED (nearest hour)

PUMPING RATE (gal. per min. to nearest gal.)

METHOD USED TO MEASURE PUMPING RATE

WATER LEVEL (distance from land surface)

BEFORE PUMPING

WHEN PUMPING

TYPE OF PUMP USED (for test)

A air P piston T turbine C centrifugal R rotary O other (describe below) J jet S submersible

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE:

CAPACITY: GALLONS PER MINUTE (to nearest gallon)

PUMP HORSE POWER

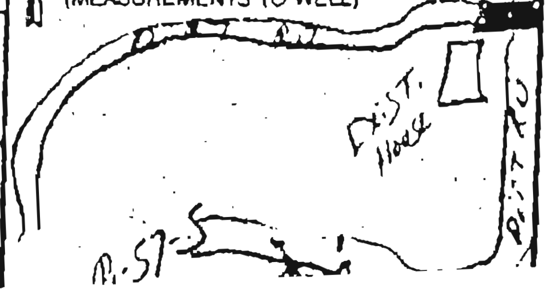
PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height)

+ above / − below LAND SURFACE 2 (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



9A

(DENV USE ONLY)

(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-8 ON ALL CARDS)

WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

COUNTY NUMBER

CO USE ONLY
DATE Received

DATE WELL COMPLETED 010495

Depth of Well 85 (TO NEAREST FOOT)

PERMIT NO. FROM PERMIT TO DRILL WELL AA-73-0226

OWNER CUNNINGHAM EXCAVATION
last name first name

STREET OR RFD 1073 STEPHENS CHURCH RD TOWN CROWNSVILLE MD 21032

SUBDIVISION ________ SECTION RT 3 CAPITAL RACEWAY LOT MAINTAINANCE # B-55

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
ORANGE DRY SAND + IRON CEMENTED SAND	0	17	
TAN, DRY TO MOIST, CLAY WITH SAND LENSES	17	44	
WHITE TO TAN, DRY, COARSE SAND	44	58	
DRY TO WET COARSE SAND + GRAVEL	58	85	✓

IN HARD ROCK AREAS, IDENTIFY SPECIFICALLY WHERE SATURATED FRACTURES WERE OBSERVED.

WELL HYDROFRACTURED yes Y no N

CIRCLE APPROPRIATE LETTER

A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED

E ELECTRIC LOG OBTAINED

P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND CONFORMS TO THE BEST OF MY KNOWLEDGE

DRILLERS IDENT. NO. MWD 413

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

SITE SUPERVISOR (sign. of driller or journeyman

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N

TYPE OF GROUTING MATERIAL

CEMENT CM BENTONITE CLAY BC

NO. OF BAGS 29 NO. OF POUNDS 1,786

GALLONS OF WATER 114

DEPTH OF GROUT SEAL (to nearest foot)

from 0 ft. to 70 ft. (enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below

ST STEEL CO CONCRETE PL PLASTIC OT OTHER

MAIN CASING TYPE PL | Nominal diameter top (main) casing (nearest inch) 2 | Total depth of main casing (nearest foot) 75

OTHER CASING (if used) diameter inch, depth (feet) from to

SCREEN RECORD

screen type or open hole insert appropriate code below

ST STEEL BR BRASS BRONZE HO OPEN HOLE PL PLASTIC OT OTHER

C 2

EACH SCREEN DEPTH (nearest ft.)

1 PL 75 85

2

3

SLOT SIZE 1 .010 2 ____ 3 ____

DIAMETER OF SCREEN 2 (NEAREST INCH)

GRAVEL PACK from 70 to 85

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 65

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)

T (E.R.O.S.) W Q

TELESCOPE LOG OTHER DATA

C 3 N/A

PUMPING TEST

HOURS PUMPED (nearest hour)

PUMPING RATE (gal. per min. to nearest gal.)

METHOD USED TO MEASURE PUMPING RATE

WATER LEVEL (distance from land surface)

BEFORE PUMPING

WHEN PUMPING

TYPE OF PUMP USED (for test)

A air P piston T turbine C centrifugal R rotary O other (describe below) J jet S submersible

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE

CAPACITY: GALLONS PER MINUTE (to nearest gallon)

PUMP HORSE POWER

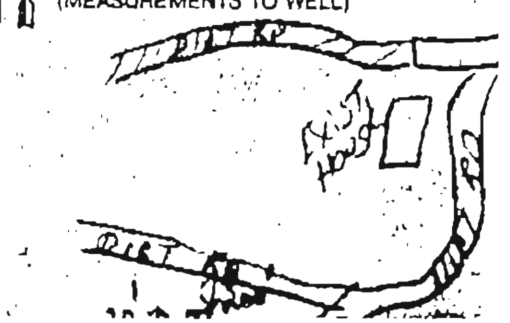
PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height)

+ above / − below LAND SURFACE 2 (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



10A

STATE OF MARYLAND
WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

[illegible] 6410 — SEQUENCE NO. (DENV USE ONLY)
(THIS NUMBER IS TO BE PUNCHED COLS. 3-8 ON ALL CARDS)

THIS REPORT MUST BE [illegible] WITHIN 45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER

T/CO USE ONLY
DATE Received: [ ]

DATE WELL COMPLETED: 010495

Depth of Well: 163 (TO NEAREST FOOT)

PERMIT NO. FROM PERMIT TO DRILL WELL: AA-93-0266

OWNER: CUNNINGHAM EXCAVATING (last name / first name)
STREET OR RFD: 1673 STEPHEN CHURCH RD   TOWN: CROWNSVILLE MD. 21032
SUBDIVISION: ______   SECTION: RT 3 CAPITAL GATEWAY   LOT: MAIN. TAX MAP #B-54-5

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
[illegible] BROWN [illegible] TAN CLAYEY SAND	0'	20'	
GRAY [illegible] SAND	20'	42'	
BROWN, CLAYEY SAND	42	47	
[illegible] CLAY	47	54	
WHITE TO TAN, [illegible] SAND	54'	91'	
LIGHT GRAY TO [illegible] BROWN, [illegible] SAND	91'	160'	✓

IN HARD ROCK AREAS, IDENTIFY SPECIFICALLY WHERE SATURATED FRACTURES WERE OBSERVED.

WELL HYDROFRACTURED: yes [Y] no [N]

CIRCLE APPROPRIATE LETTER
A — A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
E — ELECTRIC LOG OBTAINED
P — TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 WELL CONSTRUCTION AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF [illegible] KNOWLEDGE.

DRILLERS IDENT. NO.: MWD 413

DRILLERS SIGNATURE: [signature]
(MUST MATCH SIGNATURE ON APPLICATION)

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box): yes **Y** / no N
TYPE OF GROUTING MATERIAL: CEMENT **CM** / BENTONITE CLAY BC
NO. OF BAGS: 23   NO. OF POUNDS: 2162
GALLONS OF WATER: 138
DEPTH OF GROUT SEAL (to nearest foot): from 0 ft. (TOP) to 75 ft. (BOTTOM) (enter 0 if from surface)

CASING RECORD
casing types — insert appropriate code below: ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	2	90

EACH CASING — OTHER CASING (if used): diameter inch / depth (feet) from / to

SCREEN RECORD
screen type or open hole — insert appropriate code below: ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C 2

EACH SCREEN	Type	DEPTH (nearest ft.) from	to
1	PL	90	160
2			
3			

SLOT SIZE 1: 010 2: ____ 3: ____
DIAMETER OF SCREEN: 2 (NEAREST INCH)

GRAVEL PACK from 85' to 100'
IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

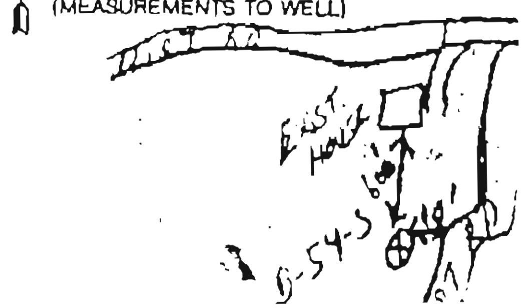
MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T [ ]   (E.R.O.S.) [ ]   W Q [ ]

C 3

PUMPING TEST
N/A
HOURS PUMPED (nearest hour)
PUMPING RATE (gal. per min. to nearest gal.)
METHOD USED TO MEASURE PUMPING RATE
WATER LEVEL (distance from land surface)
BEFORE PUMPING
WHEN PUMPING
TYPE OF PUMP USED (for test): A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

PUMP INSTALLED
DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO): YES / **NO**
IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE
TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE:
CAPACITY: GALLONS PER MINUTE (to nearest gallon)
PUMP HORSE POWER
PUMP COLUMN LENGTH (nearest ft.)
CASING HEIGHT (circle appropriate box and enter casing height): **+ above** / − below LAND SURFACE: 3 (nearest foot)

LOCATION OF WELL ON LOT
SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



11A

9420	SEQUENCE NO. (DENV USE ONLY)

NUMBER IS TO BE PUNCHED
COLS. 3-8 ON ALL CARDS)

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER

CO USE ONLY
DATE Received

DATE WELL COMPLETED 010395

Depth of Well 83 (TO NEAREST FOOT)

PERMIT NO. FROM PERMIT TO DRILL AA-93-[illegible]

OWNER Cunningham Excavating
(last name) (first name)

STREET OR RFD 1023 [redacted] St. Stephens Rd. TOWN Crownsville MD. 21032

SUBDIVISION ________ SECTION Rt 3 Capital Raceway LOT Industrial A-5[illegible]

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
[illegible] DRY SAND [illegible] CEMENT ROCK	0'	14'	
[illegible] DAMP, CLAY	14'	24'	
TAN, DAMP, CLAYEY SAND	24'	30'	
WHITE + ORANGE [illegible] COARSE SAND	30'	51'	
[illegible] + YELLOW SAND + GRAVEL	51'	67'	
[illegible], WET, SAND	67'	77'	✓
[illegible] WET SAND + CLAY LAYERS	77'	80'	✓

HARD ROCK AREAS, IDENTIFY SPECIFICALLY WHERE SATURATED FRACTURES WERE OBSERVED.

WELL HYDROFRACTURED yes Y no N

CIRCLE APPROPRIATE LETTER
A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
E ELECTRIC LOG OBTAINED
TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS IDENT. NO. MWD 413

DRILLERS SIGNATURE [signature]
(MUST MATCH SIGNATURE ON APPLICATION)

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N

TYPE OF GROUTING MATERIAL
CEMENT CM BENTONITE CLAY BC

NO. OF BAGS 78 NO. OF POUNDS 6,672
GALLONS OF WATER 110
DEPTH OF GROUT SEAL (to nearest foot)
from 0 ft. (TOP) to 65 ft. (BOTTOM) (enter 0 if from surface)

CASING RECORD
casing types insert appropriate code below
ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	2	70

OTHER CASING (if used)
diameter inch, depth (feet) from to

SCREEN RECORD
screen type or open hole insert appropriate code below
ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C 2

EACH SCREEN	type	DEPTH (nearest ft.) from	to
1	PL	70	80
2			
3			

SLOT SIZE .010

DIAMETER OF SCREEN 2 (NEAREST INCH)

GRAVEL PACK from 65' to 80'

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY
(NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W Q

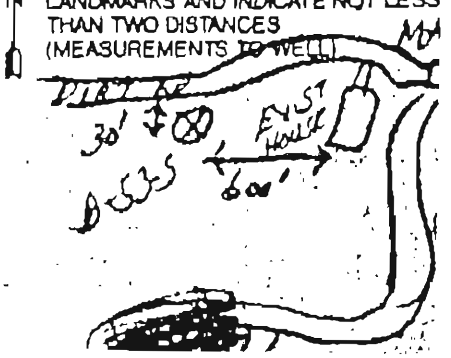
C 3

N/A

PUMPING TEST
HOURS PUMPED (nearest hour)
PUMPING RATE (gal. per min. to nearest gal.)
METHOD USED TO MEASURE PUMPING RATE
WATER LEVEL (distance from land surface)
BEFORE PUMPING
WHEN PUMPING
TYPE OF PUMP USED (for test)
A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

PUMP INSTALLED
DRILLER WILL INSTALL PUMP YES
(CIRCLE) (YES or NO)
IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE
TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE.
CAPACITY: GALLONS PER MINUTE (to nearest gallon)
PUMP HORSE POWER
PUMP COLUMN LENGTH (nearest ft.)
CASING HEIGHT (circle appropriate box and enter casing height)
+ above / − below LAND SURFACE 3 (nearest foot)

LOCATION OF WELL ON LOT
SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



FROM :

FAX NO. :4107930798

Jul. 25 2006 11:37AM P4

11B

1247

SEQUENCE NO (DENV USE ONLY)

THIS NUMBER IS TO BE PUNCHED COLS. 3-8 ON ALL CARDS)

STATE OF MARYLAND
WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER

ST/CO USE ONLY DATE Received

DATE WELL COMPLETED 1 2 . . . 4

Depth of Well 1 3 . (TO NEAREST FOOT)

11B

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-92-1985

OWNER Cunningham Excavating (last name / first name)

STREET OR RFD 1073 St. Stephens Church Rd. TOWN Crownsville, Md., 21032

SUBDIVISION SECTION Rt. #3 Capital Raceway LOT Monitoring Well #53

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Brown Sand & Sand Rock	0	23	
Gravel	23	65	
Red Gray Clay	65	115	
Brown Sand	115	122	X

IN HARD ROCK AREAS, IDENTIFY SPECIFICALLY WHERE SATURATED FRACTURES WERE OBSERVED.

WELL HYDROFRACTURED yes Y no N

CIRCLE APPROPRIATE LETTER
- A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
- E ELECTRIC LOG OBTAINED
- P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS IDENT. NO. [illegible]

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION) [illegible]

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N

TYPE OF GROUTING MATERIAL: CEMENT CM BENTONITE CLAY BC

NO. OF BAGS 13 NO. OF POUNDS 650

GALLONS OF WATER 325

DEPTH OF GROUT SEAL (to nearest foot) from 0 ft. to 110 ft. (TOP / BOTTOM) (enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below: ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	4	112

EACH CASING — OTHER CASING (if used): diameter inch; depth (feet) from to

SCREEN RECORD

screen type or open hole insert appropriate code below: ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C2

EACH SCREEN	type	DEPTH (nearest ft.) from	to
1	PL	112	122
2			
3			

SLOT SIZE 1 .010 2 3

DIAMETER OF SCREEN 4 (NEAREST INCH)

GRAVEL PACK from 109 to 122

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)

T TELESCOPE CASING — (E.R.O.S.) LOG INDICATOR — W O OTHER DATA

C3

PUMPING TEST

HOURS PUMPED (nearest hour) 2

PUMPING RATE (gal. per min. to nearest gal.) 15

METHOD USED TO MEASURE PUMPING RATE AIR

WATER LEVEL (distance from land surface)

BEFORE PUMPING 96

WHEN PUMPING 115

TYPE OF PUMP USED (for test): A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE:

CAPACITY: GALLONS PER MINUTE (to nearest gallon)

PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height) + above / − below LAND SURFACE (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

No Drawing
Refer to Plat

OWNER

12A

5422 SEQUENCE NO. (DENV USE ONLY)

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

48 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER

NUMBER IS TO BE PUNCHED ... S 3-8 ON ALL CARDS)

USE ONLY
TE Received

DATE WELL COMPLETED: 010395

Depth of Well: 55 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL": AA-93-[illegible]

OWNER: CUNNINGHAM EXCAVATING (last name / first name)

STREET OR RFD: 1075 STEPHEN CHURCH RD. TOWN: CROWNSVILLE MD. 21032

SUBDIVISION ____ SECTION RT 3 CAPITAL RACEWAY LOT MAP ... 52-5

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
... N, DRY, ... SE, SAND, ... A LITTLE GRAVEL	0'	45'	
... ANY GRAY ... IST TO WET ... SAND ... CLAY ...	45'	55'	✓

IN HARD ROCK AREAS, IDENTIFY SPECIFICALLY WHERE SATURATED FRACTURES WERE OBSERVED.

WELL HYDROFRACTURED yes Y no N

CIRCLE APPROPRIATE LETTER
A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
E ELECTRIC LOG OBTAINED
T TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ... MENTIONED PERMIT, AND THAT THE INFORMATION PRESENTED ... IS ACCURATE AND COMPLETE TO THE BEST OF ... KNOWLEDGE

DRILLERS IDENT. NO. MWD 413

DRILLERS SIGNATURE [signature]
MUST MATCH SIGNATURE ON APPLICATION

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N — Y circled

TYPE OF GROUTING MATERIAL: CEMENT CM / BENTONITE CLAY BC

NO. OF BAGS 12 NO. OF POUNDS 1128

GALLONS OF WATER 72

DEPTH OF GROUT SEAL (to nearest foot) from 0 ft. (TOP) to 40 ft. (BOTTOM) (enter 0 if from surface)

CASING RECORD
casing types insert appropriate code below: ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	2	45

EACH CASING — OTHER CASING (if used): diameter inch; depth (feet) from / to

SCREEN RECORD
screen type or open hole insert appropriate code below: ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C2

EACH SCREEN

	Type	DEPTH (nearest ft.) from	to
1	PL	45	55
2			
3			

SLOT SIZE 1 .010 2 ____ 3 ____

DIAMETER OF SCREEN 2 (NEAREST INCH)

GRAVEL PACK from 40' to 55'

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

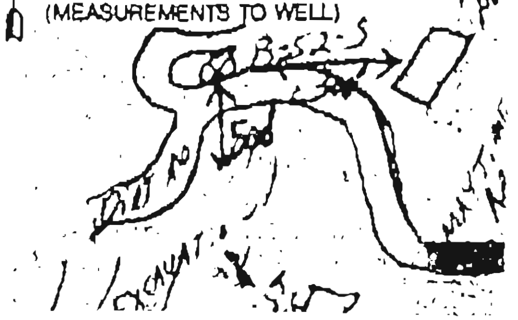
MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) WO

C3

PUMPING TEST
HOURS PUMPED (nearest hour)
PUMPING RATE (gal. per min. to nearest gal.)
METHOD USED TO MEASURE PUMPING RATE
WATER LEVEL (distance from land surface)
BEFORE PUMPING
WHEN PUMPING
TYPE OF PUMP USED (for test): A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

PUMP INSTALLED
DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES NO — NO circled
IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE
TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE:
CAPACITY: GALLONS PER MINUTE (to nearest gallon)
PUMP HORSE POWER
PUMP COLUMN LENGTH (nearest ft.)
CASING HEIGHT (circle appropriate box and enter casing height) + above / − below LAND SURFACE 3 (nearest foot)

LOCATION OF WELL ON LOT
SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



13A

9421 SEQUENCE NO. (DENV USE ONLY)

THIS NUMBER IS TO BE PUNCHED COLS. 3-8 ON ALL CARDS

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

45 DAYS AFTER WELL IS COMPLETED

COUNTY NUMBER

T/CO USE ONLY DATE Received

DATE WELL COMPLETED 011495

Depth of Well 70 (TO NEAREST FOOT)

PERMIT NO. FROM PERMIT TO DRILL WELL AA-92-1326

OWNER Cunningham Excavation (last name) (first name)

STREET OR RFD 1073 Stein's Church Rd. TOWN Crownsville Md. 21032

SUBDIVISION SECTION Rt 3 Capital Raceway LOT Hall Racing #5-15

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Reddish brown to tan, dry coarse sand with a little gravel	0'	41'	
Light gray tan, sand with clay layers	41'	57'	
Orange, wet, medium sand	57'	68'	✓

IN HARD ROCK AREAS, IDENTIFY SPECIFICALLY WHERE SATURATED FRACTURES WERE OBSERVED.

WELL HYDROFRACTURED yes Y no N

CIRCLE APPROPRIATE LETTER
A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
E ELECTRIC LOG OBTAINED
P TEST WELL CONVERTED TO PRODUCTION WELL

HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS IDENT. NO. MWD 413

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N

TYPE OF GROUTING MATERIAL CEMENT CM BENTONITE CLAY BC

NO. OF BAGS 15 NO. OF POUNDS 1,410

GALLONS OF WATER 90

DEPTH OF GROUT SEAL (to nearest foot) from 0 ft. TOP to 55 ft. BOTTOM (enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below: ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE PL | Nominal diameter top (main) casing (nearest inch) 2 | Total depth of main casing (nearest foot) 58

EACH CASING — OTHER CASING (if used) diameter inch, depth (feet) from to

SCREEN RECORD

screen type or open hole insert appropriate code below: ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C 2

EACH SCREEN — DEPTH (nearest ft.)
1: PL 58 68
2:
3:

SLOT SIZE 1 .010 2 3

DIAMETER OF SCREEN 2 (NEAREST INCH)

GRAVEL PACK from 55 to 68

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W Q

C 3

PUMPING TEST
N/A

HOURS PUMPED (nearest hour)

PUMPING RATE (gal. per min. to nearest gal.)

METHOD USED TO MEASURE PUMPING RATE

WATER LEVEL (distance from land surface)
BEFORE PUMPING
WHEN PUMPING

TYPE OF PUMP USED (for test)
A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE

CAPACITY: GALLONS PER MINUTE (to nearest gallon)

PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

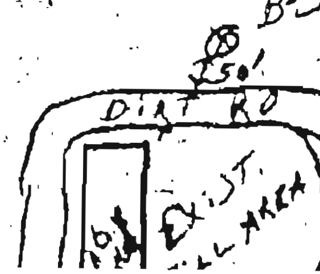
CASING HEIGHT (circle appropriate box and enter casing height) + above / - below LAND SURFACE 3 (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

N

B-51-S



14A

(DENV USE ONLY)

THIS NUMBER IS TO BE PUNCHED IN COLS. 3-8 ON ALL CARDS

WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER

ST/CO USE ONLY
DATE Received

DATE WELL COMPLETED 010395

Depth of Well 58 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL W
AA-93-0822

OWNER CUNNINGHAM EXCAVATION
last name first name

STREET OR RFD 1677 STEPHENS CHURCH RD TOWN CROWNSVILLE MD-21032

SUBDIVISION SECTION LOT

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
TAN & GRAY DAMP SILTY CLAY	0'	8'	
TAN, GRAY, SAND WITH A LITTLE GRAVEL	8'	47'	
TAN, WET, SAND	47'	55'	✓

IN HARD ROCK AREAS, IDENTIFY SPECIFICALLY WHERE SATURATED FRACTURES WERE OBSERVED.

WELL HYDROFRACTURED yes Y no N

CIRCLE APPROPRIATE LETTER

- A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
- E ELECTRIC LOG OBTAINED
- P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE

DRILLERS IDENT. NO. MWD 4113

DRILLERS SIGNATURE
(MUST MATCH SIGNATURE ON APPLICATION)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N

TYPE OF GROUTING MATERIAL
CEMENT C M BENTONITE CLAY B C

NO. OF BAGS 22 NO. OF POUNDS 1128

GALLONS OF WATER 72

DEPTH OF GROUT SEAL (to nearest foot)
from 0 ft. to 42 ft.
TOP BOTTOM
(enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below

S T STEEL C O CONCRETE
P L PLASTIC O T OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
P L	2	45

EACH CASING — OTHER CASING (If used)
diameter inch, depth (feet) from to

SCREEN RECORD

screen type or open hole insert appropriate code below

S T STEEL B R BRASS BRONZE H O OPEN HOLE
P L PLASTIC O T OTHER

C 2

EACH SCREEN — DEPTH (nearest ft.)

P L	45	55

SLOT SIZE 1 .010 2 ___ 3 ___

DIAMETER OF SCREEN 2 (NEAREST INCH)

GRAVEL PACK from 42' to 55'

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 38

MDE USE ONLY
(NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W Q

C 3 N/A

PUMPING TEST

HOURS PUMPED (nearest hour)

PUMPING RATE (gal. per min to nearest gal.)

METHOD USED TO MEASURE PUMPING RATE

WATER LEVEL (distance from land surface)
BEFORE PUMPING
WHEN PUMPING

TYPE OF PUMP USED (for test)

A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES / NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE:

CAPACITY: GALLONS PER MINUTE (to nearest gallon)

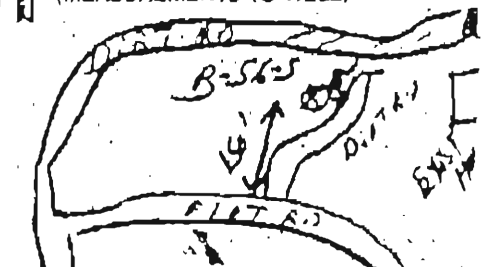
PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height)
+ above / − below LAND SURFACE 3 (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



LOG OF BORING NO. B-104

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL Surf. El.: 158.8 (+/-) ft.	REMARKS
0						0'	Red brown moist medium dense silty fine-coarse sand (SM)	
5		1	DS	8 16-16	16			
10		2	DS	10 16-15	18	13'		
15		3	DS	11 20-20	18		Tan and brown moist very dense fine-coarse sand (SW)	
20		4	DS	26 51/5	10	23'		
25							Tan and brown moist very dense fine-coarse sand & gravel (GW)	

REMARKS: Encountered water at 48'

Continued on next page

Completion Depth: 91.5'
Date: 11/4/91

DEPTH TO WATER: AT COMPLETION: WATER 48'

Marshall Engineering, Inc.

LOG OF BORING NO. B-104

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL Surf. El.: 158.8 (+/-) ft.	REMARKS
25	5	DS	8 37-51/4	16		Tan and brown moist very dense fine-coarse sand & gravel (GW)	
30	6	DS	21 26-47	18	33'		
35	7	DS	10 11-12	18	38'	Brown and red brown moist medium dense clayey fine coarse sand (SM-SC)	
40	8	DS	4 7-5	10	43'	Red brown moist stiff sandy clay (CL)	
45	9	DS	11 9-17	18	48'	Tan and red brown moist medium dense silty fine-coarse sand (SM)	
50						Tan wet medium dense fine-medium sand (SW)	

REMARKS: Encountered water at 48'

Continued on next page

Completion Depth: 91.5'
Date: 11/4/91

DEPTH TO WATER: AT COMPLETION: WATER 48'

Marshall Engineering, Inc.

LOG OF BORING NO. B-104

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL Surf. El.: 158.8 (+/-) ft.	REMARKS
50		10	DS	14 16-13	18		Tan wet medium dense fine-medium sand (SW)	
55		11	DS	20 19-17	18			
60		12	DS	5 11-24	18			
65		13	DS	20 44-40	18			
70		14	DS	26 31-44	18			
75								

REMARKS: Encountered water at 48'

Continued on next page

Completion Depth: 91.5'
Date: 11/4/91

DEPTH TO WATER: AT COMPLETION: WATER 48'

Marshall Engineering, Inc.

LOG OF BORING NO. B-104

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL Surf. El.: 158.8 (+/-) ft.	REMARKS
75		15	DS	29 38-45	16	78'	Tan wet medium dense fine-medium sand (SW)	
80		16	DS	19 26-31	12	83'	Black and dark gray wet very dense clayey fine sand (SC)	
85		17	DS	23 26-27	8		Gray and red brown moist hard silty clay (CL)	
90		18	DS	26 31-49				
95							Bottom of Boring 91.5'	

REMARKS: Encountered water at 48'

Completion Depth: 91.5'
Date: 11/4/91

DEPTH TO WATER: AT COMPLETION: WATER 48'

Marshall Engineering, Inc.

LOG OF BORING NO. B-105

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL **Surf. El.:** 155.1 (+/-) ft.	REMARKS
0						0'	Brown moist very stiff silty clay (CL)	
5		1	DS	7 6-18	18	7'		
							Red brown and tan moist very dense fine-coarse sand (SW) - trace of gravel below 35'	
10		2	DS	9 16-24	12			
15		3	DS	26 46-51	18			
20		4	DS	51/5	5			
25								

REMARKS: Encountered water at 40'

Continued on next page

Completion Depth: 91.5'
Date: 11/14/91

DEPTH TO WATER: AT COMPLETION: DRY, CAVED 36'

Marshall Engineering, Inc.

LOG OF BORING NO. B-105

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL Surf. El.: 155.1 (+/-) ft.	REMARKS
25		5	DS	51/4	4		Red brown and tan moist very dense fine-coarse sand (SW) - trace of gravel below 35'	
30		6	DS	51/3	3			
35		7	DS	51/5	5	38'		
40		8	DS	23 24-51	18		Tan wet very dense silty fine-coarse sand (SM-SW) with silty clay seams and layers	
45		9	DS	22 44-56	18			
50								

REMARKS: Encountered water at 40'

Continued on next page

Completion Depth: 91.5' **Date:** 11/14/91	**DEPTH TO WATER:** AT COMPLETION: DRY, CAVED 36'

Marshall Engineering, Inc.

LOG OF BORING NO. B-105

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL **Surf. El.:** 155.1 (+/-) ft.	REMARKS
75		15	DS	48 51- 70/5	17	78'	Gray wet very dense fine-coarse sand (SW)	
80		16	DS	30 50- 62/3	15	83'	Dark to wet very dense fine-medium sand (SP)	
85		17	DS	75 135/6	12		Red brown moist hard silty clay (CL)	
90		18	DS	50 52/5	10			
							Bottom of Boring 91.5'	
95								

REMARKS: Encountered water at 40'

Completion Depth: 91.5'
Date: 11/14/91

DEPTH TO WATER: AT COMPLETION: DRY, CAVED 36'

Marshall Engineering, Inc.

LOG OF BORING NO. B-106

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL Surf. El.: 174.7 (+/-) ft.	REMARKS
25		5	DS	19 8-21	14		Light gray and tan moist medium dense fine-coarse sand (SW) - very dense below 35' - traces of gravel below 40'	
30		6	DS	8 14-11	14			
35		7	DS	75/6	6			
40		8	DS	60/4	4			
45		9	DS	72/3	3			
						48'	Tan moist very dense fine sand (SP) - clayey seams & wet below 63'	
50								

REMARKS: Encountered water at 64'

Continued on next page

Completion Depth: 100'
Date: 11/15/91

DEPTH TO WATER: AT COMPLETION: DRY, CAVED 53'

Marshall Engineering, Inc.

LOG OF BORING NO. B-106

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL Surf. El.: 174.7 (+/-) ft.	REMARKS
50		10	DS	44 51/4	10		Tan moist very dense fine sand (SP) - clayey seams & wet below 63'	
55		11	DS	27 46-51/3	15			
60		12	DS	34 51/4	10			
65		13	DS	72/1	6			
70		14	DS	41 49-51/1	11			
75								

REMARKS: Encountered water at 64'

Continued on next page

Completion Depth: 100'
Date: 11/15/91

DEPTH TO WATER: AT COMPLETION: DRY, CAVED 53'

Marshall Engineering, Inc.

LOG OF BORING NO. B-106

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL **Surf. El.:** 174.7 (+/-) ft.	REMARKS
75	15	DS	51/5	5	78'	Tan moist very dense fine sand (SP) - clayey seams & wet below 63'	
80	16	DS	51/4	4		Red brown wet very dense silty fine-coarse sand (SM-SW)	
85	17	DS	51/5				
90	18	DS	42 51/5	5	93'		
95	19	DS	41 46-51/5	17		Red and light gray moist hard silty clay (CL)	
100	20	DS	44 49-51/3	15			

Bottom of Boring 100'

REMARKS: Encountered water at 64'

Completion Depth: 100'
Date: 11/15/91

DEPTH TO WATER: AT COMPLETION: DRY, CAVED 53'

Marshall Engineering Inc

LOG OF BORING NO. B-107

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL Surf. El.: 188.3 (+/-) ft.	REMARKS
0						0'	Red brown moist dense silty fine-medium sand (SM)	
5		1	DS	15 15-20	16	8'		
							Tan moist dense fine sand (SP)	
10		2	DS	10 15-23	16	13'		
							Tan moist medium dense clayey fine sand (SC)	
15		3	DS	10 8-8	18			
20		4	DS	4 3-6	18	23'		
							Tan moist medium stiff sandy clay (CL)	
25								

REMARKS: Encountered water at 80' (Augers locking up at 90'

Continued on next page

Completion Depth: 95.5'
Date: 11/18/91

DEPTH TO WATER: AT COMPLETION: WATER 80'

Marshall Engineering, Inc.

LOG OF BORING NO. B-107

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL **Surf. El.:** 188.3 (+/-) ft.	REMARKS
25		5	DS	3 3-4	18	28'	Tan moist medium stiff sandy clay (CL) -	
30		6	DS	4 4-6	18	33'	Tan moist medium dense clayey fine sand (SC)	
35		7	DS	2 2-7	18		Tan and light gray moist loose fine-coarse sand (SW) - clay seams to 36' (+/-) - very dense below 55', trace of gravel	
40		8	DS	5 2-2	18			
45		9	DS	1 5-12	10			
50								

REMARKS: Encountered water at 80' (Augers locking up at 90')

Continued on next page

Completion Depth: 95.5'
Date: 11/18/91

DEPTH TO WATER: AT COMPLETION: WATER 80'

Marshall Engineering, Inc.

LOG OF BORING NO. B-107

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL **Surf. El.:** 188.3 (+/-) ft.	REMARKS
50		10	DS	7 10-18	8		Tan and light gray moist loose fine-coarse sand (SW) - clay seams to 36' (+/-) - very dense below 55', trace of gravel	
55		11	DS	100/6	6			
60		12	DS	21 15-51/4	16			
65		13	DS	100/6	6	68'		
70		14	DS	42 51/4			Tan moist very dense fine-medium sand (SP) - wet below 80'	
75								

REMARKS: Encountered water at 80' (Augers locking up at 90')

Continued on next page

Completion Depth: 95.5' **Date:** 11/18/91	**DEPTH TO WATER:** AT COMPLETION: WATER 80'

Marshall Engineering, Inc.

LOG OF BORING NO. B-107

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

Surf. El.: 188.3 (+/-) ft.

DEPTH IN FEET	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL	REMARKS
75	15	DS	10 40-51/4	16		Tan moist very dense fine-medium sand (SP) - wet below 80'	
80	16	DS	36 51/5	10	83'		
85	17	DS	27 51/5	10	88'	Tan and light gray moist hard sandy clay (CL)	
90	18	DS	100/4			Red brown wet very dense fine-medium sand (SP)	
95						Bottom of Boring 95.5'	
100							

REMARKS: Encountered water at 80' (Augers locking up at 90')

Completion Depth: 95.5'
Date: 11/18/91

DEPTH TO WATER: AT COMPLETION: WATER 80'

Marshall Engineering, Inc.

LOG OF BORING NO. B-108

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS   **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL **Surf. El.:** 163.1 (+/-) ft.	REMARKS
0						0'	Brown and gray moist stiff sandy clay (CL)	
5		1	DS	3 4-6	18	8'		
10		2	DS	15 34-34	18		Tan and light gray moist very dense fine sand (SP)	
15		3	DS	6 18-25	12	18'		
20		4	DS	9 14-32	16		Tan and light gray moist very dense fine-coarse sand (SW)	
25								

REMARKS: Encountered water at 50'

Continued on next page

Completion Depth: 91.5'
Date: 11/19/91

DEPTH TO WATER: AT COMPLETION: DRY, CAVED 35'

Marshall Engineering, Inc.

LOG OF BORING NO. B-108

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL Surf. El.: 163.1 (+/-) ft.	REMARKS
25		5	DS	26 51/4	10		Tan and light gray moist very dense fine-coarse sand (SW)	
30		6	DS	100/6	6			
35		7	DS	36 26-29	14	38'		
40		8	DS	9 5-51	16		Red brown moist very dense silty fine sand (SM)	
45		9	DS	100/5	5	48'		
50							Brown wet very dense silty fine-coarse sand (SM-SW)	

REMARKS: Encountered water at 50'

Continued on next page

Completion Depth: 91.5' **Date:** 11/19/91	**DEPTH TO WATER:** AT COMPLETION: DRY, CAVED 35'

Marshall Engineering, Inc.

LOG OF BORING NO. B-108

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL Surf. El.: 163.1 (+/-) ft.	REMARKS
50		10	DS	38 25-49	18	53'	Brown wet very dense silty fine-coarse sand (SM-SW)	
55		11	DS	28 26-34	18		Light gray and green wet very dense clayey fine sand (SC)	
60		12	DS	34 51/6	12	63'		
65		13	DS	34 51/6	12	68'	Light gray wet very dense silty fine sand (SP)	
70		14	DS	28 51/5	17	73'	Light gray wet very dense clayey fine sand (SC)	
75							Brown wet very dense fine-coarse sand (SW)	

REMARKS: Encountered water at 50'

Continued on next page

Completion Depth: 91.5'
Date: 11/19/91

DEPTH TO WATER: AT COMPLETION: DRY, CAVED 35'

Marshall Engineering, Inc.

LOG OF BORING NO. B-108

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL Surf. El.: 163.1 (+/-) ft.	REMARKS
75	15	DS	100/6	6		Brown wet very dense fine-coarse sand (SW)	
					78'	Red and light gray moist hard silty clay (CL)	
80	16	DS	50 51/6	12			
85	17	DS	50 51/6	11			
90	18	DS	50 51/4	10			
						Bottom of Boring 91.5'	
95							

REMARKS: Encountered water at 50'

Completion Depth: 91.5'
Date: 11/19/91

DEPTH TO WATER: AT COMPLETION: DRY, CAVED 35'

Marshall Engineering, Inc.

MARYLAND DEPARTMENT OF THE ENVIRONMENT, WATER MANAGEMENT ADMINISTRATION
2500 BROENING HIGHWAY, BALTIMORE, MARYLAND 21224, (410) 631-3784

WATER WELL ABANDONMENT-SEALING REPORT FORM

SUBMIT COPIES OF COMPLETED FORM TO:
COUNTY ENVIRONMENT AGENCY (contact MDE, WMA if address needed)
WELL OWNER
MDE, WATER MANAGEMENT ADMINISTRATION, WELL PROGRAM

3B abandonment

DATE WELL ABANDONED: 08-06-98 (month/day/year)

PERMIT NUMBER OF ABANDONED WELL (if any) AA-81-5452

PERMIT NUMBER OF REPLACEMENT WELL AA-94-2905

PERSON ABANDONING WELL: Charles Lovell

WELL DRILLERS LICENSE NUMBER: JSD 05
CIRCLE: MWD/MSD/MGD

OWNER'S NAME: Cunningham Excav.

WELL LOCATION: Rt #3 Capital Raceway
COUNTY: Anne Arundel
NEAREST TOWN: Odenton
TAX MAP ____ BLOCK ____ PARCEL ____
SUBDIVISION: Capital Raceway
SECTION: ____ LOT: ____
NEAREST ROAD ____

MARYLAND GRID COORDINATES
E 880
BOX NUMBER
N 440

000
000 X

SHOW WELL LOCATION BY X WITHIN BOX

TYPE OF WELL BEING ABANDONED:

X DRILLED
___ JETTED
___ BORED/AUGUERED
___ HAND DUG
___ OTHER (specify) ____

USE CODE:

X DOMESTIC
___ MUNICIPAL/PUBLIC
___ IRRIGATION
___ INDUSTRIAL
___ TEST/OBSERVATION

TYPE OF CASING:

___ STEEL
X PLASTIC
___ CONCRETE
___ OTHER (specify)

SIZE OF CASING: 4 INCHES IN DIAMETER

DEPTH OF WELL: 142 FEET DEEP

WAS ANY CASING REMOVED? ___ YES X NO
if yes, length removed, in feet: ____

WAS CASING RIPPED OR PERFORATED? ___ YES X NO

LOG OF SEALING MATERIAL

MATERIAL	FEET FROM	FEET TO
Bentonite Clay	142'	3'
Clean Fill	3'	0

[signature] #288 MWD/MSD/MGD 8-6-98
SIGNATURE-MASTER WELL DRILLER OR SUPERVISING SANITARIAN — LICENSE # — CIRCLE ONE — DATE

SEQUENCE NO. (MDE USE ONLY)

STATE OF MARYLAND
PERMIT TO DRILL WELL
please print or type

STATE PERMIT NUMBER: AA-94-2905 (70–79)
fill in this form completely

OWNER INFORMATION

Received (APA): 080598 (MM DD YY, 13)

Last Name / Owner / First Name (15–34): Cunningham Excavating

Street or RFD (55): P.O. Box 2698

Town: Crofton — State (70–72): md — Zip (76): 21114

DRILLER INFORMATION

Driller's Name: Denton J. Holford — License No. (76–81): M H D 288

Firm Name: Holford's Well & Pump Service, Inc.

Address: 4629 Mountain Road-Pasadena, Maryland 21122

Signature: [signature] — Date: 8-4-98

LOCATION OF WELL

B 3 — 3B

COUNTY (8–21): Anne Arundel

SUBDIVISION (23–42): Capital Raceway

SECTION (44–46) ___ LOT (48–50) ___

NEAREST TOWN (62–71): Odenton

MILES FROM TOWN (enter 0 if in town) (73–78): 3 M I

B 4

DIRECTION OF WELL FROM TOWN (CIRCLE BOX): **N** (circled) — NW, NE, W, TOWN, E, SW, S, SE

NEAR WHAT ROAD (11–30): Rt 3 Capital Raceway Rd — ON

ON WHICH SIDE OF ROAD (CIRCLE APPROPRIATE BOX): **N** (North) — W (West), E (East), S (South)

DISTANCE FROM ROAD (34–37): 15 — ENTER FT OR MI (38–39): Ft

TAX MAP: ____ BLK. ____ PARCEL ____

2 WELL INFORMATION

APPROX. PUMPING RATE (GAL. PER MIN.) (8–12): 8

AVERAGE DAILY QUANTITY NEEDED (GAL. PER DAY) (14–20): 300

USE FOR WATER (CIRCLE APPROPRIATE BOX)

- [D] DOMESTIC POTABLE SUPPLY & RESIDENTIAL IRRIGATION
- [F] FARMING (LIVESTOCK WATERING & AGRICULTURAL IRRIGATION)
- [I] INDUSTRIAL, COMMERCIAL, DEWATERING
- [P] PUBLIC WATER SUPPLY WELL
- [T] TEST, OBSERVATION, MONITORING (circled)
- [G] GEO-THERMAL

NOT TO BE FILLED IN BY DRILLER
HEALTH DEPARTMENT APPROVAL

COUNTY NAME: Anne Arundel — COUNTY NO.: 02

STATE SIGNATURE ____ INSERT S →

DATE ISSUED (43 MM DD YY 48): 080598 — SIGNATURE: Barry D. Adams — EXP. DATE: 080599

NORTH GRID (50–55): 440000 — EAST GRID (57–63): 0883 000

APPROXIMATE DEPTH OF WELL (24–28): 150 FEET

APPROXIMATE DIAMETER OF WELL: 4" NEAREST INCH

METHOD OF DRILLING (circle one)

BORED (or Augered) — JETTED — Jetted & DRIVEN

AIR-ROTary — AIR-PERcussion — **ROTARY (Hydraulic Rotary)** (circled)

CABLE — REVerse-ROTary — DRive-POINT

Other ____

SHOW MAJOR FEATURES OF BOX & LOCATE WELL WITH AN X →

SOURCES OF DRILLING WATER
1. AA-81-0980
2. AA-81-9800
3.

WRITE THE BOX NUMBER FROM THE MAP HERE

E 880

N 440

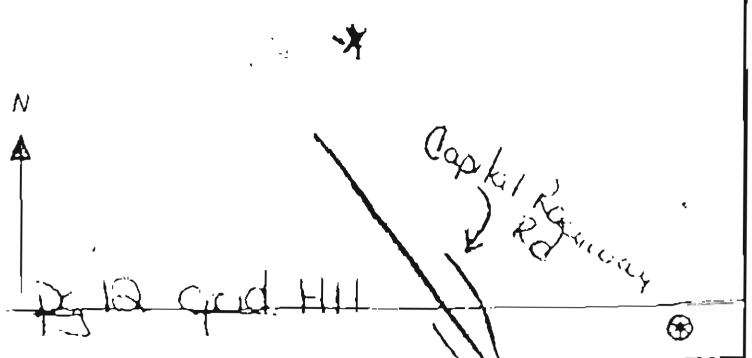
000
000
X

REPLACEMENT OR DEEPENED WELLS
(CIRCLE APPROPRIATE BOX)

- [N] THIS WELL WILL NOT REPLACE AN EXISTING WELL
- [Y] THIS WELL WILL REPLACE A WELL THAT WILL BE ABANDONED AND SEALED (circled)
- [S] THIS WELL WILL REPLACE A WELL THAT WILL BE USED AS A STANDBY-CONTACT LOCAL APPROVING AUTHORITY FOR POLICY ON STANDBY WELLS
- [D] THIS WELL WILL DEEPEN AN EXISTING WELL

PERMIT NUMBER OF WELL TO BE REPLACED OR DEEPENED (IF AVAILABLE) (41–52): AA-81-5442

DRAW A SKETCH BELOW SHOWING LOCATION OF WELL IN RELATION TO NEARBY TOWNS AND ROADS AND GIVE DISTANCE FROM WELL TO NEAREST ROAD JUNCTION



Not to be filled in by driller (MDE OR COUNTY USE ONLY)

APPROP. PERMIT NUMBER (54–63): GAP

PERMIT No (70–79): AA-94-2905

SPECIAL CONDITIONS

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

SEQUENCE NO. (MDE USE ONLY): 0793
(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER: 02

CO USE ONLY — DATE Received

DATE WELL COMPLETED: 080698

Depth of Well: 150 (TO NEAREST FOOT)

3B

PERMIT NO. FROM "PERMIT TO DRILL WELL": AA-94-2905

OWNER: Cunningham Excavating
STREET OR RFD: Rt #3 Capital Raceway Road TOWN: Odenton
SUBDIVISION: Capital Raceway SECTION: LOT:

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	check if water bearing
MONITORING WELL			
Sand Fine Silt & Gravel	0	50	
Sand Fine Medium	50	70	
Sand Med Course	70	80	
Sand Fine Course Silt	80	90	
Red Clay	90	130	
Gray Clay	130	133	
Sand Fine To Course	133	135	
Gray Clay/Fine To Course Sand	135	150	xx

NUMBER OF UNSUCCESSFUL WELLS: ____

WELL HYDROFRACTURED: yes Y / no N

CIRCLE APPROPRIATE LETTER
A — A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
E — ELECTRIC LOG OBTAINED
P — TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

TYPE MWD/MSD/MGD
DRILLERS LIC. NO. 288
DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)
LIC NO. MWD 288
Denton J. Wolford
SITE SUPERVISOR (sign. of driller or journeyman)

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box): yes Y / no N
TYPE OF GROUTING MATERIAL (Circle one): CEMENT CM / BENTONITE CLAY BC
NO. OF BAGS ____ NO. OF POUNDS ____
GALLONS OF WATER ____
DEPTH OF GROUT SEAL (to nearest foot): from 5 ft. (TOP) to 132 ft. (BOTTOM) (enter 0 if from surface)

CASING RECORD
casing types insert appropriate code below: ST STEEL; CO CONCRETE; PL PLASTIC; OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	2	140

OTHER CASING (if used): diameter inch; depth (feet) from / to

SCREEN RECORD
screen type or open hole insert appropriate code below: ST STEEL; BR BRASS BRONZE; HO OPEN HOLE; PL PLASTIC; OT OTHER

C 2

	Type	DEPTH from	DEPTH to
1	PL	140	150
2			
3			

SLOT SIZE 1 ____ 2 ____ 3 ____
DIAMETER OF SCREEN ____ (NEAREST INCH)

GRAVEL PACK from 135 to ____
IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 66

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T — TELESCOPE; (E.R.O.S.) LOG; W O — OTHER DATA

C 3

PUMPING TEST
HOURS PUMPED (nearest hour): 2
PUMPING RATE (gal. per min.): 20.
METHOD USED TO MEASURE PUMPING RATE: AIR
WATER LEVEL (distance from land surface)
BEFORE PUMPING: 104 ft.
WHEN PUMPING: 125 ft.
TYPE OF PUMP USED (for test): A air; P piston; T turbine; C centrifugal; R rotary; O other (describe below); J jet; S submersible

PUMP INSTALLED
DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO): YES NO
IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS.
TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX 29.
CAPACITY: GALLONS PER MINUTE (to nearest gallon)
PUMP HORSE POWER
PUMP COLUMN LENGTH (nearest ft.)
CASING HEIGHT (circle appropriate box and enter casing height): + above / − below LAND SURFACE (nearest foot)

LOCATION OF WELL ON LOT
SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND /OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

N

See attached drawing

B 1 9072 SEQUENCE NO. (OP USE ONLY)
(THIS NUMBER IS TO BE PUNCHED IN COLS 3-8 ON ALL CARDS)

STATE OF MARYLAND
APPLICATION FOR PERMIT TO DRILL WELL
please print or type

STATE PERMIT NUMBER: AA-92-1985
fill in this form completely

Date Received (APA) 09/12/94 04 RL

OWNER INFORMATION

Cunningham Excav.
Last Name / Owner / First Name

1653 St. Steph. Chch. Rd
Street or RFD

Crownsville Md 21032
Town / State / Zip

B 3 LOCATION OF WELL 11B

Anne Arundel
COUNTY

SUBDIVISION

SECTION ____ LOT ____

Odenton
NEAREST TOWN

MILES FROM TOWN (enter 0 if in town) 3 MI

DRILLER INFORMATION MSD/MGD/MWD

Denton J. Wolford 888
Driller's Name / License No.

Wolford's Well & Pump Service, Inc.
Firm Name

4429 Mountain Rd -> Pasadena, Md.
Address

Denton Wolford 9-9-94
Signature / Date

B 2 WELL INFORMATION

APPROX PUMPING RATE (GAL PER MIN) 8

AVERAGE DAILY QUANTITY NEEDED (GAL PER DAY) 360

B 4 DIRECTION OF WELL FROM TOWN (CIRCLE BOX): NW (circled)

Rt#3 Capital Raceway Rd
ON ~~NEAR~~ WHAT ROAD

ON WHICH SIDE OF ROAD (CIRCLE APPROPRIATE BOX): NORTH (circled)

DISTANCE FROM ROAD 15
ENTER FT OR MI: FT

TAX MAP ____ BLK ____ PARCEL ____

USE FOR WATER (CIRCLE APPROPRIATE BOX)

- D HOME (SINGLE OR DOUBLE HOUSEHOLD UNIT ONLY)
- F FARMING (LIVESTOCK WATERING & AGRICULTURAL IRRIGATION)
- I INDUSTRIAL, COMMERCIAL, STATE AND FEDERAL GOV OTHER (REQUIRES APPROPRIATION PERMIT)
- P PUBLIC OR PRIVATE WATER COMPANY (REQUIRES APPROPRIATION PERMIT AND STATE HEALTH DEPARTMENT APPROVAL)
- T TEST OBSERVATION, MONITORING (MAY REQUIRE APPROPRIATION PERMIT) #53

NOT TO BE FILLED IN BY DRILLER
HEALTH DEPARTMENT APPROVAL

COUNTY NAME ____ COUNTY NO ____

STATE SIGNATURE ____ INSERT S

DATE ISSUED 091294 CO SIGNATURE [signature] EXP DATE

NORTH GRID 435000 EAST GRID 0885000

APPROXIMATE DEPTH OF WELL 115 FEET

APPROXIMATE DIAMETER OF WELL 4" NEAREST INCH

SHOW MAJOR FEATURES OF BOX & LOCATE WELL WITH AN X

X

SOURCES OF DRILLING WATER
1. AA-81-0980
2. AA-81-9800
3.

WRITE THE BOX NUMBER FROM THE MAP HERE
E 880
N 430 000 000

METHOD OF DRILLING (circle one)

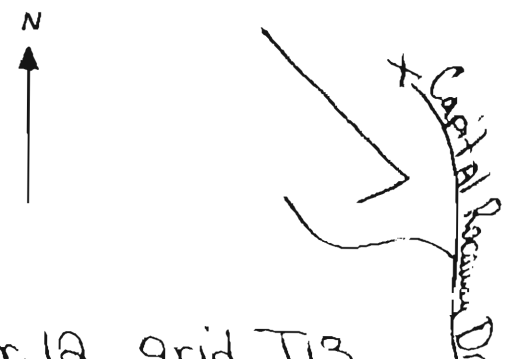
BORED (or Augered) | JETTED | Jetted & DRIVEN
AIR-ROTary | AIR-PERcussion | ROTARY (Hydraulic Rotary) (circled)
CABLE | REVerse-ROTary | DRIVE-POINT
other ____

REPLACEMENT OR DEEPENED WELLS (CIRCLE APPROPRIATE BOX)

- N THIS WELL WILL NOT REPLACE AN EXISTING WELL (circled)
- Y THIS WELL WILL REPLACE A WELL THAT WILL BE ABANDONED AND SEALED
- S THIS WELL WILL REPLACE A WELL THAT WILL BE USED AS A STANDBY-CONTACT LOCAL APPROVING AUTHORITY FOR POLICY ON STANDBY WELLS
- D THIS WELL WILL DEEPEN AN EXISTING WELL

PERMIT NUMBER OF WELL TO BE REPLACED OR DEEPENED (IF AVAILABLE) ____

DRAW A SKETCH BELOW SHOWING LOCATION OF WELL IN RELATION TO NEARBY TOWNS AND ROADS AND GIVE DISTANCE FROM WELL TO NEAREST ROAD JUNCTION



Not to be filled in by driller (OEP USE ONLY)

APPROP PERMIT NUMBER GAP

FORCE KT WRITE INITIALS IN BOX PERMIT No. AA-93-1985

Pg 12 grid J13

SPECIAL CONDITIONS

NOTE = APPROVING AUTHORITIES SHOULD USE SEPARATE SHEET IF NEEDED =

ORIGINAL-STATE

Aug-17-2006 07:53am From-MDE WMA 410 537 3163 T-493 P 003/004 F-938

(DENV USE ONLY)
(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-8 ON ALL CARDS)

WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

COUNTY NUMBER

ST/CO USE ONLY
DATE Received FEB 2 3 1995

DATE WELL COMPLETED 020395

Depth of Well 155 (TO NEAREST FOOT)

11B

PERMIT NO FROM "PERMIT TO DRILL WELL" AA-92-1985

OWNER CUNNINGHAM EXCAVATING
last name first name
STREET OR RFD 1073 ST. STEPHENS RD. TOWN CROWNSVILLE MD 21032
SUBDIVISION SECTION RT 3 CAPITAL RACEWAY LOT MONITORING B-53 (D)

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
TAN, DRY SAND IRON CEMENTED ROCK	0'	14'	
TAN, DAMP CLAY	14'	24'	
TAN, DAMP, CLAYEY SAND	24'	30'	
WHITE + ORANGE SAND	30'	51'	
ORANGE + YELLOW SAND + GRAVEL	51'	67'	
TAN, WET, SAND	67'	77'	✓
TAN, WET, SAND WITH CLAY LAYERS	77'	91'	✓
TAN, WET, SAND	91'	114'	✓
GRAY TO RED DRY CLAY	114'	144'	
GRAY WET CLAY WITH CLAYEY SAND LAYERS	144'	153'	✓
GRAY, MOIST CLAY	153'	156.5'	

CIRCLE APPROPRIATE LETTER
A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
E ELECTRIC LOG OBTAINED
P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 WELL CONSTRUCTION AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE

DRILLERS IDENT. NO MWD 423

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N — Y
TYPE OF GROUTING MATERIAL
CEMENT CM — BENTONITE CLAY BC
NO OF BAGS 14 NO OF POUNDS 97 EA
GALLONS OF WATER 84
DEPTH OF GROUT SEAL (to nearest foot)
from 0 ft. TOP to 140 ft BOTTOM (enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below
ST STEEL CO CONCRETE
PL PLASTIC OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	2	145

EACH CASING — OTHER CASING (if used) diameter inch depth (feet) from to

SCREEN RECORD

screen type or open hole insert appropriate code below
ST STEEL BR BRASS BRONZE HO OPEN HOLE
PL PLASTIC OT OTHER

C 2

EACH SCREEN — DEPTH (nearest ft)

	Type	From	To
1	PL	145	155
2			
3			

SLOT SIZE 1. 010 2. ___ 3. ___
DIAMETER OF SCREEN 2 (NEAREST INCH)

GRAVEL PACK from 140' to 155'
IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

OEP USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W Q
TELESCOPE CASING LOG INDICATOR OTHER DATA

C 3

PUMPING TEST

N/A

HOURS PUMPED (nearest hour)
PUMPING RATE (gal. per min. to nearest gal.)
METHOD USED TO MEASURE PUMPING RATE
WATER LEVEL (distance from land surface)
BEFORE PUMPING
WHEN PUMPING
TYPE OF PUMP USED (for test)
A air P piston T turbine
C centrifugal R rotary O other (describe below)
J jet S submersible

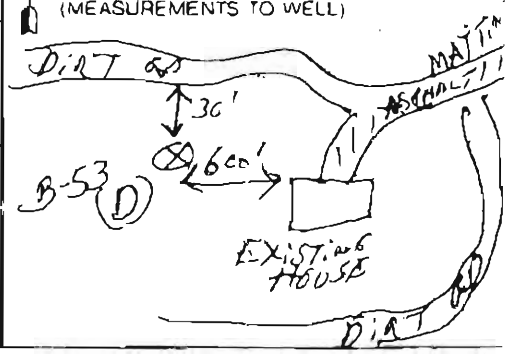
PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES NO — NO
IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE
TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE
CAPACITY GALLONS PER MINUTE (to nearest gallon)
PUMP HORSE POWER
PUMP COLUMN LENGTH (nearest ft)
CASING HEIGHT (circle appropriate box and enter casing height)
+ above — LAND SURFACE — 3 (nearest foot)
− below

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

N



ORIGINAL

(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

COUNTY NUMBER 02

ST/CO USE ONLY DATE Received: OCT 26 1994

DATE WELL COMPLETED: 10 05 94

Depth of Well: 122 (TO NEAREST FOOT)

Old 11B

PERMIT NO FROM "PERMIT TO DRILL WELL": AA-93-1985

OWNER: Cunningham Excavating (last name / first name)

STREET OR RFD: 1073 St. Stephens Church Rd. TOWN: Crownsville, Md., 21032

SUBDIVISION: ______ SECTION: Rt. #3 Capital Raceway LOT: Monitoring Well #53

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Brown Sand & Sand Rock	0	23	
Gravel	23	65	
Red Gray Clay	65	115	
Brown Sand	115	122	X

IN HARD ROCK AREAS, IDENTIFY SPECIFICALLY WHERE SATURATED FRACTURES WERE OBSERVED

WELL HYDROFRACTURED: yes Y / no N

CIRCLE APPROPRIATE LETTER
A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
E ELECTRIC LOG OBTAINED
P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE

DRILLERS IDENT NO. MWD 288

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)
Denton J. Wolford

SITE SUPERVISOR (sign of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box): Y (yes) / N (no) — Y circled

TYPE OF GROUTING MATERIAL: CEMENT CM / BENTONITE CLAY BC (circled)

NO. OF BAGS 13 NO. OF POUNDS 650

GALLONS OF WATER 325

DEPTH OF GROUT SEAL (to nearest foot): from 0 ft. (TOP) to 100 ft. (BOTTOM) (enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below: ST STEEL, CO CONCRETE, PL PLASTIC (circled), OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	4	112

OTHER CASING (if used): diameter inch / depth (feet) from / to

SCREEN RECORD

screen type or open hole insert appropriate code below: ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC (circled), OT OTHER

C 2

Each Screen	Type	DEPTH (nearest ft) from	to
1	PL	112	122
2			
3			

SLOT SIZE .020

DIAMETER OF SCREEN 4 (NEAREST INCH)

GRAVEL PACK from 107 to 122

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T — TELESCOPE CASING; (E.R.O.S.) — LOG INDICATOR; W Q — OTHER DATA

C 3 PUMPING TEST

HOURS PUMPED (nearest hour): 2

PUMPING RATE (gal. per min to nearest gal.): 15

METHOD USED TO MEASURE PUMPING RATE: AIR

WATER LEVEL (distance from land surface)
BEFORE PUMPING: 96
WHEN PUMPING: 105

TYPE OF PUMP USED (for test): A air (circled), P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO): YES / NO (NO circled)

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE.

CAPACITY GALLONS PER MINUTE (to nearest gallon)

PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height): + above (circled) / − below LAND SURFACE: 1 (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

No Drawing
Refer To Plat

ORIGINAL-STATE

Appendix D
Geotechnical Test Results

JLT LABORATORIES, INC.
GEOTECHNICAL, GEOSYNTHETIC AND MATERIALS TESTING AND RESEARCH

September 15, 2006
06LS922.01

ERM, Inc.
200 Harry S. Truman Parkway, Suite 400
Annapolis, MD 21401

Attn: Nathaniel Warner

RE: GEOTECHNICAL TEST RESULTS
TOLSON LANDFILL
W.O. #52940

Dear Mr. Warner:

JLT Laboratories, Inc. (JLT) is pleased to submit the results of geotechnical testing performed on six (6) samples identified as CU-1, CU-2, CU-3, UA-1, UA-2 and LA-2 for the above referenced project. Testing performed included the following:

Moisture Content	ASTM D-2216
Sieve/Hydrometer	ASTM D-422
Atterberg Limits	ASTM D-4318

Testing was performed in accordance with the above referenced ASTM standards and subject to JLT's internal QA/QC and data validation procedures.

We appreciate the opportunity to provide our services and look forward to working with you again. Should you have any questions, comments or require additional information, please do not hesitate to call. Thank you.

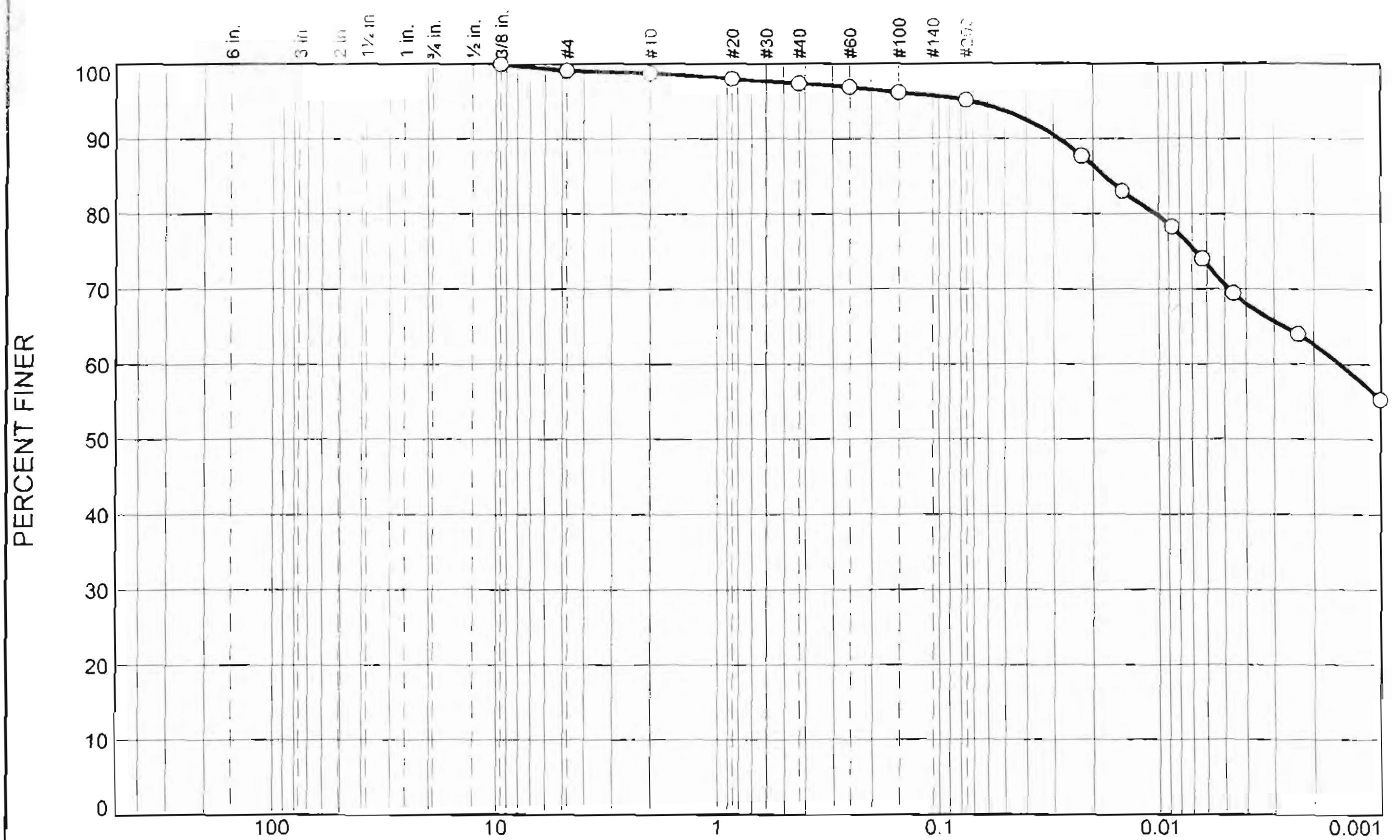
Sincerely,

JLT LABORATORIES, INC.

John Boschuk, Jr., P.E.
President

Enclosures
JB/rdo
\wp10\letter\06304

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.9	0.4	1.3	2.3	24.5	70.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	99.1		
#10	98.7		
#20	98.0		
#40	97.4		
#60	96.9		
#100	96.1		
#200	95.1		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= 19 LL= 38 PI= 19

Classification

USCS= CL AASHTO=

Coefficients

D_{85}= 0.0174 D_{60}= 0.0015 D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 09/14/06 **Tested By:** AG

Remarks

As-Rec Moisture = 26.2%
ASTM D-422

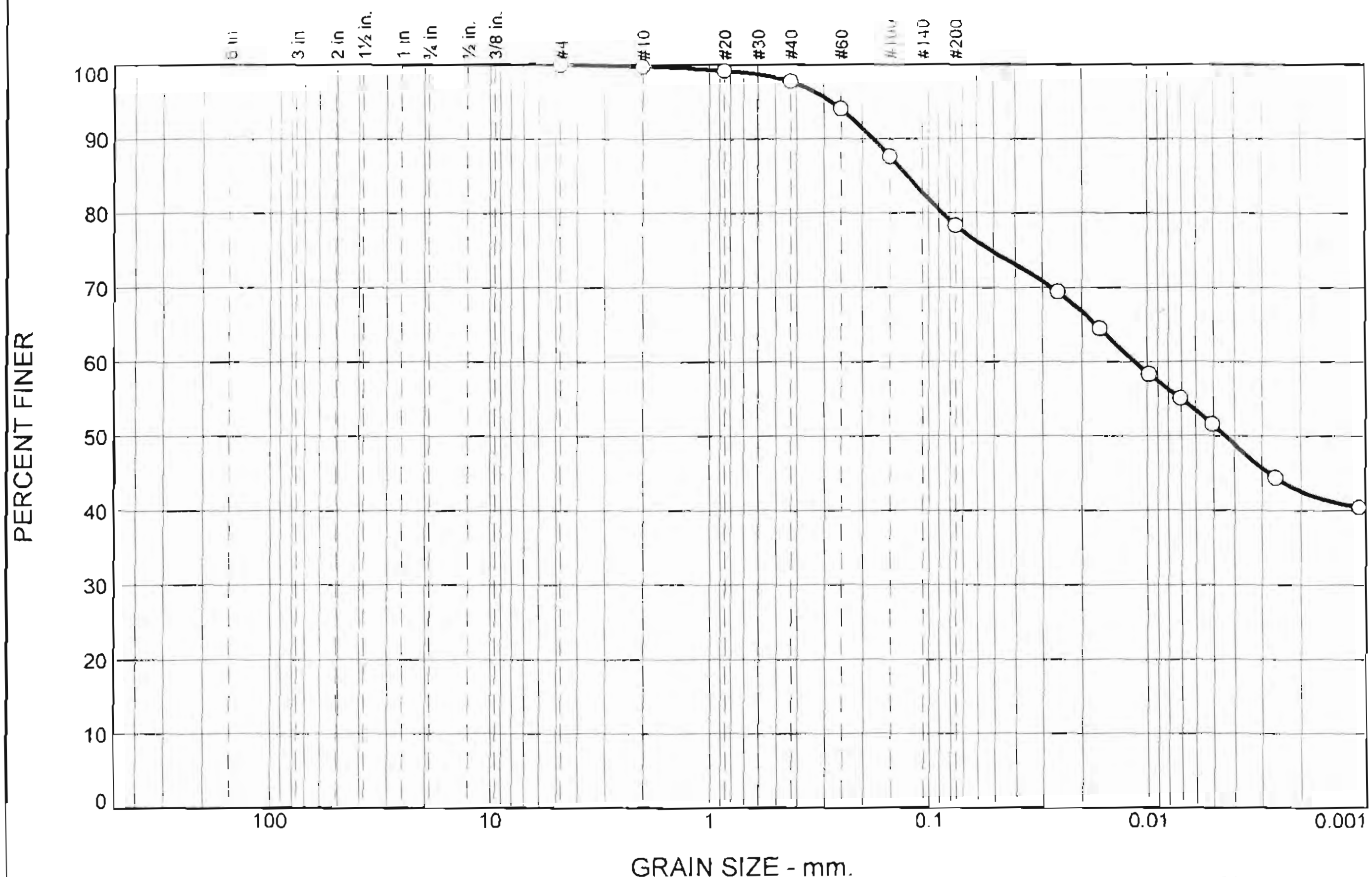
Sample No.: CU-1 **Source of Sample:** **Date Sampled:**
Location: **Elev./Depth:**
Checked By: JB **Title:** Project Manager

JLT Laboratories, Inc.

Canonsburg, PA

Client: ERM
Project: Tolson Landfill
Project No: 06LS922.01 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	2.1	19.3	27.0	51.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.8		
#20	99.2		
#40	97.7		
#60	94.0		
#100	87.6		
#200	78.4		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)
PL= 14 LL= 21 PI= 7

Classification
USCS= ML-CL AASHTO=

Coefficients
D_{85}= 0.1249 D_{60}= 0.0114 D_{50}= 0.0044
D_{30}= D_{15}= D_{10}=
C_u= C_c=

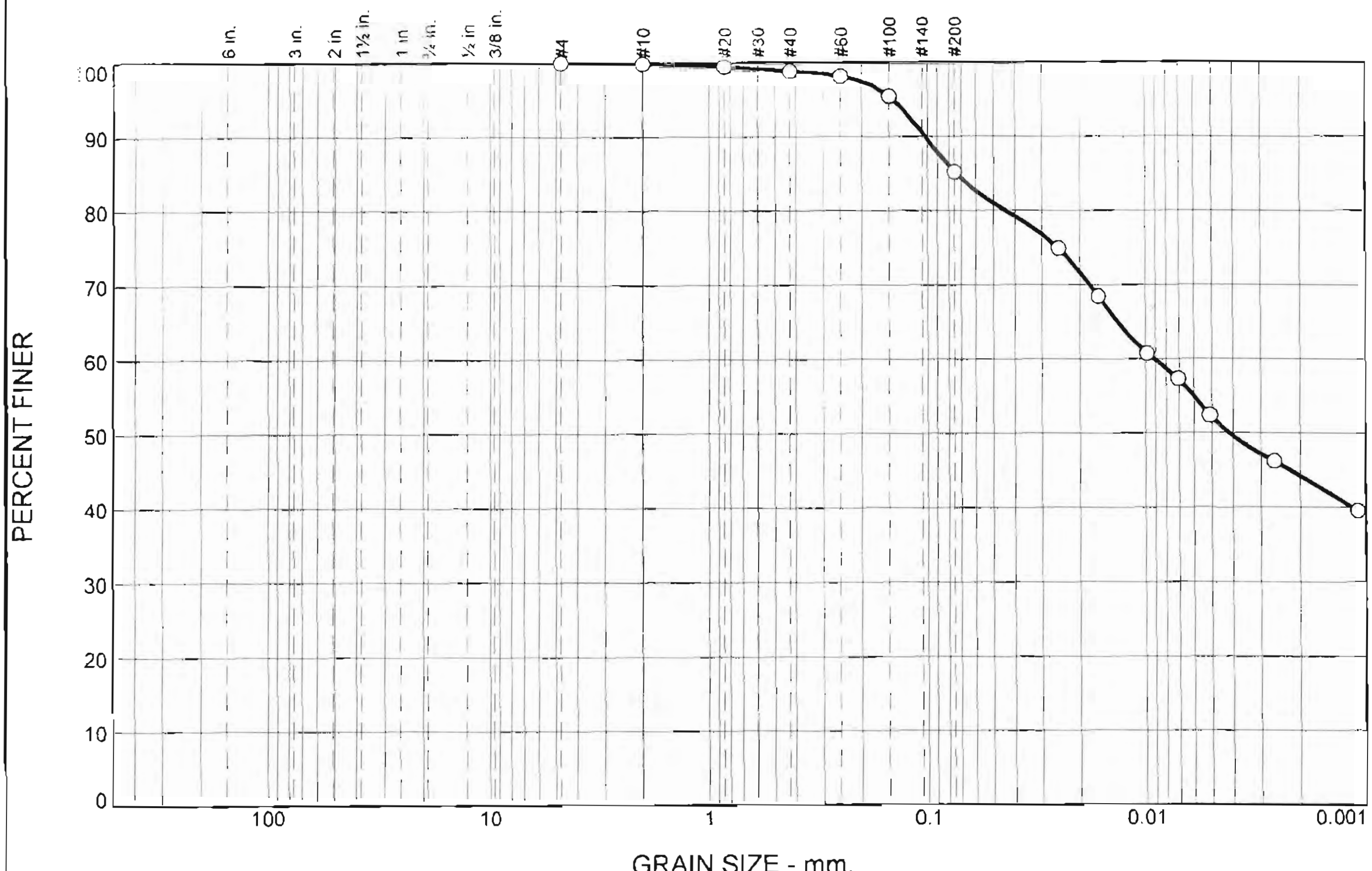
Date Tested: 09/14/06 **Tested By:** AG

Remarks
As-Rec Moisture = 18.2%
ASTM D-422

Sample No.: CU-2 **Source of Sample:** **Date Sampled:**
Location: **Elev./Depth:**
Checked By: JB **Title:** Project Managre

JLT Laboratories, Inc.	**Client:** ERM
	Project: Tolson Landfill
Canonsburg, PA	**Project No:** 06LS922.01 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	1.1	13.6	33.0	52.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.9		
#20	99.5		
#40	98.8		
#60	98.2		
#100	95.4		
#200	85.2		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= 17 LL= 25 PI= 8

Classification

USCS= CL-ML AASHTO=

Coefficients

D_{85}= 0.0739 D_{60}= 0.0092 D_{50}= 0.0042
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 09/14/06 **Tested By:** AG

Remarks

As-Rec Moisture = 18.6%
ASTM D-422

Sample No.: CU-3 **Source of Sample:** **Date Sampled:**
Location: **Elev./Depth:**

Checked By: JB **Title:** Project Manager

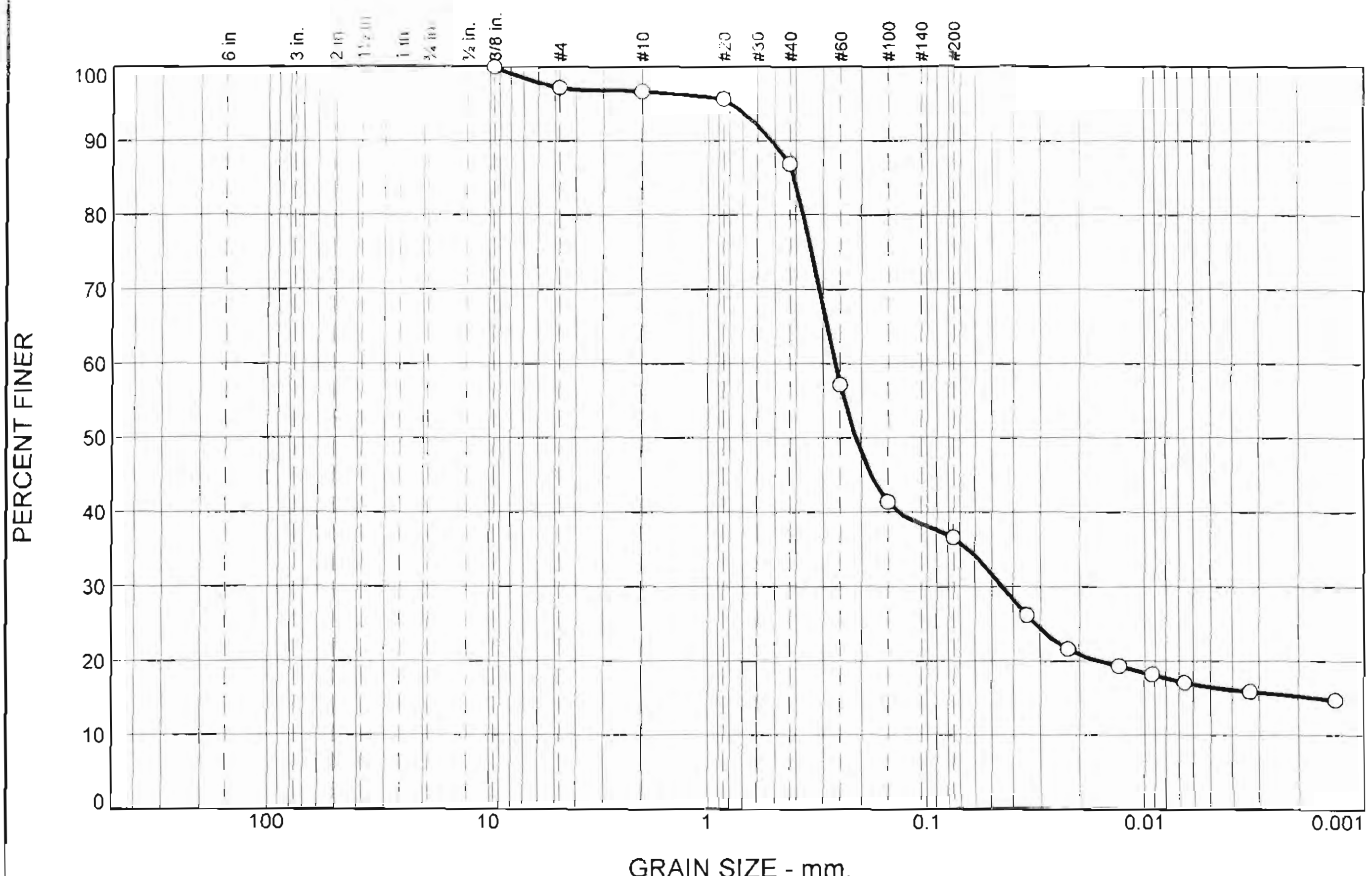
JLT Laboratories, Inc.

Canonsburg, PA

Client: ERM
Project: Tolson Landfill

Project No: 06LS922.01 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.8	0.5	9.8	50.3	20.2	16.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	97.2		
#10	96.7		
#20	95.7		
#40	86.9		
#60	57.2		
#100	41.4		
#200	36.6		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= NP LL= NP PI= NP

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= 0.4072 D_{60}= 0.2637 D_{50}= 0.2121
D_{30}= 0.0447 D_{15}= 0.0016 D_{10}=
C_u= C_c=

Date Tested: 09/14/06 **Tested By:** AG

Remarks

As-Rec Moisture = 21.7%
ASTM D-422

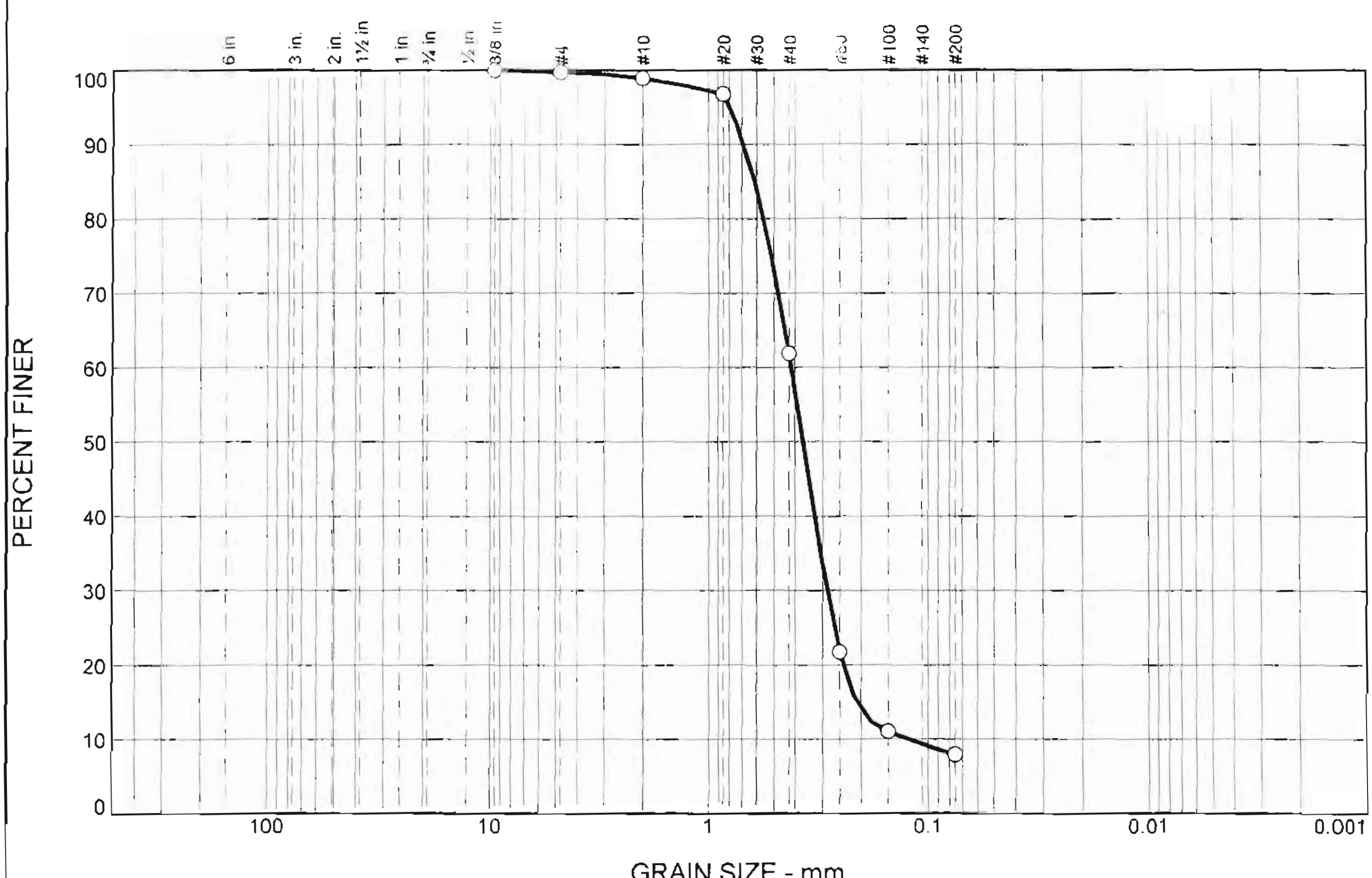
Sample No.: UA-1 **Source of Sample:** **Date Sampled:**
Location: **Elev./Depth:**
Checked By: JB **Title:** Project Manager

JLT Laboratories, Inc.

Canonsburg, PA

Client: ERM
Project: Tolson Landfill
Project No: 06LS922.01 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.3	0.8	37.0	54.0	7.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	99.7		
#10	98.9		
#20	96.8		
#40	61.9		
#60	21.7		
#100	11.0		
#200	7.9		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.6126 D_{60}= 0.4151 D_{50}= 0.3674
D_{30}= 0.2859 D_{15}= 0.2085 D_{10}= 0.1221
C_u= 3.40 C_c= 1.61

Date Tested: 09/14/06 **Tested By:** AG

Remarks

As-Rec Moisture = 22.5%
ASTM D-422

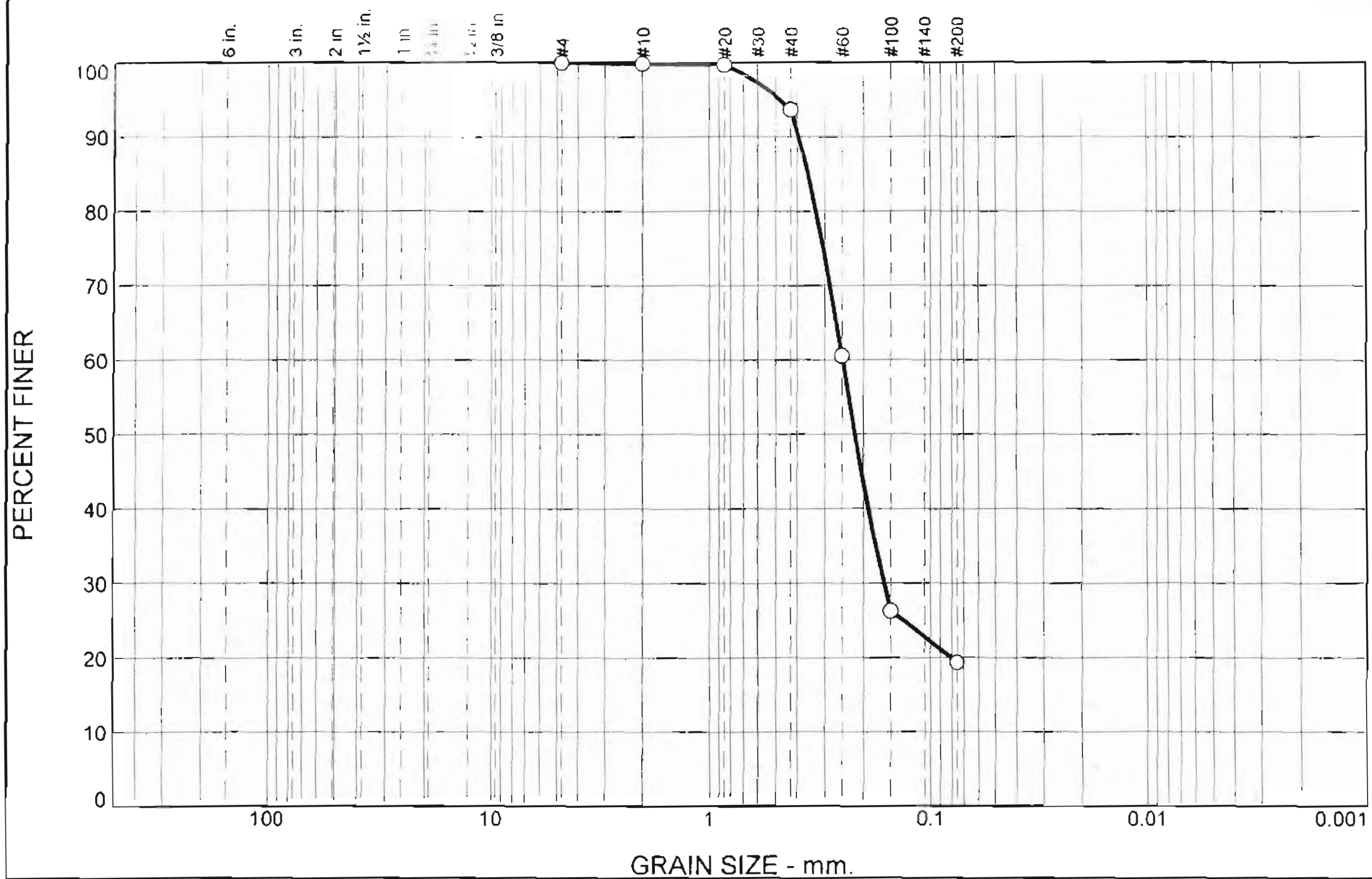
Sample No.: UA-2 **Source of Sample:** **Date Sampled:**
Location: **Elev./Depth:**
Checked By: JB **Title:** Project Manager

JLT Laboratories, Inc.

Canonsburg, PA

Client: ERM
Project: Tolson Landfill
Project No: 06LS922.01 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	6.2	74.3	19.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.8		
#20	99.7		
#40	93.6		
#60	60.5		
#100	26.3		
#200	19.3		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 0.3555 D_{60}= 0.2484 D_{50}= 0.2181
D_{30}= 0.1620 D_{15}= D_{10}=
C_u= C_c=

Date Tested: 09/14/06 **Tested By:** AG

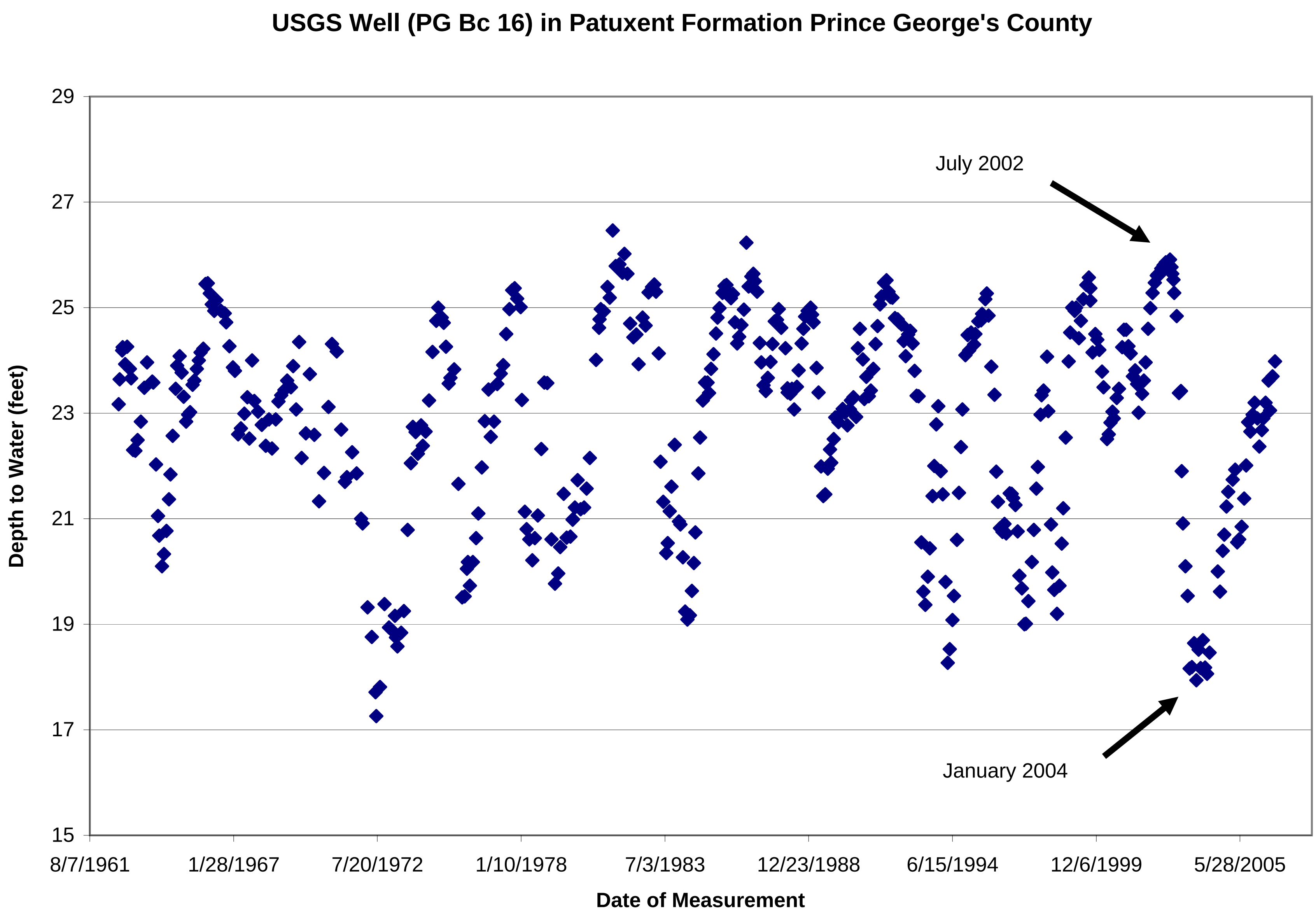
Remarks

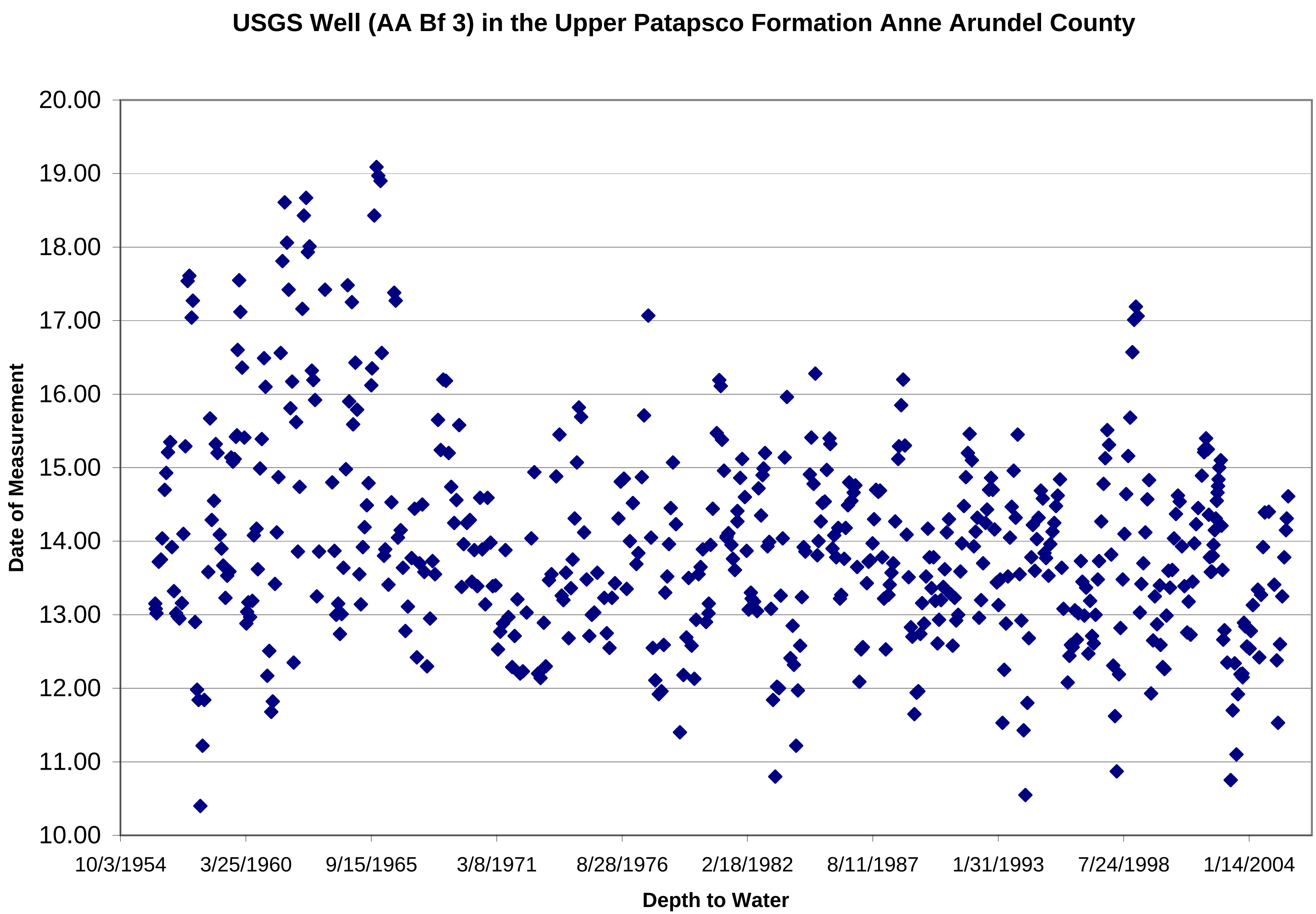
As-Rec Moisture = 20.8%
ASTM D-422

Sample No.: LA-2 **Source of Sample:** **Date Sampled:**
Location: **Elev./Depth:**
Checked By: JB **Title:** Project Manager

JLT Laboratories, Inc. Canonsburg, PA	**Client:** ERM **Project:** Tolson Landfill **Project No:** 06LS922.01 **Figure**

Appendix E
Records of Regional Wells


USGS Well (PG Bc 16) in Patuxent Formation Prince George's County
Depth to Water (feet)
29
27
25
23
21
19
17
15
July 2002
January 2004
8/7/1961
1/28/1967
7/20/1972
1/10/1978
7/3/1983
12/23/1988
6/15/1994
12/6/1999
5/28/2005
Date of Measurement



USGS Well (AA Bf 3) in the Upper Patapsco Formation Anne Arundel County
Date of Measurement
20.00
19.00
18.00
17.00
16.00
15.00
14.00
13.00
12.00
11.00
10.00
10/3/1954
3/25/1960
9/15/1965
3/8/1971
8/28/1976
2/18/1982
8/11/1987
1/31/1993
7/24/1998
1/14/2004
Depth to Water

ANNE ARUNDEL COUNTY
MARYLAND
County Executive Janet S. Owens
www.aacounty.org

Department of Health

3 Harry S. Truman Parkway
Annapolis, Maryland 21401

REQUEST FOR COPIES OF SEPTIC OR WELL RECORDS

PROPERTY INFORMATION:

Note: Tax Account Number should be provided. Transfer the 12 digit tax account number from your tax bill.

see attached list — Tax Account Number (12 digits)

A total of 70 is requested. — Property Address

Perc Number — Property Address

REQUESTED RECORD: (Please check appropriate box, please indicate whether you will pick up the record or you would like us to mail.)

☐ SEPTIC DRAWING ☐ SOIL LOG ☐ SITE PLAN RECOMMENDATIONS ☐ SITE PLAN

☐ COMPLETE ~~PERC APPLICATION~~ FILE ☒ WELL COMPLETION REPORT
Well Tag # (on well): ______

☒ PICKUP or
☐ MAIL RECORDS TO:

Name: Jill Albrecht / Bay Engineering

Address: 190 Admiral Cochrane Dr., Ste. 175

City, ST, Zip: Annapolis, MD 21401

Note: Records will be mailed or are available for pick-up at the Department of Health.

I understand records containing 3 copies or more will be charged a fee of $ .50 per page ~~and will be processed~~ within 5 business days.

Jill Albrecht — Applicant Name (please print)

5-10-06 — Date

410-897-9290 — Applicant Phone #

Jill Albrecht — Signature of Applicant

FOR OFFICE USE ONLY

☐ NO RECORD FOUND

DATE RECEIVED ______

DATE COMPLETED 5/30/06

MAILED ☐
PICKED-UP ☐
COMMENTS: 87 pages x .50 = 43.50 + 16.38 Staff time = 59.88

STAFF INITIALS BMB

Recycled Paper

ANNE ARUNDEL COUNTY
MARYLAND
County Executive Janet S. Owens
www.aacounty.org

Department of Health

3 Harry S. Truman Parkway
Annapolis, Maryland 21401

REQUEST FOR COPIES OF SEPTIC OR WELL RECORDS

PROPERTY INFORMATION:

Note: Tax Account Number should be provided. Transfer the 12 digit tax account number from your tax bill.

see attached list — Tax Account Number (12 digits)

A total of 70 is requested. — Property Address

Perc Number

Property Address

REQUESTED RECORD: (Please check appropriate box, please indicate whether you will pick up the record or you would like us to mail.)

☐ SEPTIC DRAWING ☐ SOIL LOG ☐ SITE PLAN RECOMMENDATIONS ☐ SITE PLAN

☐ COMPLETE PERC APPLICATION FILE ☒ WELL COMPLETION REPORT
Well Tag # (on well): ______

☒ PICKUP or
☐ MAIL RECORDS TO:

Name: Jill Albrecht / Bay Engineering

Address: 190 Admiral Cochrane Dr., Ste. 175

City, ST, Zip: Annapolis, MD 21401

Note: Records will be mailed or are available for pick-up at the Department of Health.

I understand records containing 3 copies or more will be charged a fee of $ .50 per page and will be processed within 5 business days.

Jill Albrecht
Applicant Name (please print)

5-10-06
Date

410-897-9290
Applicant Phone #

Jill Albrecht
Signature of Applicant

FOR OFFICE USE ONLY

☐ NO RECORD FOUND

DATE RECEIVED ______

DATE COMPLETED ______

MAILED ☐
PICKED-UP ☐
COMMENTS: ______

STAFF INITIALS ______

Recycled Paper

Well completion reports or - Abandonment reports if well is no longer there.

	ACCTID	ADDRESS	ADDRESS		CITY	ZIPCODE	
1	~~02~~0400000488650	2621	BRICKHEAD	RD	GAMBRILLS	21054	
2	020400003510455	1451	CAPITOL RACEWAY	RD	ODENTON	21113	
3	020400002380750	512	EVERGREEN	RD	GAMBRILLS	21054	Lot 3
4	020400003700500	2609	EVERGREEN	RD	ODENTON	21113	Lot 18
5	020400000624100	2613	EVERGREEN	RD	ODENTON	21113	Lot 17
6	020400006352700	2628	EVERGREEN	RD	GAMBRILLS	21054	Lot 5
~~7~~	~~020400006551600~~	~~2629~~	~~EVERGREEN~~	~~RD~~	~~ODENTON~~	~~21113~~	
~~8~~	~~020400001184475~~	~~2633~~	~~EVERGREEN~~	~~RD~~	~~ODENTON~~	~~21113~~	
9	020400005434300	2640	EVERGREEN	RD	GAMBRILLS	21054	Lot 7
10	020400001612800	2643	EVERGREEN	RD	ODENTON	21113	
11	020400002347015	2647	EVERGREEN	RD	ODENTON	21113	Lot 13
~~12~~	~~020400002401500~~	~~2654~~	~~EVERGREEN~~	~~RD~~	~~ODENTON~~	~~21113~~	
13	020400003923500	2661	EVERGREEN	RD	ODENTON	21113	
14	020400000004680	2663	EVERGREEN	RD	ODENTON	21113	Lot 11
~~15~~	~~020400002776200~~	~~2664~~	~~EVERGREEN~~	~~RD~~	~~ODENTON~~	~~21113~~	
16	020400001146925	2667	EVERGREEN	RD	ODENTON	21113	
17	020400006291750	2669	EVERGREEN	RD	ODENTON	21113	Lot 11
18	020400004435900	2671	EVERGREEN	RD	ODENTON	21113	Lot 12
19	020400090043960	883	FRANCIS STATION	RD	ODENTON	21113	
20	020400090059786	1133	MEYERS STATION	RD	ODENTON	21113	
21	020400090010238	1227	MEYERS STATION	RD	ODENTON	21113	
22	020400005347000	1113	PATUXENT	RD	ODENTON	21113	
23	020400005926200	1117	PATUXENT	RD	ODENTON	21113	
24	020400000666300	1166	PATUXENT	RD	ODENTON	21113	
25	020400090073871	1177	PATUXENT	RD	GAMBRILLS	21054	Lot 1
26	020400006505800	1182	PATUXENT	RD	ODENTON	21113	
27	020400090073872	1187	PATUXENT	RD	GAMBRILLS	21054	Lot 2
28	020400006504400	1190	PATUXENT	RD	ODENTON	21113	
~~29~~	~~020400004137000~~	~~1198~~	~~PATUXENT~~	~~RD~~	~~ODENTON~~	~~21113~~	
30	020400090045651	1210	PATUXENT	RD	ODENTON	21113	
31	020400004474400	1228	PATUXENT	RD	ODENTON	21113	
32	020400090008963	1040	WAUGH CHAPEL	RD	GAMBRILLS	21054	
33	020400000092744		RECREATION AREA		ODENTON	21113	
34	020400000093772		RECREATION AREA		GAMBRILLS	21054	
35	020400000180127		WAUGH CHAPEL	RD	GAMBRILLS	21054	
36	020400000315187		PATUXENT	RD	ODENTON	21113	
37	020400000848375		EVERGREEN	AVE	ODENTON	21113	Lot 11
38	020400001231565		EVERGREEN	AVE	ODENTON	21113	Lot 3
39	020400001286750		EVERGREEN	RD	ODENTON	21113	Lot 9
40	020400001506400		PATUXENT	RD	ODENTON	21113	
41	020400001507800		BRAGERS	RD	ODENTON	21113	
42	020400002067810		EVERGREEN	RD	GAMBRILLS	21054	Lot 4
43	020400002180450		EVERGREEN	RD	GAMBRILLS	21054	Lot 11
44	020400002714655		EVERGREEN	AVE	ODENTON	21113	Lot 11
45	020400002775900		EVERGREEN	AVE	ODENTON	21113	Lot 8
46	020400002855550		EVERGREEN	RD	GAMBRILLS	21054	Lot 2
47	020400003321160		EVERGREEN	RD	ODENTON	21113	
48	020400003510350		EVERGREEN	RD	ODENTON	21113	
49	020400004312407		EVERGREEN	RD	GAMBRILLS	21054	
50	020400004354100		EVERGREEN	RD	GAMBRILLS	21054	Lot 8
51	020400004394093		EVERGREEN	RD	GAMBRILLS	21054	Lot 2

WP - well report

52	020400004416125	BRAGERS	RD	ODENTON	21113	
53	020400004881705	EVERGREEN	RD	GAMBRILLS	21054	Lot 3
54	020400005454950	EVERGREEN	AVE	GAMBRILLS	21054	Lot 6
55	020400005465650	EVERGREEN	AVE	GAMBRILLS	21054	
56	020400005466110	EVERGREEN	RD	GAMBRILLS	21054	Lot 7
57	020400005466715	EVERGREEN	RD	GAMBRILLS	21054	Lot 1
58	020400005506210	EVERGREEN	AVE	GAMBRILLS	21054	Lot 3
59	020400005513605	EVERGREEN	AVE	GAMBRILLS	21054	Lot 1
60	020400005547700	EVERGREEN	RD	ODENTON	21113	
61	020400005613850	EVERGREEN	AVE	GAMBRILLS	21054	Lot 2
62	020400005873400	WAUGH CHAPEL	RD	GAMBRILLS	21054	
63	020400005880800	CRAIN	HWY	MILLERSVILLE	21108	
64	020400005880900	BRICKHEAD	RD	GAMBRILLS	21054	
65	020400006092800	EVERGREEN	RD	ODENTON	21113	
66	020400006312045	EVERGREEN	RD	GAMBRILLS	21054	Lot 5
67	020400006391100	BRICKHEAD	RD	GAMBRILLS	21054	
68	020400090051052	PATUXENT	RD	ODENTON	21113	
69	020400090051053	PATUXENT	RD	ODENTON	21113	
70	020400090073870	PATUXENT	RD	GAMBRILLS	21054	Lot 2
71	020400090073873	FLOOD PLAINS		GAMBRILLS	21054	
72	020400090098835	EVERGREEN	AVE	ODENTON	21113	
73	020400090212056	CRAIN	HWY	MILLERSVILLE	21108	
74	020400090213641	EVERGREEN	RD	GAMBRILLS	21054	Lot 7
75	020457190097504	SWEETFLAG	WAY	ODENTON	21113	
76	020457190097505	SWEETFLAG	WAY	ODENTON	21113	
77	020457190097506	SWEETFLAG	WAY	ODENTON	21113	

WP# 819454

```
PAGE NUMBER 1          MAP   BLK  PARCEL PLAT SECT  BLOCK     LOT     DEED REFER
   4000-0114-6925      36     11   0213                                10769-487
                                           PREMISE ADDRESS
COATES, TIMOTHY M                   2667 EVERGREEN RD
COATES, GLORIA L                                                       PLAT REFER
                                    ODENTON MD 21113
        MAILING  ADDRESS                                             GENERAL CODES
2667 EVERGREEN RD                   IMPS2.9 ACRES              EXEMPT DATE CD  CL
                                    2667 EVERGREEN RD                          000
ODENTON               MD 21113      LANDWEHRS TRACT                   USE CODE  R
                                                                      H O CODE
           LAND    BUILDINGS      TOTAL  PREFER LAND   CURTILAGE      OWN OCCUP  H
CUR       119,550    185,340      304,890                 304,890     AG TRSF TX
1          89,550    163,420      252,970                 252,970  AG DAT
2         119,550    185,340      304,890                 304,890  REASSESSMENT
3         149,550    207,260      356,810                 356,810  PH 09-01-2004
BASE       59,550    141,500      201,050                 201,050     ASSR     0275
HST        89,550    163,420      252,970                 252,970     GEO CODE   2
PREV ACCOUNT NO         PREVIOUS OWNER          TRNS NO               G F 1.000000
4000-0114-6925   COATES, TIMOTHY M                14056               PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F
```

4-©   1   AACoITD   189.9.9.3   HG0A

STATE OF MARYLAND
WATER RESOURCES ADMINISTRATION
TAWES STATE OFFICE BLDG., ANNAPOLIS, MD. 21401
WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY

C 9784

COUNTY NUMBER

DATE RECEIVED: 2 1 9 7 2

DATE WELL COMPLETED: 8-25-73 (082573)

DEPTH OF WELL (TO NEAREST FOOT): 72 ft

PERMIT NO. (FROM PERMIT TO DRILL WELL): AA-73-7946

UNIQUE IDENTIFICATION NO.: 136

OWNER: Jackson (LAST NAME), Dorothy (FIRST NAME)

STREET OR RFD: Rt 1, Box 520 POST OFFICE: Edenton, Md.

WELL DESCRIPTION

WELL LOG

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (USE ADDITIONAL SHEETS IF NECESSARY)	FEET FROM	FEET TO	CHECK IF WATER BEARING
Top soil	0	2	
Sandstone	2	15	
White clay	15	45	
Coarse brown sand	45	72	

GROUTING RECORD

WELL HAS BEEN GROUTED (CIRCLE APPROPRIATE BOX): YES Y / NO N

TYPE OF GROUTING MATERIAL (CIRCLE): CEMENT C M / BENTONITE CLAY B C

NO. OF BAGS ______ NO. OF POUNDS ______

GALLONS OF WATER ______

DEPTH OF GROUT SEAL (TO NEAREST FOOT) FROM ______ FT. TO ______ FT. (ENTER 0 IF FROM SURFACE)

CASING RECORD

CASING TYPES (INSERT APPROPRIATE CODE BELOW): STEEL S T / CONCRETE C O / PLASTIC P L / OTHER O T

MAIN CASING TYPE	NOMINAL DIAMETER TOP (MAIN) CASING (NEAREST INCH)	TOTAL DEPTH OF MAIN CASING (NEAREST FOOT)
P L	04	67

OTHER CASING (IF USED)

DIAMETER (INCH)	DEPTH (FEET) FROM	TO

SCREEN RECORD

SCREEN TYPE OR OPEN HOLE (INSERT APPROPRIATE CODE BELOW): STEEL S T / BRASS OR BRONZE B R / OPEN HOLE H O / PLASTIC P L / OTHER O T

C 2 (SEQ. NO.)

SCREEN	DEPTH (NEAREST WHOLE FOOT) FROM	TO
P L	67	72

SLOT SIZE 1. 0.30 2. ______ 3. ______

DIAMETER OF SCREEN (NEAREST INCH): 2

GRAVEL PACK FROM ______ TO ______

IF WELL DRILLED WAS A FLOWING WELL CIRCLE BOX: F

PUMPING TEST

C 3 (SEQ. NO.)

HOURS PUMPED (TO NEAREST HOUR): 1

PUMPING RATE (GALLONS PER MINUTE TO NEAREST GALLON): 10

METHOD USED TO MEASURE PUMPING RATE: Air

WATER LEVEL (DISTANCE FROM LAND SURFACE): BEFORE PUMPING 40 (NEAREST FOOT); WHEN PUMPING 48 (NEAREST FOOT)

TYPE OF PUMP USED (CIRCLE APPROPRIATE BOX) (FOR PUMPING TEST): A AIR / P PISTON / T TURBINE / C CENTRIFUGAL / R ROTARY / O OTHER (DESCRIBE BELOW) / J JET / S SUBMERSIBLE

PUMP INSTALLED

TYPE OF PUMP (WRITE APPROPRIATE LETTER IN BOX — SEE ABOVE: A, C, J, P, R, S, T, O): S

DRILLER WILL INSTALL PUMP (CIRCLE APPROPRIATE BOX): YES Y / NO N

CAPACITY: GALLONS PER MINUTE (TO NEAREST GALLON): 8

PUMP HORSE POWER: 1/2

PUMP COLUMN LENGTH (NEAREST FOOT): 60

CASING HEIGHT (CIRCLE APPROPRIATE BOX AND ENTER CASING HEIGHT): A ABOVE / B BELOW LAND SURFACE: 1 (NEAREST FOOT)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDINGS, SEPTIC TANKS, AND/OR OTHER LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL).

Pitless Adaptor

CIRCLE APPROPRIATE BOXES

A — A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED

E — ELECTRIC LOG OBTAINED

P — TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT I HAVE COMPLIED WITH ALL CONDITIONS STATED ON THE ABOVE-CAPTIONED "PERMIT TO DRILL WELL", AND THAT INFORMATION CONTAINED IN THIS REPORT IS TRUE, ACCURATE, AND COMPLETE TO THE BEST OF MY KNOWLEDGE, INFORMATION AND BELIEF.

DRILLER'S NAME: H. J. Greer Drilling Co

DRILLER'S PRINT: Elmer E. Greer

SIGNATURE: Harold J. Greer

OWR USE ONLY (NOT TO BE FILLED IN BY DRILLER): TELESCOPE CASING / LOG INDICATOR / OTHER DATA AVAILABLE

ENTERED 1 1 0 29

ENTERED 1 1 0

ORIGINAL

WP# 895355

PAGE NUMBER 1 MAP BLK PARCEL PLAT SECT BLOCK LOT DEED REFER
4000-0161-2800 36 11 0041 04476-658
PREMISE ADDRESS
HARVEY, NORMAN K 2643 EVERGREEN RD
HARVEY, JUANITA A PLAT REFER
ODENTON MD 21113
MAILING ADDRESS GENERAL CODES
2643 EVERGREEN RD IMPS5.85 ACRES EXEMPT DATE CD CL
2643 EVERGREEN RD 000
ODENTON MD 21113 LANDWEHRS TRACT USE CODE R
H O CODE

	LAND	BUILDINGS	TOTAL	PREFER LAND	CURTILAGE	OWN OCCUP H
CUR	132,818	240,794	373,612		373,612	AG TRSF TX
1	102,820	220,857	323,677		323,676	AG DAT
2	132,818	240,794	373,612		373,612	REASSESSMENT
3	162,820	260,730	423,550		423,550	PH 09-01-2004
BASE	72,820	200,920	273,740		273,740	ASSR 0275
HST	102,820	220,857	323,677		323,676	GEO CODE 2

PREV ACCOUNT NO PREVIOUS OWNER TRNS NO G F 1.000000
0000-0000-0000 00000 PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT F1-MENU F2-WB F3-UTIL F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP F

4-© 1 AACoITD 189.9.9.3 HGOA

No Query

```
 UPDATE COMPLETED WELLS            Filename: SE.WELLS            Mode: UPDATE
Record type: 01            Last record type: 01                  Auto-dup: OFF
TAG NUMBER 885355
WELL DEPTH 00152  COMPLETION DATE 19901115  DATE RECEIVED 19910103
DESCRIPTION 1 BROWN & WHITE SAND & GRAVEL    FROM 1 0000   TO 1 0045
DESCRIPTION 2 WHITE CLAY                     FROM 2 0045   TO 2 0056
DESCRIPTION 3 BROWN, WHITE SAND              FROM 3 0056   TO 3 0085
DESCRIPTION 4 RED, WHITE CLAY                FROM 4 0085   TO R 0100
DESCRIPTION 5 RED CLAY                       FROM 5 0100   TO 5 0138
DESCRIPTION 6 BROWN, WHITE SAND              FROM 6 0138   TO 6 0152
DESCRIPTION 7                                FROM 7        TO 7
DESCRIPTION 8                                FROM 8        TO 8
DESCRIPTION 9                                FROM 9        TO 9
GROUTING MATR. BC    GROUTING BAGS 10    GROUTING POUNDS 500
GROUTING GALLONS 0250  GROUTING DEPTH 4-104  CASING TYPE 1 PL CASING DIA 1 04
CASING DEPTH 1 00145  CASING TYPE 2    CASING DIA 2
CASING DEPTH 2              SCREEN TYPE PL SCREEN DEPTH 145-152
SCREEN SLOT SIZE 020  SCREEN DIA 02  GRAVEL PACK 142-152
PUMPING HOURS 03  PUMPING RATE 00020  PUMPING METHOD AIR
PUMP H2O LEV B4 0075  PUMP H2O LEV AFT 00095  PUMP TYPE A PUMP INS DRILLER Y
PUMP INS TYPE S PUMP INS GPM 00007  PUMP INS HP .5    PUMP INS COLM LG 00125
ABANDONED WELL
DELETE CODE
```

WP # 921716

```
PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0234-7015      36    11   0040                        13    05741-112
                                           PREMISE ADDRESS
ARMENTROUT, JAMES E               2647 EVERGREEN RD
                                                                    PLAT REFER
                                  ODENTON MD 21113
        MAILING  ADDRESS                                          GENERAL CODES
2647 EVERGREEN RD                 IMPSLT 13                  EXEMPT DATE CD  CL
                                  2647 EVERGREEN RD                         000
ODENTON                MD 21113   LANOWEHERS TRACT                  USE CODE  R
                                                                    H 0 CODE
          LAND     BUILDINGS     TOTAL  PREFER LAND   CURTILAGE   OWN OCCUP  H
CUR      140,836     168,474     309,310                 309,310  AG TRSF TX
1        107,503     152,777     260,280                 260,280 AG DAT
2        140,836     168,474     309,310                 309,310 REASSESSMENT
3        174,170     184,170     358,340                 358,340 PH 09-01-2004
BASE      74,170     137,080     211,250                 211,250  ASSR    0275
HST      107,503     152,777     260,280                 260,280  GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER          TRNS NO            G F 1.000000
4000-0234-7015   HARDISTY, JOHN T                08560            PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F
```

4-©   1   AACoITD   189.9.9.3   HGOA

No Query

```
 UPDATE COMPLETED WELLS           Filename: SE.WELLS            Mode: UPDATE
Record type: 01            Last record type: 01               Auto-dup: OFF
TAG NUMBER 921716
WELL DEPTH 00080  COMPLETION DATE 19940822  DATE RECEIVED 19940928
DESCRIPTION 1 BROWN SAND & GRAVEL              FROM 1 0000  TO 1 0024
DESCRIPTION 2 WHITE CLAY                       FROM 2 0024  TO 2 0032
DESCRIPTION 3 BROWN SAND                       FROM 3 0032  TO 3 0050
DESCRIPTION 4 WHITE CLAY                       FROM 4 0050  TO R 0072
DESCRIPTION 5 MEDIUM BROWN SAND                FROM 5 0072  TO 5 0080
DESCRIPTION 6                                  FROM 6       TO 6
DESCRIPTION 7                                  FROM 7       TO 7
DESCRIPTION 8                                  FROM 8       TO 8
DESCRIPTION 9                                  FROM 9       TO 9
GROUTING MATR. BC    GROUTING BAGS 12    GROUTING POUNDS 600
GROUTING GALLONS 0300  GROUTING DEPTH 4-55   CASING TYPE 1 PL CASING DIA 1 04
CASING DEPTH 1 00075  CASING TYPE 2    CASING DIA 2
CASING DEPTH 2              SCREEN TYPE PL SCREEN DEPTH 75-80
SCREEN SLOT SIZE 020  SCREEN DIA 02  GRAVEL PACK 70-80
PUMPING HOURS 01  PUMPING RATE 00020  PUMPING METHOD AIR
PUMP H2O LEV B4 0055  PUMP H2O LEV AFT 00060  PUMP TYPE A PUMP INS DRILLER Y
PUMP INS TYPE S PUMP INS GPM 00012  PUMP INS HP .50   PUMP INS COLM LG 00070
ABANDONED WELL
DELETE CODE
```

WP# 814594✓

PAGE NUMBER 1   MAP BLK PARCEL PLAT SECT BLOCK   LOT   DEED REFER
4000-0543-4300   36   11   0120   7   11802-761

PREMISE ADDRESS

SLIGH, JOHN W   2640 EVERGREEN RD

FERGUSON ET AL, BRYANT   PLAT REFER

ODENTON MD 21113

MAILING ADDRESS   GENERAL CODES

2640 EVERGREEN RD   IMPSPT LT 7 OR 2.095 ACS   EXEMPT DATE CD CL

2640 EVERGREEN RD   000

ODENTON   MD 21113   LANDWEHRS TRACT   USE CODE R

H O CODE

	LAND	BUILDINGS	TOTAL	PREFER LAND	CURTILAGE	OWN OCCUP H
CUR	127,066	39,210	166,276		166,276	AG TRSF TX
1	93,733	37,980	131,713		131,713	AG DAT
2	127,066	39,210	166,276		166,276	REASSESSMENT
3	160,400	40,440	200,840		200,840	PH 09-01-2004
BASE	60,400	36,750	97,150		97,150	ASSR 0275
HST	93,733	37,980	131,713		131,713	GEO CODE 2

PREV ACCOUNT NO   PREVIOUS OWNER   TRNS NO   G F 1.000000

4000-0543-4300   SLIGH, JOHN W   11971   PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT F1-MENU F2-WB F3-UTIL F4-LIEN

F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP   F

4-©   1   AACoITD   189.9.9.3   HGOA

C1 1 4 SEQUENCE NO (DEP USE ONLY) 1154

(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

STATE OF MARYLAND
WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED

COUNTY NUMBER 02

DATE Received MAY - 1998

DATE WELL COMPLETED 04/17/95

Depth of Well 85 (TO NEAREST FOOT)

PERMIT NO FROM "PERMIT TO DRILL WELL" AA-81-4591

OWNER SLIGH John W

STREET OR RFD [illegible] TOWN Gambrills

SUBDIVISION Landwehrs Tract SECTION LOT 7

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Sand	0	10	
Sandstone & Sand	10	25	
Black Clay	25	50	
Sand & Gravel	52	65	
White Clay	65	74	
Course Brown Sand	74	85	X

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box) Y N

TYPE OF GROUTING MATERIAL
CEMENT CM BENTONITE CLAY BC

NO OF BAGS 5 NO OF POUNDS 250

GALLONS OF WATER 110

DEPTH OF GROUT SEAL (to nearest foot) from 4 ft. to 27 ft. (enter 0 if from surface)

CASING RECORD
casing types insert appropriate code below

ST STEEL CO CONCRETE PL PLASTIC OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	4	80

OTHER CASING (if used)
EACH CASING diameter inch depth (feet) from to

SCREEN RECORD
screen type or open hole insert appropriate code below

PL PLASTIC OT OTHER

C2

EACH SCREEN DEPTH (nearest ft.)

Type	From	To
PL	80	85

SLOT SIZE 0.20

DIAMETER OF SCREEN 4

C3

PUMPING TEST
HOURS PUMPED (nearest hour) 1

PUMPING RATE (gal. per min. to nearest gal.) 15

METHOD USED TO MEASURE PUMPING RATE Air

WATER LEVEL (distance from land surface)
BEFORE PUMPING 40
WHEN PUMPING 65

TYPE OF PUMP USED (for test) A air P piston T turbine C centrifugal R rotary O other describe below J jet S submersible

PUMP INSTALLED
DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS

TYPE OF PUMP INSTALLED (A,C,J,P,R,S,T,O) SEE ABOVE

CAPACITY GALLONS PER MINUTE (to nearest gallon)

PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height) + above − below LAND SURFACE (nearest feet)

CIRCLE APPROPRIATE LETTER
A IF WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
B ELECTRIC LOG OBTAINED
C [illegible] SUBMITTED TO [illegible]

LOCATION OF [illegible] LOT

WO

C1 1 4 SEQUENCE NO. DEP USE ONLY

(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-8 ON ALL CARDS) 1154

STATE OF MARYLAND
WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED

COUNTY NUMBER 02

PERMIT NO. FROM PERMIT TO DRILL WELL AA-81-4512

DATE Received MAY [illegible]

DATE WELL COMPLETED 04/17/83

Depth of Well 85 (TO NEAREST FOOT)

OWNER SLIGH W

STREET OR RFD Evergreen [illegible] TOWN Gambrills

SUBDIVISION Landwehrs Track SECTION ____ LOT 7

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED THEIR COLOR, DEPTH THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Sand	0	10	
Sandstone & Sand	10	25	
Black Clay	25	50	
Sand & Gravel	50	65	
White Clay	65	74	
Course Brown Sand	74	85	X

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box) **Y** N

TYPE OF GROUTING MATERIAL: CEMENT CM — BENTONITE CLAY **BC**

NO OF BAGS 5 — NO OF POUNDS 250

GALLONS OF WATER 110

DEPTH OF GROUT SEAL (to nearest foot) from 4 ft to 17 ft (enter 0 if from surface)

CASING RECORD
casing types insert appropriate code below: ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE	Nominal diameter top main casing (nearest inch)	Total depth of main casing (nearest foot)
PL	4	80

OTHER CASING (if used): diameter inch — depth (feet) from — to

SCREEN RECORD
screen type or open hole insert appropriate code below: ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C2

EACH SCREEN	DEPTH (nearest ft.)	
PL	80	85

SLOT SIZE 0.020

DIAMETER OF SCREEN [illegible] (NEAREST INCH)

GRAVEL PACK from 75 to 85

IF WELL DRILLED WAS [illegible] INSERT [illegible]

DEP USE ONLY (NOT TO BE FILLED IN BY DRILLER)

T — LOG — WO

TELESCOPE CASING — LOG RECEIVED — OTHER DATA

C3

PUMPING TEST
HOURS PUMPED (nearest hour) 1

PUMPING RATE (gal. per min. to nearest gal.) 15

METHOD USED TO MEASURE PUMPING RATE Air

WATER LEVEL (distance from land surface)

BEFORE PUMPING 40

WHEN PUMPING 65

TYPE OF PUMP USED (for test): **A** air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

PUMP INSTALLED
DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) **YES** NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE

CAPACITY GALLONS PER MINUTE (to nearest gallon)

PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height): + above / - below LAND SURFACE (nearest feet)

CIRCLE APPROPRIATE LETTER

A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED

E ELECTRIC LOG OBTAINED

[illegible] TEST WELL CONVERTED TO PRODUCTION

[illegible]

337

[illegible] SIGNATURE ON APPLICATION

[illegible]

LOCATION OF WELL ON LOT
SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

C1 1774 SEQUENCE NO. (OEP USE ONLY)

(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

STATE OF MARYLAND
WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

THIS [illegible] 45 DAYS AFTER WELL IS [illegible]

COUNTY NUMBER: 02

DATE Received: DEC 16 1987

DATE WELL COMPLETED: 10 02 87

Depth of Well: 200 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL": [illegible]

OWNER: Hayes (last name) Dorothy (first name)

STREET OR RFD: Evergreen Rd TOWN: Odenton

SUBDIVISION: Capital Raceway Park SECTION ______ LOT # 2667

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Brown clay	0	2	
Gravel	2	12	
Fine white & Tan sand	12	18	
White clay	18	22	
tan sand & gravel	22	45	
White clay	45	50	
Red & tan sand	50	85	
Red clay	85	105	
White clay	105	115	
Fine White sand	115	130	
Blue clay	130	145	
Fine White sand & charcoal	145	160	
Blue clay	160	170	
White clay	170	185	
Tan sand	185	200	✓

CIRCLE APPROPRIATE LETTER

- A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
- E ELECTRIC LOG OBTAINED
- P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 10.17.13 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS IDENT. NO. 418

Robert Bruckach RB
DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

Brian Kirby RB
SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box): Y (yes) N (no) — Y circled

TYPE OF GROUTING MATERIAL: CEMENT CM; BENTONITE CLAY BC (circled)

NO. OF BAGS 3 NO. OF POUNDS 150

GALLONS OF WATER 75

DEPTH OF GROUT SEAL (to nearest foot): from 4 ft. (TOP) to 34 ft. (BOTTOM) (enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below: ST STEEL; CO CONCRETE; PL PLASTIC (circled); OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	4	193

OTHER CASING (if used): EACH CASING — diameter inch; depth (feet) from; to

SCREEN RECORD

screen type or open hole insert appropriate code below: ST STEEL; BR BRASS BRONZE; HO OPEN HOLE; PL PLASTIC (circled); OT OTHER

C2

EACH SCREEN	Type	DEPTH (nearest ft.) from	to
1	PL	193	200
2			
3			

SLOT SIZE 0 2 0

DIAMETER OF SCREEN 2 (NEAREST INCH)

GRAVEL PACK from 175 to 200

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

OEP USE ONLY (NOT TO BE FILLED IN BY DRILLER)

T TELESCOPE CASING; (E.R.O.S.) LOG INDICATOR; W Q OTHER DATA

C3

PUMPING TEST

HOURS PUMPED (nearest hour) 2

PUMPING RATE (gal. per min. to nearest gal.) 45

METHOD USED TO MEASURE PUMPING RATE: Air

WATER LEVEL (distance from land surface)

BEFORE PUMPING 90

WHEN PUMPING 110

TYPE OF PUMP USED (for test): A air (circled); P piston; T turbine; C centrifugal; R rotary; O other (describe below); J jet; S submersible

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO): YES (circled)

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX-SEE ABOVE: S

CAPACITY: GALLONS PER MINUTE (to nearest gallon) 9

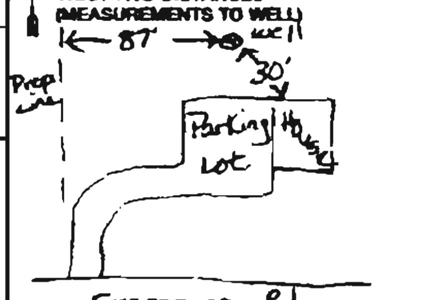
PUMP HORSE POWER .50

PUMP COLUMN LENGTH (nearest ft.) 160

CASING HEIGHT (circle appropriate box and enter casing height): + above (circled); − below LAND SURFACE 1 (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



ORIGINAL

WP # 711672*

```
PAGE NUMBER 1          MAP   BLK   PARCEL PLAT SECT  BLOCK      LOT     DEED REFER
   4000-0128-6750      36     11    0059                          9     07983-636
                                              PREMISE ADDRESS
CRAWFORD, JOHN                        EVERGREEN RD
CRAWFORD JR, SHERMAN R                                                  PLAT REFER
                                      ODENTON MD 21113
        MAILING  ADDRESS                                              GENERAL CODES
2660 EVERGREEN RD                     IMPSPT LT 9 OR 7.909 ACS  EXEMPT DATE CD  CL
                                      EVERGREEN RD                                000
ODENTON                MD 21113       LANDWEHRS TRACT                  USE CODE  R
                                                                       H O CODE
           LAND     BUILDINGS      TOTAL  PREFER LAND    CURTILAGE     OWN OCCUP  N
CUR       148,216        1,540     149,756                             AG TRSF TX
1         109,883        1,500     111,383                            AG DAT
2         148,216        1,540     149,756                            REASSESSMENT
3         186,550        1,580     188,130                            PH 09-01-2004
BASE       71,550        1,460      73,010                             ASSR     0275
HST       109,883        1,500     111,383                             GEO CODE   2
PREV ACCOUNT NO          PREVIOUS OWNER           TRNS NO              G F 1.000000
4000-0128-6750   CRAWFORD, SHERMAN                  07465              PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F

4-©           1     AACoITD    189.9.9.3                    HGOA
```

No microfische available - data screen attached.

UPDATE COMPLETED WELLS Filename: MDWELLS1 Mode: UPDATE
Record type: 01 Last record type: 01 Auto-dup: OFF
TAG NUMBER 711072
WELL DEPTH 00084 COMPLETION DATE 19710624 DATE RECEIVED 19710826
DESCRIPTION 1 FROM 1 TO 1
DESCRIPTION 2 FROM 2 TO 2
DESCRIPTION 3 FROM 3 TO 3
DESCRIPTION 4 FROM 4 TO R
DESCRIPTION 5 FROM 5 TO 5
DESCRIPTION 6 FROM 6 TO 6
DESCRIPTION 7 FROM 7 TO 7
DESCRIPTION 8 FROM 8 TO 8
DESCRIPTION 9 FROM 9 TO 9
GROUTING MATR. BC GROUTING BAGS GROUTING POUNDS
GROUTING GALLONS GROUTING DEPTH 0040 CASING TYPE 1 PL CASING DIA 1 04
CASING DEPTH 1 00079 CASING TYPE 2 CASING DIA 2
CASING DEPTH 2 SCREEN TYPE PL SCREEN DEPTH 0079-0084
SCREEN SLOT SIZE SCREEN DIA 02 GRAVEL PACK
PUMPING HOURS 01 PUMPING RATE 00012 PUMPING METHOD
PUMP H2O LEV B4 0050 PUMP H2O LEV AFT 00055 PUMP TYPE PUMP INS DRILLER
PUMP INS TYPE S PUMP INS GPM 00010 PUMP INS HP 1 PUMP INS COLM LG 00060
ABANDONED WELL
DELETE CODE

ADD/CHANGE WELL MASTER Filename: MDWELLS1 Mode: UPDATE
Record type: 01 Last record type: 01 Auto-dup: OFF
WELL TAG # 711072

TAX ACCOUNT #	400001286750	BO PERMIT #	
PERC #			
OWNER'S NAME	CRAWFORD, SHERMAN		
WELL DRILLER	GREER, H J DRLG CO		
USE OF WATER	D	TYPE OF WELL	
APPROP PERMIT			
SUBDIVISION			
MAP		BLOCK	
PARCEL		DEED REF 1	
DEED REF 2		LOT	
CITY	GAMBRILLS	ZIP CODE	
HOUSE #		STREET	EVERGREEN RD
DATE ISSUED	19710622		
COMMENT	TFSD		
SPCL CONDITIONS		RADIUM? (Y/no)	
CADMIUM? (Y/no)		GRID N	435
GRID E	0885		
RADIUMAGREE PRNT			
RADIUMAGREE DATE			
DELETE CODE			

TD 2022007 EMERGENCY/TEMP NO. IF ANY TDF 4010-0277-6200

B 1 SEQUENCE NO. (MDE USE ONLY) 1563

STATE OF MARYLAND
APPLICATION FOR PERMIT TO DRILL WELL
please type

STATE PERMIT NUMBER AA-94-6573
fill in this form completely

Date Received (APA) 4-30-2001 (MM DD YY)

OWNER INFORMATION

Manual Raymond (Last Name / Owner / First Name)

2664 Evergreen Rd. (Street or RFD)

Gambrills MD 21054 (Town / State / Zip)

DRILLER INFORMATION

JAMES HOLT — License No. M 5 D 136 (Driller's Name)

Cool Water Svc. (Firm Name)

Address

Signature James Holt — Date 4-30-01

B 2 WELL INFORMATION

APPROX. PUMPING RATE (GAL. PER MIN.) 15

AVERAGE DAILY QUANTITY NEEDED (GAL. PER DAY) 600

B 3 LOCATION OF WELL

COUNTY A. A. Co

SUBDIVISION Timers Branch Park

SECTION — LOT 7-10

NEAREST TOWN Jackson Rd. Crofton

MILES FROM TOWN (enter 0 if in town) 4 M

B 4

DIRECTION OF WELL FROM TOWN (CIRCLE BOX): N, NE, E, SE, S, SW, W, NW, TOWN — SW circled

NEAR WHAT ROAD ~~Jackson Rd~~ 2664 Evergreen Rd

ON WHICH SIDE OF ROAD (CIRCLE APPROPRIATE BOX): NORTH N, WEST W, EAST E, SOUTH S

DISTANCE FROM ROAD 310 — ENTER FT OR MI: FT

TAX MAP: 36 BLK: 11 PARCEL: 060

USE FOR WATER (CIRCLE APPROPRIATE BOX)

- D DOMESTIC POTABLE SUPPLY & RESIDENTIAL IRRIGATION (circled)
- F FARMING (LIVESTOCK WATERING & AGRICULTURAL IRRIGATION
- I INDUSTRIAL, COMMERICIAL, DEWATERING
- P PUBLIC WATER SUPPLY WELL
- T TEST, OBSERVATION, MONITORING
- G GEO-THERMAL

NOT TO BE FILLED IN BY DRILLER
HEALTH DEPARTMENT APPROVAL

COUNTY NAME Anne Arundel — COUNTY NO. 02

STATE SIGNATURE ______ INSERT S →

DATE ISSUED 5/3/01 — CO SIGNATURE S. Smith — EXP. DATE 5/3/02

NORTH GRID 441 000 — EAST GRID 0884 000

APPROXIMATE DEPTH OF WELL 150 FEET

APPROXIMATE DIAMETER OF WELL 4 NEAREST INCH

METHOD OF DRILLING (circle one)

BORED (or Augered) | JETTED | Jetted & DRIVEN
AIR-ROTary | AIR-PERcussion | ROTARY (Hydraulic Rotary) — circled
CABLE | REVerse-ROTary | DRive-POINT
other ______

REPLACEMENT OR DEEPENED WELLS
(CIRCLE APPROPRIATE BOX)

- N THIS WELL WILL NOT REPLACE AN EXISTING WELL
- Y THIS WELL WILL REPLACE A WELL THAT WILL BE ABANDONED AND SEALED (circled)
- S THIS WELL WILL REPLACE A WELL THAT WILL BE USED AS A STANDBY-CONTACT LOCAL APPROVING AUTHORITY FOR POLICY ON STANDBY WELLS
- D THIS WELL WILL DEEPEN AN EXISTING WELL

PERMIT NUMBER OF WELL TO BE REPLACED OR DEEPENED (IF AVAILABLE) AA-94-2922

Not to be filled in by driller (MDE OR COUNTY USE ONLY)

APPROP. PERMIT NUMBER _ _ _ _ _ _ G _ _ _

PERMIT No. AA-94-6573

SHOW MAJOR FEATURES OF BOX & LOCATE WELL WITH AN X →

SOURCES OF DRILLING WATER
1. Builder
2.
3.

WRITE THE BOX NUMBER FROM THE MAP HERE

E 860

N 440

000
000 X

DRAW A SKETCH BELOW SHOWING LOCATION OF WELL IN RELATION TO NEARBY TOWNS AND ROADS AND GIVE DISTANCE FROM WELL TO NEAREST ROAD JUNCTION

N

"The well must be drilled into a confined aquifer, with the bottom of the confining bed at a minimum depth of 60 ft. The confining bed can be no less than 5' thick. The annular space must be grouted from at least 2' into the confining bed to the land surface."

Radium

15.

Old well

2123072

EMERGENCY/TEMP NO. IF ANY TAX ID # 4000-0277-6200

2 — SEQUENCE NO. (MDE USE ONLY)

THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS

STATE OF MARYLAND
APPLICATION FOR PERMIT TO DRILL WELL
please print or type

STATE PERMIT NUMBER: AA - 94 - 2922

fill in this form completely

OWNER INFORMATION

Date Received (APA): 08-06-98

Last Name / Owner / First Name: MANUAL RAYMOND / FRANK RUFF

Street or RFD: 2664 EVERGREEN RD

Town / State / Zip: GAMBRILLS md 21054

DRILLER INFORMATION

Driller's Name: John F Bischoff — License No.: MSD002

Firm Name: BRANHAM Contractors

Address: P.O. BOX 1179 STEVENSVILLE, MD. 21666

Signature: J F Bischoff — Date: 8-6-98

B 3 LOCATION OF WELL

County: ANNE ARUNDEL

Subdivision: TOWSERS BRANCH PARK

SECTION: ___ LOT: 7-10

NEAREST TOWN: JACKSON RD CROFTON

MILES FROM TOWN (enter 0 if in town): 4 M

B 4

DIRECTION OF WELL FROM TOWN (CIRCLE BOX): N, NE, E, SE, S, SW, W, NW — SW

NEAR WHAT ROAD: JACKSON RD.

ON WHICH SIDE OF ROAD (CIRCLE APPROPRIATE BOX): NORTH, WEST, EAST, SOUTH — N

DISTANCE FROM ROAD: 300 — ENTER FT OR MI: FT

TAX MAP: 36 BLK: 11 PARCEL: 0060

B 2 WELL INFORMATION

APPROX. PUMPING RATE (GAL. PER MIN.): 15

AVERAGE DAILY QUANTITY NEEDED (GAL. PER DAY): 600

USE FOR WATER (CIRCLE APPROPRIATE BOX)

- D HOME (SINGLE OR DOUBLE HOUSEHOLD UNIT ONLY) — circled
- F FARMING (LIVESTOCK WATERING & AGRICULTURAL IRRIGATION
- 22 I INDUSTRIAL, COMMERCIAL, STATE AND FEDERAL GOV. OTHER (REQUIRES APPROPRIATION PERMIT)
- P PUBLIC OR PRIVATE WATER COMPANY (REQUIRES APPROPRIATION PERMIT AND STATE APPROVAL
- T TEST, OBSERVATION, MONITORING (MAY REQUIRE APPROPRIATION PERMIT)

NOT TO BE FILLED IN BY DRILLER
HEALTH DEPARTMENT APPROVAL

COUNTY NAME: Anne Arundel — COUNTY NO.: 02

STATE SIGNATURE ___ INSERT S

DATE ISSUED: 080198 — CO SIGNATURE: Walt K. Caldwell — EXP. DATE: 080199

NORTH GRID: 440 000 — EAST GRID: 0886 000

APPROXIMATE DEPTH OF WELL: 180 FEET

APPROXIMATE DIAMETER OF WELL: 4 NEAREST INCH

METHOD OF DRILLING (circle one)

BORED (or Augered)	JETTED	Jetted & DRIVEN
30 AIR-ROTary	AIR-PERcussion	ROTARY (Hydraulic Rotary) — circled
37 CABLE	REVerse-ROTary	DRive-POINT

other ___

SHOW MAJOR FEATURES OF BOX & LOCATE WELL WITH AN X

SOURCES OF DRILLING WATER
1. PUBLIC
2. BD 2123072
3. TO 2022067

WRITE THE BOX NUMBER FROM THE MAP HERE: 98c

Marmot

E 880

N 440

000
000

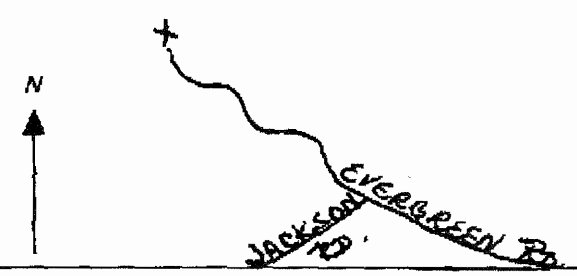
X

REPLACEMENT OR DEEPENED WELLS
(CIRCLE APPROPRIATE BOX)

- N THIS WELL WILL NOT REPLACE AN EXISTING WELL — circled
- Y THIS WELL WILL REPLACE A WELL THAT WILL BE ABANDONED AND SEALED
- 39 S THIS WELL WILL REPLACE A WELL THAT WILL BE USED AS A STANDBY-CONTACT LOCAL APPROVING AUTHORITY FOR POLICY ON STANDBY WELLS
- D THIS WELL WILL DEEPEN AN EXISTING WELL

PERMIT NUMBER OF WELL TO BE REPLACED OR DEEPENED (IF AVAILABLE) 41 ___ 52

DRAW A SKETCH BELOW SHOWING LOCATION OF WELL IN RELATION TO NEARBY TOWNS AND ROADS AND GIVE DISTANCE FROM WELL TO NEAREST ROAD JUNCTION



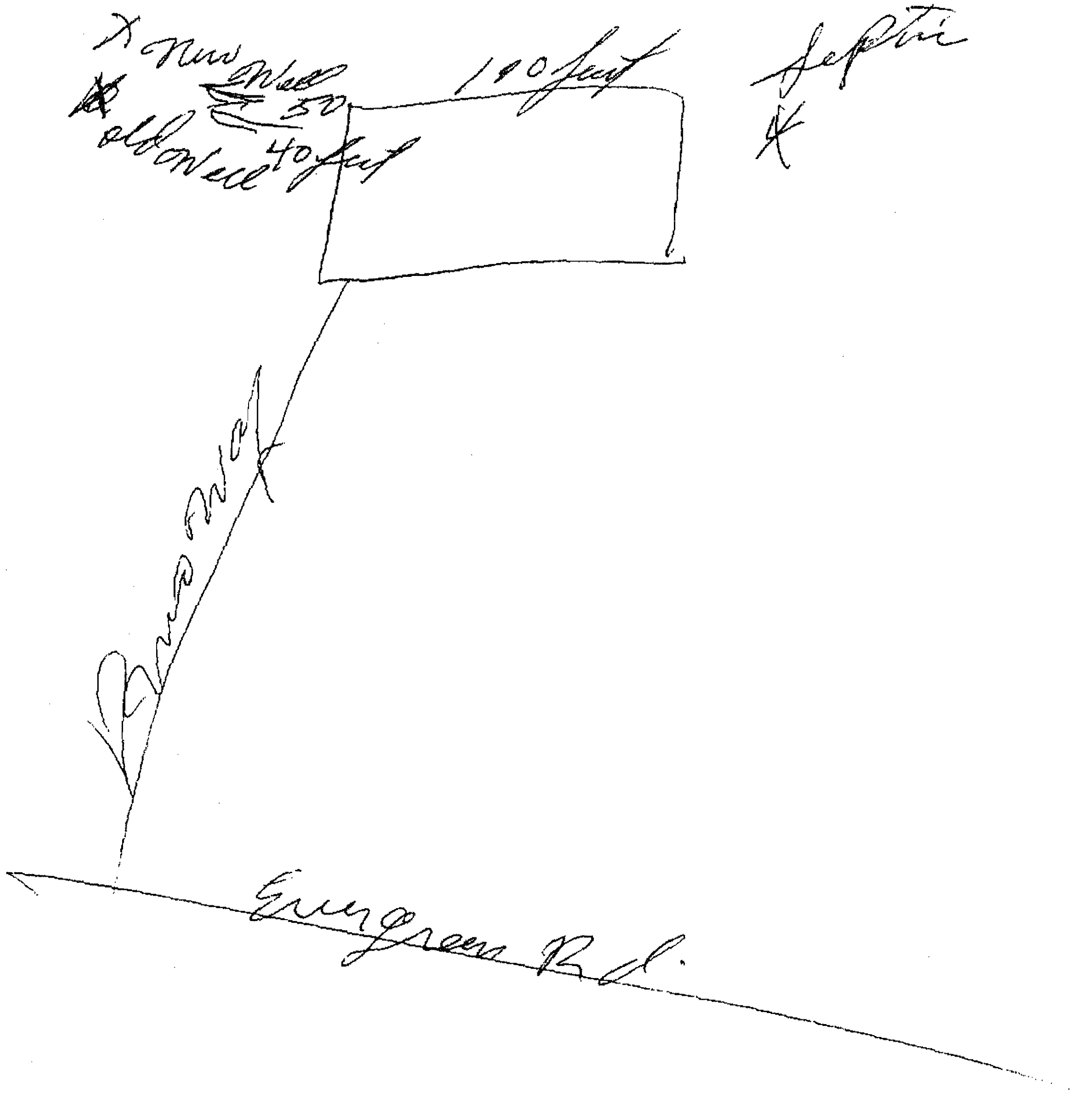
Not to be filled in by driller (MDE OR COUNTY USE ONLY)

APPROP. PERMIT NUMBER ___ GAP

FORCE: WKC (WRITE INITIALS IN BOX) — PERMIT No.: AA - 94 - 2922

SPECIAL CONDITIONS: Gross Alpha

Raymond Manual
2664 Evergreen Rd.
Gombrills MD 2154



94-2922

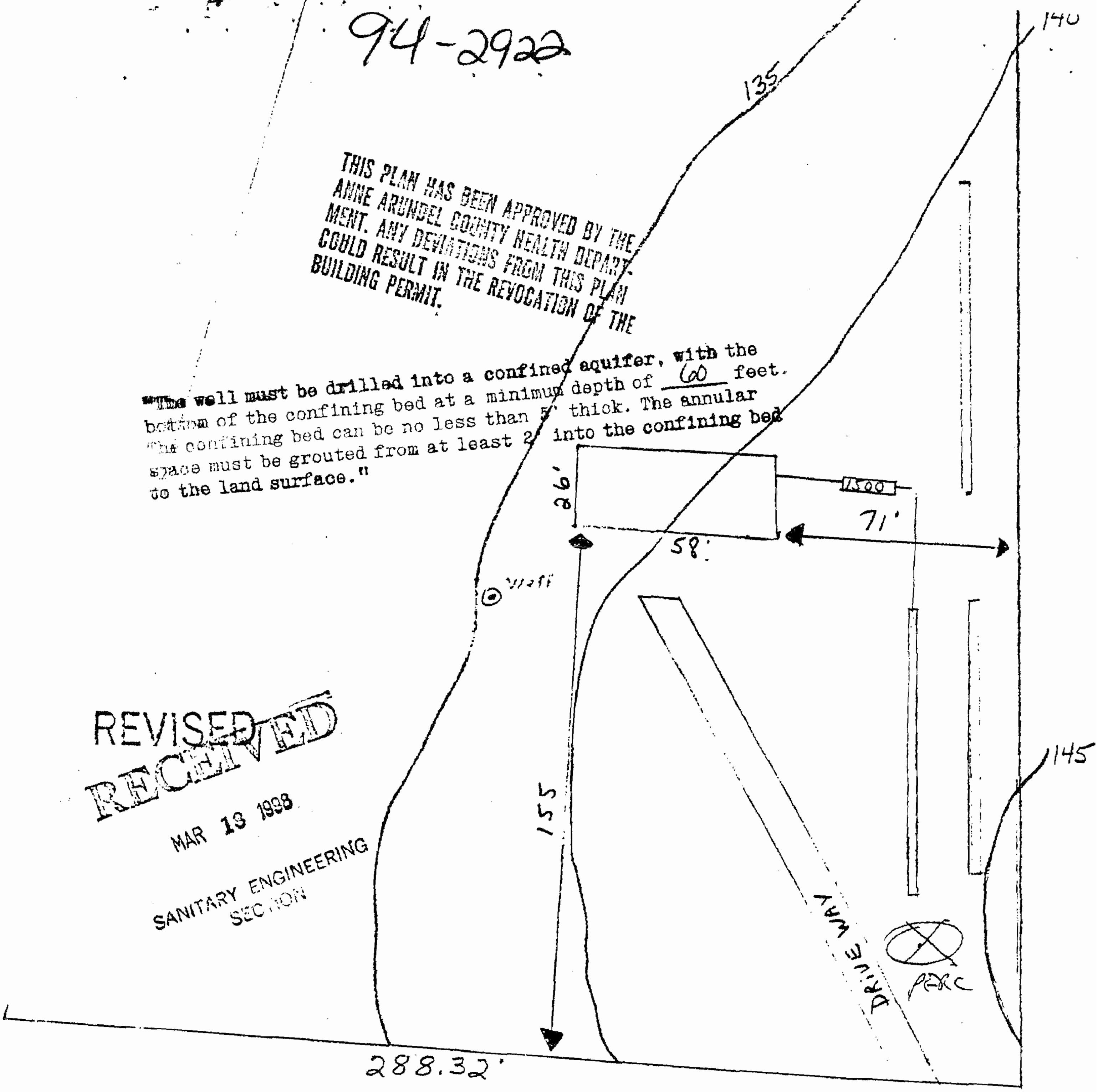
THIS PLAN HAS BEEN APPROVED BY THE ANNE ARUNDEL COUNTY HEALTH DEPARTMENT. ANY DEVIATIONS FROM THIS PLAN COULD RESULT IN THE REVOCATION OF THE BUILDING PERMIT.

"The well must be drilled into a confined aquifer, with the bottom of the confining bed at a minimum depth of 60 feet. The confining bed can be no less than 5' thick. The annular space must be grouted from at least 2' into the confining bed to the land surface."

REVISED RECEIVED

MAR 13 1998

SANITARY ENGINEERING SECTION



Trench: 81'x 2' x 10'
w pipe @ 4'
14' Separation
One Primary & Two Replacements shown

BSMT. FLOOR - WALKOUT @ GRADE
ELE = 136°
1ST FLOOR
ELE = 146°
Waste Line Elev = 141°

Site Plan
2664 Evergreen Rd
Gambrills, Md. 2111[illegible]

4-000-0277-6200

Scale = 1" = 40'

Page 2 of 2

C 1 15803 SEQUENCE NO. (MDE USE ONLY)
1 2 3 6
(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

ST/CO USE ONLY
DATE Received MM DD YY 5/31/01

DATE WELL COMPLETED MM 5 DD 5 YY 2001

Depth of Well 180 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-94-6573

OWNER Manual Raymond
STREET OR RFD 2669 Evergreen Rd TOWN Crofton
SUBDIVISION Gambrills MD 21054 SECTION ____ LOT 7-10

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	check if water bearing
Brown Sand	0	8	
Gravel & white sand	8	64	
white clay	64	78	
Gray clay	78	102	
Pink clay	102	118	
Brown sand	118	180	✓

NUMBER OF UNSUCCESSFUL WELLS: 0

WELL HYDROFRACTURED yes Y no N (N circled)

CIRCLE APPROPRIATE LETTER
A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED (A circled)
E ELECTRIC LOG OBTAINED
P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS LIC. NO. M 5 D 1 3 6
James Holt
DRILLERS SIGNATURE
(MUST MATCH SIGNATURE ON APPLICATION)

LIC. NO. __ D ____

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N
TYPE OF GROUTING MATERIAL (Circle one)
CEMENT CM BENTONITE CLAY BC (circled)
NO. OF BAGS 10 NO. OF POUNDS 500
GALLONS OF WATER 150
DEPTH OF GROUT SEAL (to nearest foot)
from 0 ft. TOP to 100 ft. BOTTOM
(enter 0 if from surface)

CASING RECORD
casing types insert appropriate code below
ST STEEL; CO CONCRETE; PL PLASTIC (circled); OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	4"	170

OTHER CASING (if used)
EACH CASING diameter inch; depth (feet) from to

SCREEN RECORD
screen type or open hole insert appropriate code below
ST STEEL; BR BRASS BRONZE; HO OPEN HOLE; PL PLASTIC; OT OTHER

C 2 DEPTH (nearest ft.)

EACH SCREEN	type	from	to
1	PL	170	180
2			
3			

SLOT SIZE 1 0 2 2 3 0
DIAMETER OF SCREEN 2" (NEAREST INCH)

GRAVEL PACK from 160 to 180
IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W Q
TELESCOPE CASING; LOG INDICATOR; OTHER DATA

C 3
PUMPING TEST
HOURS PUMPED (nearest hour) 2
PUMPING RATE (gal. per min.) 30
METHOD USED TO MEASURE PUMPING RATE timer bucket
WATER LEVEL (distance from land surface)
BEFORE PUMPING 100 ft.
WHEN PUMPING 120 ft.
TYPE OF PUMP USED (for test)
A air (circled); P piston; T turbine; C centrifugal; R rotary; O other (describe below); J jet; S submersible

PUMP INSTALLED
DRILLER INSTALLED PUMP (CIRCLE) (YES or NO) YES (circled) NO
IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS.
TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX 29. S
CAPACITY: GALLONS PER MINUTE (to nearest gallon) 10
PUMP HORSE POWER 3/4
PUMP COLUMN LENGTH (nearest ft.) 160
CASING HEIGHT (circle appropriate box and enter casing height)
+ above / − below LAND SURFACE 1 (nearest foot)

LOCATION OF WELL ON LOT
SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND /OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

Red. cond (1) 60' Radius

ANNE ARUNDEL COUNTY
MARYLAND

DEPARTMENT OF HEALTH
J. HOWARD BEARD HEALTH SERVICES BUILDING
3 HARRY S. TRUMAN PARKWAY
ANNAPOLIS, MARYLAND 21401
410-222-7274
FAX 410-222-7294
TDD FOR THE HEARING IMPAIRED 410-222-7153
www.health.co.anne-arundel.md.us/

FRANCES B. PHILLIPS, R.N., M.H.A.
Health Officer

August 30, 2001

MANUAL, RAYMOND
2664 EVERGREEN RD.
GAMBRILLS, MD 21054

Re: MANUEL, RAYMOND
2664 EVERGREEN RD.
GAMBRILLS, MD 21054

CERTIFICATE OF POTABILITY

This letter certifies that the requirements of COMAR 26.04.04 "WELL CONSTRUCTION REGULATIONS" have been met for the water supply system installed under permit number AA-94-6573 at the above referenced location.

The Anne Arundel County Department of Health has conducted an evaluation of this system and has tested the water produced by the well to determine if it met the standards set for the following parameters: coliform bacteria, nitrates, turbidity, sand, and radionuclides. The analyses indicate that the water does meet the applicable standards set for these parameters and has satisfied the review requirements of this department.

The well driller's signature on the completion report is his certification that well construction as performed under his supervision conforms to State of Maryland requirements.

Sincerely,

Kerry Topovski
Sanitary Engineering
Division of Community & Environmental Health

W.P. # 2123072 EMERGENCY/TEMP NO. IF ANY TAX ID # 4000-0277-620

B 1 2 ... SEQUENCE NO. (MDE USE ONLY) (THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)	STATE OF MARYLAND APPLICATION FOR PERMIT TO DRILL WELL please print or type	STATE PERMIT NUMBER AA - 94 - 2922 (70–79) fill in this form completely

OWNER INFORMATION

Date Received (APA): 08-06-98

Last Name / Owner / First Name: MANUAL RAYMOND / FRANK RUFF

Street or RFD: 2664 EVERGREEN RD

Town: GAMBRILLS State: MD Zip: 21054

DRILLER INFORMATION

Driller's Name: John F Bischoff License No.: MSD 002

Firm Name: BRANHAM CONTRACTORS

Address: P.O. BOX 1179 STEVENSVILLE, MD. 21666

Signature: John F Bischoff Date: 8-6-98

B 2 WELL INFORMATION

APPROX. PUMPING RATE (GAL. PER MIN.): 15

AVERAGE DAILY QUANTITY NEEDED (GAL. PER DAY): 600

B 3 LOCATION OF WELL

COUNTY: ANNE ARUNDEL

SUBDIVISION: TOWSERS BRANCH PARK

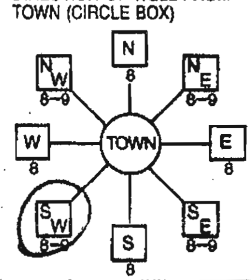
SECTION: ___ LOT: 7-10

NEAREST TOWN: JACKSON RD CROFTON

MILES FROM TOWN (enter 0 if in town): 4 M

B 4

DIRECTION OF WELL FROM TOWN (CIRCLE BOX)



NEAR WHAT ROAD: JACKSON RD.

ON WHICH SIDE OF ROAD (CIRCLE APPROPRIATE BOX): NORTH (N) / WEST (W) / EAST (E) / SOUTH (S)

DISTANCE FROM ROAD: 300

ENTER FT OR MI: FT

TAX MAP: 36 BLK: 11 PARCEL: 0066

USE FOR WATER (CIRCLE APPROPRIATE BOX)

- D HOME (SINGLE OR DOUBLE HOUSEHOLD UNIT ONLY)
- F FARMING (LIVESTOCK WATERING & AGRICULTURAL IRRIGATION
- I INDUSTRIAL, COMMERCIAL, STATE AND FEDERAL GOV. OTHER (REQUIRES APPROPRIATION PERMIT)
- P PUBLIC OR PRIVATE WATER COMPANY (REQUIRES APPROPRIATION PERMIT AND STATE APPROVAL
- T TEST, OBSERVATION, MONITORING (MAY REQUIRE APPROPRIATION PERMIT)

NOT TO BE FILLED IN BY DRILLER HEALTH DEPARTMENT APPROVAL

COUNTY NAME: Anne Arundel COUNTY NO.: 02

STATE SIGNATURE ___ INSERT S →

DATE ISSUED: 080798 CO SIGNATURE: Walt K. Caldwell EXP. DATE: 080799

NORTH GRID: 440 000 EAST GRID: 0886 000

APPROXIMATE DEPTH OF WELL: 180 FEET

APPROXIMATE DIAMETER OF WELL: 4 NEAREST INCH

METHOD OF DRILLING (circle one)

BORED (or Augered) | JETTED | Jetted & DRIVEN
AIR-ROTary | AIR-PERcussion | ROTARY (Hydraulic Rotary)
CABLE | REVerse-ROTary | DRive-POINT
other ___

SHOW MAJOR FEATURES OF BOX & LOCATE WELL WITH AN X →

SOURCES OF DRILLING WATER
1. PUBLIC
2. BD 2123072
3. TO 2022067

WRITE THE BOX NUMBER FROM THE MAP HERE: 98c Manual

E 880

N 440

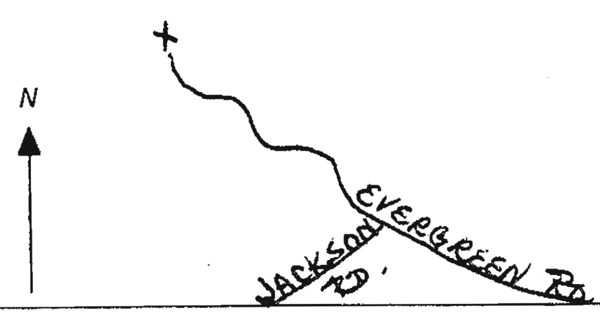
000
000
X

REPLACEMENT OR DEEPENED WELLS (CIRCLE APPROPRIATE BOX)

- N THIS WELL WILL NOT REPLACE AN EXISTING WELL
- Y THIS WELL WILL REPLACE A WELL THAT WILL BE ABANDONED AND SEALED
- S THIS WELL WILL REPLACE A WELL THAT WILL BE USED AS A STANDBY-CONTACT LOCAL APPROVING AUTHORITY FOR POLICY ON STANDBY WELLS
- D THIS WELL WILL DEEPEN AN EXISTING WELL

PERMIT NUMBER OF WELL TO BE REPLACED OR DEEPENED (IF AVAILABLE) ___

DRAW A SKETCH BELOW SHOWING LOCATION OF WELL IN RELATION TO NEARBY TOWNS AND ROADS AND GIVE DISTANCE FROM WELL TO NEAREST ROAD JUNCTION



Not to be filled in by driller (MDE OR COUNTY USE ONLY)

APPROP. PERMIT NUMBER GAP

FORCE WKC WRITE INITIALS IN BOX PERMIT No. AA - 94 - 2922

SPECIAL CONDITIONS

(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER: 02

ST/CO USE ONLY
DATE Received: 8/28/98

DATE WELL COMPLETED: MM 8 DD 18 YY 98

Depth of Well: 170 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL": AA-94-2922

OWNER: Manual Raymond (last name / first name)
STREET OR RFD: [illegible] Evergreen Rd
TOWN: Crofton
SUBDIVISION: Crofton Farms Brand SECTION
LOT: 7-10

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	check if water bearing
~~Buffa~~ San dpt	0	40	
Clay whit	40	65	
stone + sand	65	75	
Clay whit	75	110	
GRAY CLAY + Rock Layers	110	150	
white sand	150	170	✓

NUMBER OF UNSUCCESSFUL WELLS: ____

WELL HYDROFRACTURED: yes Y / no N

CIRCLE APPROPRIATE LETTER
- A — A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
- E — ELECTRIC LOG OBTAINED
- P — TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS LIC. NO.: MS 0907

[signature]
DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

LIC. NO.: M __ D ______

[signature]
SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box): **Y** (yes) / N (no)

TYPE OF GROUTING MATERIAL (Circle one): CEMENT CM / **BENTONITE CLAY BC**

NO. OF BAGS: 7
NO. OF POUNDS: 350
GALLONS OF WATER: 175
DEPTH OF GROUT SEAL (to nearest foot): from 0 ft. (TOP) to 60 ft. (BOTTOM) (enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below: ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	4	160

OTHER CASING (if used): diameter inch / depth (feet) from / to

SCREEN RECORD

screen type or open hole insert appropriate code below: ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C 2

	Type	DEPTH (nearest ft.) from	to
1	PL	160	170
2			
3			

SLOT SIZE: 1 0 2 2 3 0
DIAMETER OF SCREEN: 2" (NEAREST INCH)

GRAVEL PACK: from 150 to 170
IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68: ____

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W Q
TELESCOPE CASING — LOG INDICATOR — OTHER DATA

PUMPING TEST

C 3

HOURS PUMPED (nearest hour): 24
PUMPING RATE (gal. per min.): 15
METHOD USED TO MEASURE PUMPING RATE: Timed Flow
WATER LEVEL (distance from land surface)
BEFORE PUMPING: 72 ft.
WHEN PUMPING: 100 ft.

TYPE OF PUMP USED (for test): **A air**, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO): **YES** NO

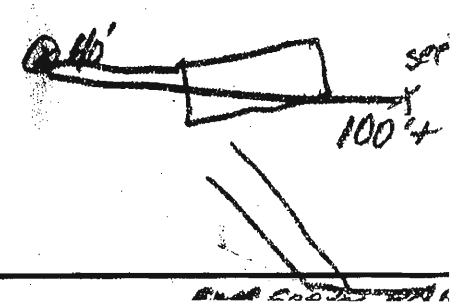
IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS.

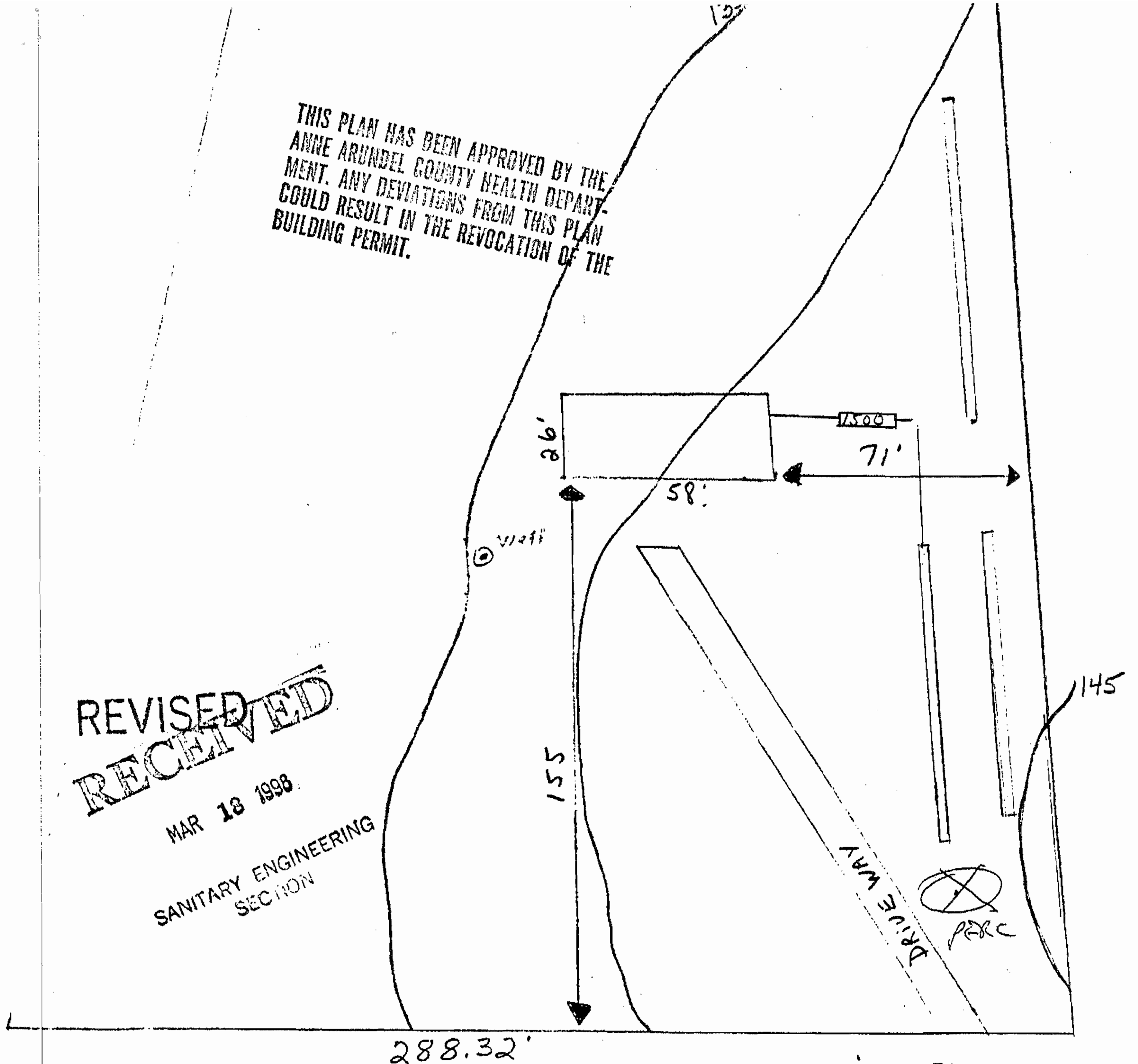
TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX 29: S
CAPACITY: GALLONS PER MINUTE (to nearest gallon): 10
PUMP HORSE POWER: .5
PUMP COLUMN LENGTH (nearest ft.): 130

CASING HEIGHT (circle appropriate box and enter casing height): **+ above** / − below LAND SURFACE: 1 (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND /OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)





Site Plan
2664 Evergreen Rd
Gambrills, Md. 2111

Trench: 81'x 2' x 10'
w pipe @ 4'
14' Separation
One Primary & Two Replacements shown

BSMT. FLOOR - WALKOUT @ GRADE
ELE: 136°

1ST FLOOR
ELE = 146°

Waste Line Elev. = 141°

4-000-0277-620

Scale = 1" = 40'

Page 2 of 2

ANNE ARUNDEL COUNTY
MARYLAND

DEPARTMENT OF HEALTH
J. HOWARD BEARD HEALTH SERVICES BUILDING
3 HARRY S. TRUMAN PARKWAY
ANNAPOLIS, MARYLAND 21401
410-222-
FAX 410-222-7678
TDD FOR THE HEARING IMPAIRED 410-222-7153
www.health.co.anne-arundel.md.us/

FRANCES B. PHILLIPS, R.N., M.H.A
Health Officer

January 20, 1999

Frank Ruff
2664 Evergreen Rd.
Gambrills, MD 21113

CERTIFICATE OF POTABILITY

This letter certifies that the requirements of COMAR 26.04.04 "WELL CONSTRUCTION REGULATIONS" have been met for the water supply system installed under permit number AA-94-2922 at the above referenced location.

The Anne Arundel County Department of Health has conducted an evaluation of this system and has tested the water produced by the well to determine if it met the standards set for the following parameters: coliform bacteria, nitrates, turbidity, sand, and radionuclides. The analyses indicate that the water does meet the applicable standards set for these parameters and has satisfied the review requirements of this department.

The well driller's signature on the completion report is his certification that well construction as performed under his supervision conforms to State of Maryland requirements.

Sincerely,

Kerry Topovski

Kerry Topovski
Sanitary Engineering
Division of Community & Environmental Health

EMERGENCY/TEMP NO. IF ANY

TAX ID # 4000-0655-160

B 1 | 1 ... (E NO. ONLY)

STATE OF MARYLAND
APPLICATION FOR PERMIT TO DRILL WELL
please type

STATE PERMIT NUMBER
AA-94-9584
70 fill in this form completely 79

Date Received (APA) 10-20-03 SAK
8 MM DD YY 13

OWNER INFORMATION

GONCE MARK T.
15 Last Name Owner First Name 34

327 WASHBURN AVENUE
36 Street or RFD 55

BALTIMORE, MD 21225
57 Town 70 State 72 Zip 76

DRILLER INFORMATION

LARRY JUREK M S D 165
Driller's Name 76 License No. 81

BRANHAM Contracting Inc.
Firm Name

3125 Mills Pond Dr. Port Repub- LIC 20676
Address

[signature] 10-16-03
Signature Date

B | 3 **LOCATION OF WELL**

ANNE ARUNDEL
8 COUNTY 21

23 SUBDIVISION 42

SECTION 44 46 LOT 16 48 50

ODENTON
52 NEAREST TOWN 71

MILES FROM TOWN (enter 0 if in town) 4 M I
73 76 77 78

B | 4
1 2
DIRECTION OF WELL FROM TOWN (CIRCLE BOX)

N, NW, NE, W, TOWN, E, SW, SE, S

2029 EVERGREEN
11 NEAR WHAT ROAD 30

ON WHICH SIDE OF ROAD (CIRCLE APPROPRIATE BOX)
NORTH N, WEST W, E EAST, S SOUTH

34 100 37
DISTANCE FROM ROAD
ENTER FT OR MI 38 39

TAX MAP: 36 BLK: 17 PARCEL 004

B | 2 **WELL INFORMATION**
1 2

APPROX. PUMPING RATE (GAL. PER MIN.) 15
8 12

AVERAGE DAILY QUANTITY NEEDED (GAL. PER DAY) 650
14 20

USE FOR WATER (CIRCLE APPROPRIATE BOX)

22
- D DOMESTIC POTABLE SUPPLY & RESIDENTIAL IRRIGATION
- F FARMING (LIVESTOCK WATERING & AGRICULTURAL IRRIGATION
- I INDUSTRIAL, COMMERICIAL, DEWATERING
- P PUBLIC WATER SUPPLY WELL
- T TEST, OBSERVATION, MONITORING
- G GEO-THERMAL

NOT TO BE FILLED IN BY DRILLER HEALTH DEPARTMENT APPROVAL

Anne Arundel 02
COUNTY NAME COUNTY NO.

STATE SIGNATURE INSERT S →

DATE ISSUED
10/22/03 William Dehn 10/22/04
43 MM DD YY 48 CO SIGNATURE EXP. DATE

NORTH GRID 447 000
50 55
EAST GRID 0883 000
57 63

APPROXIMATE DEPTH OF WELL 350 FEET
24 28

APPROXIMATE DIAMETER OF WELL 4 NEAREST INCH

METHOD OF DRILLING (circle one)

30 37
- BORED (or Augered)
- JETTED
- Jetted & DRIVEN
- AIR-ROTary
- AIR-PERcussion
- ROTARY (Hydraulic Rotary)
- CABLE
- REVerse-ROTary
- DRive-POINT
- other

SHOW MAJOR FEATURES OF BOX & LOCATE WELL WITH AN X →

SOURCES OF DRILLING WATER
1. PUBLIC
2.
3.

X

WRITE THE BOX NUMBER FROM THE MAP HERE

E 880 000
N 440 000

REPLACEMENT OR DEEPENED WELLS
(CIRCLE APPROPRIATE BOX)

39
- N THIS WELL WILL NOT REPLACE AN EXISTING WELL
- Y THIS WELL WILL REPLACE A WELL THAT WILL BE ABANDONED AND SEALED
- S THIS WELL WILL REPLACE A WELL THAT WILL BE USED AS A STANDBY-CONTACT LOCAL APPROVING AUTHORITY FOR POLICY ON STANDBY WELLS
- D THIS WELL WILL DEEPEN AN EXISTING WELL

PERMIT NUMBER OF WELL TO BE REPLACED OR DEEPENED (IF AVAILABLE) 41 __ __ - __ __ - __ __ __ __ 52

DRAW A SKETCH BELOW SHOWING LOCATION OF WELL IN RELATION TO NEARBY TOWNS AND ROADS AND GIVE DISTANCE FROM WELL TO NEAREST ROAD JUNCTION

N

EVERGREEN

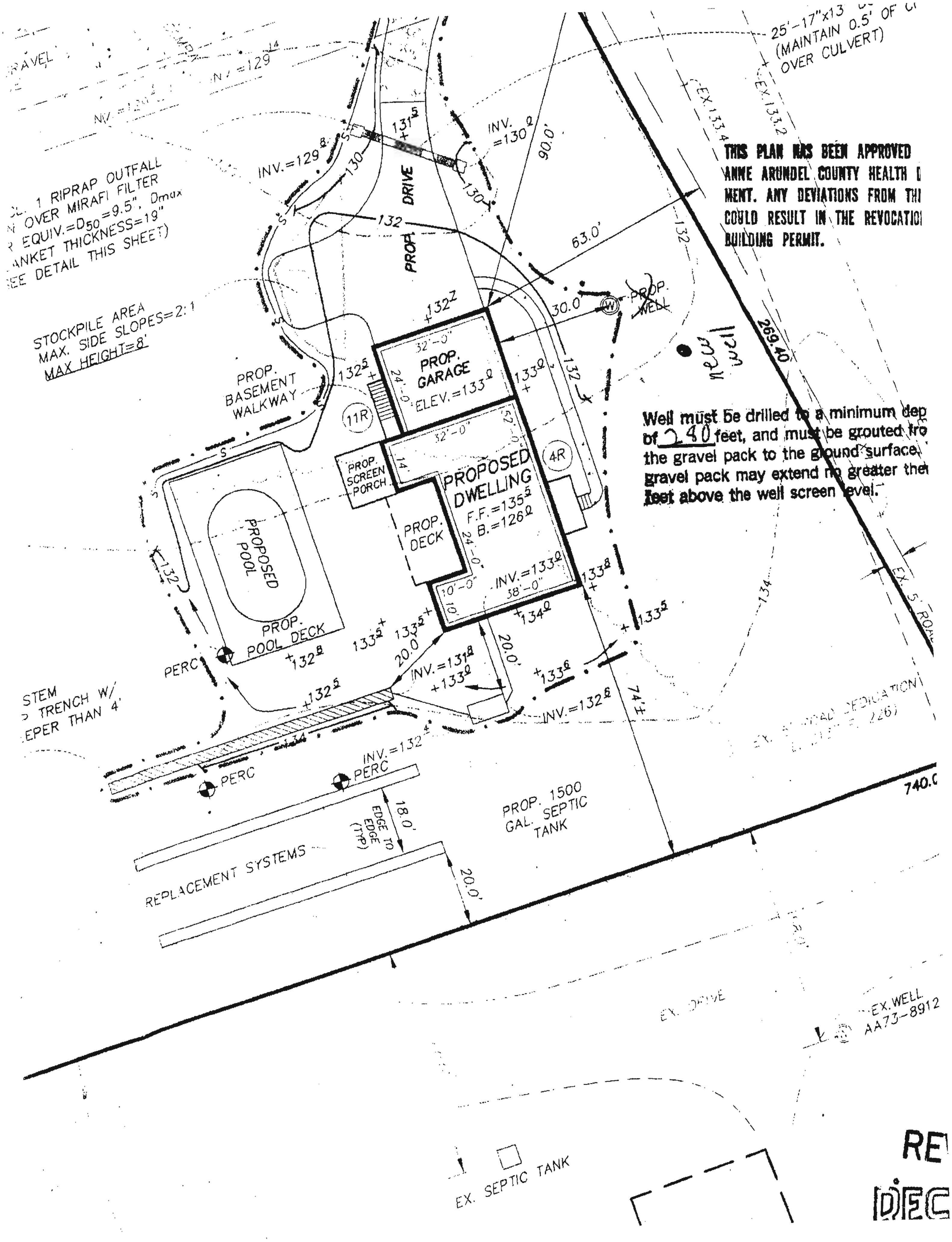
Well must be drilled to a minimum depth of 240 feet, and must be grouted from the gravel pack to the ground surface. The gravel pack may extend no greater then 1 feet above the well screen level.

Not to be filled in by driller (MDE OR COUNTY USE ONLY)

APPROP. PERMIT NUMBER _ _ _ _ _ _G_ _ _

PERMIT No. AA-94-9584
70 71 72 73 74 75 76 77 78 79

SPECIAL CONDITIONS Radium Testing Required
NOTE - APPROVING AUTHORITIES SHOULD USE SEPARATE SHEET IF NEEDED


THIS PLAN HAS BEEN APPROVED
ANNE ARUNDEL COUNTY HEALTH D
MENT. ANY DEVIATIONS FROM THI
COULD RESULT IN THE REVOCATIO
BUILDING PERMIT.
Well must be drilled to a minimum dep
of 240 feet, and must be grouted fro
the gravel pack to the ground surface.
gravel pack may extend no greater the
feet above the well screen level.
25'-17"x13
(MAINTAIN 0.5' OF C
OVER CULVERT)
1 RIPRAP OUTFALL
OVER MIRAFI FILTER
EQUIV.=D50=9.5", Dmax
BLANKET THICKNESS=19"
SEE DETAIL THIS SHEET)
STOCKPILE AREA
MAX. SIDE SLOPES=2:1
MAX HEIGHT=8'
PROP. DRIVE
PROP. BASEMENT WALKWAY
PROP. GARAGE
ELEV.=133.0
PROPOSED DWELLING
F.F.=135.5
B.=126.0
PROP. SCREEN PORCH
PROP. DECK
PROPOSED POOL
PROP. POOL DECK
PROP. WELL
new well
PERC
INV.=129.8
INV.=130.0
INV.=131.8
INV.=133.0
INV.=132.6
INV.=132.4
90.0'
63.0'
30.0'
20.0'
74'±
269.40
740.0
PROP. 1500 GAL. SEPTIC TANK
REPLACEMENT SYSTEMS
EDGE TO EDGE (TYP)
18.0'
20.0'
EX. DRIVE
EX. WELL AA73-8912
EX. SEPTIC TANK
RE
DEC

(MDE USE ONLY)

1 2 3 6
(THIS NUMBER IS TO BE PUNCHED IN COLS: 3-6 ON ALL CARDS)

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER

ST/CO USE ONLY
DATE Received MM DD YY
8 13

DATE WELL COMPLETED MM DD YY: 8 24 94
15 20

Depth of Well: 22 269 26 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL": AA-94-7584
28 29 30 31 32 33 34 35 36 37

OWNER: Gonce (last name) Mark (first name)
STREET OR RFD: Evergreen Rd TOWN: Odenton
SUBDIVISION ______ SECTION ______ LOT 16

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	check if water bearing
clay	0	15	
sand	15	55	
clay	55	80	
sand	80	95	
clay	95	100	
sand	100	110	
clay	110	140	
silk sand	140	175	
unknown	175	269	
Because of K-packer			

NUMBER OF UNSUCCESSFUL WELLS: ______

WELL HYDROFRACTURED: yes Y / no N

CIRCLE APPROPRIATE LETTER
- A — A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
- E — ELECTRIC LOG OBTAINED
- P — TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS LIC. NO. M __ D ____
Just A inspection
DRILLERS SIGNATURE
(MUST MATCH SIGNATURE ON APPLICATION)

LIC. NO. ____ D ____

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box): yes Y / no N (44)
TYPE OF GROUTING MATERIAL (Circle one): CEMENT CM (45 46) BENTONITE CLAY BC (45 46)
NO. OF BAGS ______ NO. OF POUNDS ______
GALLONS OF WATER ______
DEPTH OF GROUT SEAL (to nearest foot)
from 48 ___ TOP 52 ft. to 54 ___ BOTTOM 58 ft.
(enter 0 if from surface)

CASING RECORD
casing types insert appropriate code below: ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL (60 61)	4 (63 64)	180 (66 70)

EACH CASING — OTHER CASING (if used)

	diameter inch	depth (feet) from	to
PL	2	180	259

SCREEN RECORD
screen type or open hole insert appropriate code below: ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C 2 — EACH SCREEN — DEPTH (nearest ft.)

	Type	From	To
1	PL (8 9)	259 (11 15)	269 (17 21)
2	(23 24)	(26 30)	(32 36)
3	(38 39)	(41 45)	(47 51)

SLOT SIZE 1 ____ 2 ____ 3 ____
DIAMETER OF SCREEN: 2 (56 60) (NEAREST INCH)

	from	to
GRAVEL PACK		
IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68		68

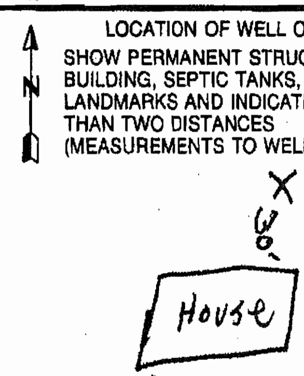
MDE USE ONLY
(NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W Q
70 ___ 72 ___ 74 75 76
TELESCOPE CASING / LOG INDICATOR / OTHER DATA

C 3
1 2

PUMPING TEST
HOURS PUMPED (nearest hour): 1/4 (8 9)
PUMPING RATE (gal. per min.): 22. (11 15)
METHOD USED TO MEASURE PUMPING RATE: Timed Flow
WATER LEVEL (distance from land surface)
BEFORE PUMPING: 87 ft. (17 20)
WHEN PUMPING: 92 ft. (22 25)
TYPE OF PUMP USED (for test):
A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible (27)

PUMP INSTALLED
DRILLER INSTALLED PUMP (CIRCLE) (YES or NO): YES NO
IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS.
TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX 29: S
CAPACITY: GALLONS PER MINUTE (to nearest gallon): 10 (31 35)
PUMP HORSE POWER: 1 (37 41)
PUMP COLUMN LENGTH (nearest ft.): 120 (43 47)
CASING HEIGHT (circle appropriate box and enter casing height)
+ above (49) / − below (49) LAND SURFACE: 1 1/2 (nearest foot) (50 51)

LOCATION OF WELL ON LOT
SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND /OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



COUNTY

MARYLAND DEPARTMENT OF THE ENVIRONMENT, WATER MANAGEMENT ADMINISTRATION
2500 BROENING HIGHWAY, BALTIMORE, MARYLAND 21224, (410) 631-3784

WATER WELL ABANDONMENT-SEALING REPORT FORM

SUBMIT COPIES OF COMPLETED FORM TO:
* COUNTY ENVIRONMENT AGENCY (contact MDE, WMA if address needed)
* WELL OWNER
* MDE, WATER MANAGEMENT ADMINISTRATION, WELL PROGRAM

DATE WELL ABANDONED: 5-4-04 (month/day/year)

* PERMIT NUMBER OF ABANDONED WELL (if any) AA-94-9584
* PERMIT NUMBER OF REPLACEMENT WELL ___-___-___
* PERSON ABANDONING WELL: William Bischoff WELL DRILLERS LICENSE NUMBER: 164
CIRCLE: MWD / MSD / MGD (MSD circled)
* OWNER'S NAME: MARK GONCE
* WELL LOCATION:
COUNTY: A.A
NEAREST TOWN: ODENTON
TAX MAP 36 BLOCK 17 PARCEL 43
SUBDIVISION:
SECTION: ____ LOT: 16
NEAREST ROAD: Ever green Rd

SITE LOCATION MAP

* TYPE OF WELL BEING ABANDONED:
✓ DRILLED ___ JETTED
___ BORED/AUGERED ___ HAND DUG
___ OTHER (specify) ___

* USE CODE:
✓ DOMESTIC ___ MUNICIPAL/PUBLIC
___ IRRIGATION ___ INDUSTRIAL
___ TEST/OBSERVATION ___ GEOTHERMAL

* TYPE OF CASING:
___ STEEL ✓ PLASTIC
___ CONCRETE ___ OTHER (specify) ___

* SIZE OF CASING: 4 INCHES IN DIAMETER
* DEPTH OF WELL: 140 FEET DEEP
* WAS ANY CASING REMOVED? ✓ YES ___ NO
if yes, length removed, in feet: 140
* WAS CASING RIPPED OR PERFORATED? ___ YES ✓ NO

LOG OF SEALING MATERIAL

MATERIAL	FEET FROM	FEET TO
Bentonite	0	60

VOLUME OF MATERIAL USED
450#

[signature] 164 MWD / MSD / MGD (MSD circled) 8-24-04
SIGNATURE-MASTER WELL DRILLER OR SUPERVISING SANITARIAN LICENSE # CIRCLE ONE DATE

Janet S. Owens
County Executive

ANNE ARUNDEL COUNTY
MARYLAND

Frances B. Phillips
Health Officer

December 12, 2005

MARK GONCE
327 WASHBURN AVE
BALTIMORE, MD 21225

Re: GONCE, MARK
2629 EVERGREEN
ODENTON, MD 21113

CERTIFICATE OF POTABILITY

This letter certifies that the requirements of COMAR 26.04.04 "WELL CONSTRUCTION REGULATIONS" have been met for the water supply system installed under permit number AA-94-9584 at the above referenced location.

The Anne Arundel County Department of Health has conducted an evaluation of this system and has tested the water produced by the well to determine if it met the standards set for the following parameters: coliform bacteria, nitrates, turbidity, sand, and radionuclides. The analyses indicate that the water does meet the applicable standards set for these parameters and has satisfied the review requirements of this department.

The well driller's signature on the completion report is his certification that well construction as performed under his supervision conforms to State of Maryland requirements.

Sincerely,

Bill Deck

Bill Deck, Program Manager
Sanitary Engineering Program
Division of Environmental Health

B 1 0064 SEQUENCE NO. (MDE USE ONLY)

STATE OF MARYLAND
PERMIT TO DRILL WELL
please print or type

STATE PERMIT NUMBER AA-94-8130
fill in this form completely

Date Received (APA) 10-11-02

OWNER INFORMATION

Weston Builders / Doval Inc.
Last Name Owner First Name

405 Headquarters Dr. Suite #2
Street or RFD

Millersville Md. 21108
Town State Zip

DRILLER INFORMATION

Denton J. Wofford MW D 288
Driller's Name License No.

Wolford's Well & Pump Service, Inc.
Firm Name

6429 Mountain Road, Pasadena, MD 21122
Address

Denton J. Wolford 6-5-02
Signature Date

B 2 WELL INFORMATION

APPROX. PUMPING RATE (GAL. PER MIN.) 8

AVERAGE DAILY QUANTITY NEEDED (GAL. PER DAY) 300

B 3 LOCATION OF WELL

Anne Arundel
COUNTY

SUBDIVISION

SECTION LOT C

Odenton
NEAREST TOWN

MILES FROM TOWN (enter 0 if in town) 3 MI

B 4

DIRECTION OF WELL FROM TOWN (CIRCLE BOX) NW

2633 Evergreen Rd
NEAR WHAT ROAD

ON WHICH SIDE OF ROAD (CIRCLE APPROPRIATE BOX) N/A

DISTANCE FROM ROAD 15

ENTER FT OR MI Ft

TAX MAP: 36 BLK: 17 PARCEL 006

USE FOR WATER (CIRCLE APPROPRIATE BOX)

D DOMESTIC POTABLE SUPPLY & RESIDENTIAL IRRIGATION

F FARMING (LIVESTOCK WATERING & AGRICULTURAL IRRIGATION

I INDUSTRIAL, COMMERICIAL, DEWATERING

P PUBLIC WATER SUPPLY WELL

T TEST, OBSERVATION, MONITORING

G GEO-THERMAL

NOT TO BE FILLED IN BY DRILLER
HEALTH DEPARTMENT APPROVAL

Anne Arundel 02
COUNTY NAME COUNTY NO.

STATE SIGNATURE INSERT S

DATE ISSUED 06/13/02 William Deh 6/13/03
CO SIGNATURE EXP. DATE

NORTH GRID 437 000 EAST GRID 0445 000

APPROXIMATE DEPTH OF WELL FEET

APPROXIMATE DIAMETER OF WELL 4" NEAREST INCH

METHOD OF DRILLING (circle one)

BORED (or Augered) JETTED Jetted & DRIVEN
AIR-ROTary AIR-PERcussion ROTARY (Hydraulic Rotary)
CABLE REVerse-ROTary DRive-POINT
other

SHOW MAJOR FEATURES OF BOX & LOCATE WELL WITH AN X

X

SOURCES OF DRILLING WATER
1. AA-81-0980
2. AA-81-9800
3. T020306506

WRITE THE BOX NUMBER FROM THE MAP HERE 2000 C

E 880

N 430

000
000

REPLACEMENT OR DEEPENED WELLS
(CIRCLE APPROPRIATE BOX)

N THIS WELL WILL NOT REPLACE AN EXISTING WELL

Y THIS WELL WILL REPLACE A WELL THAT WILL BE ABANDONED AND SEALED

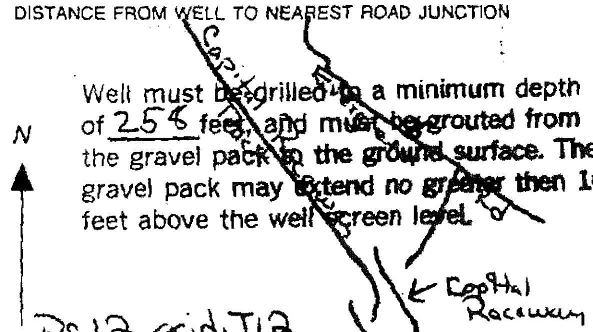
S THIS WELL WILL REPLACE A WELL THAT WILL BE USED AS A STANDBY-CONTACT LOCAL APPROVING AUTHORITY FOR POLICY ON STANDBY WELLS

D THIS WELL WILL DEEPEN AN EXISTING WELL

PERMIT NUMBER OF WELL TO BE REPLACED OR DEEPENED (IF AVAILABLE) __ - __ - __

DRAW A SKETCH BELOW SHOWING LOCATION OF WELL IN RELATION TO NEARBY TOWNS AND ROADS AND GIVE DISTANCE FROM WELL TO NEAREST ROAD JUNCTION

Well must be drilled to a minimum depth of 254 feet, and must be grouted from the gravel pack to the ground surface. The gravel pack may extend no greater then 10 feet above the well screen level.



Not to be filled in by driller (MDE OR COUNTY USE ONLY)

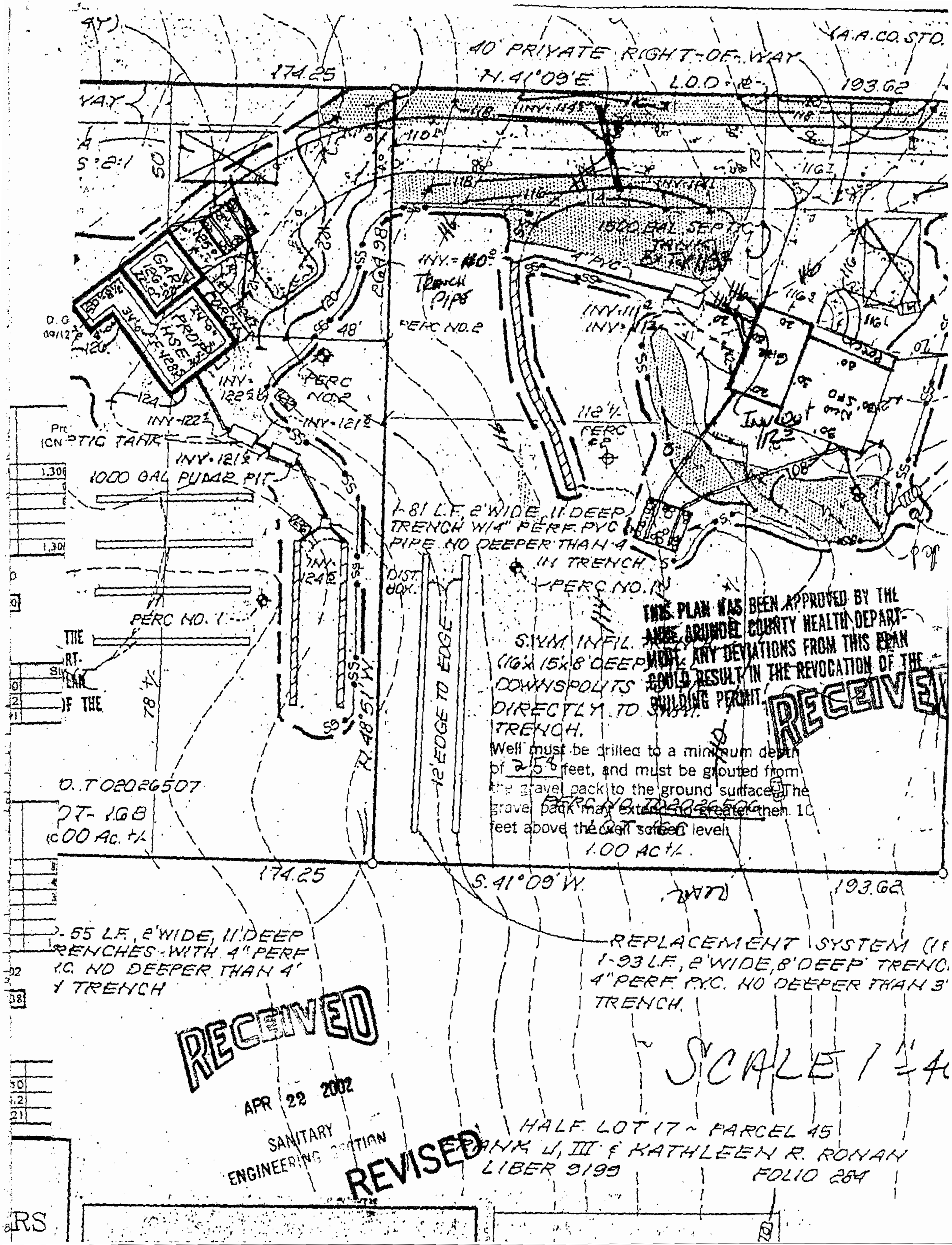
APPROP. PERMIT NUMBER __ G __

PERMIT No. AA-94-8130

Pg 12 grid J12

SPECIAL CONDITIONS Radium Testing
NOTE - APPROVING AUTHORITIES SHOULD USE SEPARATE SHEET IF NEEDED

② COUNTY



40' PRIVATE RIGHT-OF-WAY
N.41°09'E
174.25
193.62
(A.A.CO. STD.
1000 GAL SEPTIC
GAR.
PROP. HSE.
PORCH
INV. 122½
INV. 121½
1000 GAL PUMP PIT
PERC NO. 2
PERC NO. 1
1-81 L.F. 2' WIDE, 11' DEEP TRENCH W/4" PERF. PVC PIPE NO DEEPER THAN 4' IN TRENCH.
DIST. BOX.
12' EDGE TO EDGE
R.48°51'W.
SWM INFIL.
(16'x 15'x 8' DEEP
DOWNSPOUTS DIRECTLY TO SWM TRENCH.
THIS PLAN HAS BEEN APPROVED BY THE ANNE ARUNDEL COUNTY HEALTH DEPARTMENT. ANY DEVIATIONS FROM THIS PLAN COULD RESULT IN THE REVOCATION OF THE BUILDING PERMIT.
RECEIVED
Well must be drilled to a minimum depth of 254 feet, and must be grouted from the gravel pack to the ground surface. The gravel pack may extend no greater then 10 feet above the well screen level.
D.T 02026507
1.00 Ac.+/-
S.41°09'W.
-55 L.F. 2' WIDE, 11' DEEP TRENCHES WITH 4" PERF. PVC NO DEEPER THAN 4' IN TRENCH
REPLACEMENT SYSTEM
1-93 L.F., 2' WIDE, 8' DEEP TRENCH 4" PERF. PVC. NO DEEPER THAN 3' TRENCH.
RECEIVED
APR 22 2002
SANITARY ENGINEERING SECTION
REVISED
SCALE 1"=40'
HALF LOT 17 ~ PARCEL 45
FRANK J. III & KATHLEEN R. RONAN
LIBER 9199
FOLIO 284

C1 - 12489 SEQUENCE NO. (MDE USE ONLY)
1 2 3 8
(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

ST/CO USE ONLY
DATE Received MM 7 DD 26 YY 02 (8–13)

DATE WELL COMPLETED MM 07 DD 23 YY 02 (15–20)

Depth of Well 275 (22–26) (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-94-8130 (28–37)

OWNER WESTON BUILDERS
STREET OR RFD 405 HEADQUARTERS DRIVE (2633 EVERGREEN RD) TOWN MILLERSVILLE, MD. 21108
SUBDIVISION ______ SECTION ______ LOT C

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	check if water bearing
TOP SOIL	0	2	
BROWN & WHITE SAND	2	10	
GRAVEL	10	20	
WHITE CLAY	20	35	
BROWN SAND	35	60	
GRAY CLAY	60	80	
BROWN SAND & WOOD	80	100	
WHITE CLAY	100	120	
WHITE SAND	120	130	
WHITE CLAY	130	135	
WHITE SAND	135	145	
WHITE CLAY	145	155	
WHITE SAND	155	185	
GRAY CLAY	185	215	
RED CLAY	215	240	
WHITE SANDD	240	275	X

NUMBER OF UNSUCCESSFUL WELLS: ______

WELL HYDROFRACTURED yes Y no N

CIRCLE APPROPRIATE LETTER
A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
E ELECTRIC LOG OBTAINED
P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS LIC. NO. MWD 288
DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION) Wenton Wolford
LIC. NO. MWD 288
BENTON J. WOLFORD

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y (circled) no N (44)
TYPE OF GROUTING MATERIAL (Circle one)
CEMENT CM BENTONITE CLAY BC (circled)
NO. OF BAGS (45 46) 18 NO. OF POUNDS 900 450
GALLONS OF WATER ______
DEPTH OF GROUT SEAL (to nearest foot)
from 3 (48 TOP 52) ft. to 265 (54 BOTTOM 58) ft.
(enter 0 if from surface)

CASING RECORD
casing types insert appropriate code below
ST STEEL — CO CONCRETE — PL PLASTIC (circled) — OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)!	Total depth of main casing (nearest foot)
PL (60 61)	4 (63 64)	268 (66–70)

EACH CASING — OTHER CASING (if used): diameter inch ____ depth (feet) from ____ to ____

SCREEN RECORD
screen type or open hole insert appropriate code below
ST STEEL — BR BRASS BRONZE — HO OPEN HOLE — PL PLASTIC (circled) — OT OTHER

C2
EACH SCREEN — DEPTH (nearest ft.)

Type	From	To
1 PL (8 9)	268 (11–15)	275 (17–21)
2 (23 24)	(26–30)	(32–36)
3 (38 39)	(41–45)	(47–51)

SLOT SIZE 1 .016 2 ______ 3 ______
DIAMETER OF SCREEN 2 (56–60) (NEAREST INCH)

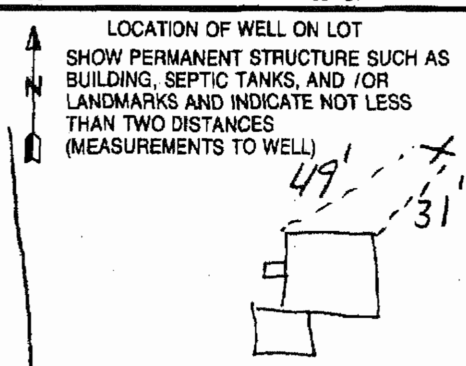
GRAVEL PACK from 260 to 275
IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W Q
70 TELESCOPE CASING — 72 LOG INDICATOR — 74 75 76 OTHER DATA
COUNTY

C3
PUMPING TEST
HOURS PUMPED (nearest hour) 2 (8 9)
PUMPING RATE (gal. per min.) 40. (11–15)
METHOD USED TO MEASURE PUMPING RATE AIR
WATER LEVEL (distance from land surface)
BEFORE PUMPING 68 ft. (17–20)
WHEN PUMPING 95 ft. (22–25)
TYPE OF PUMP USED (for test)
A air (circled) — P piston — T turbine — C centrifugal — R rotary — O other (describe below) — J jet — S submersible (27)

PUMP INSTALLED
DRILLER INSTALLED PUMP (CIRCLE) (YES or NO) YES (circled) NO
IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS.
TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX 29. S
CAPACITY: GALLONS PER MINUTE (to nearest gallon) 12 (31–35)
PUMP HORSE POWER .75 (37–41)
PUMP COLUMN LENGTH (nearest ft.) 130 (43–47)
CASING HEIGHT (circle appropriate box and enter casing height)
+ above (circled) LAND SURFACE
− below 1 (50 51) (nearest foot) (49)

LOCATION OF WELL ON LOT
SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND /OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



N Radium 258'

ANNE
ARUNDEL
COUNTY
M A R Y L A N D

DEPARTMENT OF HEALTH
J. HOWARD BEARD HEALTH SERVICES BUILDING
3 HARRY S. TRUMAN PARKWAY
ANNAPOLIS, MARYLAND 21401
410-222-7274
FAX 410-222-7294
TDD FOR THE HEARING IMPAIRED 410-222-7153
www.health.co.anne-arundel.md.us/

FRANCES B. PHILLIPS, R.N., M.H.A.
Health Officer

August 12, 2002

WESTON BUILDERS
405 HEADQUARTERS DR
#2, MILLERSVILLE, MD 21108

Re: WESTON BUILDERS
2633 EVERGREEN RD.
ODENTON, MD 21113

CERTIFICATE OF POTABILITY

This letter certifies that the requirements of COMAR 26.04.04 "WELL CONSTRUCTION REGULATIONS" have been met for the water supply system installed under permit number AA-94-8130 at the above referenced location.

The Anne Arundel County Department of Health has conducted an evaluation of this system and has tested the water produced by the well to determine if it met the standards set for the following parameters: coliform bacteria, nitrates, turbidity, sand, and radionuclides. The analyses indicate that the water does meet the applicable standards set for these parameters and has satisfied the review requirements of this department.

The well driller's signature on the completion report is his certification that well construction as performed under his supervision conforms to State of Maryland requirements.

Sincerely,

Kerry Topovski
Sanitary Engineering
Division of Community & Environmental Health

C 1 3617

SEQUENCE NO (OEP USE ONLY)

THIS NUMBER IS TO BE PUNCHED IN COL. ON ALL CARDS

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED

COUNTY NUMBER 02

Date Received (OEP use only): [illegible] 2 4 [illegible]

DATE WELL COMPLETED: [illegible]

Depth of Well: 71 ft. (TO NEAREST FOOT)

PERMIT NO. FROM PERMIT TO DRILL WELL: AA-[illegible]

OWNER: Ennis (last name) Clarence (first name)

STREET OR RFD: #2654 Evergreen Rd. TOWN: Odenton, MD 21113

SUBDIVISION: ____ SECTION ____ LOT ____

WELL LOG (Not required for driven wells)

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Brown clay	0	6	
Brown sand	6	22	
White clay	22	30	
Gravel	30	45	
Brown sand & gravel	45	62	
Coarse brown sand	62	71	x

CIRCLE APPROPRIATE BOX

A — A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED

E — ELECTRIC LOG OBTAINED

P — TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED [illegible]

DRILLERS LICENSE NO. [illegible]36

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

[illegible] Greer Drilling Co.

SITE SUPERVISOR (sign of driller or journeyman responsible for the work if different from permittee)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box): Y N

TYPE OF GROUTING MATERIAL: CEMENT CM BENTONITE CLAY BC

NO. OF BAGS 2 NO. OF POUNDS 100

GALLONS OF WATER 50

DEPTH OF GROUT SEAL (to nearest foot) from 3 ft. to 25 ft. (enter 0 if from surface)

CASING RECORD

casing type (insert appropriate code below): ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE	Nominal diameter (nearest inch)	Total depth of main casing (nearest foot)
P L	4"	66

OTHER CASING (if used): diameter (inch), depth (feet) from, to

SCREEN RECORD

screen type or open hole (insert appropriate code below): ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C 2

SCREEN TYPE	DEPTH (nearest ft.) from	to
P L	66	71

SLOT SIZE 0.30

DIAMETER OF SCREEN 2 (NEAREST INCH)

GRAVEL PACK ____ ____

IF WELL DRILLED WAS FLOWING WELL CIRCLE BOX: F

OEP USE ONLY (NOT TO BE FILLED IN BY DRILLER)

TELESCOPE CASING — LOG INDICATOR — OTHER DATA (E.R.O.S.) W Q

C 3

PUMPING TEST

HOURS PUMPED (nearest hour) 1

PUMPING RATE (gal. per min.) (to nearest gal.) 8

METHOD USED TO MEASURE PUMPING RATE: air

WATER LEVEL (distance from land surface)

BEFORE PUMPING 55

WHEN PUMPING 60

TYPE OF PUMP USED (for test): A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE APPROPRIATE BOX): YES Y NO N

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP (WRITE APPROPRIATE LETTER IN BOX - SEE ABOVE (A, C, J, P, R, S, T, O)): S

CAPACITY: GALLONS PER MINUTE (to nearest gallon) 7

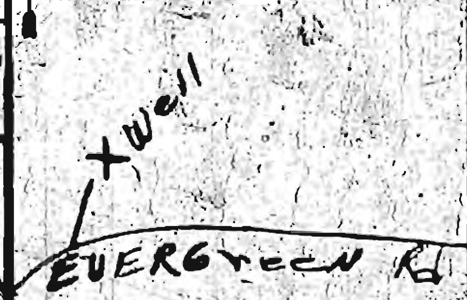
PUMP HORSE POWER .5

PUMP COLUMN LENGTH (nearest ft.) 60

CASING HEIGHT (circle appropriate box and enter casing height): above / below LAND SURFACE 1 (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



ORIGINAL

EMERGENCY/TEMP NO. IF ANY

B 1' 6166 — SEQUENCE NO. (MDE USE ONLY)
1 2 3 6
(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

STATE OF MARYLAND
APPLICATION FOR PERMIT TO DRILL WELL
please print or type

STATE PERMIT NUMBER: AA-94-2136
70 79
fill in this form completely

Date Received (APA) BC: 11 18 97
8 MM DD YY 13

OWNER INFORMATION

Last Name: Warnick — Owner — First Name: Mary
15 34

Street or RFD: 1198 Patuxent Rd
36 55

Town: Odenton — State: Md — Zip: 21113
57 70 72 76

DRILLER INFORMATION

Driller's Name: John E Greer — M S D — License No. 086
76 81

Firm Name: HJ Greer Drilling Co Inc

Address: P.O Drawer A Gambrills Md 21054

Signature: [signature] — Date: 11-17-97

B 2 WELL INFORMATION
1 2

APPROX. PUMPING RATE (GAL. PER MIN.): 10
8 12

AVERAGE DAILY QUANTITY NEEDED (GAL. PER DAY): 500
14 20

USE FOR WATER (CIRCLE APPROPRIATE BOX)

- **D** HOME (SINGLE OR DOUBLE HOUSEHOLD UNIT ONLY) — circled
- **F** FARMING (LIVESTOCK WATERING & AGRICULTURAL IRRIGATION
- 22 **I** INDUSTRIAL, COMMERCIAL, STATE AND FEDERAL GOV. OTHER (REQUIRES APPROPRIATION PERMIT)
- **P** PUBLIC OR PRIVATE WATER COMPANY (REQUIRES APPROPRIATION PERMIT AND STATE APPROVAL
- **T** TEST, OBSERVATION, MONITORING (MAY REQUIRE APPROPRIATION PERMIT)

APPROXIMATE DEPTH OF WELL: 120 FEET
24 28

APPROXIMATE DIAMETER OF WELL: 4 NEAREST INCH

METHOD OF DRILLING (circle one)

BORED (or Augered)	JETTED	Jetted & DRIVEN
30 AIR-ROTary	AIR-PERcussion	ROTARY (Hydraulic Rotary)
37 CABLE	REVerse-ROTary	DRive-POINT

other ______

REPLACEMENT OR DEEPENED WELLS
(CIRCLE APPROPRIATE BOX)

- **N** THIS WELL WILL NOT REPLACE AN EXISTING WELL
- **Y** THIS WELL WILL REPLACE A WELL THAT WILL BE ABANDONED AND SEALED
- 39 **S** THIS WELL WILL REPLACE A WELL THAT WILL BE USED AS A STANDBY-CONTACT LOCAL APPROVING AUTHORITY FOR POLICY ON STANDBY WELLS
- **D** THIS WELL WILL DEEPEN AN EXISTING WELL

PERMIT NUMBER OF WELL TO BE REPLACED OR DEEPENED (IF AVAILABLE) 41 ______ 52

Not to be filled in by driller (MDE OR COUNTY USE ONLY)

APPROP. PERMIT NUMBER 54 ______ 63

FORCE BC 67 68 WRITE INITIALS IN BOX — PERMIT No. AA-94-2136
70 71 72 73 74 75 76 77 78 79

SPECIAL CONDITIONS

B 3 LOCATION OF WELL

COUNTY: Anne Arundel
8 21

SUBDIVISION
23 42

SECTION 44 46 LOT 48 50

NEAREST TOWN: Odenton
52 71

MILES FROM TOWN (enter 0 if in town): 3 M
73 76 77 78

B 4
1 2

DIRECTION OF WELL FROM TOWN (CIRCLE BOX): N 8, NW 8-9, NE 8-9, W 8, TOWN, E 8, SW 8-9, S 8 (circled), SE 8-9

NEAR WHAT ROAD: 1198 Patuxent Rd
11 30

ON WHICH SIDE OF ROAD (CIRCLE APPROPRIATE BOX): NORTH N, WEST W (circled), 32, EAST E, SOUTH S

DISTANCE FROM ROAD: 34 200 37
ENTER FT OR MI: FT 38 39

TAX MAP: 36 BLK: 15 PARCEL: 0025

NOT TO BE FILLED IN BY DRILLER
HEALTH DEPARTMENT APPROVAL

COUNTY NAME: AA — COUNTY NO.: 02

STATE SIGNATURE ______ INSERT S → 41

DATE ISSUED: 11 18 97 — CO SIGNATURE: Brian Chew — EXP. DATE: 11/18/98
43 MM DD YY 48

NORTH GRID 436 000 — EAST GRID 0881 000
50 55 57 63

SHOW MAJOR FEATURES OF BOX & LOCATE WELL WITH AN X →

X

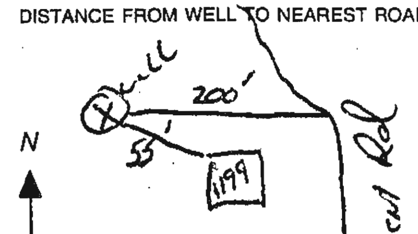
SOURCES OF DRILLING WATER
1. Drillers Well
2. TA# 4000-0413-7000
3.

NO CPF

WRITE THE BOX NUMBER FROM THE MAP HERE

E 880 000
N 430 000

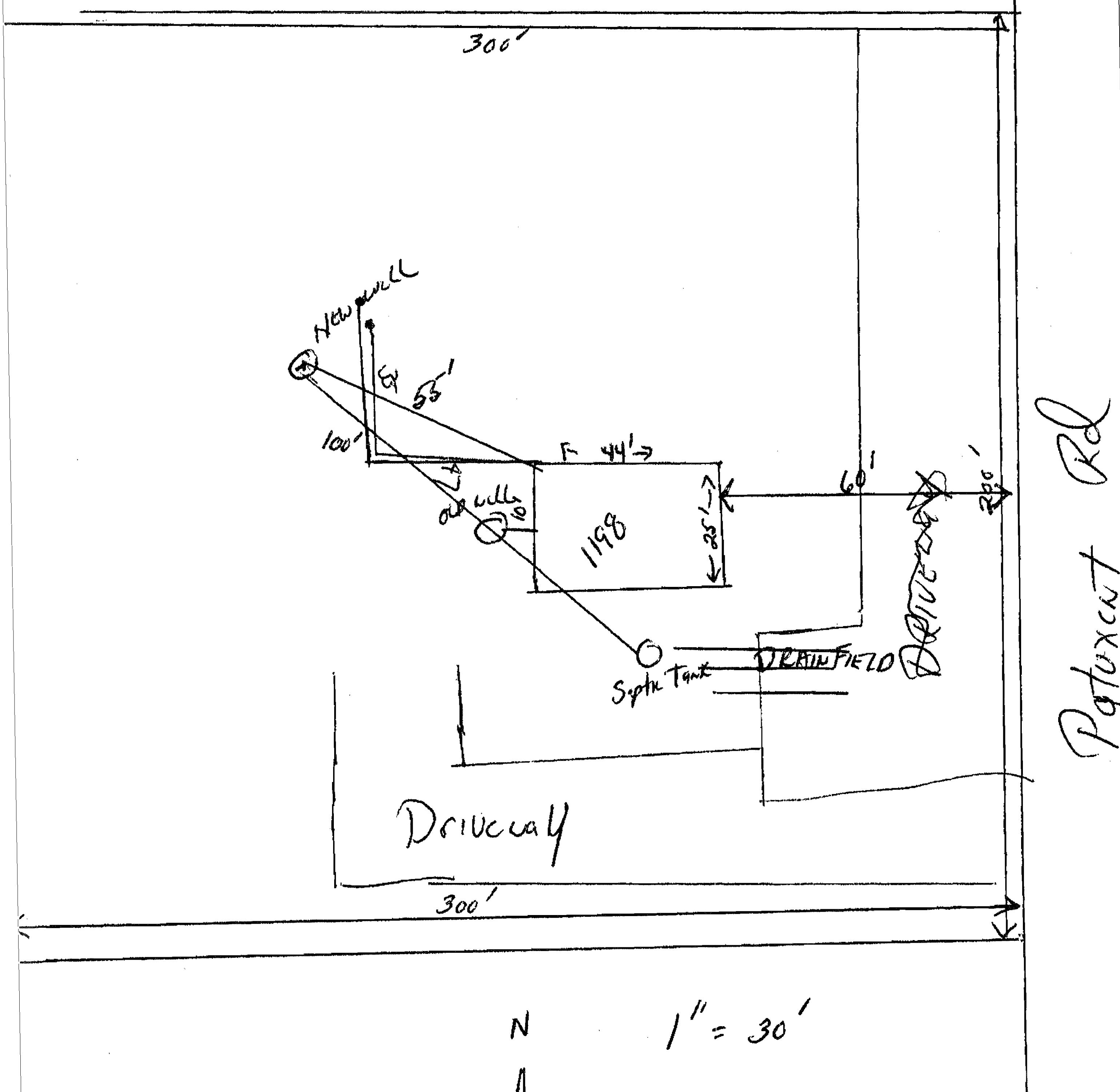
DRAW A SKETCH BELOW SHOWING LOCATION OF WELL IN RELATION TO NEARBY TOWNS AND ROADS AND GIVE DISTANCE FROM WELL TO NEAREST ROAD JUNCTION



"The well must be drilled into a confined aquifer, with the bottom of the confining bed at a minimum depth of 55 feet. The confining bed can be no less than 5' thick. The annular space must be grouted from at least 2' into the confining bed

29

1170 Patoxent Rd



"The well must be drilled into a confined aquifer, with the bottom of the confining bed at a minimum depth of 55 feet. The confining bed can be no less than 5' thick. The annular space must be grouted from at least 2' into the confining bed to the land surface."

(MDE USE ONLY)

1 2 3 6

(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

STATE OF MARYLAND WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

ST/CO USE ONLY
DATE Received MM DD YY

DATE WELL COMPLETED MM 11 DD 10 YY 97

Depth of Well 115 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-94-2136

OWNER Davnick (last name) Mary (first name)
STREET OR RFD 1198 Patuxent Rd TOWN
SUBDIVISION Odenton SECTION LOT

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	check if water bearing
Sand & Gravel	0	6	
Brown Clay	6	15	
Brown Sand	15	24	
Red Clay	24	61	
Brown Sand	61	74	
Red Clay	74	97	
Grey Clay	97	105	
Medium Brown Sand	105	115	

NUMBER OF UNSUCCESSFUL WELLS:

WELL HYDROFRACTURED yes Y no N

CIRCLE APPROPRIATE LETTER
A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
E ELECTRIC LOG OBTAINED
P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS LIC. NO. M S D 086

DRILLERS SIGNATURE
(MUST MATCH SIGNATURE ON APPLICATION)

LIC. NO. M __ D ____

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N

TYPE OF GROUTING MATERIAL (Circle one)
CEMENT CM BENTONITE CLAY BC
NO. OF BAGS 6 NO. OF POUNDS 300
GALLONS OF WATER 150
DEPTH OF GROUT SEAL (to nearest foot) from 4 ft. (TOP) to 80 ft. (BOTTOM)
(enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below

ST STEEL CO CONCRETE PL PLASTIC OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	4	110

EACH CASING — OTHER CASING (if used) diameter inch, depth (feet) from to

SCREEN RECORD

screen type or open hole insert appropriate code below

ST STEEL BR BRASS BRONZE HO OPEN HOLE PL PLASTIC OT OTHER

C 2 DEPTH (nearest ft.)

EACH SCREEN	Type	From	To
1	PL	110	115
2			
3			

SLOT SIZE 1 0 2 2 3 0

DIAMETER OF SCREEN 2 (NEAREST INCH)

GRAVEL PACK from 105 to 115

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY
(NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W Q

TELESCOPE CASING LOG INDICATOR OTHER DATA

C 3

PUMPING TEST

HOURS PUMPED (nearest hour) 1
PUMPING RATE (gal. per min.) 15
METHOD USED TO MEASURE PUMPING RATE Barrel
WATER LEVEL (distance from land surface)
BEFORE PUMPING 30 ft.
WHEN PUMPING 40 ft.

TYPE OF PUMP USED (for test)
A air P piston T turbine
C centrifugal R rotary O other (describe below)
J jet S submersible

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS.

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX 29. S

CAPACITY: GALLONS PER MINUTE (to nearest gallon) 10

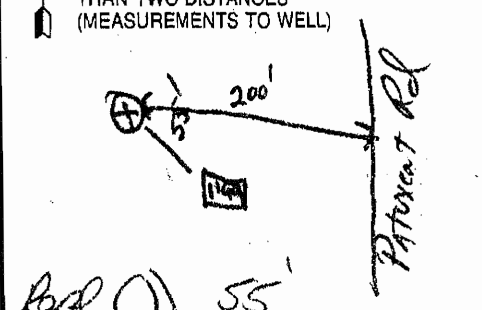
PUMP HORSE POWER .50

PUMP COLUMN LENGTH (nearest ft.) 80

CASING HEIGHT (circle appropriate box and enter casing height)
+ above LAND SURFACE 1 (nearest) foot
− below

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND /OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



MARYLAND DEPARTMENT OF THE ENVIRONMENT, WATER MANAGEMENT ADMINISTRATION
2500 BROENING HIGHWAY, BALTIMORE, MARYLAND 21224, (410) 631-3784

WATER WELL ABANDONMENT-SEALING REPORT FORM

SUBMIT COPIES OF COMPLETED FORM TO:
* COUNTY ENVIRONMENT AGENCY (contact MDE, WMA if address needed)
* WELL OWNER
* MDE, WATER MANAGEMENT ADMINISTRATION, WELL PROGRAM

DATE WELL ABANDONED: ______________ (month/day/year)

* PERMIT NUMBER OF ABANDONED WELL (if any) ______________

* PERMIT NUMBER OF REPLACEMENT WELL AA-94-2136

* PERSON ABANDONING WELL: John Greer WELL DRILLERS LICENSE NUMBER: 086
CIRCLE: MWD/MSD/MGI

* OWNER'S NAME: Mary Alice Warnick

* WELL LOCATION:
COUNTY: Anne Arundel
NEAREST TOWN: Odenton
TAX MAP 36 BLOCK 15 PARCEL 0025
SUBDIVISION: ______________
SECTION: ______________ LOT: ______________
NEAREST ROAD: Patuxent Rd

MARYLAND GRID COORDINATES
BOX NUMBER
E 880
N 430

000
000

SHOW WELL LOCATION BY X WITHIN BOX

* TYPE OF WELL BEING ABANDONED:

____ DRILLED ____ JETTED
____ BORED/AUGUERED ____ HAND DUG
____ OTHER (specify) ______________

* USE CODE:

____ DOMESTIC ____ MUNICIPAL/PUBLIC
____ IRRIGATION ____ INDUSTRIAL
____ TEST/OBSERVATION

* TYPE OF CASING:

____ STEEL ____ PLASTIC
____ CONCRETE ____ OTHER (specify) ______________

* SIZE OF CASING: 4 INCHES IN DIAMETER

* DEPTH OF WELL: 115 FEET DEEP

* WAS ANY CASING REMOVED? ____ YES ____ NO
if yes, length removed, in feet: ______

* WAS CASING RIPPED OR PERFORATED? ____ YES ____ NO

LOG OF SEALING MATERIAL

MATERIAL	FEET	
	FROM	TO

RECEIVED

SIGNATURE-MASTER WELL DRILLER OR SUPERVISING SANITARIAN   LICENSE #   MWD/MSD/MGD CIRCLE ONE   DATE

ANNE ARUNDEL COUNTY
MARYLAND

DEPARTMENT OF HEALTH
J. HOWARD BEARD HEALTH SERVICES BUILDING
3 HARRY S. TRUMAN PARKWAY
ANNAPOLIS, MARYLAND 21401
410-222- 7274
FAX 410-222-7294
TDD FOR THE HEARING IMPAIRED 410-222-7153
www.health.co.anne-arundel.md.us/

05/13/98

FRANCES B. PHILLIPS, R.N., M.H.A
Health Officer

NOWOTTNICK, THELMA
1198 PATUXENT ROAD
ODENTON MD 21114

RE: 1198 PATUXENT ROAD
ODENTON MD 21114

CERTIFICATE OF POTABILITY

THIS LETTER CERTIFIES THAT THE REQUIREMENTS OF COMAR 26.04.04 "WELL CONSTRUCTION REGULATIONS" HAVE BEEN MET FOR THE WATER SUPPLY SYSTEM INSTALLED UNDER PERMIT NUMBER AA-94-2136 AT THE ABOVE REFERENCED LOCATION.

THE ANNE ARUNDEL COUNTY DEPARTMENT OF HEALTH HAS CONDUCTED AN EVALUATION OF THIS SYSTEM AND HAS TESTED THE WATER PRODUCED BY THE WELL TO DETERMINE IF IT MET THE STANDARDS SET FOR THE FOLLOWING PARAMETERS: COLIFORM BACTERIA, NITRATES, TURBIDITY AND SAND. THE ANALYSES INDICATE THAT THE WATER DOES MEET THE APPLICABLE STANDARDS SET FOR THESE PARAMETERS AND HAS SATISFIED THE REVIEW REQUIREMENTS OF THIS DEPARTMENT.

THE WELL DRILLER'S SIGNATURE ON THE COMPLETION REPORT IS HIS CERTIFICATION THAT WELL CONSTRUCTION AS PERFORMED UNDER HIS SUPERVISION CONFORMS TO STATE OF MARYLAND REQUIREMENTS.

SINCERELY,

Kerry Topovski

KERRY TOPOVSKI
SANITARY ENGINEERING
DIVISION OF COMMUNITY & ENVIRONMENTAL HEALTH

C 1 00304

STATE OF MARYLAND
DEPARTMENT OF WATER RESOURCES
STATE OFFICE BLDG., ANNAPOLIS, MARYLAND 21401

WELL COMPLETION REPORT

THIS REPORT MUST BE SUBMITTED WITHIN 30 DAYS AFTER WELL COMPLETION

FILL IN THIS FORM COMPLETELY

COUNTY NUMBER

DATE RECEIVED: 8 9 72 — 13072

DATE WELL COMPLETED: 080972

DEPTH OF WELL (TO NEAREST FOOT): 193

PERMIT NO. FROM PERMIT TO DRILL WELL: PA-[illegible]

DRILLERS IDENTIFICATION NO.: 135

OWNER: West, James

STREET OR RFD: Box 276 Patuxent Rd. POST OFFICE: Odenton, Md.

WELL DESCRIPTION

WELL LOG

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (USE ADDITIONAL SHEETS IF NECESSARY)	FEET FROM	FEET TO	CHECK IF WATER BEARING
Top Soil	0	1	
Gravel	1	30	
White Clay	30	80	
Fine Sand	80	92	
Red Clay	92	160	
White Clay	160	178	
Medium Tan Sand	178	193	

GROUTING RECORD

WELL HAS BEEN GROUTED: YES / NO (circled: N)

TYPE OF GROUTING MATERIAL (CIRCLE BOX): CEMENT CM — BENTONITE CLAY BC

NO. OF BAGS ___ NO. OF POUNDS ___

GALLONS OF WATER ___

DEPTH OF GROUT SEAL (TO NEAREST FOOT) FROM ___ FT. TO ___ FT.

CASING RECORD

CASING TYPE (INSERT APPROPRIATE CODE BELOW): ST STEEL; CO CONCRETE; PL PLASTIC; OT OTHER

MAIN CASING TYPE	NOMINAL DIAMETER TOP (MAIN) CASING (NEAREST INCH)	TOTAL DEPTH OF MAIN CASING (NEAREST FOOT)
ST	4	188

OTHER CASING (IF USED)

DIAMETER (INCH) — DEPTH (FEET) FROM — TO

SCREEN RECORD

SCREEN TYPE OR OPEN HOLE (INSERT APPROPRIATE CODE BELOW): ST STEEL; BR BRASS OR BRONZE; HO OPEN HOLE; PL PLASTIC; OT OTHER

C 2

TYPE	DEPTH (NEAREST WHOLE FOOT) FROM	TO
PL	188	193

SLOT SIZE: .030

DIAMETER OF SCREEN: 2 (NEAREST INCH)

GRAVEL PACK FROM ___ TO ___

IF WELL DRILLED WAS A FLOWING WELL CIRCLE BOX: F

PUMPING TEST

C 3

HOURS PUMPED (TO NEAREST HOUR): 1

PUMPING RATE (GALLONS PER MINUTE TO NEAREST GALLON): 50

METHOD USED TO MEASURE PUMPING RATE: Air Comp

WATER LEVEL (DISTANCE FROM LAND SURFACE)

BEFORE PUMPING: 3 (NEAREST FOOT)

WHEN PUMPING: 12 (NEAREST FOOT)

TYPE OF PUMP USED (CIRCLE APPROPRIATE BOX) (FOR PUMPING TEST): A AIR (circled); P PISTON; T TURBINE; C CENTRIFUGAL; R ROTARY; O OTHER (DESCRIBE BELOW); J JET; S SUBMERSIBLE

PUMP INSTALLED

TYPE OF PUMP (WRITE APPROPRIATE LETTER IN BOX - SEE ABOVE: A, C, J, P, R, S, T, O)

DRILLER WILL INSTALL PUMP (CIRCLE APPROPRIATE BOX): YES (circled) / NO

CAPACITY (GALLONS PER MINUTE TO NEAREST GALLON): Owners

PUMP HORSE POWER ___

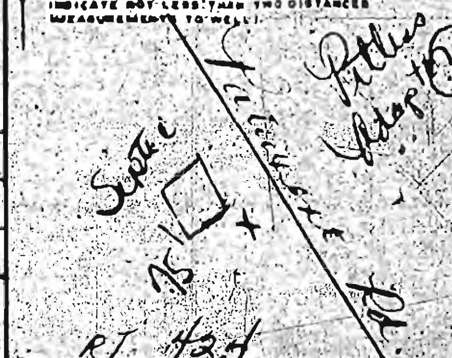
PUMP COLUMN LENGTH (NEAREST FOOT) ___

CASING HEIGHT

(CIRCLE APPROPRIATE BOX, AND ENTER CASING HEIGHT) ABOVE / BELOW LAND SURFACE: 1 (NEAREST FOOT)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDINGS, SEPTIC TANKS, AND/OR OTHER LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES MEASUREMENTS TO WELL.



CIRCLE APPROPRIATE BOXES

A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED

E ELECTRIC LOG OBTAINED

P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT I HAVE COMPLIED WITH ALL CONDITIONS STATED ON THE ABOVE-CAPTIONED PERMIT TO DRILL WELL, AND THAT INFORMATION CONTAINED IN THIS REPORT IS TRUE, ACCURATE, AND COMPLETE TO THE BEST OF MY KNOWLEDGE, INFORMATION AND BELIEF.

DRILLERS NAME: Green Drilling

DRILLER: Elmer E. Green

SIGNATURE: Harold J. Green

DWR USE ONLY (NOT TO BE FILLED IN BY DRILLER): TELESCOPE CASING; LOG INDICATOR; OTHER DATA AVAILABLE

ORIGINAL

WP # 730145 | 818882

```
PAGE NUMBER 1            MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0650-4400        36    09   0024
                                              PREMISE ADDRESS
WIST, JAMES W                        1190 PATUXENT RD
WIST, ALICE M                                                           PLAT REFER
                                     ODENTON MD 21113
        MAILING  ADDRESS                                              GENERAL CODES
1190 PATUXENT RD                     IMPS1 ACRE                 EXEMPT DATE CD  CL
                                     1190 PATUXENT RD                          000
ODENTON                  MD 21113    ODENTON                          USE CODE  R
                                                                      H O CODE
           LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE   OWN OCCUP  H
CUR      116,666      95,136    211,802                  211,802  AG TRSF TX
1         83,333      89,013    172,346                  172,346 AG DAT
2        116,666      95,136    211,802                  211,802 REASSESSMENT
3        150,000     101,260    251,260                  251,260 PH 09-01-2004
BASE      50,000      82,890    132,890                  132,890  ASSR    0275
HST       83,333      89,013    172,346                  172,346  GEO CODE   2
PREV ACCOUNT NO         PREVIOUS OWNER         TRNS NO            G F 1.000000
0000-0000-0000                                   00000            PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F
```

4-©   1   AACoITD   189.9.9.3   HGOA

WP # 9408A6

```
PAGE NUMBER 1          MAP   BLK   PARCEL PLAT SECT   BLOCK      LOT     DEED REFER
   4000-0650-5800      36     09    0023                                 16228-089
                                            PREMISE ADDRESS
1182 PATUXENT ROAD LLC             1182 PATUXENT RD
                                                                         PLAT REFER

                                   ODENTON MD 21113
        MAILING  ADDRESS                                               GENERAL CODES
3530 WILLIAMSBURG RD               IMPS16.832 ACRES            EXEMPT DATE CD   CL
                                   1182 PATUXENT RD                              000
DAVIDSONVILLE          MD 21035    ODENTON                              USE CODE  R
                                                                        H O CODE
           LAND     BUILDINGS     TOTAL  PREFER LAND   CURTILAGE        OWN OCCUP  N
CUR       193,396      71,680     265,076                               AG TRSF TX 3
1         160,063      68,050     228,113                              AG DAT 11-1996
2         193,396      71,680     265,076                              REASSESSMENT
3         226,730      75,310     302,040                              PH 09-01-2004
BASE      126,730      64,420     191,150                               ASSR     0275
HST       160,063      68,050     228,113                               GEO CODE   2
PREV ACCOUNT NO          PREVIOUS OWNER           TRNS NO               G F 1.000000
4000-0650-5800    BARLOW, RICHARD S                04855                PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP          F
```

4-© 1 AACoITD 189.9.9.3 HGOA

No Query

UPDATE COMPLETED WELLS Filename: SE.WELLS Mode: UPDATE
Record type: 01 Last record type: 01 Auto-dup: OFF
TAG NUMBER 940846
WELL DEPTH 00196 COMPLETION DATE 19960916 DATE RECEIVED 19961113
DESCRIPTION 1 SAND FROM 1 0000 TO 1 0005
DESCRIPTION 2 GRAVEL FROM 2 0005 TO 2 0012
DESCRIPTION 3 WHITE CLAY FROM 3 0012 TO 3 0030
DESCRIPTION 4 BROWN SAND FROM 4 0030 TO R 0050
DESCRIPTION 5 RED CLAY FROM 5 0050 TO 5 0125
DESCRIPTION 6 GRAY CLAY FROM 6 0125 TO 6 0162
DESCRIPTION 7 RED CLAY FROM 7 0162 TO 7 0180
DESCRIPTION 8 FINE BROWN SAND FROM 8 0180 TO 8 0185
DESCRIPTION 9 MED BROWN SAND FROM 9 0185 TO 9 0196
GROUTING MATR. BC GROUTING BAGS 6 GROUTING POUNDS 300
GROUTING GALLONS 0150 GROUTING DEPTH 4-70 CASING TYPE 1 PL CASING DIA 1 04
CASING DEPTH 1 00191 CASING TYPE 2 CASING DIA 2 00
CASING DEPTH 2 SCREEN TYPE PL SCREEN DEPTH 191-196
SCREEN SLOT SIZE 020 SCREEN DIA 02 GRAVEL PACK 186-196
PUMPING HOURS 01 PUMPING RATE 00015 PUMPING METHOD AIR
PUMP H2O LEV B4 0020 PUMP H2O LEV AFT 00030 PUMP TYPE A PUMP INS DRILLER Y
PUMP INS TYPE S PUMP INS GPM 00010 PUMP INS HP .50 PUMP INS COLM LG 00050
ABANDONED WELL 2
DELETE CODE

WP# 885118

```
PAGE NUMBER 1            MAP   BLK   PARCEL PLAT SECT  BLOCK      LOT     DEED REFER
   4000-0447-4400        36     15    0032                                05828-828
                                                PREMISE ADDRESS
POKORNY, MARIE H                       1228 PATUXENT RD
POKORNY, ANTHONY A                                                        PLAT REFER
                                       ODENTON MD 21113
        MAILING  ADDRESS                                                GENERAL CODES
1228 PATUXENT RD                       IMPS10 ACRES               EXEMPT DATE CD  CL
                                       1228 PATUXENT RD                          000
ODENTON                  MD 21113      NR BRAGER STATION                 USE CODE  R
                                                                         H O CODE
           LAND     BUILDINGS      TOTAL  PREFER LAND    CURTILAGE    OWN OCCUP  D
CUR       178,666       55,434     234,100                  178,766  AG TRSF TX
1         145,333       51,917     197,250                  138,583 AG DAT
2         178,666       55,434     234,100                  178,766 REASSESSMENT
3         212,000       58,950     270,950                  218,950 PH 09-01-2004
BASE      112,000       48,400     160,400                   98,400  ASSR     0275
HST       145,333       51,917     197,250                  138,583  GEO CODE   2
PREV ACCOUNT NO          PREVIOUS OWNER          TRNS NO             G F 1.000000
4000-0447-4400   POKORNY, ANTHONY E                10539             PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP          F

4-©             1    AACoITD    189.9.9.3                    HG0A
```

NO Query

UPDATE COMPLETED WELLS Filename: SE.WELLS Mode: UPDATE
Record type: 01 Last record type: 01 Auto-dup: OFF
TAG NUMBER 885118
WELL DEPTH 00122 COMPLETION DATE 19900927 DATE RECEIVED 19901026
DESCRIPTION 1 SAND TRACE WHITE CLAY & GRAVEL FROM 1 0000 TO 1 0026
DESCRIPTION 2 RED CLAY FROM 2 0026 TO 2 0095
DESCRIPTION 3 CLAY & SAND MIX FROM 3 0095 TO 3 0102
DESCRIPTION 4 TAN SAND FROM 4 0102 TO R 0122
DESCRIPTION 5 FROM 5 TO 5
DESCRIPTION 6 FROM 6 TO 6
DESCRIPTION 7 FROM 7 TO 7
DESCRIPTION 8 FROM 8 TO 8
DESCRIPTION 9 FROM 9 TO 9
GROUTING MATR. BC GROUTING BAGS 3 GROUTING POUNDS 150
GROUTING GALLONS 0075 GROUTING DEPTH 0-31 CASING TYPE 1 PL CASING DIA 1 04
CASING DEPTH 1 00115 CASING TYPE 2 CASING DIA 2
CASING DEPTH 2 SCREEN TYPE PL SCREEN DEPTH 115-122
SCREEN SLOT SIZE .020 SCREEN DIA 02 GRAVEL PACK 110-122
PUMPING HOURS 01 PUMPING RATE 00010 PUMPING METHOD BUCKET
PUMP H2O LEV B4 0034 PUMP H2O LEV AFT 00043 PUMP TYPE O PUMP INS DRILLER Y
PUMP INS TYPE S PUMP INS GPM 00008 PUMP INS HP .5 PUMP INS COLM LG 00060
ABANDONED WELL
DELETE CODE

WP# 731906 | 730740 missing

```
PAGE NUMBER 1            MAP   BLK  PARCEL PLAT SECT  BLOCK      LOT    DEED REFER
   4000-0277-5900        36    11   0118                          8     02785-529
                                              PREMISE ADDRESS
JACKSON, DARELETHA                    EVERGREEN AVE
                                                                        PLAT REFER
                                      ODENTON MD 21113
        MAILING  ADDRESS                                              GENERAL CODES
P O BOX 12                            IMPSHLF LT 8 OR 1.475 AC  EXEMPT DATE CD  CL
                                      EVERGREEN AVE                              000
ODENTON                  MD 21113     LANDWEHRS TRACT                  USE CODE  R
                                                                       H O CODE
           LAND     BUILDINGS       TOTAL  PREFER LAND   CURTILAGE     OWN OCCUP  D
CUR       126,366      54,134      180,500                   153,422   AG TRSF TX
1          93,033      53,057      146,090                   117,766 AG DAT
2         126,366      54,134      180,500                   153,422 REASSESSMENT
3         159,700      55,210      214,910                   189,080 PH 09-01-2004
BASE       59,700      51,980      111,680                    82,110   ASSR    0275
HST        93,033      53,057      146,090                   117,766   GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER          TRNS NO                 G F 1.000000
0000-0000-0000                                   00000                 PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP           F

4-©            1     AACoITD    189.9.9.3                   HGOA
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No microfiche available - data screens attached / RK.

```
 UPDATE COMPLETED WELLS            Filename: MDWELLS1            Mode: UPDATE
Record type: 01           Last record type: 01                 Auto-dup: OFF
TAG NUMBER 731906
WELL DEPTH 00072  COMPLETION DATE 19730825  DATE RECEIVED 19731219
DESCRIPTION 1                                FROM 1       TO 1
DESCRIPTION 2                                FROM 2       TO 2
DESCRIPTION 3                                FROM 3       TO 3
DESCRIPTION 4                                FROM 4       TO R
DESCRIPTION 5                                FROM 5       TO 5
DESCRIPTION 6                                FROM 6       TO 6
DESCRIPTION 7                                FROM 7       TO 7
DESCRIPTION 8                                FROM 8       TO 8
DESCRIPTION 9                                FROM 9       TO 9
GROUTING MATR.       GROUTING BAGS       GROUTING POUNDS
GROUTING GALLONS       GROUTING DEPTH 0000   CASING TYPE 1 PL CASING DIA 1 04
CASING DEPTH 1 00067  CASING TYPE 2    CASING DIA 2
CASING DEPTH 2             SCREEN TYPE PL SCREEN DEPTH 0067-0072
SCREEN SLOT SIZE      SCREEN DIA 02  GRAVEL PACK
PUMPING HOURS 01  PUMPING RATE 00010  PUMPING METHOD
PUMP H2O LEV B4 0040  PUMP H2O LEV AFT 00048  PUMP TYPE   PUMP INS DRILLER
PUMP INS TYPE S PUMP INS GPM 00008  PUMP INS HP 1     PUMP INS COLM LG 00060
ABANDONED WELL
DELETE CODE
```

ADD/CHANGE WELL MASTER		Filename: MDWELLS1	Mode: UPDATE
Record type: 01		Last record type: 01	Auto-dup: OFF
WELL TAG # 731906			
TAX ACCOUNT #	400002775900	BO PERMIT #	
PERC #			
OWNER'S NAME	JACKSON, DOROTHY		
WELL DRILLER	GREER, H J DRLG CO		
USE OF WATER	D	TYPE OF WELL	
APPROP PERMIT			
SUBDIVISION			
MAP		BLOCK	
PARCEL		DEED REF 1	
DEED REF 2		LOT	
CITY	GAMBRILLS	ZIP CODE	
HOUSE #		STREET	EVERGREEN
DATE ISSUED	19730822		
COMMENT	TFSD		
SPCL CONDITIONS		RADIUM? (Y/no)	
CADMIUM? (Y/no)		GRID N	435
GRID E	0880		
RADIUMAGREE PRNT			
RADIUMAGREE DATE			
DELETE CODE			

ADD/CHANGE WELL MASTER Filename: MDWELLS1 Mode: UPDATE
Record type: 01 Last record type: 01 Auto-dup: OFF
WELL TAG # 730740

TAX ACCOUNT #	400002775900	BO PERMIT #	
PERC #			
OWNER'S NAME	JACKSON, DOROTHY		
WELL DRILLER	BRUCE GREER		
USE OF WATER	D	TYPE OF WELL	
APPROP PERMIT			
SUBDIVISION			
MAP		BLOCK	
PARCEL		DEED REF 1	
DEED REF 2		LOT	
CITY	ODENTON	ZIP CODE	
HOUSE #		STREET	EVERGREEN RD
DATE ISSUED	19721218		
COMMENT	TFSD		
SPCL CONDITIONS		RADIUM? (Y/no)	
CADMIUM? (Y/no)		GRID N	435
GRID E	0880		
RADIUMAGREE PRNT			
RADIUMAGREE DATE			
DELETE CODE			

UPDATE COMPLETED WELLS Filename: MDWELLS1 Mode: UPDATE
Record type: 01 Last record type: 01 Auto-dup: OFF
TAG NUMBER 730740
WELL DEPTH 00000 COMPLETION DATE 00000000 DATE RECEIVED 00000000
DESCRIPTION 1 FROM 1 TO 1
DESCRIPTION 2 FROM 2 TO 2
DESCRIPTION 3 FROM 3 TO 3
DESCRIPTION 4 FROM 4 TO R
DESCRIPTION 5 FROM 5 TO 5
DESCRIPTION 6 FROM 6 TO 6
DESCRIPTION 7 FROM 7 TO 7
DESCRIPTION 8 FROM 8 TO 8
DESCRIPTION 9 FROM 9 TO 9
GROUTING MATR. GROUTING BAGS GROUTING POUNDS
GROUTING GALLONS GROUTING DEPTH 0000 CASING TYPE 1 CASING DIA 1 00
CASING DEPTH 1 00000 CASING TYPE 2 CASING DIA 2
CASING DEPTH 2 SCREEN TYPE SCREEN DEPTH 0000-0000
SCREEN SLOT SIZE SCREEN DIA 00 GRAVEL PACK
PUMPING HOURS 00 PUMPING RATE 00000 PUMPING METHOD
PUMP H2O LEV B4 0000 PUMP H2O LEV AFT 00000 PUMP TYPE PUMP INS DRILLER
PUMP INS TYPE PUMP INS GPM 00000 PUMP INS HP PUMP INS COLM LG 00000
ABANDONED WELL
DELETE CODE

```
PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0332-1160      36   10   0262                               03026-275
                                        PREMISE ADDRESS
CAPITOL RACEWAY PROMOTION INC     EVERGREEN RD
                                                                    PLAT REFER
                                  ODENTON MD 21113
       MAILING  ADDRESS                                           GENERAL CODES
216 PAULA LYNN DR                     50.5970 ACS          EXEMPT DATE CD  CL
                                  EVERGREEN RD                               000
SILVER SPRING          MD 20904   LITTLE PATUXENT RIVER             USE CODE  C
                                                                    H O CODE
           LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE     OWN OCCUP  N
CUR      339,466                339,466                             AG TRSF TX
1        263,033                263,033                            AG DAT
2        339,466                339,466                            REASSESSMENT
3        415,900                415,900                            PH 10-01-2004
BASE     186,600                186,600                             ASSR     0251
HST      263,033                263,033                             GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER          TRNS NO              G F 1.000000
0000-0000-0000                                   00000              PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F
```

4-©   1   AACoITD   189.9.9.3   HGOA

WP # 819166

```
PAGE NUMBER 1          MAP   BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-9004-3960      29     22   0167                              03845-177
                                           PREMISE ADDRESS
ANNE ARUNDEL COUNTY                 883 FRANCIS STATION RD
                                                                     PLAT REFER

                                    ODENTON MD 21113
        MAILING  ADDRESS                                           GENERAL CODES
C/O ARUNDEL CENTER                      20.487 ACRES          EXEMPT DATE CD  CL
PO BOX 2700                         883 FRANCIS STATION RD                3 501
ANNAPOLIS               MD 21404    FRANCIS STATION                 USE CODE  E
                                                                    H O CODE
            LAND    BUILDINGS      TOTAL  PREFER LAND   CURTILAGE   OWN OCCUP  N
CUR        16,382                 16,382                            AG TRSF TX
1          12,287                 12,287                           AG DAT
2          16,382                 16,382                           REASSESSMENT
3          20,480                 20,480                           PH 09-01-2004
BASE        8,190                  8,190                            ASSR    0275
HST        12,287                 12,287                            GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER          TRNS NO              G F 1.000000
0000-0000-0000                                   00000              PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F
```

4-©   1   AACoITD   189.9.9.3   HGOA

No Query

ADD/CHANGE WELL MASTER Filename: MDWELLS1 Mode: UPDATE
Record type: 01 Last record type: 01 Auto-dup: OFF
WELL TAG # 819166

TAX ACCOUNT #	400090043960	BO PERMIT #	
PERC #			
OWNER'S NAME	ANNE ARUNDEL COUNTY		
WELL DRILLER	SCHULTES, J.F., JR.		
USE OF WATER	I	TYPE OF WELL	
APPROP PERMIT	1987G058		
SUBDIVISION	ODENTON PARK		
MAP	29	BLOCK	22
PARCEL	0167	DEED REF 1	
DEED REF 2		LOT	
CITY	ODENTON	ZIP CODE	21113
HOUSE #	921	STREET	FRANCIS STATION RD
DATE ISSUED	19870818		
COMMENT	TFSD		
SPCL CONDITIONS		RADIUM? (Y/no)	
CADMIUM? (Y/no)		GRID N	444
GRID E	0884		
RADIUMAGREE PRNT			
RADIUMAGREE DATE			
DELETE CODE			

```
 UPDATE COMPLETED WELLS           Filename: MDWELLS1             Mode: UPDATE
Record type: 01          Last record type: 01                Auto-dup: OFF
TAG NUMBER 819166
WELL DEPTH 00216  COMPLETION DATE 19871026  DATE RECEIVED 19871203
DESCRIPTION 1                                 FROM 1       TO 1
DESCRIPTION 2                                 FROM 2       TO 2
DESCRIPTION 3                                 FROM 3       TO 3
DESCRIPTION 4                                 FROM 4       TO R
DESCRIPTION 5                                 FROM 5       TO 5
DESCRIPTION 6                                 FROM 6       TO 6
DESCRIPTION 7                                 FROM 7       TO 7
DESCRIPTION 8                                 FROM 8       TO 8
DESCRIPTION 9                                 FROM 9       TO 9
GROUTING MATR. CM    GROUTING BAGS       GROUTING POUNDS
GROUTING GALLONS       GROUTING DEPTH 0185   CASING TYPE 1 PL CASING DIA 1 06
CASING DEPTH 1 00196  CASING TYPE 2    CASING DIA 2
CASING DEPTH 2             SCREEN TYPE PL SCREEN DEPTH 0196-0216
SCREEN SLOT SIZE      SCREEN DIA 06  GRAVEL PACK
PUMPING HOURS 01  PUMPING RATE 00001  PUMPING METHOD
PUMP H2O LEV B4 0105  PUMP H2O LEV AFT 00105  PUMP TYPE   PUMP INS DRILLER
PUMP INS TYPE S PUMP INS GPM 00010  PUMP INS HP 5     PUMP INS COLM LG 00168
ABANDONED WELL
DELETE CODE
```

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PAGE NUMBER 1          MAP   BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0048-8650      36     12   0158                              04998-395
                                            PREMISE ADDRESS
B B S S INC                          2621 BRICKHEAD RD
                                                                     PLAT REFER
                                     GAMBRILLS MD 21054              00232-028
        MAILING  ADDRESS                                           GENERAL CODES
1 CHURCHVIEW RD                      IMPS2 ACS PT PAR 158      EXEMPT DATE CD  CL
                                     2621 BRICKHEAD RD                        000
MILLERSVILLE           MD 21108      WACH LLC ARC BALT SC INC         USE CODE  R
                                                                      H O CODE
           LAND    BUILDINGS      TOTAL  PREFER LAND   CURTILAGE      OWN OCCUP  N
CUR      122,986      70,060      193,046                             AG TRSF TX
1         89,573      65,550      155,123                            AG DAT
2        122,986      70,060      193,046                            REASSESSMENT
3        156,400      74,570      230,970                            PH 09-01-2004
BASE      56,160      61,040      117,200                             ASSR    0275
HST       89,573      65,550      155,123                             GEO CODE   2
PREV ACCOUNT NO          PREVIOUS OWNER          TRNS NO              G F 1.000000
4000-0048-8650    B B S INVESTORS                  13314              PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP        F

4-©           1     AACoITD   189.9.9.3                    HGOA
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No Query

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PAGE NUMBER 1           MAP  BLK  PARCEL PLAT SECT  BLOCK      LOT     DEED REFER
   4000-0392-3500       36    11   0039                                 07325-766
                                           PREMISE ADDRESS
FRANCISCO, CRISPIN                  2661 EVERGREEN RD
FRANCISCO, LYDIA                                                        PLAT REFER
                                    ODENTON MD 21113
        MAILING  ADDRESS                                              GENERAL CODES
2661 EVERGREEN RD                   IMPS4.314 ACRES              EXEMPT DATE CD  CL
                                    2661 EVERGREEN RD                           000
ODENTON                 MD 21113    LANDWEHRS TRACT                   USE CODE  R
                                                                      H O CODE
           LAND     BUILDINGS      TOTAL  PREFER LAND   CURTILAGE     OWN OCCUP  H
CUR      125,888     133,994      259,882                  259,882   AG TRSF TX
1         95,890     122,617      218,507                  218,506 AG DAT
2        125,888     133,994      259,882                  259,882 REASSESSMENT
3        155,890     145,370      301,260                  301,260 PH 09-01-2004
BASE      65,890     111,240      177,130                  177,130   ASSR    0275
HST       95,890     122,617      218,507                  218,506   GEO CODE   2
PREV ACCOUNT NO         PREVIOUS OWNER          TRNS NO              G F 1.000000
4000-0392-3500   MONTGOMERY, WILLIE               01406              PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP          F
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4-©   1   AACoITD   189.9.9.3   HGOA

No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-9005-9786      36    03   0235                              15743-547
                                          PREMISE ADDRESS
ANNE ARUNDEL COUNTY                1133 MEYERS STATION RD
                                                                    PLAT REFER

                                   ODENTON MD 21113
        MAILING  ADDRESS                                          GENERAL CODES
C/O OFFICE OF REAL EST MGT             103.782 ACRES        EXEMPT DATE CD  CL
2662 RIVA RD FL 4                  1133 MEYERS STATION RD                3 680
ANNAPOLIS              MD 21401    ODENTON                         USE CODE  E
                                                                   H O CODE
           LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE    OWN OCCUP  N
CUR        83,022                 83,022                          AG TRSF TX
1          62,267                 62,267                          AG DAT
2          83,022                 83,022                          REASSESSMENT
3         103,780                103,780                          PH 09-01-2004
BASE       41,510                 41,510                           ASSR    0275
HST        62,267                 62,267                           GEO CODE   2
PREV ACCOUNT NO          PREVIOUS OWNER          TRNS NO           G F 1.000000
4000-9005-9786   PINEY ORCHARD MASTER PTNSHP      19986            PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F
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4-©   1   AACoITD   189.9.9.3   HGOA

No Query

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PAGE NUMBER 1          MAP   BLK   PARCEL PLAT SECT  BLOCK      LOT     DEED REFER
   4000-9001-0238      36     16    0034                                05226-292
                                           PREMISE ADDRESS
ANNE ARUNDEL COUNTY                  1227 MEYERS STATION RD
                                                                        PLAT REFER

                                     ODENTON MD 21113
        MAILING  ADDRESS                                              GENERAL CODES
C/O ARUNDEL CENTER                       29.437 ACRES          EXEMPT DATE CD  CL
P O BOX 2700                         1227 MEYERS STATION RD                 3 504
ANNAPOLIS              MD 21404      WOODWARDSVILLE                    USE CODE  E
                                                                       H O CODE
           LAND     BUILDINGS       TOTAL  PREFER LAND   CURTILAGE    OWN OCCUP  N
CUR        20,600                   20,600                             AG TRSF TX
1          11,770                   11,770                            AG DAT
2          20,600                   20,600                            REASSESSMENT
3          29,430                   29,430                            PH 09-01-2004
BASE        2,940                    2,940                             ASSR    0275
HST        11,770                   11,770                             GEO CODE   2
PREV ACCOUNT NO         PREVIOUS OWNER          TRNS NO                G F 1.000000
4000-9001-0238   MITCHELL          BARTON          11608               PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP          F
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4-©   1   AACoITD   189.9.9.3   HGOA

No Query

PAGE NUMBER 1 MAP BLK PARCEL PLAT SECT BLOCK LOT DEED REFER
4000-0534-7000 36 09 0187 10505-423

PREMISE ADDRESS
KIMM TRUSTEE, DIANA C 1113 PATUXENT RD
PLAT REFER
ODENTON MD 21113

MAILING ADDRESS GENERAL CODES
PO BOX 902 IMPS1 ACRE EXEMPT DATE CD CL
1113 PATUXENT RD 000
SEVERN MD 21144 ODENTON USE CODE R
H O CODE

	LAND	BUILDINGS	TOTAL	PREFER LAND	CURTILAGE	
						OWN OCCUP N
CUR	116,666	28,846	145,512			AG TRSF TX
1	83,333	26,843	110,176			AG DAT
2	116,666	28,846	145,512			REASSESSMENT
3	150,000	30,850	180,850			PH 09-01-2004
BASE	50,000	24,840	74,840			ASSR 0275
HST	83,333	26,843	110,176			GEO CODE 2

PREV ACCOUNT NO PREVIOUS OWNER TRNS NO G F 1.000000
4000-0534-7000 KIMM, DIANA C 08116 PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT F1-MENU F2-WB F3-UTIL F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP F

4-© 1 AACoITD 189.9.9.3 HGOA

No Query

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PAGE NUMBER 1         MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0592-6200     36    09   0191                              15540-062
                                        PREMISE ADDRESS
JOHNSTON, ANGELA                  1117 PATUXENT RD
                                                                   PLAT REFER

                                  ODENTON MD 21113
        MAILING  ADDRESS                                          GENERAL CODES
1117 PATUXENT RD                  IMPS1 ACRE                 EXEMPT DATE CD  CL
                                  1117 PATUXENT RD                          000
ODENTON                MD 21113   PATUXENT                         USE CODE  R
                                                                   H O CODE
           LAND    BUILDINGS      TOTAL  PREFER LAND   CURTILAGE   OWN OCCUP  H
CUR      116,666       25,816     142,482                 142,482  AG TRSF TX
1         83,333       24,023     107,356                 107,356 AG DAT
2        116,666       25,816     142,482                 142,482 REASSESSMENT
3        150,000       27,610     177,610                 177,610 PH 09-01-2004
BASE      50,000       22,230      72,230                  72,230  ASSR    0275
HST       83,333       24,023     107,356                 107,356  GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER          TRNS NO             G F 1.000000
4000-0592-6200   FIKE, CHRISTOPHER               17055             PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F
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4-©   1   AACoITD   189.9.9.3   HGOA

No Query

PAGE NUMBER 1	MAP	BLK	PARCEL PLAT SECT	BLOCK	LOT	DEED REFER
4000-0066-6300	36	09	0186			14789-324
			PREMISE ADDRESS			
JACKSON, THOMAS A			1166 PATUXENT RD			
JACKSON, TERRY L						PLAT REFER
			ODENTON MD 21113			
MAILING ADDRESS						GENERAL CODES
1166 PATUXENT RD			IMPS2.89 ACRES			EXEMPT DATE CD CL
			1166 PATUXENT RD			000
ODENTON	MD 21113		NR ODENTON			USE CODE R
						H O CODE

	LAND	BUILDINGS	TOTAL	PREFER LAND	CURTILAGE	
						OWN OCCUP H
CUR	130,666	72,350	203,016		203,016	AG TRSF TX
1	97,333	68,480	165,813		165,813	AG DAT
2	130,666	72,350	203,016		203,016	REASSESSMENT
3	164,000	76,220	240,220		240,220	PH 09-01-2004
BASE	64,000	64,610	128,610		128,610	ASSR 0275
HST	97,333	68,480	165,813		165,813	GEO CODE 2

PREV ACCOUNT NO	PREVIOUS OWNER	TRNS NO	
			G F 1.000000
4000-0066-6300	BROWN, CLARENCE G	06477	PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT F1-MENU F2-WB F3-UTIL F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP F

4-© 1 AACoITD 189.9.9.3 HGOA

No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-9004-5651      36    15   0194                              14307-525
                                         PREMISE ADDRESS
COZZONE SR, JAMES M               1210 PATUXENT RD
COZZONE, WENDY W                                                    PLAT REFER
                                  ODENTON MD 21113
        MAILING  ADDRESS                                           GENERAL CODES
1200 PATUXENT RD                      20.193 ACRES         EXEMPT DATE CD  CL
                                  1210 PATUXENT RD                          000
ODENTON                MD 21113   BRAGERS STATION                   USE CODE  R
                                                                    H O CODE
           LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE     OWN OCCUP  N
CUR       239,896               239,896                             AG TRSF TX
1         201,563               201,563                            AG DAT
2         239,896               239,896                            REASSESSMENT
3         278,230               278,230                            PH 09-01-2004
BASE      163,230               163,230                             ASSR    0275
HST       201,563               201,563                             GEO CODE   2
PREV ACCOUNT NO          PREVIOUS OWNER          TRNS NO            G F 1.000000
4000-9004-5651   PINEY ORCHARD MASTER PTNSHP      00434             PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F

4-©            1     AACoITD   189.9.9.3                  HGOA
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No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-9000-8963      36    06   0197                                10088-032
                                          PREMISE ADDRESS
CARDINAL WILLIAM H KEELER         1040 WAUGH CHAPEL RD
ROMAN CATHOLIC ARCHBISHOP                                            PLAT REFER
                                  GAMBRILLS MD 21054                 00232-028
        MAILING  ADDRESS                                           GENERAL CODES
320 CATHEDRAL ST                  IMPS22.9 ACS PAR 197      EXEMPT DATE CD  CL
                                  1040 WAUGH CHAPEL RD                    3 710
BALTIMORE              MD 21201   WACH LLC ARC BALT SC INC          USE CODE  EC
                                                                    H O CODE
           LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE     OWN OCCUP  N
CUR      926,098   8,909,534   9,835,632                            AG TRSF TX
1        926,100   8,728,567   9,654,667                           AG DAT
2        926,098   8,909,534   9,835,632                           REASSESSMENT
3        926,100   9,090,500  10,016,600                           PH 10-01-2004
BASE     926,100   8,547,600   9,473,700                            ASSR    0251
HST      926,100   8,728,567   9,654,667                            GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER        TRNS NO                G F 1.000000
4000-9000-8963   WACH LLC                      15942                PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP          F
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4-©   1   AACoITD   189.9.9.3   HGOA

No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0018-0127      36    12   0224                              04998-395
                                          PREMISE ADDRESS
B B S S INC                        WAUGH CHAPEL RD
                                                                    PLAT REFER
                                   GAMBRILLS MD 21054
        MAILING  ADDRESS                                          GENERAL CODES
1 CHURCHVIEW RD                        31.53 ACRES          EXEMPT DATE CD  CL
                                   WAUGH CHAPEL RD                         000
MILLERSVILLE          MD 21108     GAMBRILLS                       USE CODE  R
                                                                   H O CODE
           LAND    BUILDINGS      TOTAL  PREFER LAND   CURTILAGE   OWN OCCUP  N
CUR       21,650                 21,650                            AG TRSF TX
1         11,770                 11,770                           AG DAT
2         21,650                 21,650                           REASSESSMENT
3         31,530                 31,530                           PH 09-01-2004
BASE       1,890                  1,890                            ASSR    0275
HST       11,770                 11,770                            GEO CODE   2
PREV ACCOUNT NO         PREVIOUS OWNER          TRNS NO            G F 1.000000
4000-0018-0127   BALDWIN        JR WILLIAM        13314            PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP          F
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4-©   1   AACoITD   189.9.9.3   HGOA

No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0009-2744      36    16   0035                              02637-835
                                         PREMISE ADDRESS
ANNE ARUNDEL COUNTY               RECREATION AREA
                                                                    PLAT REFER

                                  ODENTON MD 21113
        MAILING  ADDRESS                                          GENERAL CODES
DEPT OF REC & PARKS                   73.99 ACRES REC AREA  EXEMPT DATE CD  CL
PO BOX 1831                       CONWAY RD                                3 420
ANNAPOLIS              MD 21404   WOODWARDSVILLE                   USE CODE  E
                                                                   H O CODE
           LAND    BUILDINGS     TOTAL  PREFER LAND    CURTILAGE   OWN OCCUP  N
CUR       59,190                 59,190                            AG TRSF TX
1         44,390                 44,390                           AG DAT
2         59,190                 59,190                           REASSESSMENT
3         73,990                 73,990                           PH 09-01-2004
BASE      29,590                 29,590                            ASSR    0275
HST       44,390                 44,390                            GEO CODE   2
PREV ACCOUNT NO         PREVIOUS OWNER          TRNS NO            G F 1.000000
0000-0000-0000                                    00000            PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F
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4-©   1   AACoITD   189.9.9.3   HGOA

No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0009-3772      36    05   0004                               02715-633
                                          PREMISE ADDRESS
ANNE ARUNDEL COUNTY               RECREATION AREA
                                                                     PLAT REFER

                                  GAMBRILLS MD 21054
        MAILING  ADDRESS                                           GENERAL CODES
DEPT OF REC & PARKS               IMPS27.19 ACRES REC AREA  EXEMPT DATE CD  CL
PO BOX 1831                       OFF FRANCIS STATION RD                 3 420
ANNAPOLIS              MD 21404   ODENTON PARK                      USE CODE  EC
                                                                    H O CODE
           LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE     OWN OCCUP  N
CUR       10,800    120,600     131,400                             AG TRSF TX
1         10,800    120,600     131,400                            AG DAT
2         10,800    120,600     131,400                            REASSESSMENT
3         10,800    120,600     131,400                            PH 10-01-2004
BASE      10,800    120,600     131,400                             ASSR    0251
HST       10,800    120,600     131,400                             GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER          TRNS NO              G F 1.000000
0000-0000-0000                                   00000              PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F
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4-©   1   AACoITD   189.9.9.3   HG0A

No Query

PAGE NUMBER 1 MAP BLK PARCEL PLAT SECT BLOCK LOT DEED REFER
4000-0031-5187 36 09 0021 15743-547
PREMISE ADDRESS
ANNE ARUNDEL COUNTY PATUXENT RD
PLAT REFER
ODENTON MD 21113
MAILING ADDRESS GENERAL CODES
C/O OFFICE OF REAL EST MGT 96.923 ACRES EXEMPT DATE CD CL
2662 RIVA RD FL 4 PATUXENT RD 3 680
ANNAPOLIS MD 21401 BRAGERS STATION USE CODE E
H O CODE

	LAND	BUILDINGS	TOTAL	PREFER LAND	CURTILAGE	
						OWN OCCUP N
CUR	310,340		310,340			AG TRSF TX
1	257,540		257,540			AG DAT
2	310,340		310,340			REASSESSMENT
3	363,140		363,140			PH 09-01-2004
BASE	204,740		204,740			ASSR 0275
HST	257,540		257,540			GEO CODE 2

PREV ACCOUNT NO PREVIOUS OWNER TRNS NO G F 1.000000
4000-0031-5187 PINEY ORCHARD MASTER PTNSHP 19986 PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT F1-MENU F2-WB F3-UTIL F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP F

4-© 1 AACoITD 189.9.9.3 HGOA

No Query

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PAGE NUMBER 1          MAP   BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0150-6400      36     03   0302                              10505-423
                                          PREMISE ADDRESS
KIMM TRUSTEE, DIANA C              PATUXENT RD
                                                                     PLAT REFER
                                   ODENTON MD 21113
        MAILING  ADDRESS                                           GENERAL CODES
PO BOX 902                             29.92 ACRES           EXEMPT DATE CD  CL
                                   PATUXENT RD                                000
SEVERN                   MD 21144  ODENTON                          USE CODE  R
                                                                    H O CODE
           LAND    BUILDINGS      TOTAL  PREFER LAND   CURTILAGE    OWN OCCUP  N
CUR      189,600                 189,600                            AG TRSF TX
1        147,280                 147,280                           AG DAT
2        189,600                 189,600                           REASSESSMENT
3        231,920                 231,920                           PH 09-01-2004
BASE     104,960                 104,960                            ASSR     0275
HST      147,280                 147,280                            GEO CODE   2
PREV ACCOUNT NO         PREVIOUS OWNER          TRNS NO             G F 1.000000
4000-0150-6400   KIMM, DIANA C                    08116             PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP          F
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4-©   1   AACoITD   189.9.9.3   HGOA

No Query

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PAGE NUMBER 1         MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0150-7800     36    03   0315                               05084-268
                                        PREMISE ADDRESS
CIPRIANO, JOSEPH G               BRAGERS RD
RIGSBY, BILL J                                                      PLAT REFER
                                 ODENTON MD 21113
        MAILING  ADDRESS                                           GENERAL CODES
P O BOX 153 STONEY RUN RD            10.75 ACRES          EXEMPT DATE CD  CL
                                 BRAGERS RD                                 000
HANOVER               MD 21076   ODENTON                            USE CODE  R
                                                                    H O CODE
           LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE     OWN OCCUP  N
CUR        8,600                  8,600                             AG TRSF TX
1          6,450                  6,450                            AG DAT
2          8,600                  8,600                            REASSESSMENT
3         10,750                 10,750                            PH 09-01-2004
BASE       4,300                  4,300                             ASSR    0275
HST        6,450                  6,450                             GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER          TRNS NO              G F 1.000000
4000-0150-7800   DICK             CARTER         04217              PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F

4-©            1     AACoITD   189.9.9.3                   HGOA
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No Query

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PAGE NUMBER 1          MAP   BLK   PARCEL PLAT SECT  BLOCK      LOT    DEED REFER
   4000-0351-0350      36     10    0265                               02019-513
                                          PREMISE ADDRESS
MAIATICO ET AL, JERRY            EVERGREEN RD
                                                                       PLAT REFER

                                 ODENTON MD 21113
        MAILING  ADDRESS                                             GENERAL CODES
216 PAULA LYNN DR                    5.1115 ACS.              EXEMPT DATE CD  CL
                                 EVERGREEN RD.                                000
SILVER SPRING          MD 20904  LITTLE PATUXENT RIVER                USE CODE  C
                                                                      H O CODE
           LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE       OWN OCCUP  N
CUR       106,900                106,900                              AG TRSF TX
1          64,900                 64,900                             AG DAT
2         106,900                106,900                             REASSESSMENT
3         148,900                148,900                             PH 10-01-2004
BASE       22,900                 22,900                              ASSR    0251
HST        64,900                 64,900                              GEO CODE   2
PREV ACCOUNT NO         PREVIOUS OWNER         TRNS NO                G F 1.000000
0000-0000-0000                                   00000                PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F

4-©           1     AACoITD   189.9.9.3                    HGOA
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No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0431-2407      36    11   0196                               05122-662
                                         PREMISE ADDRESS
SOUTH SHORE DEVELOPMENT CO       EVERGREEN RD
                                                                    PLAT REFER
                                 GAMBRILLS MD 21054
        MAILING  ADDRESS                                          GENERAL CODES
1 CHURCHVIEW RD                      15 ACRES              EXEMPT DATE CD  CL
                                 EVERGREEN RD                              000
MILLERSVILLE          MD 21108   GAMBRILLS                          USE CODE  R
                                                                    H O CODE
          LAND    BUILDINGS      TOTAL  PREFER LAND   CURTILAGE     OWN OCCUP  N
CUR      156,032                156,032                             AG TRSF TX
1        118,517                118,517                            AG DAT
2        156,032                156,032                            REASSESSMENT
3        193,550                193,550                            PH 09-01-2004
BASE      81,000                 81,000                             ASSR    0275
HST      118,517                118,517                             GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER          TRNS NO              G F 1.000000
4000-0431-2407   PARKER            BARRINGTON     06007             PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F
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4-© 1 AACoITD 189.9.9.3 HGOA

No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0441-6125      36    09   0172                                06829-651
                                         PREMISE ADDRESS
ANNE ARUNDEL COUNTY MD           BRAGERS RD
                                                                      PLAT REFER

                                 ODENTON MD 21113
        MAILING  ADDRESS                                            GENERAL CODES
RIGHT OF WAY DIVISION                48.14 ACRES          EXEMPT DATE CD  CL
P O BOX 2700                     BRAGERS RD                                3 420
ANNAPOLIS              MD 21404  ACADEMY JCT TO COUNTY LI          USE CODE  EC
                                                                    H O CODE
           LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE    OWN OCCUP  N
CUR      240,700                 240,700                            AG TRSF TX
1        240,700                 240,700                           AG DAT
2        240,700                 240,700                           REASSESSMENT
3        240,700                 240,700                           PH 10-01-2004
BASE     240,700                 240,700                            ASSR    0251
HST      240,700                 240,700                            GEO CODE   2
PREV ACCOUNT NO         PREVIOUS OWNER          TRNS NO             G F 1.000000
4000-0441-6125   PEPPERCORN LAND LTD PTNSHP       12361             PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP          F
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4-© 1 AACoITD 189.9.9.3 HGOA

No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0546-5650      36    11   0292                              02650-473
                                         PREMISE ADDRESS
SMITH, EARLINE                      EVERGREEN AVE
                                                                    PLAT REFER

                                    GAMBRILLS MD 21054
        MAILING  ADDRESS                                           GENERAL CODES
C/O JOHNSON                            2.3785 ACRES          EXEMPT DATE CD  CL
6415 97TH AVE                       NE/S EVERGREEN AVE                      000
LANHAM                 MD 20706     TYLER SMITH PROP                 USE CODE  R
                                                                     H O CODE
           LAND    BUILDINGS      TOTAL  PREFER LAND   CURTILAGE     OWN OCCUP  N
CUR       40,840                  40,840                             AG TRSF TX
1         25,770                  25,770                            AG DAT
2         40,840                  40,840                            REASSESSMENT
3         55,910                  55,910                            PH 09-01-2004
BASE      10,700                  10,700                             ASSR    0275
HST       25,770                  25,770                             GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER          TRNS NO               G F 1.000000
0000-0000-0000                                   00000               PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F
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4-©   1   AACoITD   189.9.9.3   HGOA

No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0554-7700      36    10   0237                              01608-151
                                          PREMISE ADDRESS
SOUTH SHORES DEVLPMT CO INC        EVERGREEN RD
                                                                    PLAT REFER

                                   ODENTON MD 21113
        MAILING  ADDRESS                                          GENERAL CODES
C/O THOMAS BALDWIN                     16 ACRES              EXEMPT DATE CD  CL
1 CHURCHVIEW RD                    EVERGREEN RD                             000
MILLERSVILLE           MD 21108    ODENTON                         USE CODE  R
                                                                   H O CODE
           LAND    BUILDINGS      TOTAL  PREFER LAND   CURTILAGE   OWN OCCUP  N
CUR      131,332                 131,332                           AG TRSF TX
1        112,167                 112,167                          AG DAT
2        131,332                 131,332                          REASSESSMENT
3        150,500                 150,500                          PH 09-01-2004
BASE      93,000                  93,000                           ASSR    0275
HST      112,167                 112,167                           GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER          TRNS NO             G F 1.000000
0000-0000-0000                                   00000             PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP          F

4-©             1     AACoITD   189.9.9.3                  HG0A
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No Query

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PAGE NUMBER 1           MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0587-3400       36    12   0219                              01739-276
                                          PREMISE ADDRESS
TOWSER DEVELOPERS INC              WAUGH CHAPEL RD
                                                                     PLAT REFER
                                   GAMBRILLS MD 21054                00232-028
        MAILING  ADDRESS                                           GENERAL CODES
1 CHURCH VIEW RD                   IMPSPAR 219 OR 19.38 AC   EXEMPT DATE CD  CL
                                   OFF WAUGH CHAPEL RD                      000
MILLERSVILLE            MD 21108   WACH LLC ARC BALT SCH IN          USE CODE  I
                                                                     H O CODE
           LAND    BUILDINGS      TOTAL  PREFER LAND   CURTILAGE     OWN OCCUP  N
CUR      608,900      8,866      617,766                             AG TRSF TX
1        480,600      8,633      489,233                            AG DAT
2        608,900      8,866      617,766                            REASSESSMENT
3        737,200      9,100      746,300                            PH 10-01-2004
BASE     352,300      8,400      360,700                             ASSR    0251
HST      480,600      8,633      489,233                             GEO CODE    2
PREV ACCOUNT NO         PREVIOUS OWNER          TRNS NO              G F 1.000000
0000-0000-0000                                    00000              PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP          F

4-©            1    AACoITD   189.9.9.3                  HG0A
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No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0588-0800      36    11   0158                              01313-554
                                          PREMISE ADDRESS
TOWSER DEVELOPERS INC             CRAIN HWY
                                                                    PLAT REFER
                                  MILLERSVILLE MD 21108             00232-028
        MAILING  ADDRESS                                          GENERAL CODES
1 CHURCH VIEW RD                  IMPSPT PAR 158 OR 93.31A  EXEMPT DATE CD  CL
                                  CRAIN HWY                                000
MILLERSVILLE           MD 21108   WACH LLC ARC BALTO SC IN         USE CODE  I
                                                                   H O CODE
           LAND     BUILDINGS     TOTAL  PREFER LAND   CURTILAGE   OWN OCCUP  N
CUR     1,843,500      102,266   1,945,766                         AG TRSF TX
1       1,820,100      101,133   1,921,233                        AG DAT
2       1,843,500      102,266   1,945,766                        REASSESSMENT
3       1,866,900      103,400   1,970,300                        PH 10-01-2004
BASE    1,796,700      100,000   1,896,700                         ASSR     0251
HST     1,820,100      101,133   1,921,233                         GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER          TRNS NO             G F 1.000000
0000-0000-0000                                   00000             PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F
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4-© 1 AACoITD 189.9.9.3 HGOA

No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0588-0900      36    12   0220                              01739-281
                                         PREMISE ADDRESS
TOWSER DEVELOPERS INC              BRICKHEAD RD
                                                                    PLAT REFER
                                   GAMBRILLS MD 21054               00232-028
        MAILING  ADDRESS                                          GENERAL CODES
1 CHURCHVIEW RD                    IMPS23.462ACS PT PAR 220  EXEMPT DATE CD  CL
                                   BRICKHEAD RD                             000
MILLERSVILLE           MD 21108    WACH LLC ARC BALT SC INC        USE CODE  R
                                                                   H O CODE
           LAND    BUILDINGS      TOTAL  PREFER LAND   CURTILAGE   OWN OCCUP  N
CUR      204,156     96,344      300,500                           AG TRSF TX
1        163,823     93,907      257,730                          AG DAT
2        204,156     96,344      300,500                          REASSESSMENT
3        244,490     98,780      343,270                          PH 09-01-2004
BASE     123,490     91,470      214,960                           ASSR    0275
HST      163,823     93,907      257,730                           GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER          TRNS NO             G F 1.000000
0000-0000-0000                                   00000             PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F

4-©          1    AACoITD   189.9.9.3                    HGOA
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No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK      LOT     DEED REFER
   4000-0609-2800      36    11   0232                                11636-039
                                          PREMISE ADDRESS
SHUNNEY, PATRICIA                  EVERGREEN RD
                                                                      PLAT REFER

                                   ODENTON MD 21113
        MAILING  ADDRESS                                            GENERAL CODES
2419 BLOOMING WAY                      1.3 ACRES               EXEMPT DATE CD  CL
                                   EVERGREEN RD                                 000
GAMBRILLS              MD 21054    ODENTON                           USE CODE  R
                                                                     H O CODE
           LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE      OWN OCCUP  N
CUR       10,000                10,000                               AG TRSF TX
1         10,000                10,000                              AG DAT
2         10,000                10,000                              REASSESSMENT
3         10,000                10,000                              PH 09-01-2004
BASE      12,500                12,500                               ASSR    0275
HST       10,000                10,000                               GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER           TRNS NO              G F 1.000000
4000-0609-2800   WASHINGTON, HATTIE               09547              PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP          F
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4-©   1   AACoITD   189.9.9.3   HGOA

No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0639-1100      36    12   0222                              04998-395
                                          PREMISE ADDRESS
B B S S INC                        BRICKHEAD RD
                                                                    PLAT REFER
                                   GAMBRILLS MD 21054
        MAILING  ADDRESS                                          GENERAL CODES
1 CHURCHVIEW RD                        4.5732 ACRES         EXEMPT DATE CD  CL
                                   BRICKHEAD RD                             000
MILLERSVILLE           MD 21108    GAMBRILLS                       USE CODE  R
                                                                   H O CODE
           LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE    OWN OCCUP  N
CUR        3,136                 3,136                             AG TRSF TX
1          1,703                 1,703                            AG DAT
2          3,136                 3,136                            REASSESSMENT
3          4,570                 4,570                            PH 09-01-2004
BASE         270                   270                             ASSR    0275
HST        1,703                 1,703                             GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER          TRNS NO             G F 1.000000
4000-0639-1100   B B S INVESTORS                 13314             PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F
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4-©   1   AACoITD   189.9.9.3   HGOA

No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-9005-1052      36    07   0241                              00726-331
                                           PREMISE ADDRESS
NATIONAL WASTE MANAGERS INC       PATUXENT RD
                                                                    PLAT REFER
                                  ODENTON MD 21113
        MAILING  ADDRESS                                           GENERAL CODES
2900 LINDEN LN STE 300                325.64 ACRES          EXEMPT DATE CD  CL
                                  PATUXENT RD                                000
SILVER SPRING          MD 20910   ODENTON                           USE CODE  R
                                                                    H O CODE
           LAND    BUILDINGS      TOTAL  PREFER LAND   CURTILAGE    OWN OCCUP  N
CUR      260,510                 260,510                            AG TRSF TX
1        195,380                 195,380                           AG DAT
2        260,510                 260,510                           REASSESSMENT
3        325,640                 325,640                           PH 09-01-2004
BASE     130,250                 130,250                            ASSR    0275
HST      195,380                 195,380                            GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER          TRNS NO              G F 1.000000
4000-9005-1052                                   08872              PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP          F
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4-©   1   AACoITD   189.9.9.3   HGOA

No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-9005-1053      36    09   0310                              10505-423
                                          PREMISE ADDRESS
KIMM TRUSTEE, DIANA C              PATUXENT RD
                                                                    PLAT REFER

                                   ODENTON MD 21113
        MAILING  ADDRESS                                           GENERAL CODES
PO BOX 902                             3 ACRES              EXEMPT DATE CD  CL
                                   PATUXENT RD                             000
SEVERN                 MD 21144    ODENTON                          USE CODE  R
                                                                    H O CODE
          LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE      OWN OCCUP  N
CUR       2,400                 2,400                               AG TRSF TX
1         1,800                 1,800                              AG DAT
2         2,400                 2,400                              REASSESSMENT
3         3,000                 3,000                              PH 09-01-2004
BASE      1,200                 1,200                               ASSR    0275
HST       1,800                 1,800                               GEO CODE   2
PREV ACCOUNT NO         PREVIOUS OWNER          TRNS NO             G F 1.000000
4000-9005-1053   KIMM, DIANA C                    08116             PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP          F

4-©            1     AACoITD    189.9.9.3                    HGOA
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No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-9007-3873      36    09   0022                              15782-560
                                         PREMISE ADDRESS
PAX LLC                            FLOOD PLAINS
                                                                    PLAT REFER
                                   GAMBRILLS MD 21054               00134-044
        MAILING  ADDRESS                                          GENERAL CODES
508 GREENWOOD RD                       14.224 ACRES          EXEMPT DATE CD  CL
                                   FLOOD PLAINS                             000
TOWSON                      MD 21204    G & H PTNSHP PROPERTIES      USE CODE  I
                                                                   H O CODE
           LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE    OWN OCCUP  N
CUR        6,600                  6,600                            AG TRSF TX
1          6,100                  6,100                           AG DAT
2          6,600                  6,600                           REASSESSMENT
3          7,100                  7,100                           PH 10-01-2004
BASE       5,600                  5,600                            ASSR    0251
HST        6,100                  6,100                            GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER         TRNS NO              G F 1.000000
4000-9007-3873   CROFTON VENTURES LTD PTNSHP     20265             PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP          F
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4-©   1   AACoITD   189.9.9.3   HG0A

No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-9009-8835      36    11   0072                              08118-001
                                           PREMISE ADDRESS
B.B.S.S., INC.,                     EVERGREEN AVE
                                                                    PLAT REFER

                                    ODENTON MD 21113
        MAILING  ADDRESS                                           GENERAL CODES
1 CHURCH VIEW RD                        4.875 ACS            EXEMPT DATE CD  CL
                                    EVERGREEN AVE                             000
MILLERSVILLE           MD 21108     LANDWEHRS TRACT                 USE CODE  R
                                                                    H O CODE
           LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE     OWN OCCUP  N
CUR        69,576               69,576                              AG TRSF TX
1          63,743               63,743                             AG DAT
2          69,576               69,576                             REASSESSMENT
3          75,410               75,410                             PH 09-01-2004
BASE       57,910               57,910                              ASSR    0275
HST        63,743               63,743                              GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER          TRNS NO              G F 1.000000
4000-0277-5900                                   00000              PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP        F
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4-© 1 AACoITD 189.9.9.3 HGOA

No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-9021-2056      36    11   0220                              09327-143
                                          PREMISE ADDRESS
WACH LLC                            CRAIN HWY
                                                                    PLAT REFER
                                    MILLERSVILLE MD 21108           00232-028
        MAILING  ADDRESS                                          GENERAL CODES
1 CHURCHVIEW RD                         10.998ACS PT PAR 220  EXEMPT DATE CD  CL
                                    CRAIN HWY                                000
MILLERSVILLE           MD 21108     WACH LLC ARC BALT SC INC         USE CODE  R
                                                                     H O CODE
          LAND    BUILDINGS        TOTAL  PREFER LAND   CURTILAGE    OWN OCCUP  N
CUR       185,096                 185,096                            AG TRSF TX
1         151,763                 151,763                           AG DAT
2         185,096                 185,096                           REASSESSMENT
3         218,430                 218,430                           PH 09-01-2004
BASE      118,430                 118,430                            ASSR    0275
HST       151,763                 151,763                            GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER          TRNS NO               G F 1.000000
4000-9000-8964                                   00000               PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP          F

4-©            1     AACoITD    189.9.9.3                   HGOA
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No Query

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PAGE NUMBER 1          MAP   BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4571-9009-7504      29     15   0319                               08339-481
                                          PREMISE ADDRESS
ANNE ARUNDEL CO                    SWEETFLAG WAY
                                                                      PLAT REFER
                                   ODENTON MD 21113                   00195-035
        MAILING  ADDRESS                                            GENERAL CODES
C/O OFFICE OF REAL EST MGT             142.937 ACRES PH 3    EXEMPT DATE CD  CL
2662 RIVA RD 4TH FL                FLOOD PLAIN                            3 501
ANNAPOLIS               MD 21401   PINEY ORCHARD                     USE CODE  E
                                                                     H O CODE
           LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE      OWN OCCUP  N
CUR                                                                  AG TRSF TX
1                                                                   AG DAT
2                                                                   REASSESSMENT
3                                                                   PH 10-01-2004
BASE                                                                 ASSR    0235
HST                                                                  GEO CODE   2
PREV ACCOUNT NO         PREVIOUS OWNER          TRNS NO              G F 1.000000
4571-9009-7504   PINEY ORCHARD MASTER PTNSHP      02533              PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F

4-©            1     AACoITD    189.9.9.3                    HGOA
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No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4571-9009-7505      29    15   0319                              04556-285
                                         PREMISE ADDRESS            04771-859
PINEY ORCHARD MASTER PTNSHP        SWEETFLAG WAY
                                                                    PLAT REFER
                                   ODENTON MD 21113                 00195-035
        MAILING  ADDRESS                                          GENERAL CODES
C/O CONSTELLATION REAL EST INC         163.099 ACRES PH 3    EXEMPT DATE CD  CL
8815 CENTRE PARK DR STE 400        REC AREA                                 000
COLUMBIA               MD 21045    PINEY ORCHARD                   USE CODE  R
                                                                   H O CODE
           LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE    OWN OCCUP  N
CUR                                                                AG TRSF TX
1                                                                 AG DAT
2                                                                 REASSESSMENT
3                                                                 PH 10-01-2004
BASE                                                               ASSR     0235
HST                                                                GEO CODE   2
PREV ACCOUNT NO         PREVIOUS OWNER          TRNS NO            G F 1.000000
0000-0000-0000                                    00000            PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F
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4-©   1   AACoITD   189.9.9.3   HG0A

No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4571-9009-7506      29    15   0319                               04556-285
                                          PREMISE ADDRESS            04771-859
PINEY ORCHARD MASTER PTNSHP      SWEETFLAG WAY
                                                                     PLAT REFER
                                 ODENTON MD 21113                    00195-035
        MAILING  ADDRESS                                           GENERAL CODES
C/O CONSTELLATION REAL EST INC       6.372 ACRES PH 3      EXEMPT DATE CD  CL
8815 CENTRE PARK DR STE 400      SWM                                       000
COLUMBIA              MD 21045   PINEY ORCHARD                      USE CODE  R
                                                                    H O CODE
          LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE      OWN OCCUP  N
CUR                                                                 AG TRSF TX
1                                                                  AG DAT
2                                                                  REASSESSMENT
3                                                                  PH 10-01-2004
BASE                                                                ASSR    0235
HST                                                                 GEO CODE   2
PREV ACCOUNT NO         PREVIOUS OWNER          TRNS NO             G F 1.000000
0000-0000-0000                                    00000             PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP        F

4-©           1     AACoITD   189.9.9.3                  HGOA
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No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0238-0750      36    11   0185                        3     06788-244
                                          PREMISE ADDRESS
BBSS INC                            512 EVERGREEN RD
                                                                    PLAT REFER
                                    GAMBRILLS MD 21054              00011-004
        MAILING  ADDRESS                                          GENERAL CODES
1 CHURCHVIEW RD                         N HLF LT 3 OR4.33ACS  EXEMPT DATE CD  CL
                                    512 EVERGREEN RD                          000
MILLERSVILLE           MD 21108     LANDWEHR TRACT                   USE CODE  R
                                                                     H O CODE
           LAND    BUILDINGS      TOTAL  PREFER LAND   CURTILAGE     OWN OCCUP  N
CUR       115,480                115,480                             AG TRSF TX
1          85,480                 85,480                            AG DAT
2         115,480                115,480                            REASSESSMENT
3         145,480                145,480                            PH 09-01-2004
BASE       55,480                 55,480                             ASSR    0275
HST        85,480                 85,480                             GEO CODE   2
PREV ACCOUNT NO         PREVIOUS OWNER          TRNS NO              G F 1.000000
4000-0238-0750   JERMAN, RAYMOND M JR             10788              PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F
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4-©   1   AACoITD   189.9.9.3   HGOA

No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0370-0500      36    17   0046                        18    06341-387
                                          PREMISE ADDRESS
CARSON JR, JAMES M                  2609 EVERGREEN RD
                                                                    PLAT REFER

                                    ODENTON MD 21113
        MAILING  ADDRESS                                          GENERAL CODES
2609 EVERGREEN RD                   IMPSLT 18 OR 8.993 ACRES  EXEMPT DATE CD  CL
                                    2609 EVERGREEN RD                         000
ODENTON                 MD 21113    LANDWEHRS TRACT                USE CODE  R
                                                                   H 0 CODE
           LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE    OWN OCCUP  H
CUR      158,116     154,990    313,106                  313,106   AG TRSF TX
1        124,783     145,510    270,293                  270,293 AG DAT
2        158,116     154,990    313,106                  313,106 REASSESSMENT
3        191,450     164,470    355,920                  355,920 PH 09-01-2004
BASE      91,450     136,030    227,480                  227,480   ASSR     0275
HST      124,783     145,510    270,293                  270,293   GEO CODE   2
PREV ACCOUNT NO         PREVIOUS OWNER          TRNS NO            G F 1.000000
4000-0370-0500   CARSON, JAMES H SR               13066            PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F
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4-©   1   AACoITD   189.9.9.3   HGOA

No Query

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PAGE NUMBER 1          MAP   BLK  PARCEL PLAT SECT  BLOCK      LOT    DEED REFER
   4000-0062-4100      36     17   0045                         17    09199-284
                                           PREMISE ADDRESS
RONAN, KATHLEEN R                   2613 EVERGREEN RD
RONAN III, FRANK J                                                    PLAT REFER
                                    ODENTON MD 21113                  00011-004
        MAILING  ADDRESS                                            GENERAL CODES
2613 EVERGREEN RD                   IMPSHLF LT 17 OR 4.195AC  EXEMPT DATE CD  CL
                                    2613 EVERGREEN RD                         000
ODENTON                MD 21113     LANDWEHRS TRACT                    USE CODE  R
                                                                       H O CODE
           LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE    OWN OCCUP  H
CUR       136,516    121,184     257,700                  257,700  AG TRSF TX
1         103,183    114,317     217,500                  217,500 AG DAT
2         136,516    121,184     257,700                  257,700 REASSESSMENT
3         169,850    128,050     297,900                  297,900 PH 09-01-2004
BASE       69,850    107,450     177,300                  177,300  ASSR     0275
HST       103,183    114,317     217,500                  217,500  GEO CODE   2
PREV ACCOUNT NO         PREVIOUS OWNER         TRNS NO             G F 1.000000
4000-0062-4100    PAULEY, WILLIS J               05554             PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP        F
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4-©   1   AACoITD   189.9.9.3   HGOA

No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
  4000-0635-2700       36    11   0058                         5    04998-395
                                         PREMISE ADDRESS
B B S S INC                         2628 EVERGREEN RD
                                                                    PLAT REFER
                                    GAMBRILLS MD 21054              00011-004
        MAILING  ADDRESS                                          GENERAL CODES
1 CHURCHVIEW RD                         LT 5 OR 10.07 ACRES  EXEMPT DATE CD  CL
                                    2628 EVERGREEN RD                       000
MILLERSVILLE           MD 21108     LANDWEHRS TRACT                  USE CODE  R
                                                                     H O CODE
           LAND    BUILDINGS      TOTAL  PREFER LAND   CURTILAGE     OWN OCCUP  N
CUR       146,310                146,310                             AG TRSF TX
1         121,310                121,310                            AG DAT
2         146,310                146,310                            REASSESSMENT
3         171,310                171,310                            PH 09-01-2004
BASE       96,310                 96,310                             ASSR    0275
HST       121,310                121,310                             GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER            TRNS NO             G F 1.000000
4000-0635-2700   B B & S INVESTORS                 13314             PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F

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PAGE NUMBER 1           MAP   BLK   PARCEL PLAT SECT   BLOCK      LOT     DEED REFER
   4000-0000-4680       36     11    0267                          11     16418-709
                                            PREMISE ADDRESS
COATES, PATTRINA H                    2663 EVERGREEN RD
                                                                          PLAT REFER
                                      ODENTON MD 21113
        MAILING  ADDRESS                                               GENERAL CODES
540 RETREAT CT APT G                      PT LT 11 OR 1 ACRE       EXEMPT DATE CD  CL
                                      2663 EVERGREEN RD                            000
ODENTON                  MD 21113     LANDWEHRS TRACT                   USE CODE  R
                                                                        H O CODE
          LAND     BUILDINGS      TOTAL  PREFER LAND    CURTILAGE       OWN OCCUP   N
CUR      84,334                  84,334                                 AG TRSF TX
1        58,167                  58,167                                AG DAT
2        84,334                  84,334                                REASSESSMENT
3       110,500                 110,500                                PH 09-01-2004
BASE     32,000                  32,000                                 ASSR     0275
HST      58,167                  58,167                                 GEO CODE   2
PREV ACCOUNT NO         PREVIOUS OWNER          TRNS NO                 G F 1.000000
4000-0000-4680   ABNEY, MOZELLA                   03473                 PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP          F

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No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0629-1750      36    11   0214                        11    05128-155
                                          PREMISE ADDRESS
WEHUNT, KATHRYN M                  2669 EVERGREEN RD
                                                                    PLAT REFER

                                   ODENTON MD 21113
        MAILING  ADDRESS                                           GENERAL CODES
2669 EVERGREEN RD                  IMPSPT LT 11 OR 1.03 ACS  EXEMPT DATE CD  CL
                                   2669 EVERGREEN RD                        000
ODENTON                MD 21113    LANDWEHRS TRACT                  USE CODE  R
                                                                    H O CODE
           LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE     OWN OCCUP  H
CUR      116,966    109,906     226,872                  226,872    AG TRSF TX
1         83,633     94,413     178,046                  178,046 AG DAT
2        116,966    109,906     226,872                  226,872 REASSESSMENT
3        150,300    125,400     275,700                  275,700 PH 09-01-2004
BASE      50,300     78,920     129,220                  129,220    ASSR    0275
HST       83,633     94,413     178,046                  178,046    GEO CODE   2
PREV ACCOUNT NO         PREVIOUS OWNER          TRNS NO             G F 1.000000
4000-0629-1750   BOLLER          JR JAMES          06504            PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP          F

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No Query

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PAGE NUMBER 1         MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0443-5900     36    11   0216                       12     03160-778
                                          PREMISE ADDRESS
PINCKNEY, JIMMIE L               2671 EVERGREEN RD
PINCKNEY, IRVIN                                                    PLAT REFER
                                 ODENTON MD 21113
        MAILING  ADDRESS                                          GENERAL CODES
C/O ERVIN PINCKNEY               IMPSPT LT 12 OR 1 ACRE     EXEMPT DATE CD  CL
2671 EVERGREEN RD                2671 EVERGREEN RD                          000
ODENTON               MD 21113   LANDWEHRS TRACT                   USE CODE  R
                                                                   H O CODE
           LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE    OWN OCCUP  H
CUR      116,666     58,026     174,692                   174,692  AG TRSF TX
1         83,333     54,213     137,546                   137,546 AG DAT
2        116,666     58,026     174,692                   174,692 REASSESSMENT
3        150,000     61,840     211,840                   211,840 PH 09-01-2004
BASE      50,000     50,400     100,400                   100,400  ASSR    0275
HST       83,333     54,213     137,546                   137,546  GEO CODE   2
PREV ACCOUNT NO       PREVIOUS OWNER         TRNS NO               G F 1.000000
0000-0000-0000                                 00000               PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F
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4-©   1   AACoITD   189.9.9.3   HGOA

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-9007-3871      36    09   0022                         1    15782-560
                                          PREMISE ADDRESS
PAX LLC                             1177 PATUXENT RD
                                                                    PLAT REFER
                                    GAMBRILLS MD 21054              00134-044
        MAILING  ADDRESS                                           GENERAL CODES
508 GREENWOOD RD                        LT 1 OR 21.292 ACRES  EXEMPT DATE CD  CL
                                    1177 PATUXENT RD                         000
TOWSON                 MD 21204     G & H PTNSHP PROPERTIES          USE CODE  I
                                                                     H 0 CODE
          LAND    BUILDINGS      TOTAL  PREFER LAND   CURTILAGE      OWN OCCUP  N
CUR      529,700                529,700                              AG TRSF TX
1        529,700                529,700                             AG DAT
2        529,700                529,700                             REASSESSMENT
3        529,700                529,700                             PH 10-01-2004
BASE     540,200                540,200                              ASSR    0251
HST      529,700                529,700                              GEO CODE   2
PREV ACCOUNT NO         PREVIOUS OWNER          TRNS NO              G F 1.000000
4000-9007-3871   CROFTON VENTURES LTD PTNSHP      20265              PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP           F

4-©            1     AACoITD   189.9.9.3                   HG0A
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PAGE NUMBER 1           MAP   BLK  PARCEL PLAT SECT  BLOCK      LOT    DEED REFER
   4000-9007-3872       36     09   0022                          2    07667-370
                                           PREMISE ADDRESS
REDLAND GENSTAR, INC.,              1187 PATUXENT RD
                                                                       PLAT REFER
                                    GAMBRILLS MD 21054                 00134-044
        MAILING  ADDRESS                                             GENERAL CODES
ATTN JOHN CASEY                     IMPSPT LT 2 OR 19.624 AC  EXEMPT DATE CD  CL
300 E JOPPA RD STE 200              1187 PATUXENT RD                          000
TOWSON                  MD 21286    G & H PTNSHP PROPERTIES           USE CODE  I
                                                                      H O CODE
            LAND     BUILDINGS     TOTAL  PREFER LAND   CURTILAGE     OWN OCCUP  N
CUR        808,500     236,900   1,045,400                            AG TRSF TX
1          808,500     236,900   1,045,400                           AG DAT
2          808,500     236,900   1,045,400                           REASSESSMENT
3          808,500     236,900   1,045,400                           PH 10-01-2004
BASE     1,124,100     225,900   1,350,000                            ASSR    0265
HST        808,500     236,900   1,045,400                            GEO CODE   2
PREV ACCOUNT NO          PREVIOUS OWNER          TRNS NO              G F 1.000000
4000-9007-3872   PATUXENT ROAD LTD PTNSHP          11909              PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP           F

4-©             1      AACoITD    189.9.9.3                   HGOA
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PAGE NUMBER 1          MAP   BLK   PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0084-8375      36     11    0268                        11    11591-569
                                              PREMISE ADDRESS
SHUNNAY, PATTY                       EVERGREEN AVE
                                                                      PLAT REFER

                                     ODENTON MD 21113
        MAILING  ADDRESS                                            GENERAL CODES
2419 BLOOMING WAY                        PT LT 11 OR 1 ACRE    EXEMPT DATE CD  CL
                                     EVERGREEN AVE                              000
GAMBRILLS              MD 21054      LANDWEHRS TRACT                 USE CODE  R
                                                                     H O CODE
           LAND    BUILDINGS      TOTAL  PREFER LAND   CURTILAGE     OWN OCCUP  N
CUR        9,000                  9,000                              AG TRSF TX
1          9,000                  9,000                             AG DAT
2          9,000                  9,000                             REASSESSMENT
3          9,000                  9,000                             PH 09-01-2004
BASE      32,000                 32,000                              ASSR    0275
HST        9,000                  9,000                              GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER          TRNS NO               G F 1.000000
4000-0084-8375   WEST JR TRUSTEE, MASON          08582               PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP        F
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4-© 1 AACoITD 189.9.9.3 HGOA

No Query

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PAGE NUMBER 1          MAP   BLK   PARCEL PLAT SECT  BLOCK      LOT    DEED REFER
   4000-0123-1565      36    11    0148                          3     05948-092
                                           PREMISE ADDRESS
B B S S, INC                         EVERGREEN AVE
                                                                       PLAT REFER
                                     ODENTON MD 21113
        MAILING  ADDRESS                                              GENERAL CODES
1 CHURCHVIEW RD                          S HLF LT 3 4.50        EXEMPT DATE CD  CL
                                     ACRES EVERGREEN AVE                         000
MILLERSVILLE           MD 21108      LANDWEHR TRACT                    USE CODE  R
                                                                       H O CODE
           LAND    BUILDINGS        TOTAL  PREFER LAND   CURTILAGE     OWN OCCUP  N
CUR      116,250                  116,250                              AG TRSF TX
1         86,250                   86,250                             AG DAT
2        116,250                  116,250                             REASSESSMENT
3        146,250                  146,250                             PH 09-01-2004
BASE      56,250                   56,250                              ASSR    0275
HST       86,250                   86,250                              GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER           TRNS NO                G F 1.000000
4000-0123-1565   COOPER, ALAN I                   01627                PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP          F

4-©            1     AACoITD    189.9.9.3                     HGOA
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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0206-7810      36    11   0296                        4     05213-860
                                         PREMISE ADDRESS
GARLAND, MARY B                   EVERGREEN RD
LEWIS, KEVIN A                                                      PLAT REFER
                                  GAMBRILLS MD 21054
        MAILING  ADDRESS                                          GENERAL CODES
5113 WHITFIELD CHAPEL RD              LT 4 OR 1.7880 ACRES  EXEMPT DATE CD  CL
                                  EVERGREEN RD                              000
LANHAM                 MD 20706   GAMBRILLS                          USE CODE  R
                                                                     H O CODE
           LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE      OWN OCCUP  N
CUR       39,466                39,466                               AG TRSF TX
1         29,883                29,883                              AG DAT
2         39,466                39,466                              REASSESSMENT
3         49,050                49,050                              PH 09-01-2004
BASE      20,300                20,300                               ASSR    0275
HST       29,883                29,883                               GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER          TRNS NO               G F 1.000000
4000-0206-7810   GARLAND             MARY          10811             PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F
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4-©   1   AACoITD   189.9.9.3   HGOA

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK      LOT    DEED REFER
   4000-0218-0450      36    11   0251                         11    11105-620
                                          PREMISE ADDRESS
COATES, PATTRINA H                 EVERGREEN RD
                                                                     PLAT REFER

                                   GAMBRILLS MD 21054
        MAILING  ADDRESS                                           GENERAL CODES
540 RETREAT CT                         PT LT 11 OR 1 ACRE     EXEMPT DATE CD  CL
APT G                              EVERGREEN RD                              000
ODENTON                MD 21113    LANDWEHRS TRACT                  USE CODE  R
                                                                    H O CODE
           LAND    BUILDINGS      TOTAL  PREFER LAND   CURTILAGE    OWN OCCUP  N
CUR       10,000                 10,000                             AG TRSF TX
1         10,000                 10,000                            AG DAT
2         10,000                 10,000                            REASSESSMENT
3         10,000                 10,000                            PH 09-01-2004
BASE      10,000                 10,000                             ASSR    0275
HST       10,000                 10,000                             GEO CODE   2
PREV ACCOUNT NO         PREVIOUS OWNER          TRNS NO             G F 1.000000
4000-0218-0450   DAVIS, KARYN N                   00416             PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F
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4-©   1   AACoITD   189.9.9.3   HGOA

No Query

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PAGE NUMBER 1           MAP  BLK  PARCEL PLAT SECT  BLOCK      LOT    DEED REFER
   4000-0271-4655       36    11   0218                         11    12518-445
                                         PREMISE ADDRESS
COATES, TIMOTHY M                  EVERGREEN AVE
                                                                      PLAT REFER
                                   ODENTON MD 21113
        MAILING  ADDRESS                                            GENERAL CODES
2667 EVERGREEN RD                      PT LT 11 OR 1 ACRE    EXEMPT DATE CD  CL
                                   EVERGREEN AVE                              000
ODENTON                 MD 21113   LANDWEHRS TRACT                   USE CODE  R
                                                                     H O CODE
             LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE    OWN OCCUP  N
CUR         31,666                 31,666                            AG TRSF TX
1           22,083                 22,083                           AG DAT
2           31,666                 31,666                           REASSESSMENT
3           41,250                 41,250                           PH 09-01-2004
BASE        12,500                 12,500                            ASSR    0275
HST         22,083                 22,083                            GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER         TRNS NO               G F 1.000000
4000-0271-4655   DUDLEY, MARIA                  01233                PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP        F
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4-©   1   AACoITD   189.9.9.3   HGOA

No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK      LOT    DEED REFER
   4000-0285-5550      36    11   0294                          2    16960-197
                                        PREMISE ADDRESS
ARUNDEL HABITAT FOR HUMANITY I    EVERGREEN RD
                                                                     PLAT REFER
                                  GAMBRILLS MD 21054
        MAILING  ADDRESS                                           GENERAL CODES
273 PENINSULA FARM RD STE D           LT 2 OR 1.7879 ACRES  EXEMPT DATE CD · CL
                                  EVERGREEN RD                               000
ARNOLD                 MD 21012   GAMBRILLS                         USE CODE  R
                                                                    H 0 CODE
           LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE    OWN OCCUP  N
CUR       39,466                 39,466                             AG TRSF TX
1         29,883                 29,883                            AG DAT
2         39,466                 39,466                            REASSESSMENT
3         49,050                 49,050                            PH 09-01-2004
BASE      20,300                 20,300                             ASSR    0275
HST       29,883                 29,883                             GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER         TRNS NO              G F 1.000000
4000-0285-5550   JOHNSON, DORIS E                14822              PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F

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No Query

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PAGE NUMBER 1          MAP   BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0435-4100      36     11   0247                         8    04998-395
                                            PREMISE ADDRESS
B B S S INC                          EVERGREEN RD
                                                                     PLAT REFER

                                     GAMBRILLS MD 21054
        MAILING  ADDRESS                                           GENERAL CODES
1 CHURCHVIEW RD                          PT LT 8 OR 4.90 ACS   EXEMPT DATE CD  CL
                                     EVERGREEN RD                             000
MILLERSVILLE          MD 21108       LANDWEHRS TRACT                USE CODE  R
                                                                    H O CODE
           LAND    BUILDINGS      TOTAL  PREFER LAND   CURTILAGE    OWN OCCUP  N
CUR       62,216                 62,216                             AG TRSF TX
1         48,883                 48,883                            AG DAT
2         62,216                 62,216                            REASSESSMENT
3         75,550                 75,550                            PH 09-01-2004
BASE      35,550                 35,550                             ASSR    0275
HST       48,883                 48,883                             GEO CODE   2
PREV ACCOUNT NO         PREVIOUS OWNER         TRNS NO              G F 1.000000
4000-0435-4100   PATTON            JOHN           13314             PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F
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4-©   1   AACoITD   189.9.9.3   HG0A

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0439-4093      36    11   0290                         2    05201-522
                                         PREMISE ADDRESS
SOUTH SHORE DEVELOPMENT CO         EVERGREEN RD
                                                                    PLAT REFER

                                   GAMBRILLS MD 21054
        MAILING  ADDRESS                                          GENERAL CODES
1 CHURCHVIEW RD                        LT 2 OR 2.5939 ACRES  EXEMPT DATE CD  CL
                                   EVERGREEN RD                             000
MILLERSVILLE          MD 21108     GAMBRILLS                       USE CODE  R
                                                                   H O CODE
           LAND    BUILDINGS      TOTAL  PREFER LAND   CURTILAGE   OWN OCCUP  N
CUR        51,816                  51,816                          AG TRSF TX
1          38,483                  38,483                         AG DAT
2          51,816                  51,816                         REASSESSMENT
3          65,150                  65,150                         PH 09-01-2004
BASE       25,150                  25,150                          ASSR    0275
HST        38,483                  38,483                          GEO CODE   2
PREV ACCOUNT NO         PREVIOUS OWNER          TRNS NO            G F 1.000000
4000-0439-4093    PETTUS             GORDON         10286          PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F

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No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0488-1705      36    11   0291                         3    15350-741
                                            PREMISE ADDRESS
LANDBANK LLC                        EVERGREEN RD
                                                                    PLAT REFER

                                    GAMBRILLS MD 21054
        MAILING  ADDRESS                                           GENERAL CODES
1 CHURCHVIEW RD                         LT 3 OR 2.5939 ACRES  EXEMPT DATE CD  CL
                                    EVERGREEN RD                               000
MILLERSVILLE           MD 21108     WAUGH CHAPEL                    USE CODE  R
                                                                    H O CODE
           LAND    BUILDINGS      TOTAL  PREFER LAND   CURTILAGE    OWN OCCUP  N
CUR       51,816                  51,816                            AG TRSF TX
1         38,483                  38,483                           AG DAT
2         51,816                  51,816                           REASSESSMENT
3         65,150                  65,150                           PH 09-01-2004
BASE      25,150                  25,150                            ASSR    0275
HST       38,483                  38,483                            GEO CODE   2
PREV ACCOUNT NO         PREVIOUS OWNER         TRNS NO              G F 1.000000
4000-0488-1705   ROUNDTREE, RICHMAN              14279              PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP          F

4-©             1      AACoITD   189.9.9.3                   HGOA
```

No Query

```
PAGE NUMBER 1           MAP  BLK  PARCEL PLAT SECT  BLOCK      LOT    DEED REFER
   4000-0545-4950       36    11   0298                          6    02112-393
                                          PREMISE ADDRESS
SMITH, EARLINE                     EVERGREEN AVE
                                                                      PLAT REFER

                                   GAMBRILLS MD 21054
        MAILING  ADDRESS                                            GENERAL CODES
C/O JOHNSON                            LT 6 OR 1.7880 ACRES  EXEMPT DATE CD  CL
6415 97TH AVE                      OFF EVERGREEN AVE                          000
LANHAM                  MD 20706   NR WAUGH CHAPEL                   USE CODE  R
                                                                     H O CODE
           LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE    OWN OCCUP  N
CUR        46,966                 46,966                             AG TRSF TX
1          33,633                 33,633                            AG DAT
2          46,966                 46,966                            REASSESSMENT
3          60,300                 60,300                            PH 09-01-2004
BASE       20,300                 20,300                             ASSR    0275
HST        33,633                 33,633                             GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER          TRNS NO               G F 1.000000
0000-0000-0000                                   00000               PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP          F
```

4-©   1   AACoITD   189.9.9.3   HGOA

No Query

PAGE NUMBER 1 MAP BLK PARCEL PLAT SECT BLOCK LOT DEED REFER
4000-0546-6110 36 11 0299 7 02112-395
PREMISE ADDRESS
SMITH, ELEANOR EVERGREEN RD
PLAT REFER
GAMBRILLS MD 21054
MAILING ADDRESS GENERAL CODES
7903 DELLWOOD AVE LT 7 OR 1.7880 ACRES EXEMPT DATE CD CL
EVERGREEN RD 000
GLENARDEN MD 20706 GAMBRILLS USE CODE R
H O CODE

	LAND	BUILDINGS	TOTAL	PREFER LAND	CURTILAGE	
						OWN OCCUP N
CUR	46,966		46,966			AG TRSF TX
1	33,633		33,633			AG DAT
2	46,966		46,966			REASSESSMENT
3	60,300		60,300			PH 09-01-2004
BASE	20,300		20,300			ASSR 0275
HST	33,633		33,633			GEO CODE 2

PREV ACCOUNT NO PREVIOUS OWNER TRNS NO G F 1.000000
4000-0546-6110 SMITH GEORGE 09471 PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT F1-MENU F2-WB F3-UTIL F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP F

4-© 1 AACoITD 189.9.9.3 HGOA

No Query

```
PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK      LOT     DEED REFER
   4000-0546-6715      36    11   0293                         1     16939-083
                                           PREMISE ADDRESS
ARUNDEL HABITAT FOR HUMANITY I    EVERGREEN RD
                                                                      PLAT REFER
                                  GAMBRILLS MD 21054
        MAILING  ADDRESS                                            GENERAL CODES
273 PENINSULA FARM RD STE D          LT 1 OR 1.7880 ACRES  EXEMPT DATE CD  CL
                                  EVERGREEN RD                               000
ARNOLD                 MD 21012   WAUGH CHAPEL                       USE CODE  R
                                                                     H O CODE
           LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE      OWN OCCUP  N
CUR       46,966                 46,966                              AG TRSF TX
1         33,633                 33,633                             AG DAT
2         46,966                 46,966                             REASSESSMENT
3         60,300                 60,300                             PH 09-01-2004
BASE      20,300                 20,300                              ASSR    0275
HST       33,633                 33,633                              GEO CODE   2
PREV ACCOUNT NO         PREVIOUS OWNER          TRNS NO              G F 1.000000
4000-0546-6715   SMITH, GERALDINE                 14513              PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP          F
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4-©   1   AACoITD   189.9.9.3   HGOA

No Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0550-6210      36    11   0295                         3    02112-387
                                          PREMISE ADDRESS
SMITH, TYLER                      EVERGREEN AVE
                                                                    PLAT REFER

                                  GAMBRILLS MD 21054
        MAILING  ADDRESS                                          GENERAL CODES
C/O JOHNSON                           LT 3 OR 1.7880 ACRES  EXEMPT DATE CD  CL
6415 97TH AVE                     OFF OF EVERGREEN AVE                     000
LANHAM                 MD 20706   NR WAUGH CHAPEL                  USE CODE  R
                                                                   H O CODE
           LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE    OWN OCCUP  N
CUR       46,966                 46,966                            AG TRSF TX
1         33,633                 33,633                           AG DAT
2         46,966                 46,966                           REASSESSMENT
3         60,300                 60,300                           PH 09-01-2004
BASE      20,300                 20,300                            ASSR    0275
HST       33,633                 33,633                            GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER          TRNS NO             G F 1.000000
0000-0000-0000                                   00000             PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP          F
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4-©              1     AACoITD    189.9.9.3                   HGOA
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No Query

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PAGE NUMBER 1           MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0551-3605       36    11   0289                         1    08451-627
                                          PREMISE ADDRESS
SMITH, LARRY T                      EVERGREEN AVE
SMITH ET AL, PHYLLIS C                                               PLAT REFER
                                    GAMBRILLS MD 21054
        MAILING  ADDRESS                                           GENERAL CODES
C/O BARRY D SMITH                       LT 1 OR 2.5939 ACS    EXEMPT DATE CD  CL
15100 JOHNSTONE LN                  OFF EVERGREEN AVE                        000
BOWIE                    MD 20721   NR WAUGH CHAPEL                   USE CODE  R
                                                                      H O CODE
           LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE       OWN OCCUP  N
CUR       51,816                 51,816                               AG TRSF TX
1         38,483                 38,483                              AG DAT
2         51,816                 51,816                              REASSESSMENT
3         65,150                 65,150                              PH 09-01-2004
BASE      25,150                 25,150                               ASSR    0275
HST       38,483                 38,483                               GEO CODE   2
PREV ACCOUNT NO         PREVIOUS OWNER         TRNS NO               G F 1.000000
4000-0551-3605   SMITH, WILLIS                   05186                PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP          F

4-©           1     AACoITD    189.9.9.3                    HG0A
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No Query

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PAGE NUMBER 1           MAP  BLK  PARCEL PLAT SECT  BLOCK      LOT    DEED REFER
   4000-0561-3850       36    11   0205                          2    10899-173
                                            PREMISE ADDRESS
SHAFFER, WILLIAM                     EVERGREEN AVE
                                                                      PLAT REFER
                                     GAMBRILLS MD 21054
        MAILING  ADDRESS                                            GENERAL CODES
1393 ODENTON RD                          PT LT 2 OR 1 ACRE     EXEMPT DATE CD  CL
                                     EVERGREEN AVE                             000
ODENTON                 MD 21113     LANDWEHRS TRACT                 USE CODE  R
                                                                     H O CODE
           LAND    BUILDINGS      TOTAL  PREFER LAND   CURTILAGE    OWN OCCUP  N
CUR       10,000                 10,000                              AG TRSF TX
1         10,000                 10,000                             AG DAT
2         10,000                 10,000                             REASSESSMENT
3         10,000                 10,000                             PH 09-01-2004
BASE      10,000                 10,000                              ASSR    0275
HST       10,000                 10,000                              GEO CODE   2
PREV ACCOUNT NO         PREVIOUS OWNER          TRNS NO              G F 1.000000
4000-0561-3850   STEVENSON, JAMES L               16630              PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F
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4-©   1   AACoITD   189.9.9.3   HGOA

NO Query

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PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK     LOT    DEED REFER
   4000-0631-2045      36    11   0297                        5     02112-391
                                        PREMISE ADDRESS
WHITTMORE, JAMES                  EVERGREEN RD
WHITTMORE, LILLIE M                                                 PLAT REFER
                                  GAMBRILLS MD 21054
        MAILING  ADDRESS                                          GENERAL CODES
C/O JOYCE COUCH                       LT 5 OR 1.7880 ACRES  EXEMPT DATE CD  CL
19 S WESTFIELD AVE                EVERGREEN RD                             000
TRENTON                NJ 08618   GAMBRILLS                        USE CODE  R
                                                                   H O CODE
          LAND    BUILDINGS     TOTAL  PREFER LAND   CURTILAGE     OWN OCCUP  N
CUR      46,966                 46,966                             AG TRSF TX
1        33,633                 33,633                            AG DAT
2        46,966                 46,966                            REASSESSMENT
3        60,300                 60,300                            PH 09-01-2004
BASE     20,300                 20,300                             ASSR    0275
HST      33,633                 33,633                             GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER          TRNS NO             G F 1.000000
0000-0000-0000                                   00000             PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F

4-©           1     AACoITD   189.9.9.3                    HGOA
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No Query

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PAGE NUMBER 1          MAP   BLK   PARCEL PLAT SECT  BLOCK      LOT     DEED REFER
   4000-9007-3870      36    09    0022                           2     07667-370
                                           PREMISE ADDRESS
REDLAND GENSTAR, INC.,             PATUXENT RD
                                                                        PLAT REFER
                                   GAMBRILLS MD 21054                   00134-044
        MAILING  ADDRESS                                              GENERAL CODES
ATTN JOHN CASEY                        PT LT 2 OR 5.022 ACR  EXEMPT DATE CD  CL
300 E JOPPA RD STE 200             PATUXENT RD                                000
TOWSON                  MD 21286   G & H PTNSHP PROPERTIES             USE CODE  I
                                                                       H O CODE
           LAND    BUILDINGS      TOTAL  PREFER LAND   CURTILAGE       OWN OCCUP  N
CUR        4,000                  4,000                                AG TRSF TX
1          3,000                  3,000                               AG DAT
2          4,000                  4,000                               REASSESSMENT
3          5,000                  5,000                               PH 10-01-2004
BASE       2,000                  2,000                                ASSR    0265
HST        3,000                  3,000                                GEO CODE   2
PREV ACCOUNT NO        PREVIOUS OWNER         TRNS NO                  G F 1.000000
4000-9007-3870   PATUXENT RD LTD PTNSHP         11909                  PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP          F
```

4-©   1   AACoITD   189.9.9.3   HGOA

No Query

```
PAGE NUMBER 1          MAP  BLK  PARCEL PLAT SECT  BLOCK      LOT    DEED REFER
   4000-9021-3641      36    11   0007                         7     10735-782
                                          PREMISE ADDRESS
BBSS INC                            EVERGREEN RD
                                                                     PLAT REFER
                                    GAMBRILLS MD 21054
        MAILING  ADDRESS                                           GENERAL CODES
1 CHURCHVIEW RD                         PTLT 7 OR 9.873 AC    EXEMPT DATE CD  CL
                                    EVERGREEN RD                             000
MILLERSVILLE           MD 21108     LANDWEHRS TRACT                   USE CODE  R
                                                                      H O CODE
           LAND    BUILDINGS      TOTAL  PREFER LAND   CURTILAGE      OWN OCCUP  N
CUR       92,076                 92,076                               AG TRSF TX
1         86,243                 86,243                              AG DAT
2         92,076                 92,076                              REASSESSMENT
3         97,910                 97,910                              PH 09-01-2004
BASE      80,410                 80,410                               ASSR    0275
HST       86,243                 86,243                               GEO CODE   2
PREV ACCOUNT NO          PREVIOUS OWNER          TRNS NO              G F 1.000000
4000-0543-4300                                     00000              PGF 1.000000

FOR A DIFFERENT PAGE HIT ENTER ELSE HIT  F1-MENU  F2-WB  F3-UTIL  F4-LIEN
F5-USE F6-NAME F7-LOCAT F8-HLTH F9-PREM F10-MORE F11-FF/CAP         F

4-©            1     AACoITD    189.9.9.3                   HGOA
```

NO Query

Appendix F
Hydraulic Conductivity
Data and Analysis

WELL ID: MW-1A Test 1

INPUT

Construction:

Casing dia. (d_c)	4	Inch
Annulus dia. (d_w)	8.25	Inch
Screen Length (L)	10	Feet

Depths to:

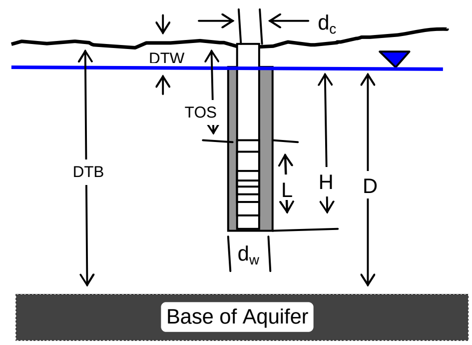
water level (DTW)	83	Feet
top of screen (TOS)	76	Feet
Base of Aquifer (DTB)	86	Feet

Annular Fill:

across screen -- Coarse Sand

above screen -- Bentonite

Aquifer Material -- Fine Sand



COMPUTED

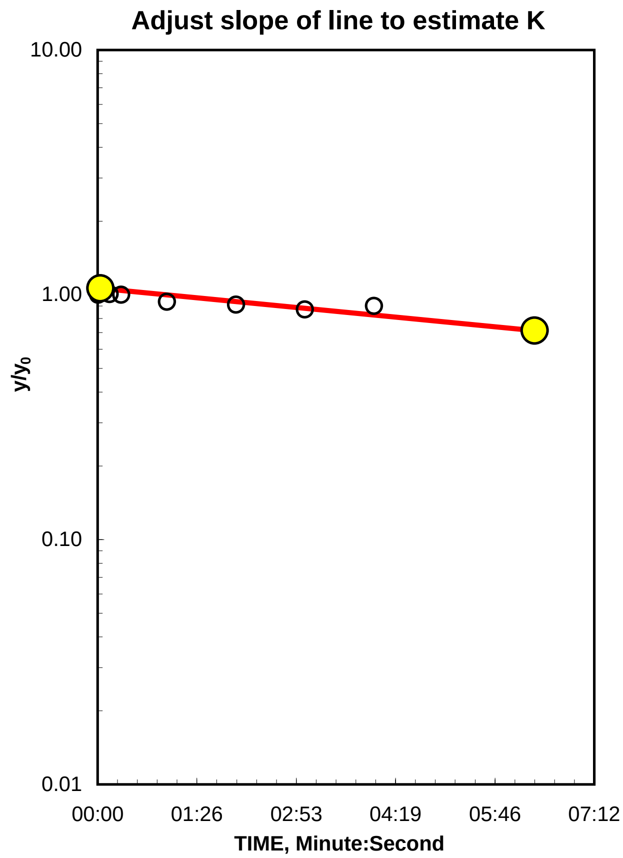
L_{wetted}	3	Feet
D =	3	Feet
H =	3	Feet
L/r_w =	8.73	
$y_{0\text{-DISPLACEMENT}}$ =	2.00	Feet
$y_{0\text{-SLUG}}$ =	2.30	Feet

From look-up table using L/r_w

Fully penetrate C =	1.142	
ln(Re/rw) =	1.566	
Re =	1.65	Feet
Slope =	0.000458	$\log_{10}$/sec
$t_{90\%}$ recovery =	2182	sec

Input is consistent.

K =	0.7	Feet/Day



K= 0.7 is less than likely minimum of 3 for Fine Sand

REMARKS: Bouwer and Rice analysis of slug test, WRR 1976

Initial test

Reduced Data

Entry	Time, Hr:Min:Sec	Water Level
1	0:00:00.0	85.00
2	0:00:10.0	84.99
3	0:00:20.0	85.00
4	0:01:00.0	85.13
5	0:02:00.0	85.18
6	0:03:00.0	85.26
7	0:04:00.0	85.20

WELL ID: MW-2B Test 1

Local ID:
Date:
Time:

INPUT

Construction:

Casing dia. (d_c)	2	Inch
Annulus dia. (d_w)	6.25	Inch
Screen Length (L)	10	Feet

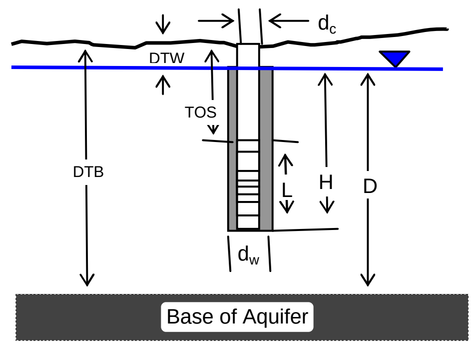
Depths to:

water level (DTW)	50.87	Feet
top of screen (TOS)	48	Feet
Base of Aquifer (DTB)	58	Feet

Annular Fill:

across screen -- Coarse Sand
above screen -- Bentonite

Aquifer Material -- Fine Sand



COMPUTED

L_{wetted}	7.13	Feet
D =	7.13	Feet
H =	7.13	Feet
L/r_w =	27.38	
$y_{0\text{-DISPLACEMENT}}$ =	2.43	Feet
$y_{0\text{-SLUG}}$ =	2.25	Feet

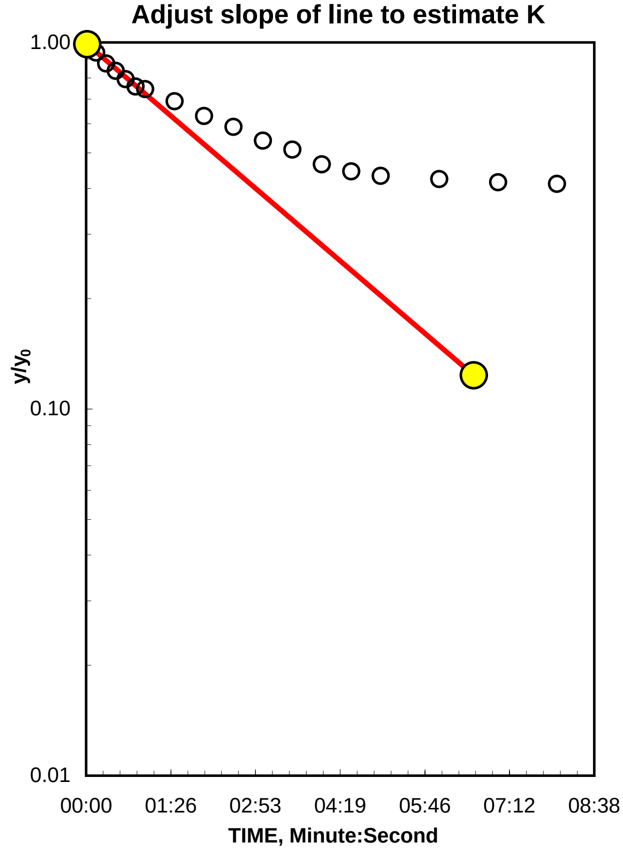
From look-up table using L/r_w

Fully penetrate C =	1.984	
ln(Re/rw) =	2.470	
Re =	3.08	Feet
Slope =	0.00229	$\log_{10}$/sec
$t_{90\%}$ recovery =	437	sec

Input is consistent.

K =	0.5	Feet/Day

Adjust slope of line to estimate K



K= 0.5 is less than likely minimum of 3 for Fine Sand

REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

Initial test

Reduced Data

Entry	Time, Hr:Min:Sec	Water Level
1	0:00:00.0	53.30
2	0:00:10.0	53.15
3	0:00:20.0	53.00
4	0:00:30.0	52.90
5	0:00:40.0	52.80
6	0:00:50.0	52.71
7	0:01:00.0	52.68
8	0:01:30.0	52.55
9	0:02:00.0	52.40
10	0:02:30.0	52.30
11	0:03:00.0	52.18
12	0:03:30.0	52.11
13	0:04:00.0	52.00
14	0:04:30.0	51.95
15	0:05:00.0	51.92
16	0:06:00.0	51.90
17	0:07:00.0	51.88
18	0:08:00.0	51.87

WELL ID: MW-2B Test 2

Local ID:
Date:
Time:

INPUT

Construction:

Casing dia. (d_c)	2	Inch
Annulus dia. (d_w)	6.25	Inch
Screen Length (L)	10	Feet

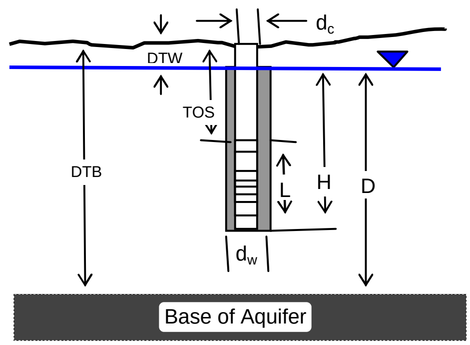
Depths to:

water level (DTW)	50.87	Feet
top of screen (TOS)	48	Feet
Base of Aquifer (DTB)	58	Feet

Annular Fill:

across screen -- Coarse Sand
above screen -- Bentonite

Aquifer Material -- Fine Sand



COMPUTED

L_{wetted}	7.13	Feet
D =	7.13	Feet
H =	7.13	Feet
L/r_w =	27.38	
$y_{0\text{-DISPLACEMENT}}$ =	1.57	Feet
$y_{0\text{-SLUG}}$ =	1.69	Feet

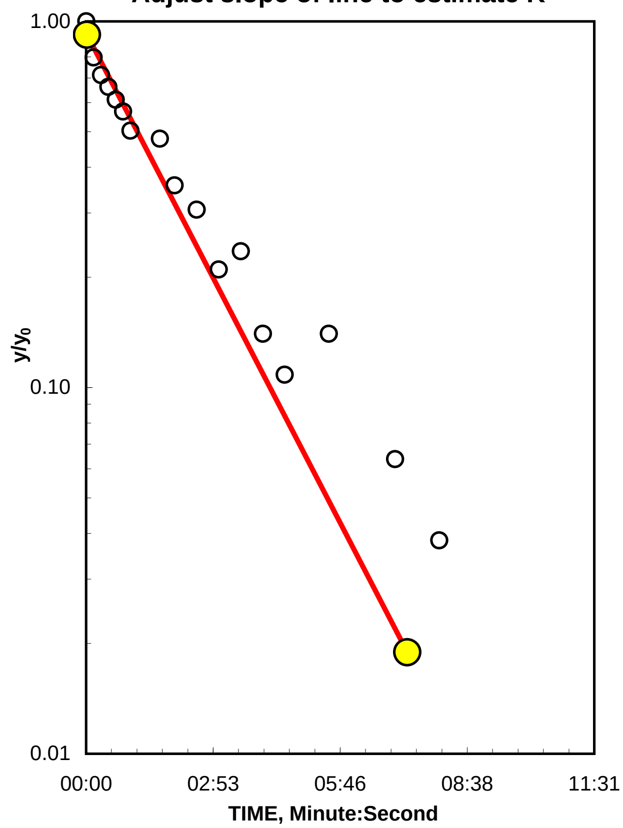
From look-up table using L/r_w

Fully penetrate C =	1.984	
ln(Re/rw) =	2.470	
Re =	3.08	Feet
Slope =	0.00387	$\log_{10}$/sec
$t_{90\%}$ recovery =	258	sec

Input is consistent.

K = 0.9 Feet/Day

Adjust slope of line to estimate K



K= 0.9 is less than likely minimum of 3 for Fine Sand

REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

Initial test

Reduced Data

Entry	Time, Hr:Min:Sec	Water Level
1	0:00:00.0	50.30
2	0:00:10.0	50.62
3	0:00:20.0	50.75
4	0:00:30.0	50.83
5	0:00:40.0	50.91
6	0:00:50.0	50.98
7	0:01:00.0	51.08
8	0:01:40.0	51.12
9	0:02:00.0	51.31
10	0:02:30.0	51.39
11	0:03:00.0	51.54
12	0:03:30.0	51.50
13	0:04:00.0	51.65
14	0:04:30.0	51.70
15	0:05:30.0	51.65
16	0:07:00.0	51.77
17	0:08:00.0	51.81
18	0:09:00.0	81.80

WELL ID: MW-5A Test 1

Local ID:
Date:
Time:

INPUT

Construction:

Casing dia. (d_c)	4 Inch
Annulus dia. (d_w)	8.25 Inch
Screen Length (L)	10 Feet

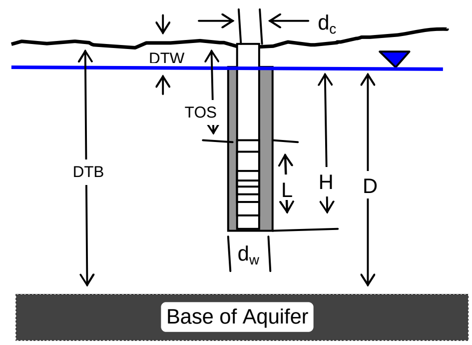
Depths to:

water level (DTW)	22.63 Feet
top of screen (TOS)	18 Feet
Base of Aquifer (DTB)	28 Feet

Annular Fill:

across screen -- Coarse Sand
above screen -- Bentonite

Aquifer Material -- Fine Sand



COMPUTED

L_{wetted}	5.37 Feet
D =	5.37 Feet
H =	5.37 Feet
L/r_w =	15.62
$y_{0\text{-DISPLACEMENT}}$ =	1.53 Feet
$y_{0\text{-SLUG}}$ =	1.69 Feet

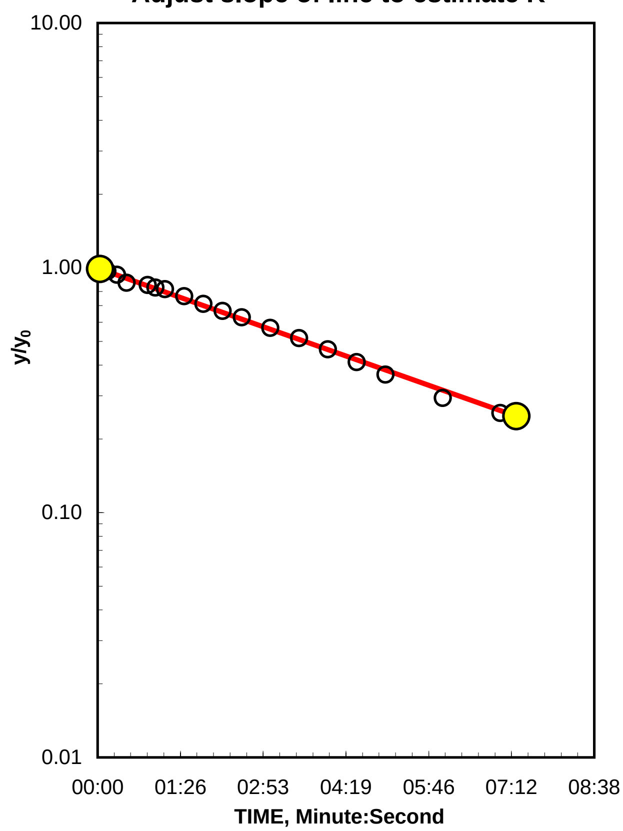
From look-up table using L/r_w

Fully penetrate C =	1.541
ln(Re/rw) =	2.005
Re =	2.55 Feet
Slope =	0.001385 $\log_{10}$/sec
$t_{90\%}$ recovery =	722 sec

Input is consistent.

K = 1 Feet/Day

Adjust slope of line to estimate K



K= 1 is less than likely minimum of 3 for Fine Sand

REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

Initial test

	Reduced Data	
	Time,	Water
Entry	Hr:Min:Sec	Level
1	14:08:00.0	21.10
2	14:08:10.0	21.15
3	14:08:20.0	21.20
4	14:08:30.0	21.30
5	14:08:52.0	21.33
6	14:09:00.0	21.36
7	14:09:10.0	21.38
8	14:09:30.0	21.46
9	14:09:50.0	21.54
10	14:10:10.0	21.61
11	14:10:30.0	21.67
12	14:11:00.0	21.76
13	14:11:30.0	21.84
14	14:12:00.0	21.92
15	14:12:30.0	22.00
16	14:13:00.0	22.07
17	14:14:00.0	22.18
18	14:15:00.0	22.24

WELL ID: MW-5A Test 2

Local ID:
Date:
Time:

INPUT

Construction:

Casing dia. (d_c)	4	Inch
Annulus dia. (d_w)	8.25	Inch
Screen Length (L)	10	Feet

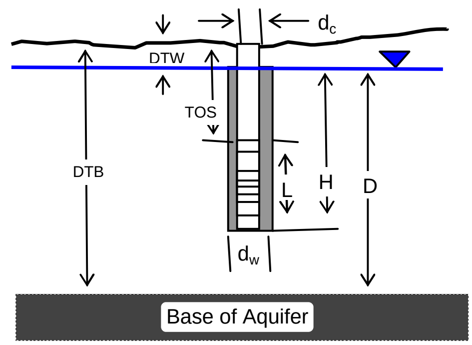
Depths to:

water level (DTW)	22.63	Feet
top of screen (TOS)	25	Feet
Base of Aquifer (DTB)	35	Feet

Annular Fill:

across screen -- Coarse Sand
above screen -- Bentonite

Aquifer Material -- Fine Sand



COMPUTED

L_{wetted}	10	Feet
D =	12.37	Feet
H =	12.37	Feet
L/r_w =	29.09	
$y_{0\text{-DISPLACEMENT}}$ =	1.13	Feet
$y_{0\text{-SLUG}}$ =	1.13	Feet

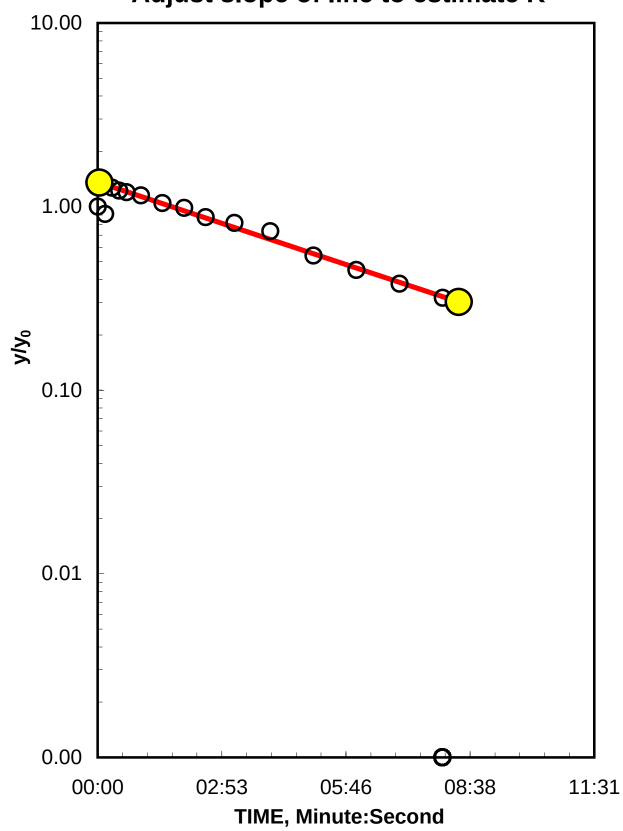
From look-up table using L/r_w

Fully penetrate C =	2.041	
ln(Re/rw) =	2.652	
Re =	4.87	Feet
Slope =	0.001299	$\log_{10}$/sec
$t_{90\%}$ recovery =	770	sec

Input is consistent.

K = 1 Feet/Day

Adjust slope of line to estimate K



K= 1 is less than likely minimum of 3 for Fine Sand

REMARKS: Bouwer and Rice analysis of slug test, WRR 1976

Initial test

Reduced Data

Entry	Time, Hr:Min:Sec	Water Level
1	14:08:00.0	21.50
2	14:08:10.0	21.60
3	14:08:20.0	21.20
4	14:08:30.0	21.25
5	14:08:40.0	21.28
6	14:09:00.0	21.33
7	14:09:30.0	21.45
8	14:10:00.0	21.52
9	14:10:30.0	21.64
10	14:11:10.0	21.71
11	14:12:00.0	21.80
12	14:13:00.0	22.02
13	14:14:00.0	22.12
14	14:15:00.0	22.20
15	14:16:00.0	22.27

WELL ID: MW-6A test 1

Local ID:

Date:

Time:

INPUT

Construction:

Casing dia. (d_c)	4	Inch
Annulus dia. (d_w)	8.25	Inch
Screen Length (L)	10	Feet

Depths to:

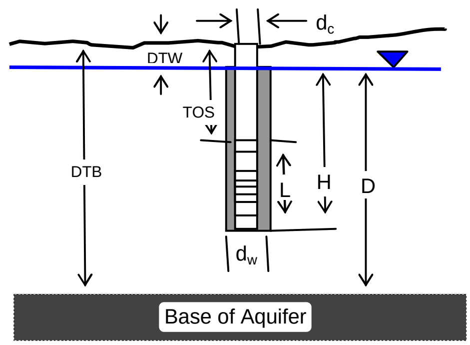
water level (DTW)	22.4	Feet
top of screen (TOS)	25	Feet
Base of Aquifer (DTB)	35	Feet

Annular Fill:

across screen -- Coarse Sand

above screen -- Bentonite

Aquifer Material -- Stream Terrace Depos



COMPUTED

L_{wetted}	10	Feet
D =	12.6	Feet
H =	12.6	Feet
L/r_w =	29.09	
$y_{0\text{-DISPLACEMENT}}$ =	3.10	Feet
$y_{0\text{-SLUG}}$ =	3.00	Feet

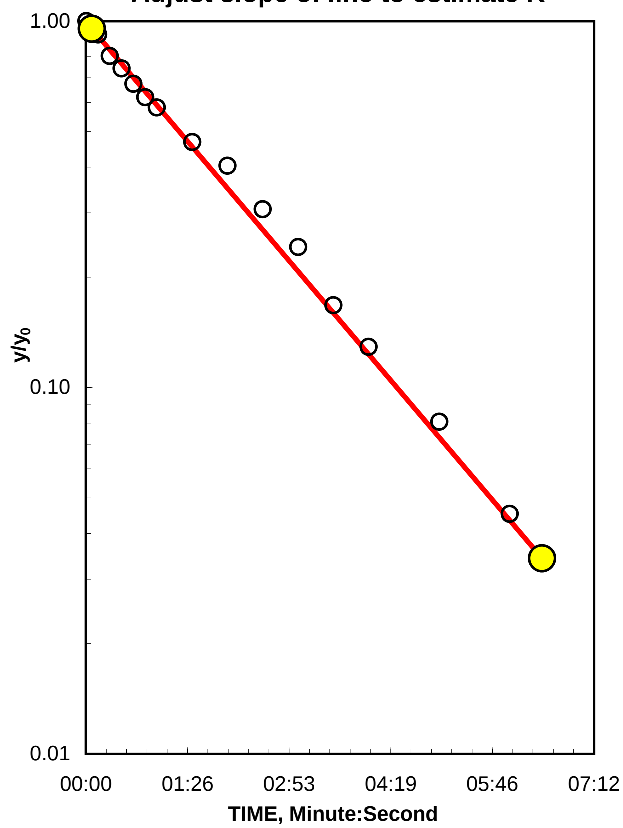
From look-up table using L/r_w

Fully penetrate C =	2.041	
ln(Re/rw) =	2.663	
Re =	4.93	Feet
Slope =	0.003775	$\log_{10}$/sec
$t_{90\%}$ recovery =	265	sec

Input is consistent.

K = 3 Feet/Day

Adjust slope of line to estimate K



REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

Initial test

Reduced Data

Entry	Time, Hr:Min:Sec	Water Level
1	0:00:00.0	19.30
2	0:00:10.0	19.55
3	0:00:20.0	19.91
4	0:00:30.0	20.10
5	0:00:40.0	20.31
6	0:00:50.0	20.48
7	0:01:00.0	20.60
8	0:01:30.0	20.95
9	0:02:00.0	21.15
10	0:02:30.0	21.45
11	0:03:00.0	21.65
12	0:03:30.0	21.88
13	0:04:00.0	22.00
14	0:05:00.0	22.15
15	0:06:00.0	22.26

WELL ID: MW-6A test 2

Local ID:
Date:
Time:

INPUT

Construction:

Casing dia. (d_c)	4	Inch
Annulus dia. (d_w)	8.25	Inch
Screen Length (L)	10	Feet

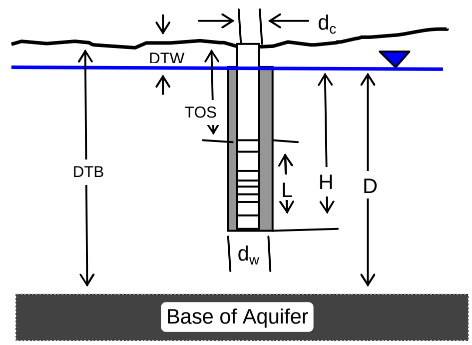
Depths to:

water level (DTW)	6.08	Feet
top of screen (TOS)	14	Feet
Base of Aquifer (DTB)	25	Feet

Annular Fill:

across screen -- Coarse Sand
above screen -- Bentonite

Aquifer Material -- Fine Sand



COMPUTED

L_{wetted}	10	Feet
D =	18.92	Feet
H =	17.92	Feet
L/r_w =	29.09	
$y_{0\text{-DISPLACEMENT}}$ =	2.94	Feet
$y_{0\text{-SLUG}}$ =	3.00	Feet

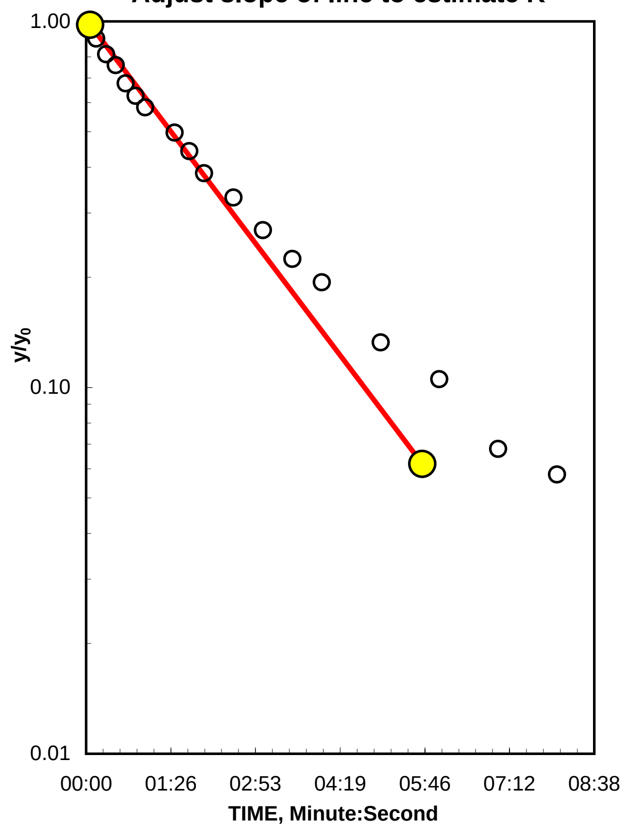
From look-up table using L/r_w

Partial penetrate A =	2.480	
B =	0.409	
ln(Re/rw) =	2.642	
Re =	4.83	Feet
Slope =	0.00354	$\log_{10}$/sec
$t_{90\%}$ recovery =	282	sec

Input is consistent.

K =	3	Feet/Day

Adjust slope of line to estimate K



REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

Initial test

Reduced Data

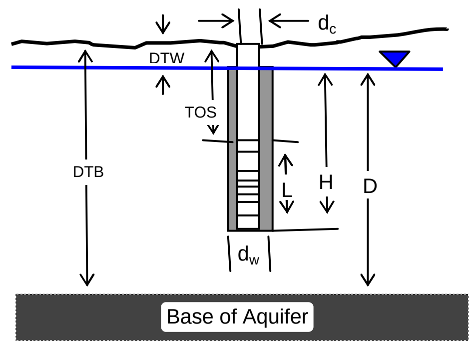
Entry	Time, Hr:Min:Sec	Water Level
1	0:00:00.0	19.60
2	0:00:10.0	19.90
3	0:00:20.0	20.15
4	0:00:30.0	20.31
5	0:00:40.0	20.55
6	0:00:50.0	20.70
7	0:01:00.0	20.83
8	0:01:30.0	21.08
9	0:01:45.0	21.24
10	0:02:00.0	21.41
11	0:02:30.0	21.57
12	0:03:00.0	21.75
13	0:03:30.0	21.88
14	0:04:00.0	21.97
15	0:05:00.0	22.15
16	0:06:00.0	22.23
17	0:07:00.0	22.34
18	0:08:00.0	22.37

WELL ID: MW-9A Test 1

Local ID:
Date:
Time:

INPUT

Construction:		
Casing dia. (d_c)	2	Inch
Annulus dia. (d_w)	6.25	Inch
Screen Length (L)	10	Feet
Depths to:		
water level (DTW)	74.96	Feet
top of screen (TOS)	70	Feet
Base of Aquifer (DTB)	80	Feet
Annular Fill:		
across screen --	Coarse Sand	
above screen --	Bentonite	
Aquifer Material --	Fine Sand	



COMPUTED

L_{wetted}	5.04	Feet
D =	5.04	Feet
H =	5.04	Feet
L/r_w =	19.35	
$y_{0\text{-DISPLACEMENT}}$ =	0.70	Feet
$y_{0\text{-SLUG}}$ =	0.75	Feet

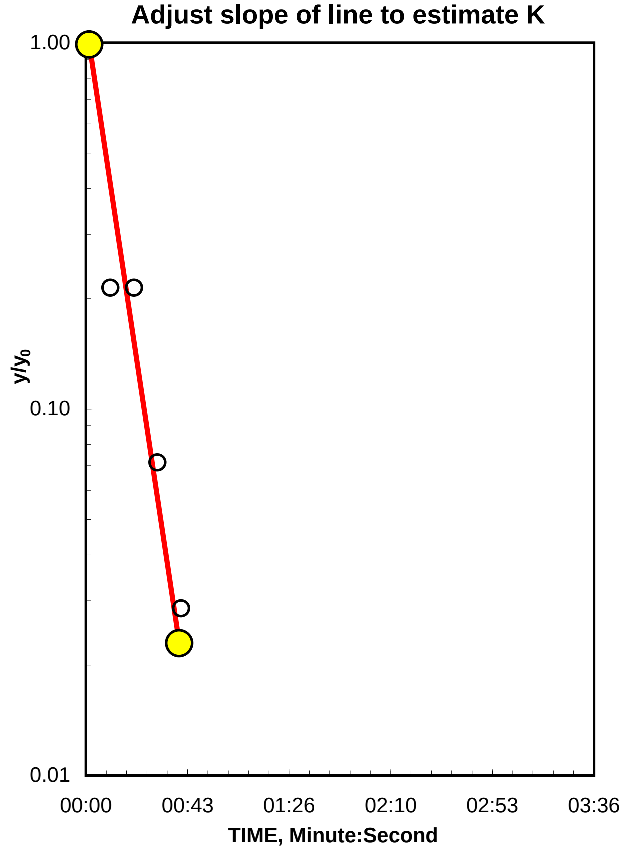
From look-up table using L/r_w

Fully penetrate C =	1.699	
ln(Re/rw) =	2.178	
Re =	2.30	Feet
Slope =	0.042691	$\log_{10}$/sec
$t_{90\%}$ recovery =	23	sec

Input is consistent.

K =	10	Feet/Day

Adjust slope of line to estimate K



REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

Initial test

Reduced Data

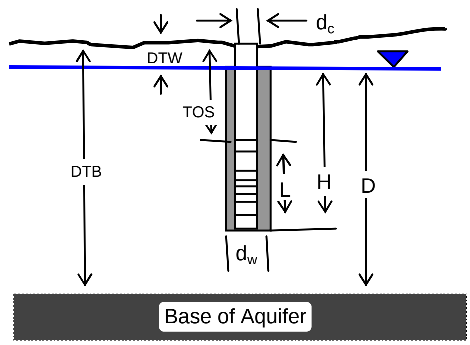
Entry	Time, Hr:Min:Sec	Water Level
1	0:00:00.0	74.60
2	0:00:10.0	75.15
3	0:00:20.0	75.15
4	0:00:30.0	75.25
5	0:00:40.0	75.28
6	0:00:50.0	75.30
7	0:01:00.0	75.30
8	0:03:00.0	75.30

WELL ID: MW-9A Test 2

Local ID:
Date:
Time:

INPUT

Construction:		
Casing dia. (d_c)	2	Inch
Annulus dia. (d_w)	6.25	Inch
Screen Length (L)	10	Feet
Depths to:		
water level (DTW)	81.95	Feet
top of screen (TOS)	75	Feet
Base of Aquifer (DTB)	85	Feet
Annular Fill:		
across screen --	Coarse Sand	
above screen --	Bentonite	
Aquifer Material --	Fine Sand	



COMPUTED

L_{wetted}	3.05	Feet
D =	3.05	Feet
H =	3.05	Feet
L/r_w =	11.71	
$y_{0\text{-DISPLACEMENT}}$ =	0.95	Feet
$y_{0\text{-SLUG}}$ =	1.13	Feet

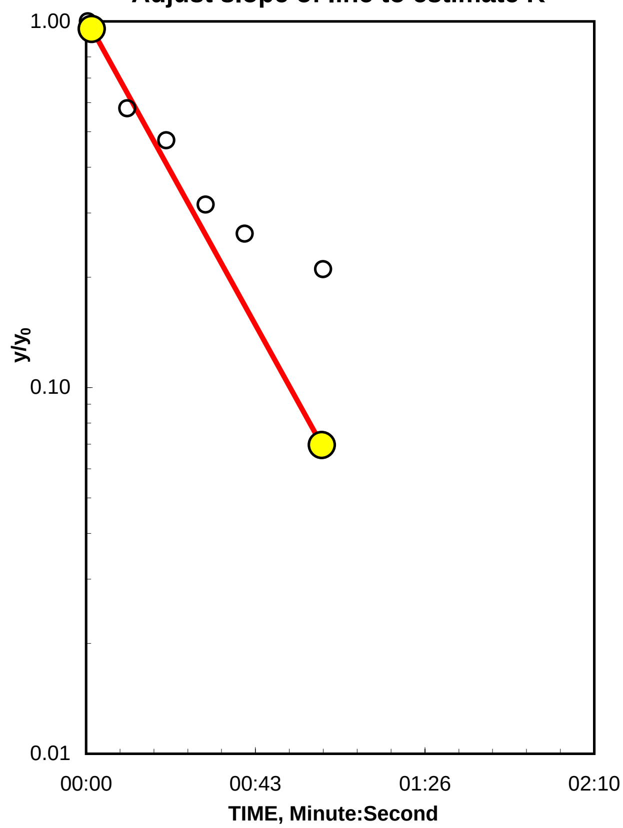
From look-up table using L/r_w

Fully penetrate C =	1.327	
ln(Re/rw) =	1.785	
Re =	1.55	Feet
Slope =	0.019364	$\log_{10}$/sec
$t_{90\%}$ recovery =	52	sec

Input is consistent.

K =	8	Feet/Day

Adjust slope of line to estimate K



REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

Initial test

Reduced Data

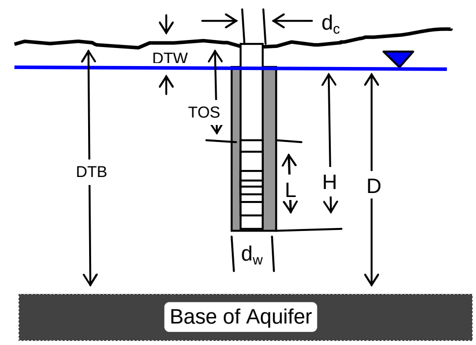
Entry	Time, Hr:Min:Sec	Water Level
1	0:00:00.0	81.40
2	0:00:10.0	81.80
3	0:00:20.0	81.90
4	0:00:30.0	82.05
5	0:00:40.0	82.10
6	0:01:00.0	82.15
7	0:02:00.0	82.35

WELL ID: MW-11A Test 1

Local ID:
Date:
Time:

INPUT

Construction:		
Casing dia. (d_c)	2	Inch
Annulus dia. (d_w)	6.25	Inch
Screen Length (L)	10	Feet
Depths to:		
water level (DTW)	74.96	Feet
top of screen (TOS)	70	Feet
Base of Aquifer (DTB)	80	Feet
Annular Fill:		
across screen --	Coarse Sand	
above screen --	Bentonite	
Aquifer Material --	Fine Sand	



COMPUTED

L_{wetted}	5.04	Feet
D =	5.04	Feet
H =	5.04	Feet
L/r_w =	19.35	
$y_{0\text{-DISPLACEMENT}}$ =	0.48	Feet
$y_{0\text{-SLUG}}$ =	0.50	Feet

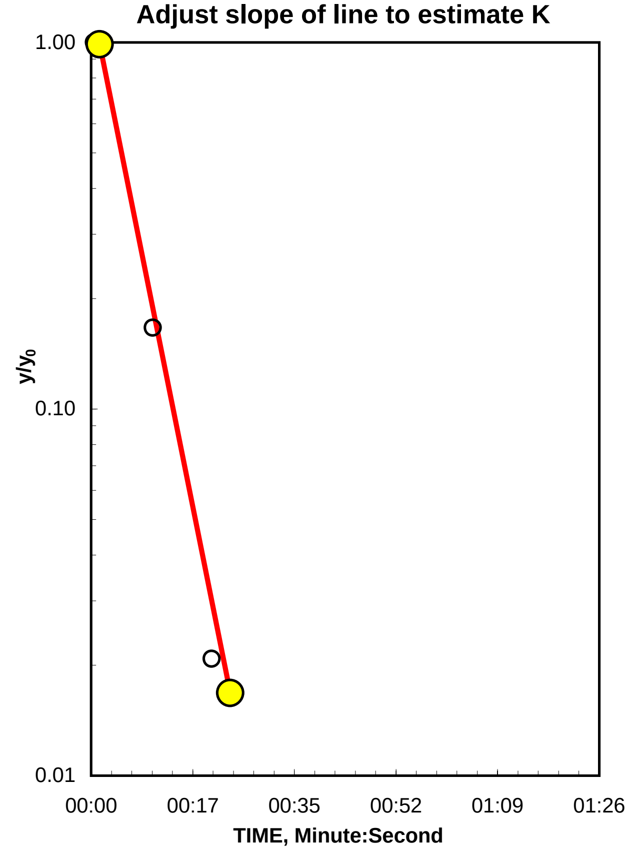
From look-up table using L/r_w

Fully penetrate C =	1.699	
ln(Re/rw) =	2.178	
Re =	2.30	Feet
Slope =	0.079712	$\log_{10}$/sec
$t_{90\%}$ recovery =	13	sec

Input is consistent.

K =	20	Feet/Day

Adjust slope of line to estimate K



REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

Initial test

Reduced Data

Entry	Time, Hr:Min:Sec	Water Level
1	0:00:00.0	75.50
2	0:00:10.0	75.10
3	0:00:20.0	75.03
4	0:00:30.0	75.00
5	0:00:40.0	75.00
6	0:00:50.0	75.00
7	0:01:00.0	75.00
8	0:01:15.0	75.02

WELL ID: MW-11A Test 2

Local ID:
Date:
Time:

INPUT

Construction:

Casing dia. (d_c)	2	Inch
Annulus dia. (d_w)	6.25	Inch
Screen Length (L)	10	Feet

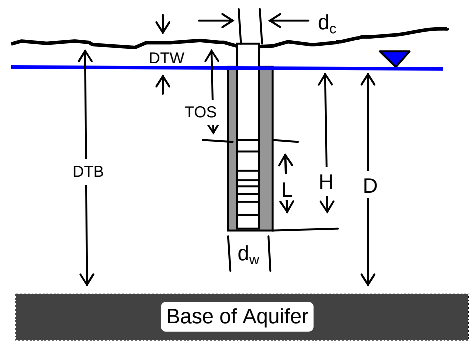
Depths to:

water level (DTW)	74.96	Feet
top of screen (TOS)	70	Feet
Base of Aquifer (DTB)	80	Feet

Annular Fill:

across screen -- Coarse Sand
above screen -- Bentonite

Aquifer Material -- Fine Sand



COMPUTED

L_{wetted}	5.04	Feet
D =	5.04	Feet
H =	5.04	Feet
L/r_w =	19.35	
$y_{0\text{-DISPLACEMENT}}$ =	0.70	Feet
$y_{0\text{-SLUG}}$ =	0.75	Feet

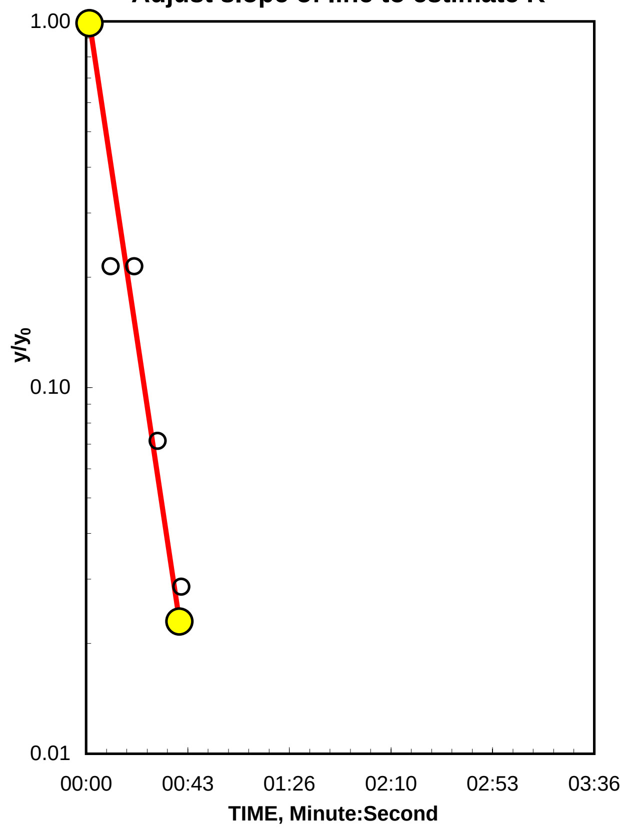
From look-up table using L/r_w

Fully penetrate C =	1.699	
ln(Re/rw) =	2.178	
Re =	2.30	Feet
Slope =	0.042691	$\log_{10}$/sec
$t_{90\%}$ recovery =	23	sec

Input is consistent.

K =	10	Feet/Day

Adjust slope of line to estimate K



REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

Initial test

Reduced Data

Entry	Time, Hr:Min:Sec	Water Level
1	0:00:00.0	74.60
2	0:00:10.0	75.15
3	0:00:20.0	75.15
4	0:00:30.0	75.25
5	0:00:40.0	75.28
6	0:00:50.0	75.30
7	0:01:00.0	75.30
8	0:03:00.0	75.30

WELL ID: MW-12A Test 1

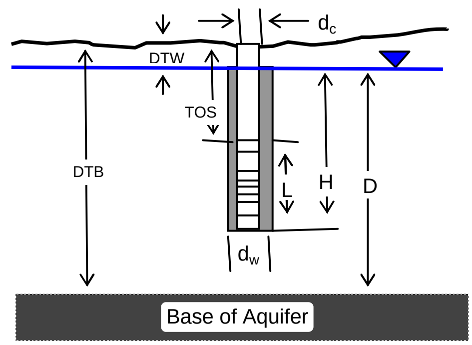
Local ID:
Date:
Time:

INPUT

Construction:	
Casing dia. (d_c)	2 Inch
Annulus dia. (d_w)	6.25 Inch
Screen Length (L)	10 Feet

Depths to:	
water level (DTW)	46.92 Feet
top of screen (TOS)	45 Feet
Base of Aquifer (DTB)	55 Feet

Annular Fill:	
across screen --	Coarse Sand
above screen --	Bentonite
Aquifer Material --	Fine Sand



COMPUTED

L_{wetted}	8.08 Feet
D =	8.08 Feet
H =	8.08 Feet
L/r_w =	31.03
$y_{0\text{-DISPLACEMENT}}$ =	0.48 Feet
$y_{0\text{-SLUG}}$ =	0.50 Feet

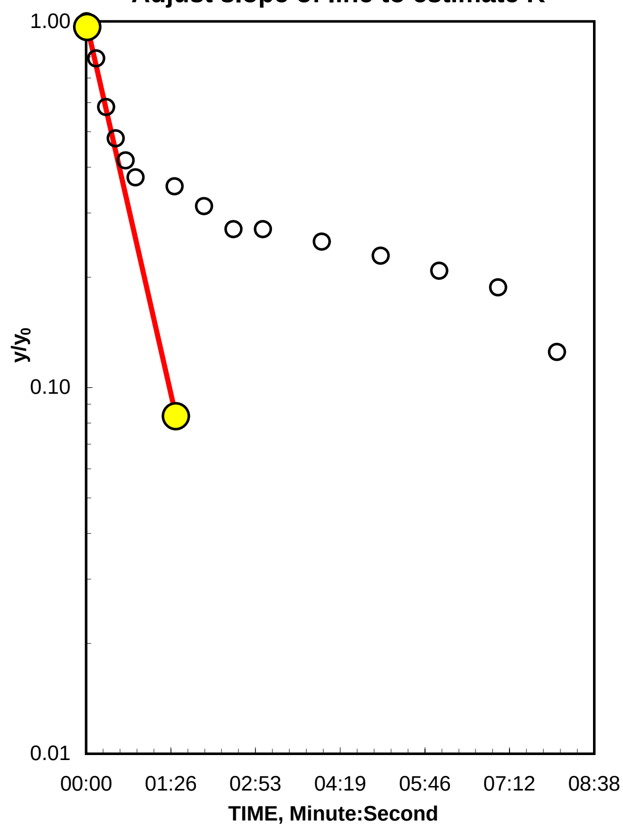
From look-up table using L/r_w

Fully penetrate C =	2.124
ln(Re/rw) =	2.573
Re =	3.41 Feet
Slope =	0.011796 $\log_{10}$/sec
$t_{90\%}$ recovery =	85 sec

Input is consistent.

K =	3 Feet/Day

Adjust slope of line to estimate K



REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

Initial test

Reduced Data

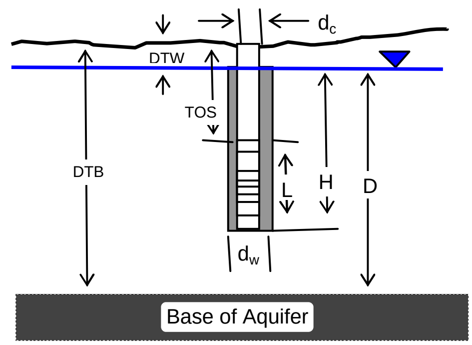
Entry	Time, Hr:Min:Sec	Water Level
1	0:00:00.0	47.40
2	0:00:10.0	47.30
3	0:00:20.0	47.20
4	0:00:30.0	47.15
5	0:00:40.0	47.12
6	0:00:50.0	47.10
7	0:01:30.0	47.09
8	0:02:00.0	47.07
9	0:02:30.0	47.05
10	0:03:00.0	47.05
11	0:04:00.0	47.04
12	0:05:00.0	47.03
13	0:06:00.0	47.02
14	0:07:00.0	47.01
15	0:08:00.0	46.98

WELL ID: MW-12A Test 2

Local ID:
Date:
Time:

INPUT

Construction:		
Casing dia. (d_c)	2	Inch
Annulus dia. (d_w)	6.25	Inch
Screen Length (L)	10	Feet
Depths to:		
water level (DTW)	46.92	Feet
top of screen (TOS)	45	Feet
Base of Aquifer (DTB)	55	Feet
Annular Fill:		
across screen --	Coarse Sand	
above screen --	Bentonite	
Aquifer Material --	Fine Sand	



COMPUTED

L_{wetted}	8.08	Feet
D =	8.08	Feet
H =	8.08	Feet
L/r_w =	31.03	
$y_{0\text{-DISPLACEMENT}}$ =	1.02	Feet
$y_{0\text{-SLUG}}$ =	1.00	Feet

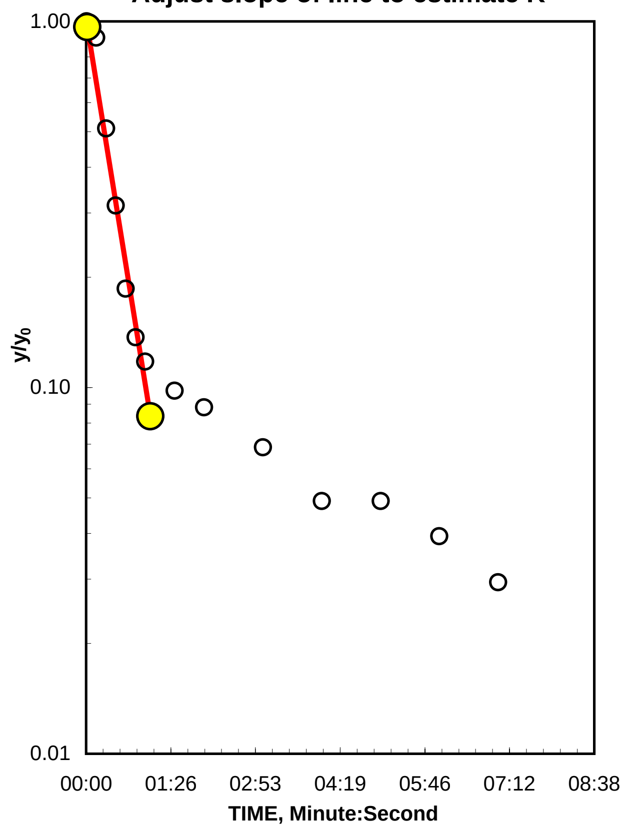
From look-up table using L/r_w

Fully penetrate C =	2.124	
ln(Re/rw) =	2.573	
Re =	3.41	Feet
Slope =	0.016559	$\log_{10}$/sec
$t_{90\%}$ recovery =	60	sec

Input is consistent.

K =	4	Feet/Day

Adjust slope of line to estimate K



REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

Initial test

Reduced Data

Entry	Time, Hr:Min:Sec	Water Level
1	0:00:00.0	48.00
2	0:00:10.0	47.90
3	0:00:20.0	47.50
4	0:00:30.0	47.30
5	0:00:40.0	47.17
6	0:00:50.0	47.12
7	0:01:00.0	47.10
8	0:01:30.0	47.08
9	0:02:00.0	47.07
10	0:03:00.0	47.05
11	0:04:00.0	47.03
12	0:05:00.0	47.03
13	0:06:00.0	47.02
14	0:07:00.0	47.01

WELL ID: MW-15A Test 1

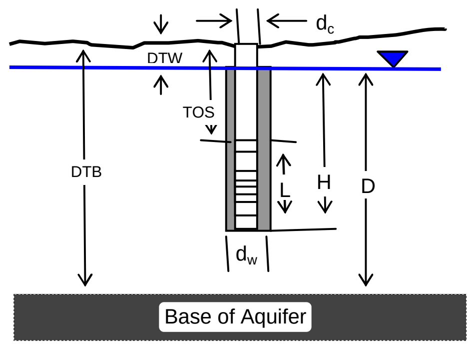
Local ID:

Date:

Time:

INPUT

Construction:	
Casing dia. (d_c)	2 Inch
Annulus dia. (d_w)	6.25 Inch
Screen Length (L)	10 Feet
Depths to:	
water level (DTW)	37.86 Feet
top of screen (TOS)	35 Feet
Base of Aquifer (DTB)	45 Feet
Annular Fill:	
across screen --	Coarse Sand
above screen --	Bentonite
Aquifer Material --	Fine Sand



COMPUTED

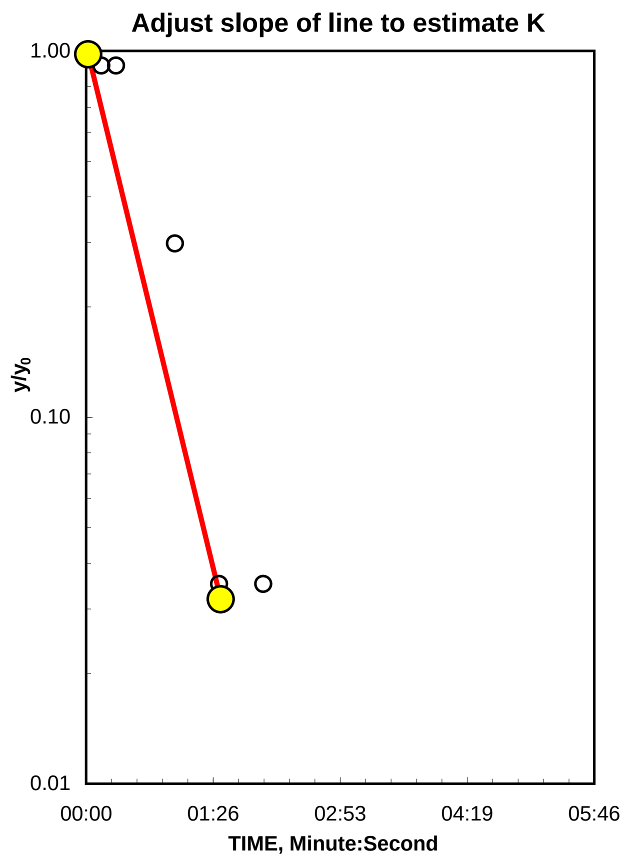
L_{wetted}	7.14 Feet
D =	7.14 Feet
H =	7.14 Feet
L/r_w =	27.42
$y_{0\text{-DISPLACEMENT}}$ =	1.14 Feet
$y_{0\text{-SLUG}}$ =	1.00 Feet

From look-up table using L/r_w

Fully penetrate C =	1.986
ln(Re/rw) =	2.471
Re =	3.08 Feet
Slope =	0.016501 $\log_{10}$/sec
$t_{90\%}$ recovery =	61 sec

Input is consistent.

K =	4 Feet/Day



REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

Initial test

Reduced Data

Entry	Time, Hr:Min:Sec	Water Level
1	0:00:00.0	39.00
2	0:00:10.0	38.90
3	0:00:20.0	38.90
4	0:01:00.0	38.20
5	0:01:30.0	37.90
6	0:02:00.0	37.90
7	0:02:30.0	37.70
8	0:03:00.0	37.65
9	0:03:30.0	37.65
10	0:04:30.0	37.65

Appendix G Groundwater Quality Data

Parameter	Date	Well Number																			
		1A	1B	2A	2B	3B	4A	4B	5A	5B	6A	7A	7B	8A	9A	10A	11A	11B	12A	13A	14A
TOC Elevation (amsl)		155.82	154.59	145.41	147.33	159.75	149.38	151.17	80.01	78.27	91.7	96.12	95.43	144.22	180.86	198.22	185.22	185.5	151.73	158.06	154.96
Depth to water (feet)	19-Jul-2002	73.97	77.97	90.18	49.72	104.30	53.81	98.95	20.82	26.65	21.45	33.76	46.71	44.88	80.65	93.73	74.98	118.61	44.53	63.05	51.85
	18-Mar-2003	74.42	79.48	88.44	48.58	102.43	53.66	96.92	17.93	24.87	21.05	33.07	43.78	43.44	80.80	94.20	74.74	117.16	39.30	62.70	48.78
	12-Jun-2003	72.91	89.45	87.59	46.98	101.81	53.58	96.27	18.48	24.10	20.65	32.63	43.09	40.63	78.30	92.44	72.55	116.56	34.15	61.38	46.91
	23-Jul-2003	71.45	81.07	87.11	46.15	101.25	53.64	95.54	18.38	23.67	20.45	32.49	42.87	38.40	75.97	90.98	71.12	116.50	35.62	60.86	45.23
	11-Aug-2003	70.80	79.13	88.42	45.97	102.69	53.64	97.36	18.95	25.24	20.50	32.42	43.15	38.38	75.16	90.22	70.67	116.46	37.09	60.53	45.74
	08-Sep-2003	70.47	77.45	88.61	46.15	102.90	53.74	97.73	19.73	25.65	20.73	32.53	43.27	38.97	74.78	89.61	70.49	116.48	38.68	60.49	46.31
	29-Oct-2003	70.17	95.04	86.40	46.18	100.57	53.64	94.61	19.52	22.92	20.44	32.33	41.33	38.75	74.50	88.60	70.12	115.54	40.23	60.49	46.66
	18-Nov-2003	70.33	86.08	87.82	46.28	102.22	53.63	96.81	19.39	24.65	20.45	32.35	41.95	38.67	74.92	88.65	70.13	115.78	40.66	60.50	48.88
	22-Dec-2003	70.35	79.48	87.31	46.28	101.75	53.61	96.33	18.15	24.05	19.99	32.04	41.21	37.99	74.38	88.46	70.08	115.48	40.22	60.60	45.93
	14-Jan-2004	70.03	77.58	87.56	45.77	102.03	53.61	96.68						38.05	73.62	87.73	69.26	115.35	39.88	60.43	46.47
	27-Feb-2004	70.05	76.02	87.65	45.90	102.08	53.60	96.74	18.85	24.58	20.12	32.13	41.60	38.27	73.55	87.58	69.02	115.38	40.40	60.85	46.85
	29-Mar-2004	70.10	75.72	87.70	46.02	102.00	53.64	96.89	19.35	24.71	20.35	32.25	41.09	38.63	73.43	87.25	68.85	115.10	40.96	61.02	47.14
	22-Apr-2004	70.31	102.24	87.67	46.05	101.95	53.65	96.81	19.08	24.64	20.22	32.17	41.42	38.39	73.66	87.27	68.67	114.98	40.67	61.06	47.13
	11-May-2004	70.41	89.95	87.63	45.97		53.65	96.70	19.26	24.61	20.39	32.25	41.72	38.26	74.50	88.05	68.58	115.00	41.25	61.05	47.59
	18-Jun-2004	70.30	79.82	88.01	45.99	102.21	53.66	97.09	19.80	25.07	20.50	32.46	42.28	38.23	73.62	87.48	68.36	115.12	40.24	60.70	46.33
	27-Jul-2004	70.30	76.75	88.02	46.10	102.15	53.67	96.98	20.01	25.10	20.57	32.55	42.53	38.55	75.04	87.39	68.62	115.35	41.13	60.75	47.97
	27-Aug-2004	70.48	75.95	88.56	46.35	102.77	53.65	97.66	20.07	25.57	20.72	32.66	43.04	39.81	74.64	87.79	69.05	115.75	41.66	60.83	47.98
	21-Sep-2004	70.72	75.80	88.53	46.64	102.75	53.65	97.59	20.17	25.53	20.75	32.68	43.27	40.13	74.34	87.83	69.36	115.80	42.30	61.14	47.91
	14-Oct-2004	70.68	123.63	88.37	46.73	102.58	53.68	97.53	19.94	25.40	20.63	32.73	42.74	39.38	74.50	87.75	69.56	115.44	42.52	61.10	47.66
	22-Nov-2004	71.14	91.90	88.58	46.84	102.45	53.66	97.20	20.19	25.57	20.84	32.70	43.18	39.85	74.54	87.87	69.66	115.91	42.60	61.35	48.47
	08-Dec-2004	71.39	85.75	87.78	47.10	101.98	53.67	96.79	19.90	24.67	20.83	32.76	41.75	40.05	75.39	88.57	70.35	115.28	43.36	61.53	48.61
	04-Jan-2005	71.55	80.57	88.38	47.08	102.37	53.68	97.32	19.74	25.24	20.85	32.84	43.80	40.36	75.72	88.76	70.60	115.57	43.42	61.70	48.80
	01-Feb-2005	71.86	78.32	87.95	47.16	102.14	53.60	96.97	19.23	24.85	20.87	32.79	42.15	41.10	78.02	89.71	70.95	115.24	43.21	61.92	49.95
	14-Mar-2005	72.35	72.32	88.10	47.52	102.31	53.70	97.10	19.82	24.95	21.10	32.93	42.05	41.82	78.90	90.70	71.53	115.43	93.50	62.25	51.12
	11-Apr-2005	72.43	126.53	87.85	47.56	101.86	53.62	96.61	19.01	24.40	20.62	32.53	41.85	41.18	78.67	90.21	71.42	115.89	42.51	62.32	50.63
	16-May-2005	72.15	94.57	88.27	47.37	102.47	53.62	97.27	19.50	25.17	21.02	32.88	43.32	41.69	77.12	90.13	71.10	115.47	42.23	62.33	50.48
	13-Jun-2005	71.95	84.39	88.30	47.26	102.61	53.62	97.39	19.79	25.33	21.10	32.94	43.41	41.73	76.49	89.76	71.98	115.74	42.08	62.48	50.33
	19-Sep-2005	78.59	72.56	89.82	49.41	103.81	53.41	98.30	22.31	26.70	21.97	33.40	43.35	43.22	79.73	92.54	72.03	117.10	44.17	62.54	51.60
	27-Oct-2005	81.11	72.82	88.56	49.68	102.68	54.14	97.08	22.01	25.25	22.01	33.51	44.93	43.90	81.75	93.45	72.97	116.60	44.80	62.81	52.16
	30-Nov-2005	79.20	73.30	88.20	50.07	102.11	54.21	96.79	22.18	24.81	22.21	33.31	43.75	44.03	80.61	93.00	72.78	116.13	45.00	62.73	52.05
	30-Dec-2005	78.86	73.32	88.35	50.30	102.31	54.16	96.99	22.03	24.93	22.16	33.68	43.55	43.90	80.03	93.25	73.17	116.03	44.92	62.87	52.20
	25-Jan-2006	78.78	73.72	88.10	50.47	102.31	54.13	96.75	21.69	24.75	22.00	33.56	43.61	43.82	80.55	93.31	73.54	115.98		63.15	
	16-Feb-2006	78.70	73.45	88.18	50.50	102.20	53.65	97.04	20.91	24.85	21.40	33.28	43.95	43.80	80.45	92.55	73.40	116.13	45.28	63.00	
	16-Mar-2006	81.39	73.45	88.00	50.45	102.09	53.65	97.58	20.68	25.46	21.35	33.31	45.52	44.10	80.05	92.28	71.31	116.48	43.73	63.00	
	19-Apr-2006	73.75	79.85	88.88	50.59	103.00	54.10	87.71	21.30	25.68	22.08	33.40	44.80	44.51	80.21	92.61	73.50	116.55	44.30	63.17	52.12
	30-May-2006	79.79	74.50	89.50	50.84	103.90	54.12	98.34	20.06	26.56	22.42	34.00	46.75	45.13	80.75	92.90	73.79	117.42	45.02	63.65	52.91
	29-Jun-2006	80.06	74.56	88.95	51.09	102.20	54.10	96.30	22.20	24.33	22.48	33.68	45.70	45.50	80.72	93.04	74.02	117.47	45.70	63.82	
	24-Jul-2006	80.22	74.84	89.10	51.27	103.25	54.11	97.69	21.92	25.76	22.60	34.18	45.00	44.92	81.10	93.18	74.23	117.45	45.63	64.09	
	24-Aug-2006	80.30	74.96	90.63	51.42	104.62	54.11	98.98	22.50	27.21	22.77	34.39	49.40	45.79	81.50	93.45	74.38	118.53	46.11	64.15	
	25-Sep-2006	80.55	75.05	90.00	51.60	104.02	54.21	98.21	22.52	26.22	22.79	34.35	49.00	45.75	81.80	93.80	74.68	118.55	46.16	64.41	

Parameter	Date	Well Number																			
		1A	1B	2A	2B	3B	4A	4B	5A	5B	6A	7A	7B	8A	9A	10A	11A	11B	12A	13A	14A
Potentiometric Surface Elevation (amsl)	19-Jul-2002	81.85	76.62	55.23	97.61	55.45	95.57	52.22	59.19	51.62	70.25	62.36	48.72	99.34	100.21	104.49	110.24	66.89	107.20	95.01	103.11
	18-Mar-2003	81.40	75.11	56.97	98.75	57.32	95.72	54.25	62.08	53.40	70.65	63.05	51.65	100.78	100.06	104.02	110.48	68.34	112.43	95.36	106.18
	12-Jun-2003	82.91	65.14	57.82	100.35	57.94	95.80	54.90	61.53	54.17	71.05	63.49	52.34	103.59	102.56	105.78	112.67	68.94	117.58	96.68	108.05
	23-Jul-2003	84.37	73.52	58.30	101.18	58.50	95.74	55.63	61.63	54.60	71.25	63.63	52.56	105.82	104.89	107.24	114.10	69.00	116.11	97.20	109.73
	11-Aug-2003	85.02	75.46	56.99	101.36	57.06	95.74	53.81	61.06	53.03	71.20	63.70	52.28	105.84	105.70	108.00	114.55	69.04	114.64	97.53	109.22
	08-Sep-2003	85.35	77.14	56.80	101.18	56.85	95.64	53.44	60.28	52.62	70.97	63.59	52.16	105.25	106.08	108.61	114.73	69.02	113.05	97.57	108.65
	29-Oct-2003	85.65	59.55	59.01	101.15	59.18	95.74	56.56	60.49	55.35	71.26	63.79	54.10	105.47	106.36	109.62	115.10	69.96	111.50	97.57	108.30
	18-Nov-2003	85.49	68.51	57.59	101.05	57.53	95.75	54.36	60.62	53.62	71.25	63.77	53.48	105.55	105.94	109.57	115.09	69.72	111.07	97.56	106.08
	22-Dec-2003	85.47	75.11	58.10	101.05	58.00	95.77	54.84	61.86	54.22	71.71	64.08	54.22	106.23	106.48	109.76	115.14	70.02	111.51	97.46	109.03
	14-Jan-2004	85.79	77.01	57.85	101.56	57.72	95.77	54.49						106.17	107.24	110.49	115.96	70.15	111.85	97.63	108.49
	27-Feb-2004	85.77	78.57	57.76	101.43	57.67	95.78	54.43	61.16	53.69	71.58	63.99	53.83	105.95	107.31	110.64	116.20	70.12	111.33	97.21	108.11
	29-Mar-2004	85.72	78.87	57.71	101.31	57.75	95.74	54.28	60.66	53.56	71.35	63.87	54.34	105.59	107.43	110.97	116.37	70.40	110.77	97.04	107.82
	22-Apr-2004	85.51	52.35	57.74	101.28	57.80	95.73	54.36	60.93	53.63	71.48	63.95	54.01	105.83	107.20	110.95	116.55	70.52	111.06	97.00	107.83
	11-May-2004	85.41	64.64	57.78	101.36		95.73	54.47	60.75	53.66	71.31	63.87	53.71	105.96	106.36	110.17	116.64	70.50	110.48	97.01	107.37
	18-Jun-2004	85.52	74.77	57.40	101.34	57.54	95.72	54.08	60.21	53.20	71.20	63.66	53.15	105.99	107.24	110.74	116.86	70.38	111.49	97.36	108.63
	27-Jul-2004	85.52	77.84	57.39	101.23	57.60	95.71	54.19	60.00	53.17	71.13	63.57	52.90	105.67	105.82	110.83	116.60	70.15	110.60	97.31	106.99
	27-Aug-2004	85.34	78.64	56.85	100.98	56.98	95.73	53.51	59.94	52.70	70.98	63.46	52.39	104.41	106.22	110.43	116.17	69.75	110.07	97.23	106.98
	21-Sep-2004	85.10	78.79	56.88	100.69	57.00	95.73	53.58	59.84	52.74	70.95	63.44	52.16	104.09	106.52	110.39	115.86	69.70	109.43	96.92	107.05
	14-Oct-2004	85.14	30.96	57.04	100.60	57.17	95.70	53.64	60.07	52.87	71.07	63.39	52.69	104.84	106.36	110.47	115.66	70.06	109.21	96.96	107.30
	22-Nov-2004	84.68	62.69	56.83	100.49	57.30	95.72	53.97	59.82	52.70	70.86	63.42	52.25	104.37	106.32	110.35	115.56	69.59	109.13	96.71	106.49
	08-Dec-2004	84.43	68.84	57.63	100.23	57.77	95.71	54.38	60.11	53.60	70.87	63.36	53.68	104.17	105.47	109.65	114.87	70.22	108.37	96.53	106.35
	04-Jan-2005	84.27	74.02	57.03	100.25	57.38	95.70	53.85	60.27	53.03	70.85	63.28	51.63	103.86	105.14	109.46	114.62	69.93	108.31	96.36	106.16
	01-Feb-2005	83.96	76.27	57.46	100.17	57.61	95.78	54.20	60.78	53.42	70.83	63.33	53.28	103.12	102.84	108.51	114.27	70.26	108.52	96.14	105.01
	14-Mar-2005	83.47	82.27	57.31	99.81	57.44	95.68	54.07	60.19	53.32	70.60	63.19	53.38	102.40	101.96	107.52	113.69	70.07	58.23	95.81	103.84
	11-Apr-2005	83.39	28.06	57.56	99.77	57.89	95.76	54.56	61.00	53.87	71.08	63.59	53.58	103.04	102.19	108.01	113.80	69.61	109.22	95.74	104.33
	16-May-2005	83.67	60.02	57.14	99.96	57.28	95.76	53.90	60.51	53.10	70.68	63.24	52.11	102.53	103.74	108.09	114.12	70.03	109.50	95.73	104.48
	13-Jun-2005	83.87	70.20	57.11	100.07	57.14	95.76	53.78	60.22	52.94	70.60	63.18	52.02	102.49	104.37	108.46	113.24	69.76	109.65	95.58	104.63
	19-Sep-2005	77.23	82.03	55.59	97.92	55.94	95.97	52.87	57.70	51.57	69.73	62.72	52.08	101.00	101.13	105.68	113.19	68.40	107.56	95.52	103.36
	27-Oct-2005	74.71	81.77	56.85	97.65	57.07	95.24	54.09	58.00	53.02	69.69	62.61	50.50	100.32	99.11	104.77	112.25	68.90	106.93	95.25	102.80
	30-Nov-2005	76.62	81.29	57.21	97.26	57.64	95.17	54.38	57.83	53.46	69.49	62.81	51.68	100.19	100.25	105.22	112.44	69.37	106.73	95.33	102.91
	30-Dec-2005	76.96	81.27	57.06	97.03	57.44	95.22	54.18	57.98	53.34	69.54	62.44	51.88	100.32	100.83	104.97	112.05	69.47	106.81	95.19	102.76
	25-Jan-2006	77.04	80.87	57.31	96.86	57.44	95.25	54.42	58.32	53.52	69.70	62.56	51.82	100.40	100.31	104.91	111.68	69.52		94.91	
	16-Feb-2006	77.12	81.14	57.23	96.83	57.55	95.73	54.13	59.10	53.42	70.30	62.84	51.48	100.42	100.41	105.67	111.82	69.37	106.45	95.06	
	16-Mar-2006	74.43	81.14	57.41	96.88	57.66	95.73	53.59	59.33	52.81	70.35	62.81	49.91	100.12	100.81	105.94	113.91	69.02	108.00	95.06	
	19-Apr-2006	82.07	74.74	56.53	96.74	56.75	95.28	63.46	58.71	52.59	69.62	62.72	50.63	99.71	100.65	105.61	111.72	68.95	107.43	94.89	102.84
	30-May-2006	76.03	80.09	55.91	96.49	55.85	95.26	52.83	59.95	51.71	69.28	62.12	48.68	99.09	100.11	105.32	111.43	68.08	106.71	94.41	102.05
	29-Jun-2006	75.76	80.03	56.46	96.24	57.55	95.28	54.87	57.81	53.94	69.22	62.44	49.73	98.72	100.14	105.18	111.20	68.03	106.03	94.24	
	24-Jul-2006	75.60	79.75	56.31	96.06	56.50	95.27	53.48	58.09	52.51	69.10	61.94	50.43	99.30	99.76	105.04	110.99	68.05	106.10	93.97	
	24-Aug-2006	75.52	79.63	54.78	95.91	55.13	95.27	52.19	57.51	51.06	68.93	61.73	46.03	98.43	99.36	104.77	110.84	66.97	105.62	93.91	
	25-Sep-2006	75.27	79.54	55.41	95.73	55.73	95.17	52.96	57.49	52.05	68.91	61.77	46.43	98.47	99.06	104.42	110.54	66.95	105.57	93.65	
Highest Reported Elevation		85.79	82.27	59.01	101.56	59.18	95.97	63.46	62.08	55.35	71.71	64.08	54.34	106.23	107.43	110.97	116.86	70.52	117.58	97.63	109.73
Lowest Reported Elevation		74.43	28.06	54.78	95.73	55.13	95.17	52.19	57.49	51.06	68.91	61.73	46.03	98.43	99.06	104.02	110.24	66.89	58.23	93.65	102.05

Parameter	Date	Well Number																			
		1A	1B	2A	2B	3B	4A	4B	5A	5B	6A	7A	7B	8A	9A	10A	11A	11B	12A	13A	14A
Total Depth (feet)	7/19/2002	148.55	83.46	149.48	56.11	150.45	62.67	146.92	26.92	61.72	36.63	52.00	94.00	50.11	87.76	101.55	82.60	158.08	52.55	70.27	57.55
	3/18/2003	148.40	83.30	149.52	55.95	150.25	62.68	146.75	26.68	51.53	36.32	51.70	95.45	49.93	87.31	101.35	82.45	157.90	51.90	70.14	57.45
	9/10/2003	148.55	83.46	149.48	56.11	150.45	62.67	146.92	26.92	61.72	36.63	52.00	94.00	50.11	87.76	101.55	82.60	158.08	52.55	70.27	57.55
	9/21/2004	83.46	148.55	149.48	56.11	150.45	62.67	146.92	26.92	61.72	36.63	52.00	94.00	50.11	87.76	101.55	82.60	158.08	52.55	70.27	57.55
	3/14/2005	151.82	83.24	88.60	55.66	150.98	62.72	146.65	30.60	61.42	36.20	51.52	45.20	49.81	82.40	101.21	82.21	158.90	49.65	70.06	61.10
	9/19/2005	149.48	83.16	NM	NM	150.21	NM	NM	27.98	61.30	36.09	NM	NM	NM	89.01	103.71	83.27	NM	NM	70.00	57.18
pH	7/19/2002	6.4	5.411	4.28	5.84	5.43	4.01	5.21	5.34	4.16	5.89	5.5	5.04	6.18	4.81	4.88	5.22	6.35	5.23	4.76	4.12
	3/18/2003	5.44	6.26	4.18	6.13	4.06	3.59	4.52	5.98	4.29	5.96	5.83	5.89	6.25	4.87	4.75	5.06	8.78	5.2	4.51	5.59
	9/10/2003	5.72	6.06	4.19	6.03	4.86	3.43	3.72	5.88	4.46	5.95	5.65	5.36	6.21	5	4.9	5.4	8.07	4.9	4.71	5.3
	9/21/2004	4.72	5.59	4.1	5.95	5.10	3.87	4.55	6.14	5.42	5.95	5.32	5.31	6.22	4.1	5.24	5.4	5.34	5.24	4.93	4.48
	3/14/2005	4.34	5.59	NM	5.17	4.76	3.93	4.05	5.31	5.05	5.36	4.58	4.57	5.29	4.19	5.86	5.39	5.48	5.26	4.74	3.45
	9/19/2005	8.30	8.21	8.21	8.24	7.92	6.61	6.71	9.12	8.51	9.09	7.79	7.71	8.17	6.87	7.71	7.46	9.46	NM	7.89	6.89
	2/14/2006	6.64	6.57	6.11	7.35	6.87	6.07	6.15	7.54	6.81	7.19	7.18	6.78	7.16	7.07	7.07	7.56	8.42	NM	6.34	NM
Specific Conductivity (µS/cm)	7/19/2002	1,000	118	54	541	32	93	40	429	99	360	193	181	503	50	35	53	78	176	104	763
	3/18/2003	800	95	75	588	290	195	40	341	120	334	253	227	454	470	450	740	111	128	149	140
	9/10/2003	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
	9/21/2004	106	85	56	463	38	127	38	1,380	156	221	161	170	990	28	27	30	143	288	114	156
	3/14/2005	490	42	NM	213	35	195	33	700	118	335	177	163	581	43	32	200	87	700	130	648
	9/19/2005	630	510	82	720	33	19,030	49	910	147	300	178	163	896	42	44	40	112	NM	158	1,288
	2/14/2006	70	54	81	770	32	165	47	387	132	328	178	144	668	45	44	32	106	NM	156	NM
Turbidity (NTU)	7/19/2002	10	8	51	150	92	70	6	53	73	29	67	30	285	532	1.05	592	87	112	246	212
	3/18/2003	20	33	360	11	270	48	14	518	43	279	26	20	258	271	32	465	28	253	65	23
	9/10/2003	10	11	21	7	76	70	30	58	21	129	139	97	37	74	>999	>999	56	10	146	287
	9/21/2004	0	-3	18	258	-10	3	1	10	5	20	16	46	103	102	225	130	274	27	59	815
	3/14/2005	156	43	NM	39	35	19	241	8	18	0	8	5	18	154	191	42	170	48	12	999
	9/19/2005	57.7	84.3	48.5	72.1	96.9	414	18.32	248	51.8	41.3	110	93.6	82.5	88.5	78.1	2,000	91.5	NM	137	98.6
	2/14/2006	57	45.9	32.5	32.3	62.3	478	85.3	280	49.0	66.4	61.4	106	75.3	104	304	2,000	840	NM	113	NM
Dissolved Oxygen (mg/l)	7/19/2002	14.07	13.56	14.7	14.2	14.54	11.7	12.57	12.3	12.13	10.74	12.58	12.44	15.42	12.45	13.98	13.04	12.95	12.56	14.09	12.59
	3/18/2003	9.76	9.65	10.04	9.11	9.62	9.19	9.61	10.86	10.61	11.3	10.69	9.75	10.23	10.53	10.67	10.34	10.34	10.13	9.67	9.63
	9/10/2003	5.76	10.53	12.28	12.58	5.61	12.2	13.3	13.38	14.1	15.78	15.84	15.88	11.27	11.32	11.41	12.34	12.27	12.5	12.35	11.81
	9/21/2004	10.60	10.30	10.45	11.75	12.33	11.08	10.61	10.87	11.07	10.10	11.15	11.12	11.35	12.16	13.10	13.29	11.08	11.45	11.24	11.73
	3/14/2005	9.43	10.31	NM	11.20	10.31	10.20	9.98	11.15	10.70	9.4	11.06	10.96	12.55	9.98	10.30	10.82	10.12	10.63	10.76	10.53
	9/19/2005	0.83	1.85	0.96	0.52	1.56	0.21	1.58	2.02	1.22	0.80	1.00	0.78	0.62	1.11	0.89	0.85	0.42	NM	1.33	1.53
	2/14/2006	0.18	0.45	0.01	0.16	6.59	7.23	5.94	9.29	4.10	0.27	0.00	0.91	0.24	9.26	9.58	9.31	0.00	NM	7.06	NM
Temperature (°C)	7/19/2002	17.4	18.9	19.8	20.4	17.6	19.1	17.7	15.9	16.4	19.7	16.4	16.6	20.1	16.5	15.9	15.9	16.2	18.3	17.5	15.8
	3/18/2003	12.3	13.5	13.7	14.7	12.7	13	11.5	9.6	12.9	13.5	11.3	9.6	12.5	12.4	10.6	11.4	11.3	13	11.9	12.4
	9/10/2003	14.1	15.1	16.5	16.4	13.8	15.5	14.7	15.9	15.6	16	15.8	15.5	15.7	16.2	15.5	14.2	14.1	17.3	17.1	15.8
	9/21/2004	16.3	15.7	15.5	16.3	16.7	15.9	15.1	16.0	15.6	17.6	15.6	15.5	17.5	16.8	15.8	16.5	14.5	15.8	15.6	16.5
	3/14/2005	12.8	11.8	NM	13.1	12.5	12.8	12.3	12.0	12.9	14.9	12.7	13.0	12.8	11.8	10.8	11.1	11.2	11.7	12.6	12.3
	9/19/2005	18.40	19.80	18.31	18.45	17.11	19.03	18.32	17.46	16.81	18.30	18.35	17.21	17.00	18.04	18.28	21.50	19.01	NM	19.11	17.90
	2/14/2006	16.78	15.98	17.03	17.63	17.45	15.96	16.68	15.22	15.60	17.67	14.69	16.13	16.36	16.38	16.30	18.28	16.66	NM	15.68	NM

NOTES: NM = Not Measured
µS/cm = microseimens per centimeter
NTU = Nephelometric Turbidity Units
mg/l = milligrams per liter
°C = Degrees Centigrade

Appenidx G. Historical general water quality parameters, Tolson Rubble Landfill, Crofton, Maryland

Well	Date	pH	Alkalinity (mg/l)	TDS (mg/l)	Hardness (mg/l)	Chloride (mg/l)	Sulfate (mg/l)	TOC (mg/l)	Turbidity (NTU)	Specific Conductivity (µS/cm)	TOX (mg/l)	COD (mg/l)	Nitrogen, Ammonia (mg/l)	Nitrogen, Nitrate + Nitrite (mg/l)	Nitrogen, Nitrate (mg/l)	Nitrogen, Nitrite (mg/l)
NPDWR Standard:									**5**							
NSDWR Standard:		**6.5-8.5**		**500**		**250**	**250**								**10**	**1**
MW-1A	1/1/2000	6.81	300	400	290	30	23	20	1.1	720	31	45	4.3	0.2		< 0.02
	9/26/2000													< 0.10		
	7/19/2002	6.2	385	524	328	28.1	< 20	17.1	258	892	< 0.20	88.9	4.2	< 0.10	< 0.11	< 0.010
	3/18/2003	6.5	314	371	243	20.7	33.8	10.4	103	621	< 0.050	40	3.3	<0.04	< 0.11	< 0.010
	9/10/2003	6.1	231	298	209	20	26	11.1	22.2	546	< 0.014	45.5	3.3	0.21		
	4/2/2004	5.8	52	79.5	43.1	4.9	8.9	2.4	34.2	148.	< 0.014	21.5 J	0.49	0.33		
	9/23/2004	5.74	23.5	94	25.1	< 20	< 20	3.5	55.3	69	< 0.05	< 20	< 0.1	0.50	0.33	< 0.01
	3/17/2005	5.46	13.8	34.0	23.9	2.4	5.1	< 0.1	25.7	55.6	5.0	29.5	0.15		0.50	< 0.01
	9/19/2005	5.27	7.2	46	11.7	4.51	9.90	ND (1.0)	1.30	59	ND (0.010)	ND (10)	ND (0.20)	ND (0.08)	ND (0.06)	ND (0.02)
	2/14/2006	5.87	8.9	44	13.4	5.06	14.1	ND (1.0)	0.77	66	0.019	12	ND (0.20)	ND (0.08)	ND (0.06)	ND (0.02)
MW-1B	1/1/2000	6.21	12.0	92	31	4	21	12	110	110	< 5.0	29	0.4	0.05		< 0.02
	9/26/2000													< 0.10		
	7/19/2002	4	< 5.0	48	15.6	< 20	< 20	8.8	54.6	46.9	< 0.20	76.2	< 0.10	0.1	< 0.11	< 0.010
	3/18/2003	5.4	< 5.0	80	41.6	< 20	26.5	5.3	494	141	< 0.050	25	< 0.10	<0.04	< 0.11	< 0.010
	9/10/2003	4.4	< 0.41	52	15.5	3.5	22.7	18.3	28.1	82.7	< 0.014	95.5	0.064 J	0.045 J		
	4/2/2004	5.8	10.2	65.5	24.4	5.0	17.0	4.3	13.3	95.6	<14.0	23.9 J	0.20	< 0.1		
	9/23/2004	5.7	16.2	42	13.4	< 20	20.2	3.4	20.8	69.6	< 0.2	39.6	0.15	< 0.1	< 0.11	< 0.01
	3/17/2005	4.03	< 5	22.0	8.0	8.9	16.7	< 0.1	12.9	64.7	1.2	< 20	< 0.1		< 0.11	< 0.01
	9/19/2005	5.35	10	34	13.6	2.55	5.17	ND (1.0)	4.11	47	ND (0.010)	ND (10)	ND (0.20)	0.71	0.71	ND (0.02)
	2/14/2006	5.91	12.9	53	15.5	2.85	7.24	ND (1.0)	1.5	52	0.014	13	ND (0.20)	0.34	0.34	ND (0.02)
MW-2A	1/1/2000	4.31	<1	66	5	2	15	< 0.1	2.6	78	< 5.0	<10	< 0.2	1.5		< 0.02
	9/26/2000													< 0.10		
	7/19/2002	4.1	< 5.0	31	<4.0	< 20	< 20	11.8	28.9	50.3	< 0.20	38.1	< 0.10	0.13	< 0.11	< 0.010
	3/18/2003	4.2	< 5.0	24	8.8	< 20	25.6	2.1	13.5	64	< 0.050	< 20	< 0.10	<0.04	0.13	< 0.010
	9/10/2003	4.2	< 0.41	30	6.8	2.2	14.1	10.9	13.6	67.3	< 0.014	45.5 J	0.048 J	<0.04		
	4/2/2004	4.2	< 0.41	40.0	10.6	2.4	14.2	9.3	66.4	62.5	< 0.014	43.4 J	0.086 J	< 0.1		
	9/23/2004	4.02	< 5	27.0	5	< 20	< 20	1	7.6	58.5	< 0.2	< 20	< 0.1	NS	< 0.11	< 0.01
	3/17/2005	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		NS	NS
	9/22/2005	4	ND(1.0)	32	4.8	2.2	35	ND(1.0)	1.2	80	ND(0.010)	ND(10)	ND(0.20)	ND(0.08)	ND(0.06)	ND(0.02)
	2/15/2006	4.05	ND	62	4.01	2.34	33.2	ND (1.0)	0.19	76	ND (0.010)	ND (10)	ND (0.20)	ND (0.08)	ND (0.06)	ND (0.02)
MW-2B	1/1/2000	6.49	260	310	340	12	51	18	21	680	0.013	42	1.6	< 0.02		< 0.02
	9/26/2000													< 0.10		
	7/19/2002	5.8	225	300	192	< 20	46	10.7	159	483	< 0.20	48.3	0.95	0.12	< 0.11	< 0.010
	3/18/2003	6.1	235	306	199	< 20	47.8	12.8	31.9	433	< 0.050	72.5	0.74	<0.04	< 0.30	< 0.20
	9/10/2003	6	150	246	96.1	3.9	75.5	15.1	29.3	444	0.0199	81.2	0.44	<0.04		
	4/2/2004	6.0	156	306	110	3.8	107	6.5	15.5	480	< 0.014	48.3 J	0.28	< 0.1		
	9/23/2004	6.4	175	313	2180	< 20	116	5.9	72.8	373	< 0.05	31.7	0.26	< 0.1	< 0.11	< 0.01
	3/17/2005	6.28	173	402	114	5.5	81.9	< 0.1	908	329	7.2	54.1	0.35		< 0.11	< 0.01
	9/22/2005	5.76	96	293	125	4.99	89	3.7	77	504	0.381	28	0.4	ND(0.08)	ND(0.06)	ND(0.02)
	2/15/2006	6.13	77.5	55	144	6.20	74.6	6.2	260	498	0.023	37	0.40	ND (0.08)	ND (0.06)	ND (0.02)
MW-3B	1/1/2000	5.16	1.0	100	4	2	6	< 0.1	61	32	< 5.0	<10	0.6	0.63		< 0.02
	9/26/2000													0.77		
	7/19/2002	4.6	< 5.0	28	5.9	< 20	< 20	20.8	29.3	172	< 0.20	91.4	< 0.10	0.84	0.77	< 0.010
	3/18/2003	5.2	< 5.0	20	<4.0	< 20	< 20	1.1	9.2	37.1	< 0.050	< 20	< 0.10	0.7	0.82	0.017
	9/10/2003	5.2	< 0.41	16.5 J	12.1	3.1	3.3 J	2.6	9.5	35.7	< 0.014	26.5	0.09 J	0.79		
	4/2/2004	5.1	1.4 J	29.0 J	9.0	2.7	4.1 J	0.91 J	35.9	33.7	< 0.014	43.4 J	0.035 J	0.91		
	9/23/2004	4.97	< 5	<10	5.0	< 20	< 20	<1	5.3	32.5	< 0.05	< 20	< 0.1	0.87	0.91	< 0.01
	3/17/2005	5.18	< 5	<10	8.0	2.9	4.4	< 0.1	2.5	36.5	2.4	< 20	< 0.1		0.87	< 0.01
	9/19/2005	4.76	1.3	32	3.61	2.65	5.93	ND (1.0)	0.24	30	ND (0.010)	ND (10)	ND (0.20)	0.83	0.83	ND (0.02)
	2/16/2006	5.64	2.3	17	4.53	2.80	4.78	ND (1.0)	5.5	27	ND (0.010)	ND (10)	ND (0.20)	0.77	0.77	ND (0.02)

Appenidx G. Historical general water quality parameters, Tolson Rubble Landfill, Crofton, Maryland

Well	Date	pH	Alkalinity (mg/l)	TDS (mg/l)	Hardness (mg/l)	Chloride (mg/l)	Sulfate (mg/l)	TOC (mg/l)	Turbidity (NTU)	Specific Conductivity (µS/cm)	TOX (mg/l)	COD (mg/l)	Nitrogen, Ammonia (mg/l)	Nitrogen, Nitrate + Nitrite (mg/l)	Nitrogen, Nitrate (mg/l)	Nitrogen, Nitrite (mg/l)
NPDWR Standard:									**5**							
NSDWR Standard:		**6.5-8.5**		**500**		**250**	**250**								**10**	**1**
MW-4A	1/1/2000	4.89	150	120	8	4	19	4.6	260	83	< 5.0	63	< 0.2	< 0.02		< 0.02
	9/26/2000													< 0.10		
	7/19/2002	3.4	< 5.0	40	5.8	< 20	34.6	2	950	108	< 0.20	< 20	0.1	< 0.10	< 0.11	< 0.010
	3/18/2003	3.7	< 5.0	97.5	32.9	< 20	93	47	38,900	45.4	< 0.20	75	< 0.10	<0.04	< 0.11	< 0.010
	9/10/2003	3.8	< 0.41	87	21.1	4.8	69.8	1.9 J	4.6	205	< 0.014	19.3	0.05 J	<0.040		
	4/2/2004	3.7	< 0.41	185	31.9	4.7	149	3.4	87.6	301	< 0.014	19.0 J	0.041 J	< 0.1		
	9/23/2004	3.77	< 5	127	20	< 20	39.5	2.5	103	168	< 0.05	< 20	< 0.1	< 0.1	< 0.11	< 0.01
	3/17/2005	3.86	< 5	81	25.9	5.6	93.6	< 0.1	26.1	203	2.2	27.1	< 0.1		< 0.11	< 0.01
	9/22/2005	3.57	ND(1.0)	74	6.87	4.66	68.4	ND (1.0)	330	205	62	ND (10)	ND (0.20)	ND(0.08)	ND(0.06)	ND (0.02)
	2/15/2006	3.85	ND	85	7.19	4.84	65.9	ND (1.0)	56	156	0.245	ND (10)	ND (0.20)	ND (0.08)	ND (0.06)	ND (0.02)
MW-4B	1/1/2000	4.55	1.0	6	4	2	8	0.1	2.4	41	< 5.0	<10	0.5	< 0.02		< 0.02
	9/26/2000													0.44		
	7/19/2002	4.7	8.2	39	42.8	< 20	< 20	4.6	134	55.9	< 0.20	< 20	0.15	0.39	0.44	< 0.010
	3/18/2003	4.5	< 5.0	22	<4.0	< 20	< 20	3.2	38.8	172	< 0.20	< 20	< 0.10	0.33	0.39	< 0.010
	9/10/2003	4.4	< 0.41	14.5 J	4.8	2.7	23.8	1.5 J	20.7	41.2	< 0.014	16.9	0.04 J	0.37		
	4/2/2004	4.3	< 0.41	22.5 J	5.6	2.4	6.7	0.80 J		36.0	0.0394	19.0 J	0.033 J	0.33		
	9/23/2004	4.22	< 5	12	6.7	< 20	< 20	<1	24.4	37.4	< 0.2	< 20	< 0.1	0.38	0.33	< 0.01
	3/17/2005	4.38	< 5	10.0	23.9	2.3	22.8	< 0.1	13.6	39.2	2.8	22.1	< 0.1		0.38	< 0.01
	9/22/2005	4.32	ND (1.0)	24	3.30	2.28	19.7	ND (1.0)	1.3	46	ND (10)	ND (10)	ND (0.20)	0.39	0.39	ND (0.02)
	2/15/2006	4.39	ND	34	3.03	2.32	12.0	ND (1.0)	1.6	42	ND (0.010)	ND (10)	ND (0.20)	0.39	0.39	ND (0.02)
MW-5A	1/1/2000	6.13	32.0	230	52	59	45	1	32	420	< 5.0	16	< 0.2	< 0.02		< 0.02
	9/26/2000													1.2		
	7/19/2002	5.5	40.3	272	95.3	93.1	53.2	5.4	558	522	< 0.20	20	< 0.10	1.3	1.2	< 0.010
	3/18/2003	5.9	31.8	172	52.6	47.3	31.2	3.7	116	375	< 0.20	47.5	< 0.10	0.78	1.3	< 0.010
	9/10/2003	6	75.8	434	152	138	80.7	5.0	11.3	760	0.0185 J	47.9 J	0.034 J	0.81		
	4/2/2004	6.1	107	436	149	123	76.3	5.7	15.1	784	0.0246 J	41.0 J	0.038 J	0.59		
	9/23/2004	6.5	191	792	235	264	63.6	7.6	22.7	1290	0.27	< 20	0.13	0.66	0.59	< 0.01
	3/17/2005	6.46	141	422	160	125	41.7	< 0.2	37.1	710	5.2	< 20	< 0.1		0.66	< 0.01
	9/19/2005	5.92	99	479	149	160	51.3	4.2	563	875	0.055	ND (10)	ND (0.20)	0.30	0.30	ND (0.02)
	2/14/2006	6.31	62.9	315	88.5	96.5	38.8	2.3	140	516	0.046	18	ND (0.20)	1.14	1.14	ND (0.02)
MW-5B	1/1/2000	4.39	<1.0	4	5	4	15	< 0.1	0.6	86	< 5.0	<10	< 0.2	< 0.02		< 0.02
	9/26/2000													< 0.10		
	7/19/2002	3.6	< 5.0	99	<4.0	< 20	23	1.3	66	73.7	< 0.20	< 20	< 0.10	0.14	< 0.11	>0.010
	3/18/2003	4.5	< 5.0	59	24.1	< 20	22.5	6.8	26.1	1050	< 0.20	32.5	< 0.10	<0.04	0.14	< 0.010
	9/10/2003	4.5	< 0.41	39	12.5	7.9	18.8	1.3 J	3.8	83.2	< 0.014	21.7	0.051 J	0.046 J		
	4/2/2004	4.2	< 0.41	47.0	11.2	7.0	16.9	0.76 J	18.5	81.8	< 0.014	19.0 J	0.031 J	< 0.1		
	9/23/2004	4.69	< 5	36.0	23.4	< 20	21.6	1.2	15.3	99.4	< 0.2	< 20	< 0.1	< 0.1	< 0.11	< 0.01
	3/17/2005	5.21	12.3	58.0	34	21.6	19.2	< 0.2	12.9	120	1.2	< 20	< 0.1		< 0.11	< 0.01
	9/19/2005	4.70	1.3	51	9.71	8.21	26.3	ND (1.0)	1.29	82	ND (0.010)	ND (10)	ND (0.20)	0.08	0.08	ND (0.02)
	2/14/2006	5.23	1.9	90	17.2	20.7	21.8	ND (1.0)	0.56	127	0.016	14	ND (0.20)	0.12	0.12	ND (0.02)

Appenidx G. Historical general water quality parameters, Tolson Rubble Landfill, Crofton, Maryland

Well	Date	pH	Alkalinity (mg/l)	TDS (mg/l)	Hardness (mg/l)	Chloride (mg/l)	Sulfate (mg/l)	TOC (mg/l)	Turbidity (NTU)	Specific Conductivity (µS/cm)	TOX (mg/l)	COD (mg/l)	Nitrogen, Ammonia (mg/l)	Nitrogen, Nitrate + Nitrite (mg/l)	Nitrogen, Nitrate (mg/l)	Nitrogen, Nitrite (mg/l)
NPDWR Standard:									**5**							
NSDWR Standard:		**6.5-8.5**		**500**		**250**	**250**								**10**	**1**
MW-6A	1/1/2000	5.71	12.0	190	56	26	44	< 0.1	0.6	240	< 5.0	<10	< 0.2	0.40		< 0.02
	9/26/2000													0.72		
	7/19/2002	5.5	40.9	199	87.5	66.6	31.2	3.8	960	352	< 0.050	< 20	0.39	0.44	0.72	< 0.010
	3/18/2003	6	19.2	182	59.1	56.6	36.1	2.3	35.6	380	< 0.20	< 20	< 0.10	0.73	0.44	< 0.010
	9/10/2003	6.1	34.9	202	69.6	79.7	29.6	2.6	9	411	< 0.014	19.3 J	0.54	0.10		
	4/2/2004	6.2	40.4	166	54.9	46.0	32.4	2.5	10.3	313	< 0.014	11.7 J	0.44	0.23		
	9/23/2004	6.24	43.9	209	53.4	40.7	31.8	1.7	10.9	285	< 0.2	< 20	0.17	0.18	0.23	< 0.01
	3/17/2005	6.13	65.6	165	120	45.3	34.2	< 0.2	14.6	310	2.0	< 20	0.26		0.18	< 0.01
	9/19/2005	5.82	39	161	60.6	40.3	31.5	ND (1.0)	3.97	289	ND (0.010)	ND (10)	ND (0.20)	0.37	0.37	ND (0.02)
	2/14/2006	6.08	52.1	190	73.1	42.9	35.1	1.6	12	313	0.044	18	ND (0.20)	0.22	0.22	ND (0.02)
MW-7A	1/1/2000	5.39	4.0	34	12	8	10	22	20	78	< 5.0	16	< 0.2	0.41		< 0.02
	9/26/2000													< 0.10		
	7/19/2002	5.1	43.1	109	42.8	< 20	< 20	3.7	320	175	< 0.20	< 20	0.48	0.18	< 0.11	< 0.010
	3/18/2003	5.6	37.8	113	48.2	36	24.5	4.8	27.7	226	< 0.20	< 20	0.45	<0.04	0.18	< 0.010
	9/10/2003	5.5	42.7	110	52.3	22.6	21.7	4.8	4.9	213	0.0202	14.5 J	0.81	<0.040		
	4/2/2004	5.3	23.2	98.0	38.5	23.6	22.2	4.5	12.3	185	0.0222 J	19.0 J	0.39	< 0.1		
	9/23/2004	5.19	16.2	161.0	38.4	21.1	22.4	3.3	15	168	< 0.2	< 20	0.33	< 0.1	< 0.11	< 0.01
	3/17/2005	5.17	21.0	70.0	68	22.4	25.7	< 0.2	16.8	150	3.4	< 20	0.34		< 0.11	< 0.01
	9/22/2005	5.52	21	96	27.8	17.4	22.1	2.3	52	157	0.093	12	0.42	ND(0.08)	ND(0.06)	ND (0.02)
	2/14/2006	5.94	20.9	98	29.0	19.4	22.7	2.5	19	167	0.075	18	0.30	ND (0.08)	ND (0.06)	ND (0.02)
MW-7B	1/1/2000	5.98	7.0	40	12	5	13	< 0.1	11	74	< 5.0	25	0.2	0.09		< 0.02
	9/26/2000													0.32		
	7/19/2002	5.3	55.6	162	62.2	< 20	22.7	6.2	93	223	< 0.20	< 20	0.1	0.15	0.32	< 0.010
	3/18/2003	5.6	61.9	91	28.5	<40	22.6	6.2	49.3	161	< 0.20	22.5	0.2	<0.04	0.15	< 0.010
	9/10/2003	5.4	14.9	79	38.2	16.8	20.6	4.2	150	155	0.0219	50.3	0.24	<0.040		
	4/2/2004	5.4	23.4	101	44.3	18.7	21.1	4.5	25.8	179	< 0.014	24.6 J	0.33	< 0.1		
	9/23/2004	5.57	16.2	79	46.8	< 20	24.2	4	39.7	162	< 0.2	< 20	0.44	< 0.1	< 0.11	< 0.01
	3/17/2005	5.28	14.9	92.0	52	16.8	27.8	< 0.2	33.5	130	3.6	< 20	0.24		< 0.11	< 0.01
	9/22/2005	5.37	16	83	26.4	14.4	31.1	2.2	68	149	0.076	ND(10)	0.5	ND(0.08)	ND(0.06)	ND (0.02)
	2/14/2006	5.93	15.8	102	23.2	13.1	27.7	2.6	18	137	0.058	19	0.45	0.11	0.11	ND (0.02)
MW-8A	1/1/2000	7.06	160	230	150	9	19	7.1	29	390	0.012	32	0.3	0.06		<0.04
	9/26/2000	6.39		393	170	8.4	52.4	40	1200	634	0.234	121	0.73	0.16	<0.5	< 0.05
	7/19/2002	5.8	138	192	127	< 20	22.3	10.9	1790	315	< 0.20	73.7	0.49	< 0.10	0.16	< 0.010
	3/18/2003	6.1	206	209	548	< 20	43.4	11	746	262	< 0.050	40	0.51	<0.04	<0.35	< 0.25
	9/10/2003	6.5	276	323	130	4.7	6.8	33.2	234	325	0.0183 J	207	4.2	<0.040		
	4/2/2004	6.1	123	374	135	3.4	36.8	4.4	121	577	0.0157 J	94.7	3.4	< 0.1		
	9/23/2004	6.46	382	323	1950	< 20	39.4	13.5	578	348	< 0.05	79.2	2.9	< 0.1	< 0.11	< 0.01
	3/17/2005	6.21	83	365	64.7	2.6	101	< 0.1	1860	348	7.9	77.5	2.2		< 0.11	0.012
	9/22/2005	5.75	136	411	101	4.15	129	3.6	195	638	0.022	36	1.28	ND(0.08)	ND(0.06)	ND (0.02)
	2/15/2006	5.41	3.6	210	67.8	4.10	102	2.9	351	439	0.048	34	0.88	ND (0.08)	ND (0.06)	ND (0.02)

Appenidx G. Historical general water quality parameters, Tolson Rubble Landfill, Crofton, Maryland

Well	Date	pH	Alkalinity (mg/l)	TDS (mg/l)	Hardness (mg/l)	Chloride (mg/l)	Sulfate (mg/l)	TOC (mg/l)	Turbidity (NTU)	Specific Conductivity (µS/cm)	TOX (mg/l)	COD (mg/l)	Nitrogen, Ammonia (mg/l)	Nitrogen, Nitrate + Nitrite (mg/l)	Nitrogen, Nitrate (mg/l)	Nitrogen, Nitrite (mg/l)
NPDWR Standard:									**5**							
NSDWR Standard:		**6.5-8.5**		**500**		**250**	**250**								**10**	**1**
MW-9A	1/1/2000	5.03	<1.0	130	12	3	4	< 0.1	19	47	< 5.0	<10	< 0.2	2.63		< 0.02
	9/26/2000	5.01	209	82	29	< 5.0	< 5.0	12.4	1320	85	< 0.02	51		4.6	7.44	< 0.05
	7/19/2002	4.2	< 5.0	81	19.5	< 20	< 20	1.7	30.6	57.9	< 0.20	< 20	< 0.10	2.3	4.6	< 0.010
	3/18/2003	5	< 5.0	36	13.1	< 20	< 20	2	286	48.3	< 0.050	< 20	< 0.10	2.8	2.3	< 0.010
	9/10/2003	5.1	2.8	33.5	16.1	2.6	<1.5	1.8 J	301	51.4	0.0142 J	33.6 J	0.11	2.9		
	4/2/2004	5.1	4.1	28.5 J	24.0	2.4	1.7 J	4.0	4,750	43.0	< 0.014	55.6	0.038 J	2.3		
	9/23/2004	4.95	< 5	18	18.4	< 20	< 20	<1	1120	51.5	< 0.05	< 20	< 0.1	4.8	2.3	< 0.01
	3/17/2005	5.03	< 5	20.0	19.9	2.5	1.2	< 0.1	1.3	60.2	<1	27.5	0.11		4.8	< 0.01
	9/23/2005	5.42	4.6	23	8.7	3.02	1.31	ND(1.0)	17	38	ND(1.0)	ND(10)	ND(0.20)	1.75	1.75	ND(0.02)
	2/16/2006	5.75	4.4	62	9.84	2.98	ND (0.38)	ND (1.0)	29	40	ND (0.010)	ND (10)	ND (0.20)	2.17	2.17	ND (0.02)
MW-10A	1/1/2000	5.87	2.0	<1.0	11	5	5	< 0.1	17	47	< 5.0	<14	< 0.2	1.6		< 0.02
	9/26/2000	4.88	< 5	190	<4.0	8.6	< 5.0	15.7	1420	42	< 0.02	28	< 0.1	1.8	1.78	< 0.05
	7/19/2002	4.1	< 5.0	125	19.7	< 20	< 20	4.3	1310	38.7	< 0.20	< 20	< 0.10	1.6	1.8	< 0.010
	3/18/2003	4.9	< 5.0	28	10.9	< 20	< 20	5.9	514	47.2	< 0.050	< 20	< 0.10	1.3	1.6	< 0.010
	9/10/2003	5	2.6	47.5	27.9	4.3	4.1 J	1.3 J	1,290	48	< 0.014	20.8	0.042 J	1.3		
	4/2/2004	4.9	0.51 J	37.0	11.7	5.6	4.4 J	9.3	6,250	43.1	< 0.014	185.	0.037 J	1.4		
	9/23/2004	5.01	< 5	26	10	< 20	< 20	<1	945	37.4	< 0.2	< 20	< 0.1	1.3	1.4	< 0.01
	3/17/2005	4.84	< 5	<10		5.1	3.5	< 0.1	1400	36.1	3.6	< 20	< 0.1		1.3	< 0.01
	9/21/2005	5.24	2.4	38	7.11	4.37	5.93	ND(1.0)	16	40	0.032	ND(10)	ND(0.20)	1.16	1.16	ND(0.02)
	2/16/2006	5.59	2.3	64	7.11	4.63	3.74	ND (1.0)	174	39	ND (0.010)	ND (10)	ND (0.20)	1.23	1.23	ND (0.02)
MW-11A	1/1/2000	5.51	7.0	130	24	8	15	12.2	62	80	< 5.0	<10	0.3	2.1		0.60
	9/26/2000	5.16	6	193	25	< 5.0	< 5.0	21	818	74	< 0.02	97	< 0.1	4	<0.5	< 0.05
	7/19/2002	4.2	< 5.0	189	13.7	< 20	< 20	4.6	2150	62.3	< 0.20	30	< 0.10	4.2	4	< 0.010
	3/18/2003	4.9	< 5.0	53	21.9	< 20	< 20	1.1	1080	80.9	< 0.050	45	< 0.10	1.1	4.2	< 0.010
	9/10/2003	5.4	5.8	53	35 J	2.8	1.7 J	2.1	1,950	42.8	< 0.014	44	<0.03	0.66		
	4/2/2004	4.9	0.96 J	36.0	8.4	4.0	5.4	1.9 J	1,810	38.8	< 0.014	99.5	0.033 J	0.45		
	9/23/2004	4.95	< 5	33	40.1	< 20	< 20	4.6	5840	33.7	< 0.2	< 20	< 0.1	0.69	0.45	< 0.01
	3/17/2005	5.00	< 5	10.0	8.0	3.9	3.7	< 0.2	1010	35.7	<1	20.0	0.35		0.69	< 0.01
	9/21/2005	5.46	5.4	51	8.56	3.07	2.82	ND(1.0)	2,390	35	ND(0.010)	11	ND(0.20)	0.98	0.98	ND(0.02)
	2/16/2006	5.62	4.7	64	9.81	3.33	2.64	ND (1.0)	1420	29	ND (0.010)	27	ND (0.20)	0.54	0.54	ND (0.02)
MW-11B	1/1/2000	10.54	290	62	46	4	10	< 0.1	31	140	< 5.0	84	0.2	1.7		0.03
	9/26/2000	8.09	161	164	160	7.1	15.9	3.8	286	221	< 0.02	29	0.4	1.2	1.02	< 0.05
	7/19/2002	8.7	33.2	96	39.1	< 20	< 20	22.6	42.8	112	< 0.20	68.6	< 0.10	1.2	1.2	0.015
	3/18/2003	9	31.8	80	116	< 20	< 20	9.2	122	144	< 0.050	105	< 0.10	0.97	1	0.16
	9/10/2003	8.9	28.9	76	37.6	4.8	10.4	5.5	17.1	108	< 0.014	33.6 J	<0.03	0.89		
	4/2/2004	8.3	38.6	73.5	81.4	5.5	12.1	101	53.5	108	0.0221 J	185	<0.030	0.77		
	9/23/2004	7.05	36.6	64	55.1	< 20	< 20	5.3	32.3	118	< 0.2	< 20	0.16	0.68	0.68	0.092
	3/17/2005	7.33	33.3	51.0	41.8	4.5	11.1	< 0.1	3.2	106	1.6	< 20	0.15		0.44	0.24
	9/21/2005	6.25	33	79	38.9	3.75	9.4	ND(1.0)	10	108	ND(0.010)	ND(10)	ND(0.20)	0.35	0.17	0.18
	2/16/2006	6.11	32.7	58	38.9	3.70	10.5	ND (1.0)	386	105	ND (0.010)	ND (10)	ND (0.20)	0.15	0.15	ND (0.02)

Appenidx G. Historical general water quality parameters, Tolson Rubble Landfill, Crofton, Maryland

Well	Date	pH	Alkalinity (mg/l)	TDS (mg/l)	Hardness (mg/l)	Chloride (mg/l)	Sulfate (mg/l)	TOC (mg/l)	Turbidity (NTU)	Specific Conductivity (µS/cm)	TOX (mg/l)	COD (mg/l)	Nitrogen, Ammonia (mg/l)	Nitrogen, Nitrate + Nitrite (mg/l)	Nitrogen, Nitrate (mg/l)	Nitrogen, Nitrite (mg/l)
NPDWR Standard:									**5**							
NSDWR Standard:		**6.5-8.5**		**500**		**250**	**250**								**10**	**1**
MW-12A	1/1/2000	8.07	20.0	2,500	140	33	86	29	1950	500	0.23	<10	0.2	1.2		0.05
	9/26/2000	6.68	36.0	213	160	10.9	37.6	9.8	1600	160	< 0.02	31	< 0.1	0.46	0.55	0.07
	7/19/2002	5.6	43.6	175	165	< 20	91.5	7.1	1480	270	< 0.050	67.9	0.2	0.99	0.46	< 0.010
	3/18/2003	5.3	8.8	105	76.7	< 20	67.5	2.7	53.4	194	< 0.050	< 20	< 0.10	0.38	0.99	< 0.010
	9/10/2003	5.2	3.6	125	73	3.4	70	3.9	34.5	195	< 0.014	36 J	<0.03	0.35		
	4/2/2004	4.8	0.60 J	242	152	2.4	163	4.8	44.8	353	< 0.014	19.0 J	<0.030	0.8		
	9/23/2004	5.6	< 5	392	227	< 20	200	4.6	170	435	< 0.2	< 20	0.23	1.2	0.8	< 0.01
	3/17/2005	4.99	< 5	253	149	2.4	169	< 0.2	1200	367	5.0	67.5	< 0.1		1.2	< 0.01
	9/23/2005	5.48	10	100	136	2.98	116	1.5	563	271	11	36	ND(0.20)	0.43	0.43	ND(0.02)
	2/16/2006	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-13A	1/1/2000	5.12	2.0	130	28	16	19	< 0.1	19	140	< 5.0	18	< 0.2	1.2		< 0.02
	9/26/2000	4.62	< 5	133	31	21.1	27.0	6.8	1200	141	0.027	<15	< 0.1	0.67	1.01	< 0.05
	7/19/2002	4.3	< 5.0	83	29.3	< 20	40	11.1	1460	131	< 0.20	38.1	< 0.10	0.84	0.67	< 0.010
	3/18/2003	4.9	< 5.0	85.3	50.4	< 20	49.6	3.8	3930	228	< 0.20	35	< 0.10	0.86	0.84	< 0.010
	9/10/2003	5.2	< 0.41	101	44.1	9.8	45.4	0.89 J	1,560	166	< 0.014	47.9 J	<0.03	0.83		
	4/2/2004	4.8	< 0.41	83.0	38.3	7.0	44.0	1.6 J	3,000	142	< 0.014	36.1 J	<0.030	0.8		
	9/23/2004	4.92	< 5	174	50.1	< 20	45.2	<1	776	150	< 0.2	< 20	0.16	1.2	0.8	< 0.01
	3/17/2005	4.88	< 5	76.0	39.8	5.9	55.5	< 0.1	794	149	1.9	< 20	< 0.1		1.2	< 0.01
	9/19/2005	4.77	1.5	86	40.6	6.47	56.2	ND (1.0)	16.8	150	ND (0.010)	ND (10)	ND (0.20)	0.75	0.75	ND (0.02)
	2/15/2006	5.05	1.7	106	41.7	8.24	49.5	ND (1.0)	26	149	ND (0.010)	ND (10)	ND (0.20)	0.70	0.70	ND (0.02)
MW-14A	1/1/2000	4.13	4.0	640	86	3	430	4.8	14	710	< 5.0		< 0.2	0.68		< 0.02
	9/26/2000													0.93		
	7/19/2002	2.9	< 5.0	517	379	< 20	383	8.6	189	806	< 0.20	22	< 0.10	1.2	0.93	< 0.010
	3/18/2003	4.6	< 5.0	140	63.5	< 20	119	4.1	1890	184	< 0.050	< 20	< 0.10	0.42	1.2	< 0.010
	9/10/2003	5.2	4.2	79	47.5	3.6	45.9	1.9 J	931	146	< 0.014	13.9	<0.03	0.77		
	4/2/2004	5.6	11.4	83.5	53.9	4.5	30.8	3.4	238	131	< 0.014	41.0 J	<0.030	1		
	9/23/2004	4.08	< 5	369	109	< 20	263	3.2	1930	436	< 0.2	< 20	< 0.1	1.3	1	< 0.01
	3/17/2005	3.23	< 5	565	109	3.0	434	< 0.1	5280	769	2.4	20.0	0.11		1.3	< 0.01
	9/21/2005	2.99	ND(1.0)	888	93.9	2.87	46.2	2.4	7.1	1,186	0.011	ND(10)	ND(0.20)	1.11	1.11	ND(0.02)
	2/16/2006	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI

NOTES:
mg/l = miligrams per liter.
NTU = Nepholometric Turbidity Units.
TOC = Total Organic Carbon.
TOX = Total Organic Halides.
COD = Chemical Oxygen Demand.

ND = Not Detected (detection limit is in parentheses)
< = Less than.
J = Estimated value.
blank = not analyzed.
NS = Not Sampled.

WI = Well Inaccessible.

Well	Date	Acetone (µg/l)	Acrylonitrile (µg/l)	Benzene (µg/l)	Bromobenzene (µg/l)	Bromochloro methane (µg/l)	Bromodichloro methane (µg/l)	Bromoform (µg/l)	Bromomethane (µg/l)	2-Butanone (MEK) (µg/l)	n-Butylbenzene (µg/l)	sec-Butylbenzene (µg/l)	tert-Butylbenzene (µg/l)	Carbon Disulfide (µg/l)	Carbon Tetrachloride (µg/l)	Chlorobenzene (µg/l)	Chloroethane (µg/l)	Chloroform (µg/l)	Chloromethane (µg/l)
NPDWR Standard:				**5**											**5**	**100**			
NSDWR Standard:																			
MW-1A	7/23/2002	**16.3**	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	3/21/2003	**10.3**	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	9/11/2003	**6 J**	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	4/1/2004	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	9/22/2004	ND (10)	NA	ND (1.0)	NA	NA	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	3/17/2005	ND (10)	ND (50)	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	9/19/2005	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/14/2006	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-1B	7/19/2002	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	3/21/2003	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	9/11/2003	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	4/1/2004	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	9/24/2004	ND (50)	NA	ND (1.0)	NA	NA	ND (2.0)	ND (2.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)
	3/17/2005	ND (10)	ND (50)	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	9/19/2005	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/14/2006	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-2A	7/23/2002	**74.8**	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	3/21/2003	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	9/10/2003	**100**	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	4/1/2004	**240**	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	9/24/2004	**24.0**	NA	ND (1.0)	NA	NA	ND (2.0)	ND (2.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)
	3/17/2005	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	9/22/2005	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/15/2006	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-2B	7/23/2002	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	3/21/2003	**23.6**	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	9/10/2003	**130**	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	**9 J**	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	3/30/2004	**24**	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	9/23/2004	ND (10)	NA	ND (1.0)	NA	NA	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	3/17/2005	ND (10)	ND (50)	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	9/23/2005	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/15/2006	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-3B	7/23/2002	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	3/21/2003	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	9/11/2003	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	4/1/2004	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	9/23/2004	ND (10)	NA	ND (1.0)	NA	NA	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	3/17/2005	ND (10)	ND (50)	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	9/19/2005	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/16/2006	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-4A	7/29/2002	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	3/20/2003	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	9/11/2003	**19 J**	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	3/30/2004	**22**	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	9/24/2004	ND (50)	NA	ND (1.0)	NA	NA	ND (2.0)	ND (2.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)
	3/17/2005	ND (10)	ND (50)	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	9/22/2005	**127**	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/15/2006	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-4B	7/25/2002	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	3/20/2003	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	9/11/2003	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	4/1/2004	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	9/24/2005	ND (50)	NA	ND (1.0)	NA	NA	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	3/17/2005	ND (10)	ND (50)	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	9/22/2005	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/15/2006	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-5A	7/25/2002	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	**0.41 J**	ND (5.0)
	3/20/2003	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	9/11/2003	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	3/30/2004	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	9/22/2004	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	3/16/2005	ND (10)	ND (50)	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	9/19/2005	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/14/2006	**2.5 J**	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-5B	7/25/2002	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)

Appendix G. Historical Volatile Organic Compound (VOC) Data for Tolson Rubble Landfill, Crofton, Maryland

Well	Date	Acetone (µg/l)	Acrylonitrile (µg/l)	Benzene (µg/l)	Bromobenzene (µg/l)	Bromochloro methane (µg/l)	Bromodichloro methane (µg/l)	Bromoform (µg/l)	Bromomethane (µg/l)	2-Butanone (MEK) (µg/l)	n-Butylbenzene (µg/l)	sec-Butylbenzene (µg/l)	tert-Butylbenzene (µg/l)	Carbon Disulfide (µg/l)	Carbon Tetrachloride (µg/l)	Chlorobenzene (µg/l)	Chloroethane (µg/l)	Chloroform (µg/l)	Chloromethane (µg/l)
NPDWR Standard:				5											5	100			
NSDWR Standard:																			
	3/20/2003	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	9/11/2003	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	4/1/2004	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	9/24/2004	ND (50)	NA	ND (1.0)	NA	NA	ND (2.0)	ND (2.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)
	3/16/2005	ND (10)	ND (50)	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	9/19/2005	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/14/2006	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-6A	7/29/2002	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	3/20/2003	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	9/11/2003	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	3/30/2004	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	9/22/2004	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	3/16/2005	ND (10)	ND (50)	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	9/19/2005	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/14/2006	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-7A	7/25/2002	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	3/20/2003	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	9/11/2003	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	3/30/2004	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	9/22/2004	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	3/16/2005	ND (10)	ND (50)	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	9/22/2005	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/14/2006	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-7B	7/25/2002	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	3/20/2003	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	9/11/2003	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	4/1/2004	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	9/24/2004	ND (50)	NA	ND (1.0)	NA	NA	ND (2.0)	ND (2.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)
	3/16/2005	ND (10)	ND (50)	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	9/22/2005	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/14/2006	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-8A	7/23/2002	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	3/21/2003	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	**1.9 J**	ND (5.0)	ND (5.0)
	9/10/2003	**46**	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	**3 J**	ND 0.8)	ND (1)
	3/30/2004	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	**4 J**	ND 0.8)	ND (1)
	9/23/2004	ND (10)	NA	ND (1.0)	NA	NA	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	**3.1**	ND (1.0)	ND (1.0)
	3/18/2005	ND (10)	ND (50)	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	9/22/2005	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/15/2006	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	**1.3**	ND (1.0)	ND (1.0)
MW-9A	7/24/2002	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	3/21/2003	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	9/10/2003	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	3/30/2004	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	9/23/2004	ND (10)	NA	ND (1.0)	NA	NA	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	3/18/2005	ND (10)	ND (50)	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	9/23/2005	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/16/2006	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-10A	7/24/2002	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	3/21/2003	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	9/10/2003	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	3/30/2004	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	9/23/2004	ND (10)	NA	ND (1.0)	NA	NA	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	3/18/2005	ND (10)	ND (50)	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	9/21/2005	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/16/2006	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-11A	7/24/2002	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	3/21/2003	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	9/10/2003	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	3/30/2004	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	9/23/2004	ND (10)	NA	ND (1.0)	NA	NA	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	3/18/2005	ND (10)	ND (50)	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	9/21/2005	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/16/2006	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-11B	7/24/2002	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	3/21/2003	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	9/10/2003	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)

Well	Date	Acetone (µg/l)	Acrylonitrile (µg/l)	Benzene (µg/l)	Bromobenzene (µg/l)	Bromochloro methane (µg/l)	Bromodichloro methane (µg/l)	Bromoform (µg/l)	Bromomethane (µg/l)	2-Butanone (MEK) (µg/l)	n-Butylbenzene (µg/l)	sec-Butylbenzene (µg/l)	tert-Butylbenzene (µg/l)	Carbon Disulfide (µg/l)	Carbon Tetrachloride (µg/l)	Chlorobenzene (µg/l)	Chloroethane (µg/l)	Chloroform (µg/l)	Chloromethane (µg/l)
NPDWR Standard:				**5**											**5**	**100**			
NSDWR Standard:																			
	3/30/2004	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	9/24/2004	ND (50)	NA	ND (1.0)	NA	NA	ND (2.0)	ND (2.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)
	3/18/2005	ND (10)	ND (50)	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	9/21/2005	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/16/2006	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-12A	7/29/2002	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	3/21/2003	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	9/10/2003	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	3/30/2004	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	9/22/2004	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	3/18/2005	ND (10)	ND (50)	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	9/23/2005	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/16/2006	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-13A	7/23/2002	**4.8**	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	3/20/2003	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	9/10/2003	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	3/30/2004	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	9/22/2004	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	3/18/2005	ND (10)	ND (50)	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	9/19/2005	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/15/2006	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-14A	7/24/2002	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	3/21/2003	ND (10)	NA	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (4.0)	ND (5.0)	ND (10)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)
	9/10/2003	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	3/30/2004	ND (6)	NA	ND (0.5)	NA	ND (1)	NA	ND (1)	ND (1)	ND (3)	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (1)	ND 0.8)	ND (1)
	9/23/2004	ND (10)	NA	ND (1.0)	NA	NA	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	3/18/2005	ND (10)	ND (50)	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (4.0)	ND (2.0)	ND (10)	NA	NA	NA	ND (2.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	9/21/2005	ND (5.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/16/2006	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI

Well	Date	o-Chlorotoluene (µg/l)	p-Chlorotoluene (µg/l)	Dibromochloromethane (µg/l)	1,2-Dibromo-3-Chloropropane (µg/l)	1,2-Dibromoethane (EDB) (µg/l)	Dibromomethane (µg/l)	1,2-Dichlorobenzene (µg/l)	1,3-Dichlorobenzene (µg/l)	1,4-Dichlorobenzene (µg/l)	Dichlorodifluoromethane (µg/l)	trans-1,4-Dichloro-2-Butene (µg/l)	1,1-DCA (µg/l)	1,2-DCA (µg/l)	1,1-DCE (µg/l)	cis-1,2-DCE (µg/l)	trans-1,2-DCE (µg/l)	Dichloromethane (µg/l)	1,2-Dichloropropane (µg/l)
NPDWR Standard:						0.05		600		75				5	7	70	100	5	5
NSDWR Standard:																			
MW-1A	7/23/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	3/21/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	9/11/2003	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	4/1/2004	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	9/22/2004	NA	NA	ND (1.0)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	3/17/2005	NA	NA	ND (1.0)	ND (10)	ND (2.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	9/19/2005	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/14/2006	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-1B	7/19/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	3/21/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	9/11/2003	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	4/1/2004	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	9/24/2004	NA	NA	ND (2.0)	NA	NA	NA	NA	NA	NA	NA	NA	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (2.0)
	3/17/2005	NA	NA	ND (1.0)	ND (10)	ND (2.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	9/19/2005	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/14/2006	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-2A	7/23/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	3/21/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	9/10/2003	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	4/1/2004	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	9/24/2004	NA	NA	ND (2.0)	NA	NA	NA	NA	NA	NA	NA	NA	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (2.0)
	3/17/2005	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	9/22/2005	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/15/2006	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-2B	7/23/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	3/21/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	9/10/2003	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	3/30/2004	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	9/23/2004	NA	NA	ND (1.0)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	3/17/2005	NA	NA	ND (1.0)	ND (10)	ND (2.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	9/23/2005	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/15/2006	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-3B	7/23/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	3/21/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	9/11/2003	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	4/1/2004	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	9/23/2004	NA	NA	ND (1.0)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	3/17/2005	NA	NA	ND (1.0)	ND (10)	ND (2.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	9/19/2005	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/16/2006	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-4A	7/29/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	3/20/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	9/11/2003	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	3/30/2004	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	9/24/2004	NA	NA	ND (2.0)	NA	NA	NA	NA	NA	NA	NA	NA	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (2.0)
	3/17/2005	NA	NA	ND (1.0)	ND (10)	ND (2.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	9/22/2005	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/15/2006	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-4B	7/25/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	3/20/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	9/11/2003	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	4/1/2004	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	9/24/2005	NA	NA	ND (1.0)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	3/17/2005	NA	NA	ND (1.0)	ND (10)	ND (2.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	9/22/2005	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/15/2006	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-5A	7/25/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	3/20/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	9/11/2003	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	3/30/2004	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	9/22/2004	ND (5.0)	ND (5.0)	ND (1.0)	ND (10)	ND (2.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	3/16/2005	NA	NA	ND (1.0)	ND (10)	ND (2.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	9/19/2005	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/14/2006	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-5B	7/25/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)

Appendix G. Historical Volatile Organic Compound (VOC) Data for Tolson Rubble Landfill, Crofton, Maryland

Well	Date	o-Chlorotoluene (µg/l)	p-Chlorotoluene (µg/l)	Dibromochloro methane (µg/l)	1,2-Dibromo-3-Chloropropane (µg/l)	1,2-Dibromoethane (EDB) (µg/l)	Dibromomethane (µg/l)	1,2-Dichlorobenzene (µg/l)	1,3-Dichlorobenzene (µg/l)	1,4-Dichlorobenzene (µg/l)	Dichlorodifluoro methane (µg/l)	trans-1,4-Dichloro-2-Butene (µg/l)	1,1-DCA (µg/l)	1,2-DCA (µg/l)	1,1-DCE (µg/l)	cis-1,2-DCE (µg/l)	trans-1,2-DCE (µg/l)	Dichloromethane (µg/l)	1,2-Dichloropropane (µg/l)
NPDWR Standard:						0.05		600		75				5	7	70	100	5	5
NSDWR Standard:																			
	3/20/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	9/11/2003	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	4/1/2004	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	9/24/2004	NA	NA	ND (2.0)	NA	NA	NA	NA	NA	NA	NA	NA	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (2.0)
	3/16/2005	NA	NA	ND (1.0)	ND (10)	ND (2.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	9/19/2005	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/14/2006	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-6A	7/29/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	3/20/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	9/11/2003	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	3/30/2004	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	9/22/2004	ND (5.0)	ND (5.0)	ND (1.0)	ND (10)	ND (2.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	3/16/2005	NA	NA	ND (1.0)	ND (10)	ND (2.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	9/19/2005	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/14/2006	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-7A	7/25/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	3/20/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	9/11/2003	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	3/30/2004	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	9/22/2004	ND (5.0)	ND (5.0)	ND (1.0)	ND (10)	ND (2.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	3/16/2005	NA	NA	ND (1.0)	ND (10)	ND (2.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	9/22/2005	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/14/2006	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-7B	7/25/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	3/20/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	9/11/2003	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	4/1/2004	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	9/24/2004	NA	NA	ND (2.0)	NA	NA	NA	NA	NA	NA	NA	NA	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (2.0)
	3/16/2005	NA	NA	ND (1.0)	ND (10)	ND (2.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	9/22/2005	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/14/2006	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-8A	7/23/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	3/21/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	9/10/2003	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	3/30/2004	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	9/23/2004	NA	NA	ND (1.0)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	3/18/2005	NA	NA	ND (1.0)	ND (10)	ND (2.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	9/22/2005	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/15/2006	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-9A	7/24/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	3/21/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	9/10/2003	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	3/30/2004	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	9/23/2004	NA	NA	ND (1.0)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	3/18/2005	NA	NA	ND (1.0)	ND (10)	ND (2.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	9/23/2005	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/16/2006	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-10A	7/24/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	3/21/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	9/10/2003	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	3/30/2004	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	9/23/2004	NA	NA	ND (1.0)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	3/18/2005	NA	NA	ND (1.0)	ND (10)	ND (2.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	9/21/2005	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/16/2006	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-11A	7/24/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	3/21/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	9/10/2003	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	3/30/2004	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	9/23/2004	NA	NA	ND (1.0)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	3/18/2005	NA	NA	ND (1.0)	ND (10)	ND (2.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	9/21/2005	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/16/2006	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-11B	7/24/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	3/21/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	9/10/2003	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)

Appendix G. Historical Volatile Organic Compound (VOC) Data for Tolson Rubble Landfill, Crofton, Maryland

Well	Date	o-Chlorotoluene (µg/l)	p-Chlorotoluene (µg/l)	Dibromochloromethane (µg/l)	1,2-Dibromo-3-Chloropropane (µg/l)	1,2-Dibromoethane (EDB) (µg/l)	Dibromomethane (µg/l)	1,2-Dichlorobenzene (µg/l)	1,3-Dichlorobenzene (µg/l)	1,4-Dichlorobenzene (µg/l)	Dichlorodifluoromethane (µg/l)	trans-1,4-Dichloro-2-Butene (µg/l)	1,1-DCA (µg/l)	1,2-DCA (µg/l)	1,1-DCE (µg/l)	cis-1,2-DCE (µg/l)	trans-1,2-DCE (µg/l)	Dichloromethane (µg/l)	1,2-Dichloropropane (µg/l)
NPDWR Standard:						0.05		600		75				5	7	70	100	5	5
NSDWR Standard:																			
	3/30/2004	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	9/24/2004	NA	NA	ND (2.0)	NA	NA	NA	NA	NA	NA	NA	NA	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (2.0)
	3/18/2005	NA	NA	ND (1.0)	ND (10)	ND (2.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	9/21/2005	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/16/2006	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-12A	7/29/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	3/21/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	9/10/2003	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	3/30/2004	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	9/22/2004	ND (5.0)	ND (5.0)	ND (1.0)	ND (10)	ND (2.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	3/18/2005	NA	NA	ND (1.0)	ND (10)	ND (2.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	9/23/2005	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/16/2006	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-13A	7/23/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	3/20/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	9/10/2003	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	3/30/2004	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	9/22/2004	ND (5.0)	ND (5.0)	ND (1.0)	ND (10)	ND (2.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	3/18/2005	NA	NA	ND (1.0)	ND (10)	ND (2.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	9/19/2005	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/15/2006	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
MW-14A	7/24/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	3/21/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (10)	ND (2.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (5.0)	ND (2.0)	ND (2.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)
	9/10/2003	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	3/30/2004	NA	NA	ND (1)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1)	ND (1)	ND (0.8)	ND (0.8)	ND (0.8)	ND (2)	ND (1)
	9/23/2004	NA	NA	ND (1.0)	NA	NA	NA	NA	NA	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	3/18/2005	NA	NA	ND (1.0)	ND (10)	ND (2.0)	ND (5.0)	ND (1.0)	NA	ND (1.0)	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (2.0)	ND (1.0)
	9/21/2005	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	ND (1.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
	2/16/2006	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI

Well	Date	cis-1,2-Dichloropropene (µg/l)	trans-1,2-Dichloropropene (µg/l)	1,3-Dichloropropane (µg/l)	2,2-Dichloropropane (µg/l)	1,1-Dichloropropene (µg/l)	cis-1,3-Dichloropropene (µg/l)	trans-1,3-Dichloropropene (µg/l)	Ethylbenzene (µg/l)	Hexachlorobutadiene (µg/l)	Isopropylbenzene (µg/l)	p-Isopropyltoluene (µg/l)	2-Hexanone (µg/l)	Methyl Iodine (µg/l)	MTBE (µg/l)	4-Methyl-2-Pentanone (MIBK) (µg/l)	Naphthalene (µg/l)
NPDWR Standard:									700								
NSDWR Standard:																	
MW-1A	7/23/2002	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	3/21/2003	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	9/11/2003	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	4/1/2004	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	9/22/2004	NA	NA	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (5.0)	NA	NA	ND (5.0)	NA
	3/17/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (25)	ND (1.0)	ND (5.0)	NA
	9/19/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
	2/14/2006	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
MW-1B	7/19/2002	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	3/21/2003	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	9/11/2003	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	4/1/2004	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	9/24/2004	ND (2.0)	ND (2.0)	NA	NA	NA	NA	NA	ND (2.0)	NA	NA	NA	ND (10)	NA	NA	ND (10)	NA
	3/17/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (25)	ND (1.0)	ND (5.0)	NA
	9/19/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
	2/14/2006	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
MW-2A	7/23/2002	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	3/21/2003	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	9/10/2003	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	4/1/2004	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	9/24/2004	ND (2.0)	ND (2.0)	NA	NA	NA	NA	NA	ND (2.0)	NA	NA	NA	ND (10)	NA	NA	ND (10)	NA
	3/17/2005	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	9/22/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
	2/15/2006	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
MW-2B	7/23/2002	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	3/21/2003	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	9/10/2003	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	3/30/2004	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	9/23/2004	NA	NA	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (5.0)	NA	NA	ND (5.0)	NA
	3/17/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (25)	0.55 J	ND (5.0)	NA
	9/23/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
	2/15/2006	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
MW-3B	7/23/2002	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	3/21/2003	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	9/11/2003	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	4/1/2004	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	9/23/2004	NA	NA	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (5.0)	NA	NA	ND (5.0)	NA
	3/17/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (25)	ND (1.0)	ND (5.0)	NA
	9/19/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
	2/16/2006	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
MW-4A	7/29/2002	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	3/20/2003	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	9/11/2003	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	3/30/2004	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	9/24/2004	ND (2.0)	ND (2.0)	NA	NA	NA	NA	NA	ND (2.0)	NA	NA	NA	ND (10)	NA	NA	ND (10)	NA
	3/17/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (25)	ND (1.0)	ND (5.0)	NA
	9/22/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
	2/15/2006	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
MW-4B	7/25/2002	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	3/20/2003	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	9/11/2003	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	4/1/2004	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	9/24/2005	NA	NA	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (5.0)	NA	NA	ND (5.0)	NA
	3/17/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (25)	ND (1.0)	ND (5.0)	NA
	9/22/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
	2/15/2006	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
MW-5A	7/25/2002	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	3/20/2003	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	9/11/2003	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	3/30/2004	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	9/22/2004	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	ND (1.0)	ND (5.0)	ND (5.0)
	3/16/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (25)	ND (1.0)	ND (5.0)	NA
	9/19/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
	2/14/2006	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
MW-5B	7/25/2002	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)

Well	Date	cis-1,2-Dichloropropene (µg/l)	trans-1,2-Dichloropropene (µg/l)	1,3-Dichloropropane (µg/l)	2,2-Dichloropropane (µg/l)	1,1-Dichloropropene (µg/l)	cis-1,3-Dichloropropene (µg/l)	trans-1,3-Dichloropropene (µg/l)	Ethylbenzene (µg/l)	Hexachlorobutadiene (µg/l)	Isopropylbenzene (µg/l)	p-Isopropyltoluene (µg/l)	2-Hexanone (µg/l)	Methyl Iodide (µg/l)	MTBE (µg/l)	4-Methyl-2-Pentanone (MIBK) (µg/l)	Naphthalene (µg/l)
NPDWR Standard:									700								
NSDWR Standard:																	
	3/20/2003	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	9/11/2003	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	4/1/2004	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	9/24/2004	ND (2.0)	ND (2.0)	NA	NA	NA	NA	NA	ND (2.0)	NA	NA	NA	ND (10)	NA	NA	ND (10)	NA
	3/16/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (25)	ND (1.0)	ND (5.0)	NA
	9/19/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
	2/14/2006	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
MW-6A	7/29/2002	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	3/20/2003	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	9/11/2003	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	3/30/2004	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	9/22/2004	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	ND (1.0)	ND (5.0)	ND (5.0)
	3/16/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (25)	0.51 J	ND (5.0)	NA
	9/19/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
	2/14/2006	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
MW-7A	7/25/2002	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	3/20/2003	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	9/11/2003	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	3/30/2004	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	9/22/2004	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	0.76 J	ND (5.0)	ND (5.0)
	3/16/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (25)	0.49 J	ND (5.0)	NA
	9/22/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
	2/14/2006	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
MW-7B	7/25/2002	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	3/20/2003	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	9/11/2003	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	4/1/2004	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	9/24/2004	ND (2.0)	ND (2.0)	NA	NA	NA	NA	NA	ND (2.0)	NA	NA	NA	ND (10)	NA	NA	ND (10)	NA
	3/16/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (25)	0.49 J	ND (5.0)	NA
	9/22/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
	2/14/2006	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
MW-8A	7/23/2002	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	3/21/2003	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	9/10/2003	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	3/30/2004	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	9/23/2004	NA	NA	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (5.0)	NA	NA	ND (5.0)	NA
	3/18/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (25)	ND (1.0)	ND (5.0)	NA
	9/22/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
	2/15/2006	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
MW-9A	7/24/2002	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	3/21/2003	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	9/10/2003	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	3/30/2004	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	9/23/2004	NA	NA	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (5.0)	NA	NA	ND (5.0)	NA
	3/18/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (25)	ND (1.0)	ND (5.0)	NA
	9/23/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
	2/16/2006	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
MW-10A	7/24/2002	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	3/21/2003	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	9/10/2003	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	3/30/2004	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	9/23/2004	NA	NA	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (5.0)	NA	NA	ND (5.0)	NA
	3/18/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (25)	ND (1.0)	ND (5.0)	NA
	9/21/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
	2/16/2006	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
MW-11A	7/24/2002	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	3/21/2003	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	9/10/2003	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	3/30/2004	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	9/23/2004	NA	NA	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (5.0)	NA	NA	ND (5.0)	NA
	3/18/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (25)	ND (1.0)	ND (5.0)	NA
	9/21/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
	2/16/2006	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
MW-11B	7/24/2002	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	3/21/2003	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	9/10/2003	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA

Well	Date	cis-1,2-Dichloropropene (µg/l)	trans-1,2-Dichloropropene (µg/l)	1,3-Dichloropropane (µg/l)	2,2-Dichloropropane (µg/l)	1,1-Dichloropropene (µg/l)	cis-1,3-Dichloropropene (µg/l)	trans-1,3-Dichloropropene (µg/l)	Ethylbenzene (µg/l)	Hexachlorobutadiene (µg/l)	Isopropylbenzene (µg/l)	p-Isopropyltoluene (µg/l)	2-Hexanone (µg/l)	Methyl Iodine (µg/l)	MTBE (µg/l)	4-Methyl-2-Pentanone (MIBK) (µg/l)	Naphthalene (µg/l)
NPDWR Standard:									700								
NSDWR Standard:																	
	3/30/2004	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	9/24/2004	ND (2.0)	ND (2.0)	NA	NA	NA	NA	NA	ND (2.0)	NA	NA	NA	ND (10)	NA	NA	ND (10)	NA
	3/18/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (25)	ND (1.0)	ND (5.0)	NA
	9/21/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
	2/16/2006	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
MW-12A	7/29/2002	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	3/21/2003	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	9/10/2003	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	3/30/2004	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	9/22/2004	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	ND (1.0)	ND (5.0)	ND (5.0)
	3/18/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (25)	ND (1.0)	ND (5.0)	NA
	9/23/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
	2/16/2006	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-13A	7/23/2002	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	3/20/2003	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	9/10/2003	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	3/30/2004	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	9/22/2004	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	ND (1.0)	ND (5.0)	ND (5.0)
	3/18/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (25)	ND (1.0)	ND (5.0)	NA
	9/19/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
	2/15/2006	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
MW-14A	7/24/2002	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	3/21/2003	NA	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (2.0)	ND (5.0)	NA	NA	NA	ND (5.0)	ND (5.0)
	9/10/2003	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	3/30/2004	ND (1)	ND (1)	NA	NA	NA	NA	NA	ND (0.8)	NA	NA	NA	ND (3)	NA	NA	ND (3)	NA
	9/23/2004	NA	NA	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	ND (5.0)	NA	NA	ND (5.0)	NA
	3/18/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (5.0)	ND (25)	ND (1.0)	ND (5.0)	NA
	9/21/2005	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	NA	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	NA
	2/16/2006	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI

Well	Date	n-Propylbenzene (µg/l)	Styrene (µg/l)	1,1,1,2-Tetrachloroethane (µg/l)	1,1,2,2-Tetrachloroethane (µg/l)	PCE (µg/l)	Toluene (µg/l)	1,2,3-Trichlorobenzene (µg/l)	1,2,4-Trichlorobenzene (µg/l)	1,1,1-TCA (µg/l)	1,1,2-TCA (µg/l)	TCE (µg/l)	Trichlorofluoromethane (µg/l)	1,2,3-Trichloropropane (µg/l)	1,2,4-Trimethylbenzene (µg/l)	1,3,5-Trimethylbenzene (µg/l)	Vinyl Acetate (µg/l)	Vinyl Chloride (µg/l)	Total Xylenes (µg/l)
NPDWR Standard:						5	1,000			200	5	5						2	10,000
NSDWR Standard:																			
MW-1A	7/23/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	3/21/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	9/11/2003	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	4/1/2004	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	9/22/2004	NA	ND (5.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	ND (1.0)
	3/17/2005	NA	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	NA	NA	ND (10)	ND (1.0)	ND (1.0)
	9/19/2005	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
	2/14/2006	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
MW-1B	7/19/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	3/21/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	9/11/2003	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	4/1/2004	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	9/24/2004	NA	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	NA	NA	ND (2.0)	ND (2.0)	ND (2.0)	NA	NA	NA	NA	NA	ND (2.0)	ND (6.0)
	3/17/2005	NA	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	NA	NA	ND (10)	ND (1.0)	ND (1.0)
	9/19/2005	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
	2/14/2006	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
MW-2A	7/23/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	3/21/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	9/10/2003	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	4/1/2004	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	9/24/2004	NA	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	NA	NA	ND (2.0)	ND (2.0)	ND (2.0)	NA	NA	NA	NA	NA	ND (2.0)	ND (6.0)
	3/17/2005	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	9/22/2005	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
	2/15/2006	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
MW-2B	7/23/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	3/21/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	9/10/2003	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	3/30/2004	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	9/23/2004	NA	ND (5.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	ND (1.0)
	3/17/2005	NA	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	NA	NA	ND (10)	ND (1.0)	ND (1.0)
	9/23/2005	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
	2/15/2006	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
MW-3B	7/23/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	3/21/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	9/11/2003	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	4/1/2004	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	9/23/2004	NA	ND (5.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	ND (1.0)
	3/17/2005	NA	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	NA	NA	ND (10)	ND (1.0)	ND (1.0)
	9/19/2005	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
	2/16/2006	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
MW-4A	7/29/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	3/20/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	9/11/2003	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	3/30/2004	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	9/24/2004	NA	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	NA	NA	ND (2.0)	ND (2.0)	ND (2.0)	NA	NA	NA	NA	NA	ND (2.0)	ND (6.0)
	3/17/2005	NA	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	NA	NA	ND (10)	ND (1.0)	ND (1.0)
	9/22/2005	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
	2/15/2006	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
MW-4B	7/25/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	3/20/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	9/11/2003	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	4/1/2004	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	9/24/2005	NA	ND (5.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	ND (1.0)
	3/17/2005	NA	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	NA	NA	ND (10)	ND (1.0)	ND (1.0)
	9/22/2005	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
	2/15/2006	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
MW-5A	7/25/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	3/20/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	9/11/2003	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	3/30/2004	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	9/22/2004	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	3/16/2005	NA	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	NA	NA	ND (10)	ND (1.0)	ND (1.0)
	9/19/2005	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
	2/14/2006	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
MW-5B	7/25/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)

Well	Date	n-Propylbenzene (µg/l)	Styrene (µg/l)	1,1,1,2-Tetrachloroethane (µg/l)	1,1,2,2-Tetrachloroethane (µg/l)	PCE (µg/l)	Toluene (µg/l)	1,2,3-Trichlorobenzene (µg/l)	1,2,4-Trichlorobenzene (µg/l)	1,1,1-TCA (µg/l)	1,1,2-TCA (µg/l)	TCE (µg/l)	Trichlorofluoromethane (µg/l)	1,2,3-Trichloropropane (µg/l)	1,2,4-Trimethylbenzene (µg/l)	1,3,5-Trimethylbenzene (µg/l)	Vinyl Acetate (µg/l)	Vinyl Chloride (µg/l)	Total Xylenes (µg/l)
NPDWR Standard:						5	1,000			200	5	5						2	10,000
NSDWR Standard:																			
	3/20/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	9/11/2003	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	4/1/2004	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	9/24/2004	NA	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	NA	NA	ND (2.0)	ND (2.0)	ND (2.0)	NA	NA	NA	NA	NA	ND (2.0)	ND (6.0)
	3/16/2005	NA	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	NA	NA	ND (10)	ND (1.0)	ND (1.0)
	9/19/2005	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
	2/14/2006	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
MW-6A	7/29/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	3/20/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	9/11/2003	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	3/30/2004	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	9/22/2004	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	3/16/2005	NA	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	NA	NA	ND (10)	ND (1.0)	ND (1.0)
	9/19/2005	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
	2/14/2006	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
MW-7A	7/25/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	3/20/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	9/11/2003	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	3/30/2004	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	9/22/2004	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	3/16/2005	NA	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	NA	NA	ND (10)	ND (1.0)	ND (1.0)
	9/22/2005	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
	2/14/2006	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
MW-7B	7/25/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	3/20/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	9/11/2003	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	4/1/2004	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	9/24/2004	NA	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	NA	NA	ND (2.0)	ND (2.0)	ND (2.0)	NA	NA	NA	NA	NA	ND (2.0)	ND (6.0)
	3/16/2005	NA	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	NA	NA	ND (10)	ND (1.0)	ND (1.0)
	9/22/2005	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
	2/14/2006	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
MW-8A	7/23/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	3/21/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	9/10/2003	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	3/30/2004	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	9/23/2004	NA	ND (5.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	ND (1.0)
	3/18/2005	NA	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	NA	NA	ND (10)	ND (1.0)	ND (1.0)
	9/22/2005	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
	2/15/2006	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
MW-9A	7/24/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	3/21/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	9/10/2003	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	3/30/2004	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	9/23/2004	NA	ND (5.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	ND (1.0)
	3/18/2005	NA	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	NA	NA	ND (10)	ND (1.0)	ND (1.0)
	9/23/2005	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
	2/16/2006	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
MW-10A	7/24/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	3/21/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	9/10/2003	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	3/30/2004	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	9/23/2004	NA	ND (5.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	ND (1.0)
	3/18/2005	NA	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	NA	NA	ND (10)	ND (1.0)	ND (1.0)
	9/21/2005	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
	2/16/2006	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
MW-11A	7/24/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	3/21/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	9/10/2003	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	3/30/2004	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	9/23/2004	NA	ND (5.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	ND (1.0)
	3/18/2005	NA	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	NA	NA	ND (10)	ND (1.0)	ND (1.0)
	9/21/2005	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
	2/16/2006	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
MW-11B	7/24/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	3/21/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	9/10/2003	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)

Appendix G. Historical Volatile Organic Compound (VOC) Data for Tolson Rubble Landfill, Crofton, Maryland

Well	Date	n-Propylbenzene (µg/l)	Styrene (µg/l)	1,1,1,2-Tetrachloroethane (µg/l)	1,1,2,2-Tetrachloroethane (µg/l)	PCE (µg/l)	Toluene (µg/l)	1,2,3-Trichlorobenzene (µg/l)	1,2,4-Trichlorobenzene (µg/l)	1,1,1-TCA (µg/l)	1,1,2-TCA (µg/l)	TCE (µg/l)	Trichlorofluoromethane (µg/l)	1,2,3-Trichloropropane (µg/l)	1,2,4-Trimethylbenzene (µg/l)	1,3,5-Trimethylbenzene (µg/l)	Vinyl Acetate (µg/l)	Vinyl Chloride (µg/l)	Total Xylenes (µg/l)
NPDWR Standard:						5	1,000			200	5	5						2	10,000
NSDWR Standard:																			
	3/30/2004	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	9/24/2004	NA	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	NA	NA	ND (2.0)	ND (2.0)	ND (2.0)	NA	NA	NA	NA	NA	ND (2.0)	ND (6.0)
	3/18/2005	NA	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	NA	NA	ND (10)	ND (1.0)	ND (1.0)
	9/21/2005	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
	2/16/2006	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
MW-12A	7/29/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	3/21/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	9/10/2003	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	3/30/2004	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	9/22/2004	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	3/18/2005	NA	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	NA	NA	ND (10)	ND (1.0)	ND (1.0)
	9/23/2005	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
	2/16/2006	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-13A	7/23/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	3/20/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	9/10/2003	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	3/30/2004	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	9/22/2004	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	3/18/2005	NA	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	NA	NA	ND (10)	ND (1.0)	ND (1.0)
	9/19/2005	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
	2/15/2006	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
MW-14A	7/24/2002	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	3/21/2003	ND (5.0)	ND (5.0)	ND (5.0)	ND (2.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (3.0)	ND (1.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	NA	ND (1.0)	ND (1.0)
	9/10/2003	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	3/30/2004	NA	ND (1)	NA	ND (1)	ND (0.8)	ND (0.7)	NA	NA	ND (0.8)	ND (0.8)	ND (1)	NA	NA	NA	NA	NA	ND (1)	ND (0.8)
	9/23/2004	NA	ND (5.0)	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	NA	NA	NA	ND (1.0)	ND (1.0)
	3/18/2005	NA	ND (5.0)	ND (5.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (5.0)	ND (5.0)	NA	NA	ND (10)	ND (1.0)	ND (1.0)
	9/21/2005	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	NA	NA	ND (1.0)	ND (1.0)	ND (1.0)
	2/16/2006	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI

Well	Date	Antimony (µg/l)	Arsenic (µg/l)	Barium (µg/l)	Beryllium (µg/l)	Cadmium (µg/l)	Calcium (µg/l)	Chromium (µg/l)	Cobalt (µg/l)	Copper (µg/l)	Iron (µg/l)	Lead (µg/l)	Magnesium (µg/l)	Manganese (µg/l)	Mercury (µg/l)	Nickel (µg/l)	Potassium (µg/l)	Selenium (µg/l)	Silver (µg/l)	Sodium (µg/l)	Thallium (µg/l)	Vanadium (µg/l)	Zinc (µg/l)
NPDWR Standard:		**6**	**50**	**2,000**	**4**	**5**		**100**		**1,300**		**15**			**2**			**50**			**2**		
NSDWR Standard:										**1,000**	**300**			**50**					**100**				**5,000**
MW-1A	Jan-00		< 50	80		<0.5	72,000	< 10		10	**500**	< 2	27,000	**160**	0.4	< 40	16,000	**< 500**		34,000			20
	7/19/2002		12.1	< 200		<4.0	105,000	< 10		< 25	**54,400**	4.2	27,700	**158**	**4**		19,500	< 5.0		31,000			34.2
	3/18/2003		16.7	< 200		<4.0	67,800	< 10		34.8	**48,400**	5.2	17,600	**108**	< 0.20		14,800	< 5.0		19,800			28.7
	9/10/2003		6.7 J	48.3		<0.87	55,300	< 2.2		3.9 J	**9,720**	< 9.3	17,300	**80.2**	< 0.16		14,800	< 4.7		23,700			31.2
	3/31/2004		< 4.9	19.9		<0.87	10,300	2.6 J		3.6 J	**4,160**	< 9.3	3,730	25.3	< 0.16		5,360	< 4.7		7,290			15.6 J
	9/23/2004		< 5	< 200		<4	< 5,000	< 10		< 25	**738**	< 3	< 5,000	< 15	0.30		< 5,000	< 5		< 5,000			< 20
	3/17/2005	< 5	< 5	< 200		<4	< 5,000	< 10		< 25	**527**		< 5,000	< 15	0.40		< 5,000	< 5		< 5,000			< 20
	9/19/2005	ND (2)	ND (2)	18	ND (2)	ND (4)	2,930	ND (10)	ND (10)	ND (10)	236	ND (2)	1,060	**153**	ND (0.2)	11	1,430	ND (50)	ND (10)	3,350	ND (2)	ND (10)	45
	2/14/2006	ND (2)	ND (2)	21	ND (2)	ND (4)	3,440	ND (10)	11	ND (10)	**901**	ND (2)	1,180	**160**	ND (0.2)	11	1,510	ND (2)	ND (2)	3,810	ND (2)	ND (10)	52
MW-1B	Jan-00		< 50	70		1	8,900	40		30	**10,000**	5	2,100	**270**	< 0.2		< 5,000	< 50		4,700			570
	7/19/2002		< 5.0	< 200		<4.0	< 5,000	< 10		31.2	**4,540**	3	< 5,000	43.1	< 1.5		< 5,000	< 5.0		< 5,000			469
	3/18/2003		< 5.0	< 200		<4.0	< 5,000	< 10		< 25	**14,800**	6.6	< 5,000	**273**	< 0.20		< 5,000	< 5.0		< 5,000			285
	9/10/2003		< 4.9	7.7		<0.87	2,940	2.5 J		9.0 J	**4,110**	< 9.3	1,400	**307**	< 0.16		1,510	< 4.7		3,840			103
	3/31/2004		< 4.9	21.1		<0.87	5,260	< 2.2		8.0 J	**4,880**	< 9.3	1,970	**261**	< 0.16		2,280	< 4.7		5,490			92.6
	9/23/2004		< 5	< 200		<4	< 5,000	< 10		28.4	**7,850**	< 3	< 5,000	**268**	< 0.2		< 5,000	< 5		< 5,000			102
	3/17/2005	5.5	< 5	< 200	**< 5**	<4	< 5,000	< 10	< 50	< 25	**504**		< 5,000	**124**	< 0.2	< 40	< 5,000	< 5	< 10	< 5,000	**< 10**	< 50	165
	9/19/2005	ND (2)	ND (2)	11	ND (2)	ND (4)	3,360	ND (10)	ND (10)	ND (10)	230	ND (2)	1,260	ND (10)	ND (0.2)	ND (11)	1,660	ND (50)	ND (10)	2,110	ND (2)	ND (10)	ND (10)
	2/14/2006	ND (2)	2	14	ND (2)	ND (4)	3,430	ND (10)	ND (10)	ND (10)	240	ND (2)	1,680	ND (10)	ND (0.2)	ND (11)	1,730	ND (2)	ND (2)	1,750	ND (2)	ND (10)	ND (10)
MW-2A	Jan-00		**< 500**	< 50		2	1,200	< 10		30	**600**	9	500	30	< 0.2		< 5,000	**< 500**		1,600			90
	7/19/2002		< 5.0	< 200		**7.7**	< 5,000	< 10		49.4	**2,340**	9	< 5,000	43.2	< 1.5		< 5,000	< 5.0		< 5,000			124
	3/18/2003		< 5.0	< 200		**6.5**	< 5,000	< 10		61	**435**	5.8	< 5,000	**50.1**	< 0.20		< 5,000	< 5.0		< 5,000			144
	9/10/2003		<4.9	14		3.2 J	1,720	2.3 J		33.2	**670**	< 9.3	591	**56.8**	< 0.16		833	< 4.7		1,960			97.1
	3/31/2004		<4.9	24.3		5.2	2,020	13.2		27	**4,110**	< 9.3	769	**62.2**	< 0.16		877	< 4.7		2,020			188
	9/23/2004		< 5	< 200		<4	< 5,000	< 10		33.4	295	8.0	< 5,000	26.8	< 0.2		< 5,000	< 5		< 5,000			80.5
	9/22/2005	ND (2)	ND (2)	14	ND (2)	ND (4)	1,030	ND (10)	12	29	227	7	540	42	ND (0.2)	18	835	ND (5.0)	ND (10)	2260	ND (2)	ND (10)	37
	2/15/2006	ND (2)	ND (2)	14	ND (2)	ND (4)	877	ND (10)	14	35	ND (50)	8	443	34	ND (0.2)	15	723	ND (2)	ND (2)	1,790	ND (2)	ND (10)	45
MW-2B	Jan-00		**< 500**	100		<0.5	97,000	10		20	**26,000**	< 2	24,000	**500**	< 0.2		9,900	**< 500**		21,000			40
	7/19/2002		23.9	< 200		<4.0	63,000	< 10		< 25	**79,100**	< 3.0	17700	**693**	< 1.5		7,300	< 5.0		10,500			78.7
	3/18/2003		25.3	< 200		<4.0	51,100	< 10		< 25	**54,800**	3.2	13900	**478**	< 0.20		5,410	5.8		8,940			40.7
	9/10/2003		16.1	44.7		<0.87	22,100	< 2.2		7.3 J	**92,000**	< 9.3	8,310	**408**	< 0.16		2,230	< 4.7					22
	3/31/2004		18.8	24.9		<0.87	13,400	< 2.2		< 2.1	**124,000**	< 9.3	10,400	**1,260**	< 0.16		1,050	< 4.7		1,140			<4.1
	9/23/2004		16.7	< 200		<4	15,200	< 10		< 25	**177,000**	< 3	13,900	**1,960**	< 0.2		< 5,000	< 5		< 5,000			< 20
	3/17/2005	5.5	11.7	< 200	**< 5**	<4	28,500	< 10	< 50	< 25	**218,000**		15500	**2,080**	< 0.2	< 40	< 5,000	11.6	< 10	< 5,000	**< 10**	< 50	< 20
	9/22/2005	ND (2)	7	40	ND (2)	ND (4)	30,200	ND (10)	22	ND (10)	**134,000**	ND (2)	12,200	**1,390**	ND (0.2)	ND (11)	2,300	ND (50)	ND (10)	4,060	ND (2)	ND (10)	ND (10)
	2/15/2006	ND (2)	7	55	ND (2)	ND (4)	32,400	ND (10)	15	ND (10)	**178,000**	ND (2)	15,400	**1,570**	ND (0.2)	ND (11)	2,770	ND (2)	ND (2)	3,980	ND (2)	ND (10)	ND (10)
MW-3B	Jan-00		< 50	< 10		<0.5	950	< 10		< 10	50	< 2	< 500	< 10	< 0.2		< 5,000	< 50		2,000			20
	7/19/2002		< 5.0	< 200		<4.0	< 5,000	< 10		< 25	**2,550**	4.5	< 5,000	23.8	< 1.5		< 5,000	< 5.0		< 5,000			57.5
	3/18/2003		< 5.0	< 200		<4.0	< 5,000	< 10		< 25	270	3.1	< 5,000	15.7	< 0.20		< 5,000	< 5.0		< 5,000			41.3
	9/10/2003		5.6 J	8.8		2.2 J	3,100	3.5 J		6.6 J	**1,680**	< 9.3	607	27.3	< 0.16		764	< 4.7		1,800			80.5
	3/31/2004		<4.9	11.5		1.5 J	1,960	4.0 J		8.9 J	**1,000**	< 9.3	519	19.3	< 0.16		684	< 4.7		2,170			64.6
	9/23/2004		< 5	< 200		<4	< 5,000	< 10		< 25	< 100	< 3	< 5,000	< 15	< 0.2		< 5,000	< 5		< 5,000			28.6
	3/17/2005	< 5	< 5	< 200	**< 5**	<4	< 5,000	< 10	< 50	< 25	195		< 5,000	< 15	< 0.2	< 40	< 5,000	< 5	< 10	< 5,000	**< 10**	< 50	51.2
	9/19/2005	ND (2)	ND (2)	ND (10)	ND (2)	ND (4)	855	ND (10)	ND (10)	ND (10)	ND (50)	ND (2)	360	ND (10)	ND (0.2)	ND (11)	634	ND (50)	ND (10)	1,720	ND (2)	ND (10)	ND (10)
	2/16/2006	ND (2)	3	ND (10)	ND (2)	ND (4)	1,150	ND (10)	11	12	223	7	404	ND (10)	ND (0.2)	12	711	ND (2)	ND (2)	1,880	ND (2)	ND (10)	12
MW-4A	Jan-00		**< 500**	< 50		0.5	1,100	10		10	**8,200**	8	1,200	40	0.8		< 5,000	**< 500**		3,200			410
	7/19/2002		< 5.0	< 200		<4.0	< 5,000	< 10			**4,540**	3	< 5,000	43.1	< 1.5		< 5,000	< 5.0		< 5,000			469
	3/18/2003		33.6	295		<4.0	< 5,000	**189**		110	**82,300**	**67.7**	< 5,000	**96.8**	3.8		10,100	< 5.0		< 5,000			1,220
	9/10/2003		5.0 J	43		1.0 J	1,670	2.9 J		4.4 J	**9,940**	< 9.3	1,640	**64.8**	< 0.16		1,270	< 4.7		3,560			981
	3/31/2004		<4.9	64.1		<0.87	1,860	7.1		13.4	**21,800**	< 9.3	2,380	**85.9**	0.28		1,730	< 4.7		4,010			1,840
	9/23/2004		< 5	< 200		<4	< 5,000	< 10		< 25	**7,450**	3.1	< 5,000	40.4	< 0.2		< 5,000	< 5		< 5,000			741
	3/17/2005	< 5	< 5	< 200	**< 5**	<4	< 5,000	< 10	173	< 25	**6,600**		< 5,000	**59.3**	< 0.2	182	< 5,000	< 5	< 10	< 5,000	**< 10**	< 50	1,150
	9/22/2005	ND (2)	ND (2)	28	ND (2)	ND (4)	974	20	112	30	**12,900**	4	1,080	36	0.30	128	1,390	ND (50)	ND (10)	3,860	ND (2)	ND (10)	633
	2/15/2006	ND (2)	ND (2)	38	ND (2)	ND (4)	816	22	125	21	**12,600**	4	1,250	40	ND (0.2)	129	1,580	ND (2)	ND (2)	3,790	ND (2)	ND (10)	753

Well	Date	Antimony (µg/l)	Arsenic (µg/l)	Barium (µg/l)	Beryllium (µg/l)	Cadmium (µg/l)	Calcium (µg/l)	Chromium (µg/l)	Cobalt (µg/l)	Copper (µg/l)	Iron (µg/l)	Lead (µg/l)	Magnesium (µg/l)	Manganese (µg/l)	Mercury (µg/l)	Nickel (µg/l)	Potassium (µg/l)	Selenium (µg/l)	Silver (µg/l)	Sodium (µg/l)	Thallium (µg/l)	Vanadium (µg/l)	Zinc (µg/l)
NPDWR Standard:		**6**	**50**	**2,000**	**4**	**5**		**100**		**1,300**		**15**			**2**			**50**			**2**		
NSDWR Standard:										**1,000**	**300**			**50**					**100**				**5,000**
MW-4B	Jan-00		< 50	< 10		<0.5	1,100	< 10		< 10	230	< 2	< 500	10	< 0.2		< 5,000	< 50		1,900			50
	7/19/2002		< 5.0	< 200		**5.1**	< 5,000	< 10		< 25	**24,000**	4.2	< 5,000	**51.1**	< 1.5		< 5,000	< 5.0		< 5,000			155
	3/18/2003		< 5.0	< 200		<4.0	< 5,000	< 10		< 25	**4,490**	< 3.0	< 5,000	25.7	< 0.20		< 5,000	< 5.0		< 5,000			61.6
	9/10/2003		<4.9	10.9		1.6 J	1,480	2.8 J		4.9 J	**6,130**	< 9.3	363	26.8	< 0.16		597	< 4.7		1,830			71.7
	3/31/2004		<4.9	10.7		1.2 J	1,200	< 2.2		5.2 J	**2,210**	< 9.3	408	23.5	< 0.16		668	< 4.7		1,770			57.6
	9/23/2004		< 5	< 200		<4	< 5,000	< 10		< 25	**427**	< 3	< 5,000	16.2	< 0.2		< 5,000	< 5		< 5,000			35.2
	3/17/2005	< 5	< 5	< 200	**< 5**	<4	< 5,000	< 10	< 50	< 25	**849**		< 5,000	23.6	< 0.2	< 40	< 5,000	< 5	< 10	< 5,000	**< 10**	< 50	57.9
	9/22/2005	ND (2)	ND (2)	ND(10)	ND (2)	ND (4)	731	ND(10)	ND(10)	ND(10)	207.0	ND(2)	358	19	ND(0.2)	13	632	ND (50)	ND (10)	1,540	ND (2)	ND (10)	16
	2/15/2006	ND (2)	2	ND (10)	ND (2)	ND (4)	681	ND (10)	10	11	**426**	ND (2)	323	15	ND (0.2)	ND (11)	733	ND (2)	ND (2)	1,580	ND (2)	ND (10)	20
MW-5A	Jan-00		< 50	60		<0.5	13,000	< 10		< 10	280	< 2	5,100	< 10	0.2		27,000	< 50		37,000			30
	7/19/2002		< 5.0	< 200		<4.0	17,300	15.7		27.1	**5,630**	5.5	7310	20.7	< 1.5		16,100	< 5.0		43,700			35.5
	3/18/2003		< 5.0	< 200		<4.0	13,200	13.1		< 25	**3,580**	5.7	5310	16.5	< 0.20		12,700	< 5.0		31,800			34.7
	9/10/2003		<4.9	139		<0.87	38,100	2.3 J		4.4 J	**1,260**	< 9.3	14,500	9.7	< 0.16		28,600	< 4.7		73,300			32.9
	3/31/2004		<4.9	134		<0.87	38,000	< 2.2		< 2.1	**1,930**	< 9.3	15,100	6.2	< 0.16		46,400	< 4.7		68,000			<4.1
	9/23/2004		< 5	208		<4	63,800	< 10		< 25	< 100	< 3	26,400	< 15	< 0.2		77,400	< 5		147,000			< 20
	3/17/2005	< 5	< 5	< 200	**< 5**	<4	34,600	< 10	< 50	< 25	231		13,700	< 15	< 0.2	< 40	47,000	< 5	< 10	72,900	**< 10**	< 50	< 20
	9/19/2005	ND (2)	4	161	ND (2)	ND (4)	36,500	80	ND (10)	18	**5,750**	9	14,000	14	0.2	49	42,500	ND (50)	ND (10)	74,600	ND (2)	20	16
	2/14/2006	ND (2)	2	79	ND (2)	ND (4)	21,800	10	ND (10)	10	**924**	ND (2)	8,230	ND (10)	ND (0.2)	ND (11)	26,300	ND (2)	ND (2)	43,300	ND (2)	ND (10)	ND (10)
MW-5B	Jan-00		< 50	< 10		<0.5	1,200	< 10		< 10	**550**	< 2	530	20	0.2		< 5,000	< 50		3,100			50
	7/19/2002		< 5.0	< 200		<4.0	< 5,000	< 10		< 25	**1,500**	3.3	< 5,000	38.2	< 1.5		< 5,000	< 5.0		< 5,000			70.7
	3/18/2003		< 5.0	< 200		<4.0	< 5,000	< 10		< 25	**2,040**	3.1	< 5,000	39.4	< 0.20		< 5,000	< 5.0		5,240			135
	9/10/2003		<4.9	17.8		4.3 J	2,950	7.4		6.1 J	**1,320**	< 9.3	947	35	< 0.16		1,750	< 4.7		4,300			86.6
	3/31/2004		<4.9	17.1		1.7 J	2,190	2.2 J		10	**755**	< 9.3	940	30.7	< 0.16		1,680	< 4.7		4,610			116
	9/23/2004		< 5	< 200		<4	< 5,000	< 10		< 25	**532**	< 3	< 5,000	23.7	< 0.2		< 5,000	< 5		7,580			66.4
	3/17/2005	< 5	< 5	< 200	**< 5**	<4	< 5,000	< 10	< 50	< 25	**527**		< 5,000	22.5	< 0.2	< 40	< 5,000	< 5	< 10	13,200	**< 10**	< 50	67.5
	9/19/2005	ND (2)	ND (2)	11	ND (2)	ND (4)	2,290	ND (10)	12	ND (10)	**418**	ND (2)	968	13	ND (0.2)	17	2,430	ND (50)	ND (10)	4,850	ND (2)	ND (10)	28
	2/14/2006	ND (2)	ND (2)	19	ND (2)	ND (4)	4,030	ND (10)	16	ND (10)	ND (50)	ND (2)	1,730	20	ND (0.2)	16	5,050	ND (2)	ND (2)	10,300	ND (2)	ND (10)	43
MW-6A	Jan-00		< 50	< 10		<0.5	14,000	< 10		10	**630**	< 2	5,300	30	0.2		< 5,000	< 50		17,000			20
	7/19/2002		10	< 200		<4.0	16,400	24.3		26.2	**8,490**	8.2	6500	25.2	< 1.5		8,340	< 5.0		37,600			29.8
	3/18/2003		13.2	< 200		<4.0	15,400	< 10		< 25	**3,870**	< 3.0	5610	23.1	< 0.20		7,520	< 5.0		32,700			28.2
	9/10/2003		7.0 J	39.4		<0.87	16,900	< 2.2		3.0 J	**1,100**	< 9.3	6,620	23.7	< 0.16		8,470	< 4.7		44,800			26.1
	3/31/2004		<4.9	28.6		<0.87	13,300	< 2.2		5.5 J	**952**	< 9.3	5,090	14	< 0.16		8,100	< 4.7		33,800			13.8 J
	9/23/2004		< 5	< 200		<4	17,000	< 10		< 25	193	< 3	6,690	< 15	< 0.2		7,130	< 5		29,000			< 20
	3/17/2005	< 5	5.5	< 200	**< 5**	<4	21,000	< 10	< 50	< 25	**638**		7,790	17.2	< 0.2	< 40	7,170	< 5	< 10	31,800	**< 10**	< 50	< 20
	9/19/2005	ND (2)	3	25	ND (2)	ND (4)	15,300	ND (10)	ND (10)	ND (10)	**430**	ND (2)	5,430	ND (10)	ND (0.2)	ND (11)	5,440	ND (50)	ND (10)	23,600	ND (2)	ND (10)	ND (10)
	2/14/2006	ND (2)	4	26	ND (2)	ND (4)	18,400	ND (10)	ND (10)	ND (10)	**651**	ND (2)	6,550	10	ND (0.2)	ND (11)	5,670	ND (2)	ND (2)	24,600	ND (2)	ND (10)	ND (10)
MW-7A	Jan-00		< 50	< 10		<0.5	2,400	< 10		10	**440**	6	1,500	30	0.4		< 5,000	< 50		6,900			80
	7/19/2002		< 5.0	< 200		<4.0	8,500	13.7		54.9	**3,150**	3.7	< 5,000	44.5	< 1.5		< 5,000	< 5.0		10,600			87.6
	3/18/2003		< 5.0	< 200		<4.0	11,800	< 10		< 25	**1,430**	< 3.0	< 5,000	**63.6**	< 0.20		< 5,000	< 5.0		14,800			107
	9/10/2003		<4.9	46		1.6 J	12,000	< 2.2		9.1 J	**2,040**	< 9.3	5,290	**62.9**	< 0.16		3,950	< 4.7		16,800			74.9
	3/31/2004		<4.9	47.3		<0.87	8,170	< 2.2		21.4	**1,750**	< 9.3	4,110	**53.1**	0.21		3,710	< 4.7		16,600			75.3
	9/23/2004		< 5	< 200		<4	6,880	< 10		< 25	**1,340**	< 3	< 5,000	**50.2**	0.27		< 5,000	< 5		18,100			68.7
	3/17/2005	< 5	< 5	< 200	**< 5**	<4	6,800	< 10	< 50	< 25	**2,100**		< 5,000	46.5	0.45	55.7	< 5,000	< 5	< 10	19,100	**< 10**	< 50	93.0
	9/19/2005	ND (2)	ND (2)	38	ND (2)	ND (4)	6,310	ND (10)	34	ND (10)	**6,200**	ND (2)	2,940	37	ND (0.2)	48	3,880	ND (50)	ND (10)	12,900	ND (2)	ND (10)	ND (10)
	2/14/2006	ND (2)	2	37	ND (2)	ND (4)	6,530	ND (10)	32	11	**5,700**	ND (2)	3,080	36	ND (0.2)	40	4,020	ND (2)	ND (2)	13,200	ND (2)	ND (10)	43

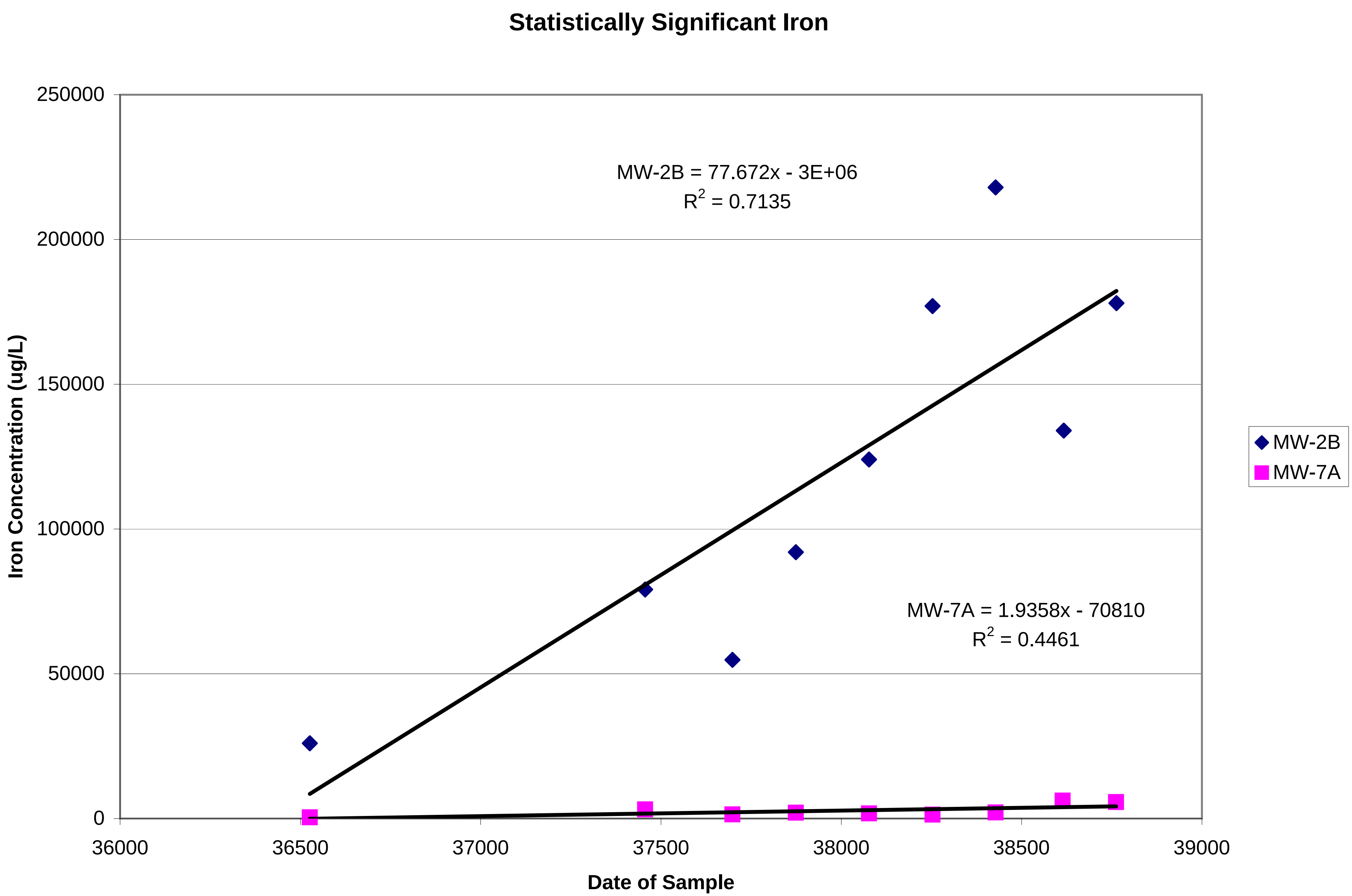
Well	Date	Antimony (µg/l)	Arsenic (µg/l)	Barium (µg/l)	Beryllium (µg/l)	Cadmium (µg/l)	Calcium (µg/l)	Chromium (µg/l)	Cobalt (µg/l)	Copper (µg/l)	Iron (µg/l)	Lead (µg/l)	Magnesium (µg/l)	Manganese (µg/l)	Mercury (µg/l)	Nickel (µg/l)	Potassium (µg/l)	Selenium (µg/l)	Silver (µg/l)	Sodium (µg/l)	Thallium (µg/l)	Vanadium (µg/l)	Zinc (µg/l)
NPDWR Standard:		**6**	**50**	**2,000**	**4**	**5**		**100**		**1,300**		**15**			**2**			**50**			**2**		
NSDWR Standard:										**1,000**	**300**			**50**					**100**				**5,000**
MW-7B	Jan-00		< 50	< 10		<0.5	2,800	< 10		10	**6,700**	< 2	1,200	**70**	< 0.2		< 5,000	< 50		4,100			70
	7/19/2002		< 5.0	< 200		<4.0	13,700	15.4		< 25	**5,530**	3.8	6,200	**99**	< 1.5		< 5,000	5		5,000			20
	3/18/2003		< 5.0	< 200		4.5	7,520	< 10		< 25	**8,550**	< 3.0	< 5,000	**88**	< 0.20		< 5,000	< 5.0		10,100			89.4
	9/10/2003		<4.9	42.4		**6.8**	8,600	4.0 J		6.5 J	**7,950**	< 9.3	3,690	**96.9**	< 0.16		2,690	5.0 J		10,900			104
	3/31/2004		<4.9	40.9		<0.87	8,960	< 2.2		4.1 J	**5,910**	< 9.3	4,160	**95.8**	< 0.16		3,210	< 4.7		12,600			67.1
	9/23/2004		< 5	< 200		<4	8,560	< 10		< 25	**6,670**	< 3	< 5,000	**99.7**	< 0.2		< 5,000	< 5		13,800			78.5
	3/17/2005	< 5	< 5	< 200	**< 5**	<4	6,600	< 10	< 50	< 25	**7,720**		< 5,000	**91.0**	< 0.2	< 40	< 5,000	< 5	< 10	11,500	**< 10**	< 50	79.1
	9/22/2005	ND (2)	2	40	ND (2)	ND (4)	5,750	ND (10)	29	ND (10)	**3,930**	2	2,910	**60**	ND (0.2)	46	3,460	ND (50)	ND (10)	12,000	ND (2)	ND (10)	54
	2/14/2006	ND (2)	3	38	ND (2)	ND (4)	5,020	ND (10)	34	13	**1,970**	ND (2)	2,600	44	ND (0.2)	41	3,770	ND (2)	ND (2)	11,800	ND (2)	ND (10)	62
MW-8A	Jan-00		< 50	< 10		<0.5	48,000	< 10		< 10	**43,000**	< 2	6,900	**530**	< 0.2		< 5,000	< 50		11,000			30
	9/26/2000																				**20**		260
	7/19/2002		**63.7**	< 200		<4.0	44,300	**109**		225	**237,000**	**33.5**	10000	**683**	< 1.5		8,870	< 5.0		8,370			461
	3/18/2003		37.8	< 200		4.4	25,500	94.7		152	**198,000**	**29.8**	6600	**492**	0.39		7,940	10.9		7,380			390
	9/10/2003		8.8 J	33.7		**6.3**	20,900	< 2.2		2.9 J	**276,000**	< 9.3	7,840	**711**	< 0.16		3,760	< 4.7		4,390			7.1 J
	3/31/2004		14.9	34.5		<0.87	27,700	3.0 J		8.7 J	**251,000**	< 9.3	7,930	**666**	< 0.16		4,010	< 4.7		3,870			24.6
	9/23/2004		11.9	< 200		<4	24,700	< 10		< 25	**241,000**	< 3	9,120	**709**	< 0.2		< 5,000	< 5		5,260			< 20
	3/17/2005	< 5	10.4	< 200	**< 5**	<4	19,600	< 10	< 50	< 25	**183,000**		5,780	**508**	< 0.2	< 40	< 5,000	7.7	< 10	< 5,000	**< 10**	< 50	< 20
	9/22/2005	ND (2)	3	38	ND (2)	ND (4)	27,700	ND (10)	15	ND (10)	197	ND (2)	7,810	**571**	ND (0.2)	11	3,340	ND (50)	ND (10)	2,490	ND (2)	ND (10)	15
	2/15/2006	ND (2)	2	36	ND (2)	ND (4)	19,200	ND (10)	13	ND (10)	**178,000**	ND (2)	4,820	**361**	ND (0.2)	ND (11)	3,550	ND (2)	ND (2)	1,970	ND (2)	ND (10)	ND (10)
MW-9A	Jan-00		**< 500**	< 50		<0.5	2,400	< 10		< 10	250	< 2	1,500	< 10	< 0.2		< 5,000	**< 500**		1,900			20
	9/26/2000																						30
	7/19/2002		< 5.0	< 200		<4.0	< 5,000	11		71.4	**10,300**	3.9	< 5,000	< 15	< 1.5		< 5,000	< 5.0		< 5,000			< 20
	3/18/2003		7.2	< 200		<4.0	< 5,000	26.8		78	**21,000**	8.5	< 5,000	< 15.0	< 0.20		< 5,000	< 5.0		< 5,000			39.3
	9/10/2003		<4.9	39.3		<0.87	2,700	9.2		9.6 J	**6,560**	< 9.3	2,050	14	< 0.16		2,590	< 4.7		1,390			36.3
	3/31/2004		39.6	65.3		<0.87	3,640	8.3		22.2	**8,600**	< 9.3	2,780	15.2	< 0.16		2,290	< 4.7		1,510			13.4 J
	9/23/2004		< 5	< 200		<4	< 5,000	< 10		< 25	< 100	< 3	< 5,000	< 15	< 0.2		< 5,000	< 5		< 5,000			< 20
	3/17/2005	5.8	< 5	< 200	**< 5**	<4	< 5,000	< 10	< 50	< 25	158		< 5,000	< 15	< 0.2	< 40	< 5,000	< 5	< 10	< 5,000	**< 10**	< 50	< 20
	9/23/2005	ND (2)	ND (2)	11	ND (2)	ND (4)	1,940	ND (10)	ND (10)	ND (10)	159	ND (2)	935	ND (10)	0.40	ND (11)	1,050	ND (50)	ND (10)	1,940	ND (2)	ND (10)	ND (10)
	2/16/2006	ND (2)	ND (2)	14	ND (2)	ND (4)	1,920	ND (10)	ND (10)	ND (10)	**477**	ND (2)	1,230	ND (10)	0.2	ND (11)	1,230	ND (2)	ND (2)	1,590	ND (2)	ND (10)	ND (10)
MW-10A	Jan-00		**< 500**	< 50		<0.5	1,600	< 10		1,200	**390**	< 2	930	10	<0.5		< 5,000	**< 500**		2,900			110
	9/26/2000																				**< 10**		200
	7/19/2002		16.4	< 200		<4.0	< 5,000	46.5		53.1	**26,200**	**19.9**	< 5,000	26.9	< 1.5		< 5,000	< 5.0		< 5,000			49.9
	3/18/2003		12.9	< 200		<4.0	< 5,000	34.5		40.3	**16,800**	14	< 5,000	19.6	< 0.20		< 5,000	< 5.0		< 5,000			48.9
	9/10/2003		<4.9	14.4		<0.87	1,910	8		7.1 J	**4,470**	< 9.3	954	8.9	< 0.16		1,320	< 4.7		2,900			20.7
	3/31/2004		103	45.5		1.3 J	3,990	25.8		75.5	**14,600**	**22.6**	2,170	27.7	< 0.16		2,560	< 4.7		3,070			85.7
	9/23/2004		< 5	< 200		<4	< 5,000	< 10		< 25	< 100	< 3	< 5,000	< 15	< 0.2		< 5,000	< 5		< 5,000			< 20
	3/17/2005	**6.1**	< 5	< 200	**< 5**	<4	< 5,000	< 10	< 50	< 25	**306**		< 5,000	< 15	< 0.2	< 40	< 5,000	< 5	< 10	< 5,000	**< 10**	< 50	< 20
	9/21/2005	ND (2)	ND (2)	ND (10)	ND (2)	ND (4)	1,370	ND (10)	13	ND (10)	288	ND (2)	897	ND (10)	ND (0.02)	17	990	ND (50)	ND (10)	2,960	ND (2)	ND (10)	19
	2/16/2006	ND (2)	2	11	ND (2)	ND (4)	1,250	13	15	11	**2,150**	3	966	ND (10)	ND (0.2)	20	1,170	ND (2)	ND (2)	2,520	ND (2)	ND (10)	20
MW-11A	Jan-00		**< 500**	< 50		<0.5	5,900	< 10		30	**2,600**	8	2,200	20	< 0.2		< 5,000	**< 500**		4,600			60
	9/26/2000																				**< 10**		250
	7/19/2002		43.7	< 200		<4.0	< 5,000	60.6		64.7	**29,800**	**23.5**	< 5,000	26.2	< 1.5		< 5,000	< 5.0		< 5,000			97.4
	3/18/2003		47.5	< 200		<4.0	< 5,000	113		96.8	**47,600**	**47.4**	< 5,000	48	< 0.20		7,220	< 5.0		< 5,000			214
	9/10/2003		48.8	59.9		0.92 J	2,520	46.3		40.7	**32,500**	**16.5 J**	1,170	17.7	< 0.16		3,590	< 4.7		3,380			56.4
	3/31/2004		<4.9	13.6		<0.87	1,310	< 2.2		3.2 J	**648**	< 9.3	1,160	5.4	< 0.16		969	< 4.7		2,740			45.9
	9/23/2004		< 5	< 200		<4	< 5,000	< 10		< 25	**587**	3.1	< 5,000	< 15	< 0.2		< 5,000	< 5		< 5,000			48.5
	3/17/2005	5.4	< 5	< 200	**< 5**	<4	< 5,000	< 10	< 50	< 25	258		< 5,000	< 15	< 0.2	< 40	< 5,000	< 5	< 10	< 5,000	**< 10**	< 50	34.8
	9/21/2005	ND (2)	9	30	ND (2)	ND (4)	1,610	42	11	19	**9,350**	10	1,100	ND (10)	ND (0.02)	30	1,740	ND (50)	ND (10)	3,300	ND (2)	26	50
	2/16/2006	ND (2)	8	44	ND (2)	ND (4)	1,670	62	13	44	**18,200**	**22**	1,370	13	ND (0.2)	26	2,260	ND (2)	ND (2)	2,860	ND (2)	49	70

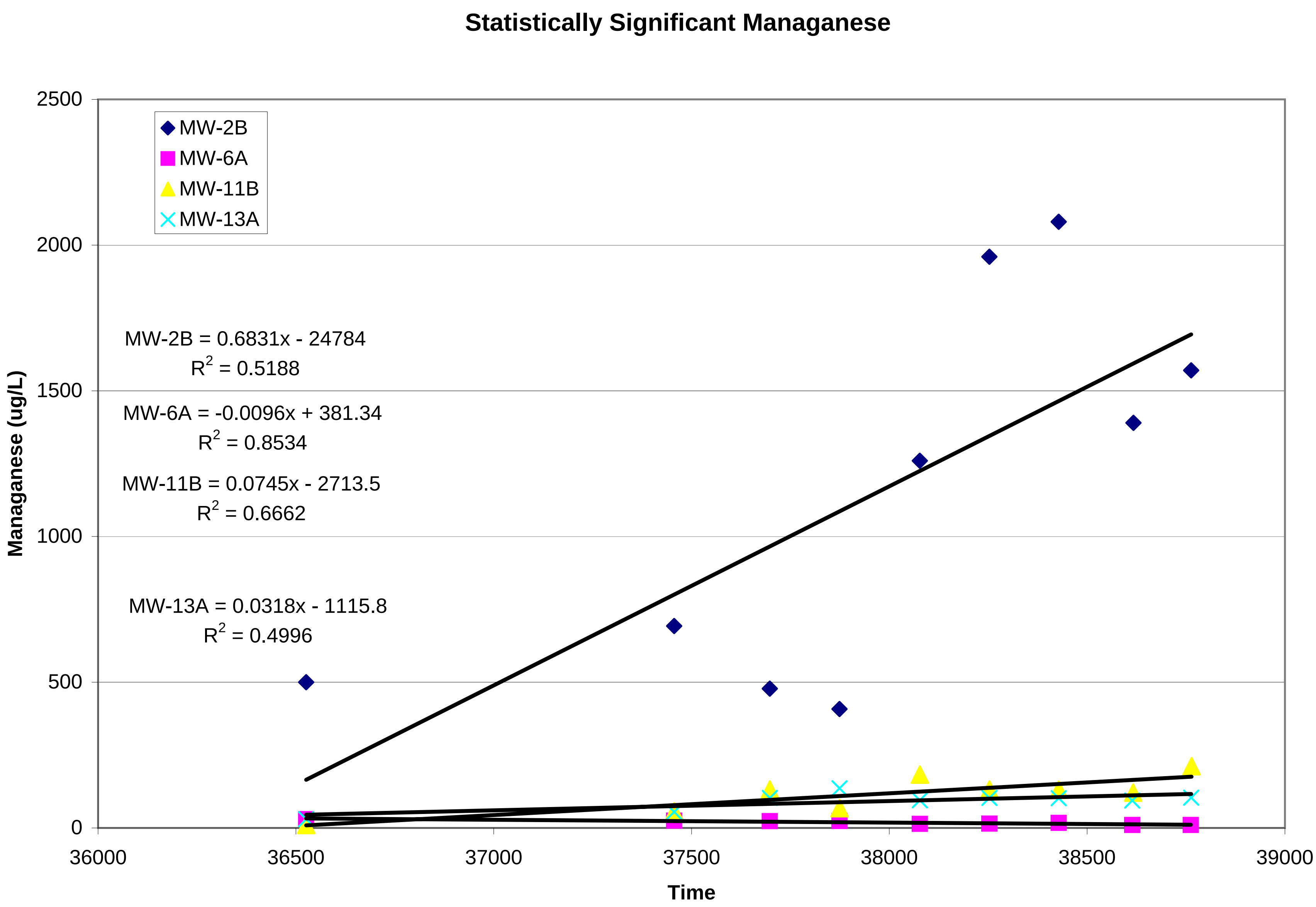
Well	Date	Antimony (µg/l)	Arsenic (µg/l)	Barium (µg/l)	Beryllium (µg/l)	Cadmium (µg/l)	Calcium (µg/l)	Chromium (µg/l)	Cobalt (µg/l)	Copper (µg/l)	Iron (µg/l)	Lead (µg/l)	Magnesium (µg/l)	Manganese (µg/l)	Mercury (µg/l)	Nickel (µg/l)	Potassium (µg/l)	Selenium (µg/l)	Silver (µg/l)	Sodium (µg/l)	Thallium (µg/l)	Vanadium (µg/l)	Zinc (µg/l)
NPDWR Standard:		**6**	**50**	**2,000**	**4**	**5**		**100**		**1,300**		**15**			**2**			**50**			**2**		
NSDWR Standard:										**1,000**	**300**			**50**					**100**				**5,000**
MW-11B	Jan-00		< 50	70		<0.5	18,000	10		< 10	**720**	< 2	< 500	< 10	< 0.2		< 5,000	< 50		3,400			20
	9/26/2000																				**< 10**		120
	7/19/2002		< 5.0	< 200		<4.0	19,100	< 10		< 25	**2,140**	< 3.0	< 5,000	**56.7**	< 1.5		< 5,000	< 5.0		< 5,000			26.5
	3/18/2003		24.3	< 200		**12.1**	30,400	15.2		25.8	**11,800**	9.5	< 5,000	**132**	< 0.20		< 5,000	< 5.0		< 5,000			140
	9/10/2003		<4.9	76.1		<0.87	14,300	3.0 J		< 2.1	**734**	< 9.3	1,150	**67.9**	< 0.16		3,230	< 4.7		2,630			16.0 J
	3/31/2004		<4.9	117		2.2 J	31,900	4.6 J		11.2	**2,530**	< 9.3	1,920	**183**	< 0.16		3,680	< 4.7		3,120			73.0
	9/23/2004		< 5	< 200		<4	16,100	< 10		< 25	**1,300**	< 3	< 5,000	**132**	< 0.2		< 5,000	< 5		< 5,000			36.0
	3/17/2005	5.2	< 5	< 200	**< 5**	<4	14,600	< 10	< 50	< 25	270		< 5,000	**131**	< 0.2	< 40	< 5,000	< 5	< 10	< 5,000	**< 10**	< 50	< 20
	9/21/2005	ND (2)	ND (2)	75	ND (2)	ND (4)	13,200	ND (10)	ND (10)	ND (10)	**329**	ND (2)	1,420	**121**	ND (0.02)	ND (11)	2,730	ND (50)	ND (10)	2,980	ND (2)	ND (10)	ND (10)
	2/16/2006	ND (2)	ND (2)	112	ND (2)	ND (4)	12,900	18	22	12	**22,200**	4	1,600	**212**	ND (0.2)	23	2,820	ND (2)	ND (2)	2,330	ND (2)	ND (10)	70
MW-12A	Jan-00		**< 500**	170		0.8	33,000	40		90	**52,000**	**51**	13,000	**220**	<0.5		6,600	**< 500**		83,000			450
	9/26/2000																				**< 100**		360
	7/19/2002		24.8	255		<4.0	51,600	43		120	**41,100**	**44.1**	9430	**904**	< 1.5		6,860	< 5.0		< 5,000			332
	3/18/2003		< 5.0	< 200		4.4	21,600	< 10		73.7	**3,940**	6.7	< 5,000	**101**	< 0.20		< 5,000	< 5.0		< 5,000			201
	9/10/2003		<4.9	35.7		<0.87	25,100	< 2.2		3.9 J	107.0 J	< 9.3	2,920	51.1	< 0.16		1,270	< 4.7		1,720			48.6
	3/31/2004		<4.9	66.8		<0.87	53,000	< 2.2		12.0	**1,310**	< 9.3	6,740	**78.4**	< 0.16		1,700	< 4.7		2,080			44.1
	9/23/2004		< 5	< 200		<4	63,000	< 10		< 25	**307**	< 3	6,660	**82.6**	< 0.2		< 5,000	< 5		< 5,000			52.1
	3/17/2005	**7.5**	< 5	< 200	**< 5**	<4	55,800	< 10	< 50	< 25	269		5,950	**99.0**	< 0.2	< 40	< 5,000	< 5	< 10	< 5,000	**< 10**	< 50	63.0
	9/23/2005	ND (2)	10	257	ND (2)	ND (4)	44,100	78	37	65	**24,900**	**29**	6,390	**364**	0.2	64	5,570	ND (50)	ND (10)	3,180	ND (2)	16	113
	2/16/2006	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-13A	Jan-00		< 50	< 10		<0.5	4,900	< 10		< 10	**700**	< 2	3,900	30	< 0.2		< 5,000	< 50		9,800			50
	9/26/2000																				**< 10**		140
	7/19/2002		**118**	< 200		<4.0	7,630	66.9		152	**94,600**	**21**	< 5,000	**55**	< 1.5		6,740	< 5.0		6,100			137
	3/18/2003		**134**	< 200		4.4	9,680	**101**		192	**113,000**	**24.9**	5,780	**103**	< 0.20		7,990	5.7		5,830			225
	9/10/2003		39.9	70.2		1.2 J	10,200	22.6		42	**31,800**	< 9.3	4,930	**136**	< 0.16		4,030	< 4.7		6,200			67.6
	3/31/2004		12.9 J	47.8		<0.87	8,900	< 2.2		13.1	**2,310**	< 9.3	4,320	**94.8**	< 0.16		3,190	< 4.7		5,400			36.1
	9/23/2004		< 5	< 200		<4	10,100	< 10		< 25	< 100	< 3	5,280	**103**	< 0.2		< 5,000	5.4		< 5,000			33.3
	3/17/2005	**6.4**	< 5	< 200	**< 5**	<4	9,990	< 10	< 50	< 25	< 100		< 5,000	**102**	< 0.2	< 40	< 5,000	< 5	< 10	< 5,000	**< 10**	< 50	36.8
	9/19/2005	ND (2)	ND (2)	37	ND (2)	ND (4)	9,160	ND (10)	18	ND (10)	**472**	ND (2)	4,300	**94**	ND (0.2)	26	2,530	ND (50)	ND (10)	4,250	ND (2)	ND (10)	31
	2/15/2006	ND (2)	2	36	ND (2)	ND (4)	9,440	ND (10)	21	ND (10)	**521**	ND (2)	4,390	**104**	ND (0.2)	25	2,750	ND (2)	ND (2)	4,940	ND (2)	ND (10)	29
MW-14A	Jan-00		**< 500**	60		**46**	12,000	< 10		< 10	**380**	< 2	14,000	**560**	< 0.2		< 5,000	**< 500**		4,600			180
	7/19/2002		35	< 200		**29**	14,900	**177**		285	**63,000**	20.7	5740	**299**	< 1.5		5,760	5		< 5,000			153
	3/18/2003		39.4	< 200		**9.6**	10,800	**114**		138	**77,600**	17.6	5620	**246**	0.38		6,730	5.9		< 5,000			148
	9/10/2003		10.1	106		3.3 J	11,600	36.4		53.7	**27,700**	< 9.3	5,010	**175**	0.16 J		3,380	< 4.7		3,320			95.6
	3/31/2004		46.4	89.1		**17.6**	12,700	14.7		53.5	**3,660**	< 9.3	4,730	**190**	< 0.16		2,420	< 4.7		3,540			82.1
	9/23/2004		< 5	< 200		**11.6**	11,500	< 10		< 25	**305**	< 3	7,250	**196**	< 0.2		< 5,000	5.8		< 5,000			25.9
	3/17/2005	**6.0**	< 5	< 200	**< 5**	**48.0**	10,500	18.9	173	< 25	**1,180**		9,470	**572**	< 0.2	273	< 5,000	5.8	< 10	< 5,000	**< 10**	< 50	63.5
	9/19/2005	ND (2)	4	19	ND (2)	**62**	19,100	**167**	310	132	**818**	9	11,200	**626**	0.8	515	3	ND (50)	ND (10)	2,840	ND (2)	ND (10)	204
	2/16/2006	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI	WI

NOTES:

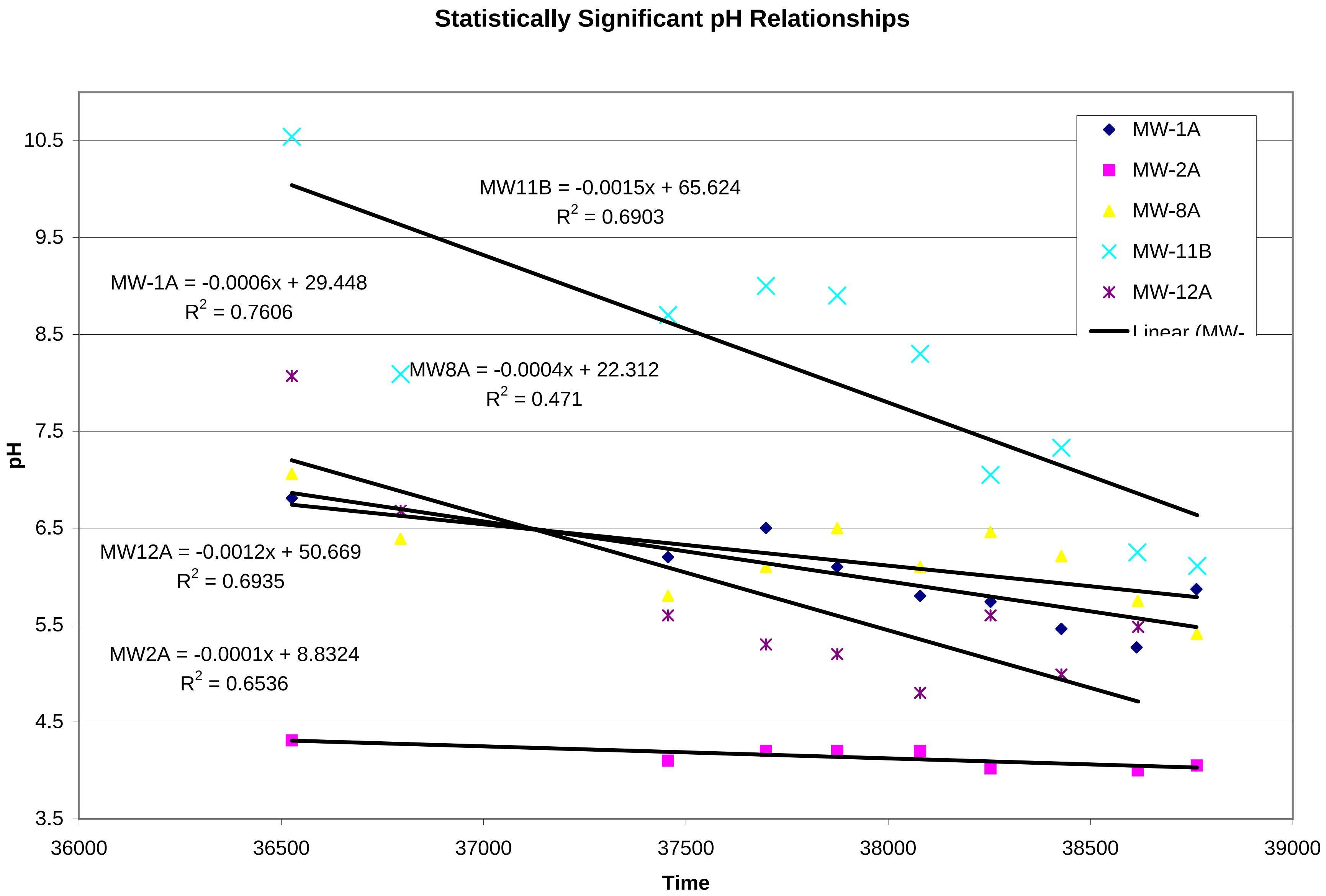
NPDWR: National Primary Drinking Water Standard.
NSDWR: National Secondary Drinking Water Standard.
µg/l: micrograms per liter.
< less than.
ND Not Detected (the method detection limit is in parenthses).
J Value is an estimated concentration below the Limit of Quantitation (LOQ) but above the Method Detection Limit (MDL).
bold # Concetration exceeded NPDWR or NSDWR.

Appendix H
Groundwater Trend Analysis

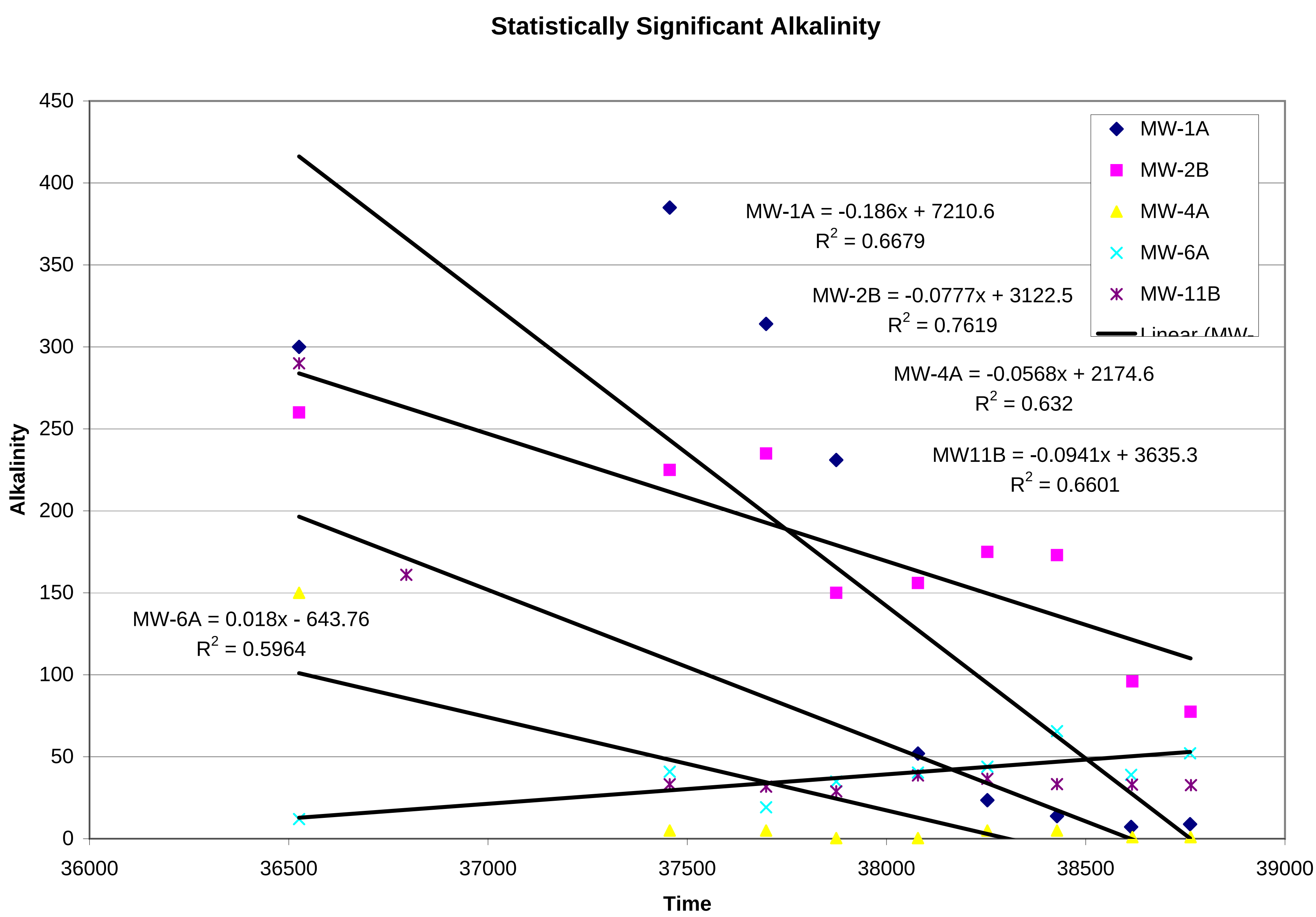

Statistically Significant Iron
MW-2B = 77.672x - 3E+06
R2 = 0.7135
MW-7A = 1.9358x - 70810
R2 = 0.4461
250000
200000
150000
100000
50000
0
Iron Concentration (ug/L)
36000
36500
37000
37500
38000
38500
39000
Date of Sample
MW-2B
MW-7A



Statistically Significant Managanese
Managanese (ug/L)
Time
MW-2B
MW-6A
MW-11B
MW-13A
MW-2B = 0.6831x - 24784
R^2 = 0.5188
MW-6A = -0.0096x + 381.34
R^2 = 0.8534
MW-11B = 0.0745x - 2713.5
R^2 = 0.6662
MW-13A = 0.0318x - 1115.8
R^2 = 0.4996
0
500
1000
1500
2000
2500
36000
36500
37000
37500
38000
38500
39000



Statistically Significant pH Relationships
MW11B = -0.0015x + 65.624
R2 = 0.6903
MW-1A = -0.0006x + 29.448
R2 = 0.7606
MW8A = -0.0004x + 22.312
R2 = 0.471
MW12A = -0.0012x + 50.669
R2 = 0.6935
MW2A = -0.0001x + 8.8324
R2 = 0.6536
MW-1A
MW-2A
MW-8A
MW-11B
MW-12A
Linear (MW-
pH
10.5
9.5
8.5
7.5
6.5
5.5
4.5
3.5
36000
36500
37000
37500
38000
38500
39000
Time


Statistically Significant Alkalinity
Alkalinity
Time
MW-1A
MW-2B
MW-4A
MW-6A
MW-11B
Linear (MW-
MW-1A = -0.186x + 7210.6
R2 = 0.6679
MW-2B = -0.0777x + 3122.5
R2 = 0.7619
MW-4A = -0.0568x + 2174.6
R2 = 0.632
MW11B = -0.0941x + 3635.3
R2 = 0.6601
MW-6A = 0.018x - 643.76
R2 = 0.5964
0
50
100
150
200
250
300
350
400
450
36000
36500
37000
37500
38000
38500
39000

MW-1B

Regression Statistics	
Multiple R	0.10596961
R Square	0.01122956
Adjusted R Square	-0.13002336
Standard Error	0.89300475
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.063397597	0.0633976	0.0794997	0.786130477
Residual	7	5.582202403	0.79745749		
Total	8	5.6456			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	10.1193202	17.44960747	0.57991678	0.5801489	-31.14244481	51.38108519	-31.14244481	51.38108519
X Variable 1	-0.00012957	0.00045955	-0.2819568	0.7861305	-0.001216236	0.00095709	-0.001216236	0.00095709

MW-2A

Regression Statistics	
Multiple R	0.8084509
R Square	0.65359286
Adjusted R Square	0.59585833
Standard Error	0.06930738
Observations	8

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.054378926	0.05437893	11.320659	0.015142861
Residual	6	0.028821074	0.00480351		
Total	7	0.0832			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	8.8324066	1.396333576	6.32542736	0.0007298	5.415701429	12.24911177	5.415701429	12.24911177
X Variable 1	-0.00012392	3.68289E-05	-3.3646187	0.0151429	-0.000214032	-3.37981E-05	-0.000214032	-3.37981E-05

MW-1A

Regression Statistics	
Multiple R	0.87214181
R Square	0.76063133
Adjusted R Square	0.72643581
Standard Error	0.25477132
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	1.443796589	1.44379659	22.243593	0.002166851
Residual	7	0.454358967	0.06490842		
Total	8	1.898155556			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	29.4480924	4.978315586	5.91527232	0.0005903	17.67624662	41.21993815	17.67624662	41.21993815
Date	-0.00061835	0.000131108	-4.7163114	0.0021669	-0.000928368	-0.000308325	-0.000928368	-0.000308325

MW-2B

Regression Statistics	
Multiple R	0.31501868
R Square	0.09923677
Adjusted R Square	-0.0294437
Standard Error	0.25531119
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.050268935	0.05026894	0.7711875	0.408978589
Residual	7	0.45628662	0.0651838		
Total	8	0.506555556			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	10.4850952	4.985300412	2.10320228	0.0735227	-1.303267058	22.27345745	-1.303267058	22.27345745
X Variable 1	-0.0001153	0.00013129	-0.8781728	0.4089786	-0.000425748	0.000195157	-0.000425748	0.000195157

MW-3B

Regression Statistics	
Multiple R	0.21029793
R Square	0.04422522
Adjusted R Square	-0.09231404
Standard Error	0.30986191
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.031099174	0.03109917	0.3239011	0.58706099
Residual	7	0.672100826	0.0960144		
Total	8	0.7032			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	1.64600643	6.052284764	0.27196447	0.7934962	-12.6653729	15.95738576	-12.6653729	15.95738576
X Variable 1	9.0713E-05	0.000159391	0.56912312	0.587061	-0.000286187	0.000467613	-0.000286187	0.000467613

MW-4A

Regression Statistics	
Multiple R	0.62285372
R Square	0.38794676
Adjusted R Square	0.30051058
Standard Error	0.35176099
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.549005008	0.54900501	4.4369135	0.073176578
Residual	7	0.866150548	0.12373579		
Total	8	1.415155556			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	18.3037075	6.868614763	2.66483245	0.0322404	2.062014435	34.54540051	2.062014435	34.54540051
X Variable 1	-0.00038102	0.000180889	-2.1063982	0.0731766	-0.000808757	4.67101E-05	-0.000808757	4.67101E-05

MW-4B

Regression Statistics	
Multiple R	0.66062068
R Square	0.43641968
Adjusted R Square	0.3559082
Standard Error	0.1166313
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.073735529	0.07373553	5.4205898	0.052752294
Residual	7	0.095220026	0.01360286		
Total	8	0.168955556			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	9.71925132	2.277385837	4.26772274	0.0037111	4.334089537	15.10441309	4.334089537	15.10441309
X Variable 1	-0.00013964	5.99761E-05	-2.328216	0.0527523	-0.000281458	2.18363E-06	-0.000281458	2.18363E-06

MW-5A

Regression Statistics	
Multiple R	0.38385548
R Square	0.14734503
Adjusted R Square	0.02553717
Standard Error	0.30750298
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.114382307	0.11438231	1.2096513	0.307780763
Residual	7	0.661906582	0.09455808		
Total	8	0.776288889			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-0.51655544	6.008709698	-0.0859678	0.9338993	-14.72489611	13.69178523	-14.72489611	13.69178523
X Variable 1	0.00017404	0.000158244	1.09984148	0.3077808	-0.000200145	0.000548232	-0.000200145	0.000548232

MW-5B

Regression Statistics	
Multiple R	0.61096108
R Square	0.37327344
Adjusted R Square	0.28374107
Standard Error	0.4226476
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.744738577	0.74473858	4.1691453	0.080492989
Residual	7	1.250416979	0.178631		
Total	8	1.995155556			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-12.3027288	8.258673622	-1.4896737	0.1799237	-31.83138871	7.225931149	-31.83138871	7.225931149
X Variable 1	0.0004441	0.000217499	2.04184849	0.080493	-7.02034E-05	0.000958404	-7.02034E-05	0.000958404

MW-6A

Regression Statistics	
Multiple R	0.55895187
R Square	0.31242719
Adjusted R Square	0.21420251
Standard Error	0.21983796
Observations	9

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.153721123	0.15372112	3.1807401	0.117697555
Residual	7	0.3383011	0.04832873		
Total	8	0.492022222			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-1.68456257	4.295706264	-0.3921503	0.706613	-11.84229378	8.473168636	-11.84229378	8.473168636
X Variable 1	0.00020176	0.000113131	1.78346294	0.1176976	-6.57474E-05	0.000469277	-6.57474E-05	0.000469277

MW-7A

Regression Statistics	
Multiple R	0.30103245
R Square	0.09062054
Adjusted R Square	-0.03929081
Standard Error	0.26772992
Observations	9

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.050000385	0.05000039	0.6975567	0.431185229
Residual	7	0.501755171	0.07167931		
Total	8	0.551755556			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	1.04570578	5.228879062	0.19998661	0.8471768	-11.31862846	13.41004001	-11.31862846	13.41004001
X Variable 1	0.00011501	0.000137706	0.83519862	0.4311852	-0.000210611	0.000440634	-0.000210611	0.000440634

MW-7B

Regression Statistics	
Multiple R	0.3083765
R Square	0.09509607
Adjusted R Square	-0.03417592
Standard Error	0.26504037
Observations	9

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.051675203	0.0516752	0.7356278	0.419458797
Residual	7	0.491724797	0.0702464		
Total	8	0.5434			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	9.97571138	5.176351078	1.92717055	0.0953185	-2.264413913	22.21583667	-2.264413913	22.21583667
X Variable 1	-0.00011692	0.000136322	-0.8576875	0.4194588	-0.000439273	0.000205429	-0.000439273	0.000205429

MW-8A

Regression Statistics	
Multiple R	0.68628152
R Square	0.47098233
Adjusted R Square	0.40485512
Standard Error	0.35772438
Observations	10

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.911426167	0.91142617	7.1223682	0.028416099
Residual	8	1.023733833	0.12796673		
Total	9	1.93516			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	22.3122346	6.046612958	3.69003849	0.0061299	8.368720092	36.25574904	8.368720092	36.25574904
X Variable 1	-0.00042628	0.000159729	-2.6687765	0.0284161	-0.000794615	-5.79452E-05	-0.000794615	-5.79452E-05

MW-9A

Regression Statistics	
Multiple R	0.49451168
R Square	0.2445418
Adjusted R Square	0.15010953
Standard Error	0.35948522
Observations	10

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.334653011	0.33465301	2.5895998	0.146233846
Residual	8	1.033836989	0.12922962		
Total	9	1.36849			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-4.71430847	6.074371419	-0.7760982	0.4600179	-18.72183407	9.293217131	-18.72183407	9.293217131
X Variable 1	0.00025822	0.000160461	1.60922336	0.1462338	-0.000111806	0.000628242	-0.000111806	0.000628242

Mw-10A

Regression Statistics	
Multiple R	0.01361792
R Square	0.00018545
Adjusted R Square	-0.12479137
Standard Error	0.50267224
Observations	10

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.00037494	0.00037494	0.0014839	0.97021632
Residual	8	2.02143506	0.25267938		
Total	9	2.02181			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	5.3602321	8.496416932	0.63088148	0.5457152	-14.23254046	24.95300466	-14.23254046	24.95300466
X Variable 1	-8.6457E-06	0.000224443	-0.0385209	0.9702163	-0.000526213	0.000508921	-0.000526213	0.000508921

MW-11A

Regression Statistics	
Multiple R	0.13241855
R Square	0.01753467
Adjusted R Square	-0.10527349
Standard Error	0.44094205
Observations	10

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.027760893	0.02776089	0.142781	0.715360401
Residual	8	1.555439107	0.19442989		
Total	9	1.5832			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	2.29426612	7.453022387	0.3078303	0.7660734	-14.89243431	19.48096655	-14.89243431	19.48096655
X Variable 1	7.4394E-05	0.000196881	0.37786372	0.7153604	-0.000379614	0.000528402	-0.000379614	0.000528402

MW-11B

Regression Statistics	
Multiple R	0.83081774
R Square	0.69025812
Adjusted R Square	0.65154039
Standard Error	0.80719138
Observations	10

ANOVA

	df	SS	MS	F	Significance F
Regression	1	11.61594665	11.6159467	17.827957	0.002906629
Residual	8	5.212463346	0.65155792		
Total	9	16.82841			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	65.6243094	13.64355123	4.8099141	0.0013385	34.16222393	97.08639497	34.16222393	97.08639497
X Variable 1	-0.00152177	0.000360411	-4.2223166	0.0029066	-0.002352879	-0.00069066	-0.002352879	-0.00069066

MW-12A

Regression Statistics	
Multiple R	0.83279146
R Square	0.69354162
Adjusted R Square	0.64976185
Standard Error	0.60462371
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	5.791211219	5.79121122	15.841601	0.005322873
Residual	7	2.558988781	0.36556983		
Total	8	8.3502			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	50.6690553	11.28840383	4.48859343	0.0028369	23.97622181	77.36188872	23.97622181	77.36188872
X Variable 1	-0.00119008	0.000299003	-3.9801508	0.0053229	-0.001897108	-0.000483048	-0.001897108	-0.000483048

MW-13A

Regression Statistics	
Multiple R	0.14804441
R Square	0.02191715
Adjusted R Square	-0.10034321
Standard Error	0.27256244
Observations	10

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.013317735	0.01331774	0.1792662	0.683157809
Residual	8	0.594322265	0.07429028		
Total	9	0.60764			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	2.90481418	4.609198319	0.63022113	0.5461258	-7.724016194	13.53364456	-7.724016194	13.53364456
X Variable 1	5.1552E-05	0.000121759	0.42339837	0.6831578	-0.000229223	0.000332328	-0.000229223	0.000332328

MW-14A

Regression Statistics	
Multiple R	0.13531891
R Square	0.01831121
Adjusted R Square	-0.14530359
Standard Error	1.08081383
Observations	8

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.130736296	0.1307363	0.1119166	0.749357347
Residual	6	7.008951204	1.16815853		
Total	7	7.1396875			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	11.9111624	23.37828851	0.50949677	0.6285952	-45.29344873	69.11577349	-45.29344873	69.11577349
X Variable 1	-0.00020651	0.000617309	-0.3345393	0.7493573	-0.001717014	0.001303986	-0.001717014	0.001303986

Manganese MW-1A

Regression Statistics	
Multiple R	0.29726323
R Square	0.08836543
Adjusted R Square	-0.0418681
Standard Error	66.3338827
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	2985.592056	2985.59	0.678515	0.437259493
Residual	7	30801.28794	4400.18		
Total	8	33786.88			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	1164.7635	1296.255625	0.89856	0.39874	-1900.39399	4229.92098	-1900.393987	4229.920984
X Variable 1	-0.0281203	0.034138171	-0.82372	0.437259	-0.10884425	0.05260364	-0.108844253	0.052603639

MW-1B

Regression Statistics	
Multiple R	0.48253574
R Square	0.23284074
Adjusted R Square	0.12324656
Standard Error	117.761655
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	29463.15733	29463.2	2.124572	0.188306381
Residual	7	97074.65156	13867.8		
Total	8	126537.8089			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	3527.76883	2301.225276	1.533	0.169143	-1913.76426	8969.30193	-1913.764263	8969.301928
X Variable 1	-0.0883374	0.060605038	-1.45759	0.188306	-0.23164551	0.05497077	-0.231645513	0.054970771

MW-2A

Regression Statistics	
Multiple R	0.08195043
R Square	0.00671587
Adjusted R Square	-0.1588315
Standard Error	13.6337696
Observations	8

ANOVA

	df	SS	MS	F	Significance F
Regression	1	7.540707416	7.54071	0.040568	0.847029525
Residual	6	1115.278043	185.88		
Total	7	1122.81875			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-12.183203	274.7036733	-0.04435	0.966064	-684.358875	659.992469	-684.3588754	659.9924694
X Variable 1	0.00145934	0.007245473	0.20141	0.84703	-0.01626969	0.01918837	-0.016269692	0.019188374

MW-2B

Regression Statistics	
Multiple R	0.72026836
R Square	0.51878652
Adjusted R Square	0.45004173
Standard Error	483.500134
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	1764176.897	1764177	7.546558	0.02862345
Residual	7	1636406.658	233772		
Total	8	3400583.556			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-24784.205	9441.506342	-2.62503	0.034159	-47109.8199	-2458.5902	-47109.81993	-2458.590201
X Variable 1	0.68306207	0.248648421	2.7471	0.028623	0.095101987	1.27102216	0.095101987	1.271022158

MW-3B

Regression Statistics	
Multiple R	0.15670574
R Square	0.02455669
Adjusted R Square	-0.1147924
Standard Error	6.56213698
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	7.588507949	7.58851	0.176224	0.687222573
Residual	7	301.4314921	43.0616		
Total	8	309.02			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	70.0342135	128.1798387	0.54637	0.60178	-233.062942	373.131369	-233.0629416	373.1313687
X Variable 1	-0.0014171	0.003375722	-0.41979	0.687223	-0.00939941	0.00656522	-0.009399412	0.006565218

MW-4A

Regression Statistics	
Multiple R	0.0603287
R Square	0.00363955
Adjusted R Square	-0.1386977
Standard Error	23.7715905
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	14.44927265	14.4493	0.02557	0.877471523
Residual	7	3955.619616	565.089		
Total	8	3970.068889			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	130.506061	464.1976433	0.28114	0.786729	-967.146944	1228.15907	-967.1469438	1228.159065
X Variable 1	-0.0019548	0.012224957	-0.15991	0.877472	-0.03086227	0.02695259	-0.030862274	0.026952586

MW-4B

Regression Statistics	
Multiple R	0.11263525
R Square	0.0126867
Adjusted R Square	-0.1283581
Standard Error	12.4869924
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	14.02514606	14.0251	0.089948	0.772953421
Residual	7	1091.474854	155.925		
Total	8	1105.5			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	96.5531517	243.8386457	0.39597	0.703918	-480.033623	673.139927	-480.0336233	673.1399266
X Variable 1	-0.0019259	0.006421655	-0.29991	0.772953	-0.01711074	0.01325886	-0.017110741	0.01325886

MW-5A

Regression Statistics	
Multiple R	0.05107064
R Square	0.00260821
Adjusted R Square	-0.1398763
Standard Error	4.70960829
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.406017248	0.40602	0.018305	0.896185607
Residual	7	155.2628716	22.1804		
Total	8	155.6688889			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	25.4609659	92.03224637	0.27665	0.790037	-192.160716	243.082647	-192.1607158	243.0826475
X Variable 1	-0.0003279	0.00242376	-0.1353	0.896186	-0.00605921	0.00540335	-0.006059209	0.005403355

MW-5B

Regression Statistics	
Multiple R	0.33404544
R Square	0.11158636
Adjusted R Square	-0.0153299
Standard Error	9.30360974
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	76.10214244	76.1021	0.879213	0.379633233
Residual	7	605.9000798	86.5572		
Total	8	682.0022222			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	197.391885	181.8053756	1.08573	0.313567	-232.509515	627.293285	-232.5095149	627.2932853
X Variable 1	-0.0044896	0.004788024	-0.93766	0.379633	-0.01581143	0.00683232	-0.015811432	0.006832323

MW-6A

Regression Statistics	
Multiple R	0.92377166
R Square	0.85335408
Adjusted R Square	0.83240466
Standard Error	2.90817228
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	344.506627	344.507	40.73402	0.000373518
Residual	7	59.2022619	8.45747		
Total	8	403.7088889			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	381.341521	56.82970025	6.71025	0.000275	246.9606332	515.722408	246.9606332	515.7224079
X Variable 1	-0.0095522	0.001496666	-6.38232	0.000374	-0.01309126	-0.00601315	-0.013091258	-0.006013151

MW-7A

Regression Statistics	
Multiple R	0.09300265
R Square	0.00864949
Adjusted R Square	-0.132972
Standard Error	12.4372797
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	9.447399333	9.4474	0.061075	0.81189688
Residual	7	1082.80149	154.686		
Total	8	1092.248889			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-12.965974	243.0416124	-0.05335	0.958945	-587.668065	561.736117	-587.6680646	561.7361167
X Variable 1	0.00158183	0.006400741	0.24713	0.811897	-0.01355351	0.01671718	-0.013553512	0.016717181

MW-7B

Regression Statistics	
Multiple R	0.25615379
R Square	0.06561476
Adjusted R Square	-0.0678688
Standard Error	20.6649284
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	209.9140189	209.914	0.491557	0.505865171
Residual	7	2989.27487	427.039		
Total	8	3199.188889			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	365.649837	403.6164278	0.90593	0.395083	-588.751356	1320.05103	-588.7513559	1320.051031
X Variable 1	-0.0074525	0.010629542	-0.70111	0.505865	-0.03258736	0.01768238	-0.032587362	0.017682383

MW-8A

Regression Statistics	
Multiple R	0.20614721
R Square	0.04249667
Adjusted R Square	-0.0942895
Standard Error	125.564575
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	4898.317714	4898.32	0.31068	0.594629784
Residual	7	110365.2378	15766.5		
Total	8	115263.5556			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	1947.70727	2451.951198	0.79435	0.453076	-3850.236	7745.65053	-3850.235998	7745.650531
X Variable 1	-0.0359925	0.064573784	-0.55739	0.59463	-0.18868528	0.11670019	-0.188685283	0.116700189

MW-9A

Regression Statistics	
Multiple R	0.00474869
R Square	2.255E-05
Adjusted R Square	-0.1428314
Standard Error	2.62681592
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.00108922	0.00109	0.000158	0.990326222
Residual	7	48.301133	6.90016		
Total	8	48.30222222			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	12.6003118	51.27557363	0.24574	0.812935	-108.647153	133.847777	-108.6471531	133.8477767
X Variable 1	1.6966E-05	0.001350369	0.01256	0.990326	-0.00317615	0.00321008	-0.003176148	0.003210081

MW-10A

Regression Statistics	
Multiple R	0.13330769
R Square	0.01777094
Adjusted R Square	-0.1225475
Standard Error	7.75846655
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	7.623377582	7.62338	0.126647	0.732417461
Residual	7	421.3566224	60.1938		
Total	8	428.98			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	69.8061405	151.4968852	0.46078	0.658933	-288.427068	428.039349	-288.4270681	428.0393492
X Variable 1	-0.0014199	0.003989772	-0.35588	0.732417	-0.01085417	0.00801445	-0.010854174	0.008014451

MW-11A

Regression Statistics	
Multiple R	0.40930823
R Square	0.16753322
Adjusted R Square	0.0486094
Standard Error	12.0916988
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	205.9713024	205.971	1.408744	0.273978474
Residual	7	1023.464253	146.209		
Total	8	1229.435556			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	299.122061	236.1104076	1.26687	0.245721	-259.190334	857.434457	-259.1903344	857.434457
X Variable 1	-0.0073803	0.006218126	-1.18691	0.273978	-0.02208386	0.00732321	-0.022083859	0.007323206

MW-11B

Regression Statistics	
Multiple R	0.81618707
R Square	0.66616133
Adjusted R Square	0.6184701
Standard Error	38.7793632
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	21005.94248	21005.9	13.96821	0.007287515
Residual	7	10526.87307	1503.84		
Total	8	31532.81556			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-2713.491	757.231174	-3.58344	0.008935	-4504.05824	-922.923848	-4504.058244	-922.9238482
X Variable 1	0.07453209	0.019942192	3.73741	0.007288	0.0273763	0.12168788	0.0273763	0.121687883

MW-12A

Regression Statistics	
Multiple R	0.22788651
R Square	0.05193226
Adjusted R Square	-0.106079
Standard Error	303.35673
Observations	8

ANOVA

	df	SS	MS	F	Significance F
Regression	1	30245.19504	30245.2	0.328662	0.587275644
Residual	6	552151.8337	92025.3		
Total	7	582397.0288			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	3997.43872	6559.380525	0.60942	0.564592	-12052.7872	20047.6646	-12052.78719	20047.66463
X Variable 1	-0.0992949	0.173201825	-0.57329	0.587276	-0.52310452	0.32451468	-0.523104517	0.324514679

Manganese Regression

MW-13A

Regression Statistics	
Multiple R	0.70685533
R Square	0.49964446
Adjusted R Square	0.42816509
Standard Error	23.372761
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	3818.567183	3818.57	6.990052	0.033236135
Residual	7	3824.001706	546.286		
Total	8	7642.568889			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-1115.8128	456.6409792	-2.44352	0.044528	-2195.59716	-36.0284964	-2195.597163	-36.02849635
X Variable 1	0.03179533	0.012026055	2.64387	0.033236	0.003358232	0.06023243	0.003358232	0.060232433

MW-14A

Regression Statistics	
Multiple R	0.00730543
R Square	5.3369E-05
Adjusted R Square	-0.1666044
Standard Error	209.121972
Observations	8

ANOVA

	df	SS	MS	F	Significance F
Regression	1	14.00442477	14.0044	0.00032	0.986302807
Residual	6	262391.9956	43732		
Total	7	262406			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	438.984735	4526.141714	0.09699	0.925894	-10636.085	11514.0545	-10636.08504	11514.05451
X Variable 1	-0.0021387	0.119515335	-0.0179	0.986303	-0.29458222	0.29030476	-0.294582222	0.290304756

MW-1A

Regression Statistics	
Multiple R	0.33662152
R Square	0.11331405
Adjusted R Square	-0.01335537
Standard Error	22016.6956
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	433626934.1	433626934	0.89456515	0.375738537
Residual	7	3393144189	484734884		
Total	8	3826771123			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	420151.735	430236.6199	0.9765597	0.36132068	-597196.2098	1437499.68	-597196.21	1437499.681
X Variable 1	-10.7167463	11.3307058	-0.945815	0.37573854	-37.50960804	16.0761154	-37.509608	16.07611539

MW-1B

Regression Statistics	
Multiple R	0.65039733
R Square	0.42301668
Adjusted R Square	0.34059049
Standard Error	4012.10377
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	82610755.37	82610755	5.13206654	0.057868144
Residual	7	112678836.6	16096977		
Total	8	195289592			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	182825.994	78402.04534	2.3319034	0.05246665	-2565.384203	368217.371	-2565.3842	368217.3713
X Variable 1	-4.67760045	2.064795205	-2.265406	0.05786814	-9.560065263	0.20486437	-9.56006526	0.204864367

MW-2A

Regression Statistics	
Multiple R	0.1422344
R Square	0.02023062
Adjusted R Square	-0.14306427
Standard Error	1511.28262
Observations	8

ANOVA

	df	SS	MS	F	Significance F
Regression	1	282961.957	282961.96	0.12389012	0.736885535
Residual	6	13703850.92	2283975.2		
Total	7	13986812.88			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	11807.1949	30450.48424	0.3877506	0.71158322	-62702.45569	86316.8456	-62702.4557	86316.84555
X Variable 1	-0.28269283	0.803149625	-0.35198	0.73688553	-2.247929166	1.6825435	-2.24792917	1.682543499

MW-2B

Regression Statistics	
Multiple R	0.84467831
R Square	0.71348144
Adjusted R Square	0.67255022
Standard Error	36175.2622
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	22811368411	2.281E+10	17.4312272	0.004162736
Residual	7	9160547144	1.309E+09		
Total	8	31971915556			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-2828557.62	706409.2498	-4.004134	0.00516268	-4498950.063	-1158165.18	-4498950.06	-1158165.177
X Variable 1	77.6720514	18.60376278	4.1750721	0.00416274	33.68114275	121.66296	33.68114275	121.66296

MW-3B

Regression Statistics	
Multiple R	0.23625798
R Square	0.05581783
Adjusted R Square	-0.07906533
Standard Error	924.870268
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	353978.4713	353978.47	0.41382356	0.540528262
Residual	7	5987695.084	855385.01		
Total	8	6341673.556			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	12299.6034	18065.71886	0.6808256	0.5178614	-30419.03357	55018.2403	-30419.0336	55018.24028
X Variable 1	-0.30606231	0.475775685	-0.643291	0.54052826	-1.431093031	0.81896841	-1.43109303	0.818968414

MW-4A

Regression Statistics	
Multiple R	0.08184978
R Square	0.00669939
Adjusted R Square	-0.1352007
Standard Error	26058.7109
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	32059607.21	32059607	0.04721199	0.834185095
Residual	7	4753394882	679056412		
Total	8	4785454489			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	129031.559	508859.1842	0.2535703	0.80711392	-1074229.208	1332292.33	-1074229.21	1332292.326
X Variable 1	-2.91184467	13.40114892	-0.217283	0.83418509	-34.60052639	28.776837	-34.6005264	28.77683704

MW-4B

Regression Statistics	
Multiple R	0.31028917
R Square	0.09627937
Adjusted R Square	-0.03282358
Standard Error	7798.49521
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	45354322.34	45354322	0.74575653	0.416428636
Residual	7	425715692.5	60816528		
Total	8	471070014.9			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	135819.29	152284.4292	0.891879	0.40207393	-224276.164	495914.745	-224276.164	495914.7448
X Variable 1	-3.46336646	4.010512882	-0.863572	0.41642864	-12.94672248	6.01998956	-12.9467225	6.019989557

MW-5A

Regression Statistics	
Multiple R	0.03821081
R Square	0.00146007
Adjusted R Square	-0.1411885
Standard Error	2413.31886
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	59612.09836	59612.098	0.0102354	0.922252236
Residual	7	40768755.46	5824107.9		
Total	8	40828367.56			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-2583.22667	47159.5815	-0.054776	0.95784729	-114097.9168	108931.463	-114097.917	108931.4634
X Variable 1	0.12565276	1.2419941	0.1011702	0.92225224	-2.811196609	3.06250213	-2.81119661	3.062502128

MW-5B

Regression Statistics	
Multiple R	0.41184818
R Square	0.16961892
Adjusted R Square	0.05099305
Standard Error	615.194833
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	541153.2181	541153.22	1.42986451	0.270717006
Residual	7	2649252.782	378464.68		
Total	8	3190406			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	15227.8235	12021.75616	1.2666888	0.24578385	-13199.11262	43654.7597	-13199.1126	43654.75971
X Variable 1	-0.37858635	0.316604808	-1.195769	0.27071701	-1.127237754	0.37006506	-1.12723775	0.370065059

MW-6A

Regression Statistics	
Multiple R	0.34338989
R Square	0.11791662
Adjusted R Square	-0.00809529
Standard Error	2719.39118
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	6920010.897	6920010.9	0.9357577	0.365596429
Residual	7	51765618.66	7395088.4		
Total	8	58685629.56			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	53281.6845	53140.65704	1.0026539	0.34942044	-72376.0018	178939.371	-72376.0018	178939.3709
X Variable 1	-1.35381155	1.399511625	-0.967346	0.36559643	-4.663130677	1.95550758	-4.66313068	1.955507577

MW-7A

Regression Statistics	
Multiple R	0.66788728
R Square	0.44607342
Adjusted R Square	0.36694105
Standard Error	1584.27784
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	14148645.97	14148646	5.63705383	0.049297282
Residual	7	17569554.03	2509936.3		
Total	8	31718200			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-70810.2602	30958.97577	-2.287229	0.05603595	-144016.6051	2396.08471	-144016.605	2396.084713
X Variable 1	1.93580793	0.815335167	2.3742481	0.04929728	0.007846627	3.86376924	0.007846627	3.863769243

MW-7B

Regression Statistics	
Multiple R	0.45382675
R Square	0.20595872
Adjusted R Square	0.09252425
Standard Error	1988.57713
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	7179926.883	7179926.9	1.81566256	0.219812237
Residual	7	27681073.12	3954439		
Total	8	34861000			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	58431.0378	38839.83444	1.5044101	0.17618801	-33410.57666	150272.652	-33410.5767	150272.6522
X Variable 1	-1.37829015	1.022876222	-1.347465	0.21981224	-3.797008072	1.04042777	-3.79700807	1.04042777

MW-8A

Regression Statistics	
Multiple R	0.57185626
R Square	0.32701959
Adjusted R Square	0.21485618
Standard Error	76345.0848
Observations	8

ANOVA

	df	SS	MS	F	Significance F
Regression	1	16993575091	1.699E+10	2.91556408	0.138596499
Residual	6	34971431867	5.829E+09		
Total	7	51965006958			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	4326443.11	2419426.085	1.7882105	0.12395963	-1593679.239	10246565.5	-1593679.24	10246565.46
X Variable 1	-108.29302	63.42188877	-1.707502	0.1385965	-263.4807914	46.8947505	-263.480791	46.89475048

MW-9A

Regression Statistics	
Multiple R	0.26075874
R Square	0.06799512
Adjusted R Square	-0.06514843
Standard Error	7412.18026
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	28057536.88	28057537	0.51069029	0.497973102
Residual	7	384582913.1	54940416		
Total	8	412640450			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	108670.714	144686.1168	0.7510791	0.47709027	-233457.5863	450799.015	-233457.586	450799.0149
X Variable 1	-2.72299902	3.810383492	-0.714626	0.4979731	-11.73312423	6.28712619	-11.7331242	6.287126185

MW-10A

Regression Statistics	
Multiple R	0.2873782
R Square	0.08258623
Adjusted R Square	-0.04847288
Standard Error	9800.91697
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	60530442.27	60530442	0.6301449	0.453366616
Residual	7	672405813.7	96057973		
Total	8	732936256			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	159153.787	191379.106	0.8316153	0.43307507	-293385.8879	611693.462	-293385.888	611693.4625
X Variable 1	-4.00091335	5.040097436	-0.793817	0.45336662	-15.91884998	7.91702327	-15.91885	7.917023272

MW-11A

Regression Statistics	
Multiple R	0.61680865
R Square	0.38045292
Adjusted R Square	0.27719507
Standard Error	15128.1386
Observations	8

ANOVA

	df	SS	MS	F	Significance F
Regression	1	843235418.6	843235419	3.68449398	0.103337231
Residual	6	1373163462	228860577		
Total	7	2216398881			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	937466.994	479372.0665	1.9556146	0.0982909	-235514.1942	2110448.18	-235514.194	2110448.183
X Variable 1	-24.1206194	12.56607163	-1.919504	0.10333723	-54.86868899	6.6274501	-54.868689	6.627450098

MW-11B

Regression Statistics	
Multiple R	0.27818106
R Square	0.0773847
Adjusted R Square	-0.07638451
Standard Error	8152.50802
Observations	8

ANOVA

	df	SS	MS	F	Significance F
Regression	1	33447848.65	33447849	0.50325224	0.504694512
Residual	6	398780322.2	66463387		
Total	7	432228170.9			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-178087.254	258332.1534	-0.689373	0.51634833	-810203.2607	454028.752	-810203.261	454028.7522
X Variable 1	4.80394616	6.771817908	0.7094027	0.50469451	-11.7660953	21.3739876	-11.7660953	21.37398762

MW-12A

Regression Statistics	
Multiple R	0.29977143
R Square	0.08986291
Adjusted R Square	-0.09216451
Standard Error	16998.7743
Observations	7

ANOVA

	df	SS	MS	F	Significance F
Regression	1	142652336.5	142652336	0.49367789	0.513646573
Residual	5	1444791638	288958328		
Total	6	1587443975			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	461511.991	642249.0781	0.7185872	0.50456457	-1189441.823	2112465.8	-1189441.82	2112465.804
X Variable 1	-11.8566198	16.87481638	-0.702622	0.51364657	-55.23471623	31.5214767	-55.2347162	31.52147668

MW-13A

Regression Statistics	
Multiple R	0.32915027
R Square	0.1083399
Adjusted R Square	-0.01904011
Standard Error	45345.1845
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	1748837603	1.749E+09	0.8505251	0.387086105
Residual	7	14393300321	2.056E+09		
Total	8	16142137924			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	843981.09	885923.1241	0.9526573	0.37249243	-1250894.214	2938856.39	-1250894.21	2938856.394
X Variable 1	-21.5173061	23.33158971	-0.922239	0.3870861	-76.68774896	33.6531367	-76.687749	33.65313672

Mw-14A

Regression Statistics	
Multiple R	0.25307068
R Square	0.06404477
Adjusted R Square	-0.09194777
Standard Error	32952.9779
Observations	8

ANOVA

	df	SS	MS	F	Significance F
Regression	1	445829863.1	445829863	0.41056301	0.545363038
Residual	6	6515392505	1.086E+09		
Total	7	6961222368			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	478766.093	713219.401	0.6712746	0.52702938	-1266418.908	2223951.09	-1266418.91	2223951.095
X Variable 1	-12.0672565	18.83296215	-0.640752	0.54536304	-58.1498547	34.0153417	-58.1498547	34.01534167

Alkalinity Regression

MW-1A

Regression Statistics	
Multiple R	0.81727852
R Square	0.667944179
Adjusted R Square	0.620507633
Standard Error	96.32938285
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	130660.6055	130660.6	14.08079	0.00714529
Residual	7	64955.45001	9279.35		
Total	8	195616.0556			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	7210.594266	1882.307923	3.83072	0.006452	2759.643304	11661.5452	2759.6433	11661.54523
X Variable 1	-0.18601641	0.049572145	-3.752438	0.007145	-0.30323591	-0.06879692	-0.30323591	-0.06879692

MW-1B alk

Regression Statistics	
Multiple R	0.134730909
R Square	0.018152418
Adjusted R Square	-0.12211152
Standard Error	5.275200694
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	3.60135901	3.601359	0.129416	0.72964654
Residual	7	194.7941965	27.82774		
Total	8	198.3955556			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-28.5545485	103.079162	-0.277016	0.78977	-272.2980348	215.188938	-272.298035	215.1889377
X Variable 1	0.00097659	0.002714675	0.359745	0.729647	-0.005442598	0.00739578	-0.0054426	0.007395777

MW-2A

Regression Statistics	
Multiple R	0.123039071
R Square	0.015138613
Adjusted R Square	-0.14900495
Standard Error	2.367247619
Observations	8

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.516832249	0.516832	0.092228	0.771619469
Residual	6	33.62316775	5.603861		
Total	7	34.14			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	16.83163655	47.69286504	0.352917	0.736218	-99.86859989	133.531873	-99.8685999	133.531873
X Variable 1	-0.00038202	0.001257919	-0.30369	0.771619	-0.003460036	0.002696	-0.00346004	0.002696

MW-2B

Regression Statistics	
Multiple R	0.872853848
R Square	0.76187384
Adjusted R Square	0.727855818
Standard Error	31.93430517
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	22839.62329	22839.62	22.39618	0.00212645
Residual	7	7138.598928	1019.8		
Total	8	29978.22222			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	3122.492317	623.5610188	5.007517	0.001552	1648.00481	4596.97982	1648.00481	4596.979824
X Variable 1	-0.07771553	0.016421803	-4.73246	0.002126	-0.116546924	-0.03888414	-0.11654692	-0.03888414

MW-3B

Regression Statistics	
Multiple R	0.10981738
R Square	0.012059857
Adjusted R Square	-0.12907445
Standard Error	2.146962142
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.393874927	0.393875	0.08545	0.778518027
Residual	7	32.26612507	4.609446		
Total	8	32.66			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-9.32318375	41.9348936	-0.222325	0.830408	-108.4834501	89.8370826	-108.48345	89.83708262
X Variable 1	0.000322831	0.001104384	0.292317	0.778518	-0.002288622	0.00293428	-0.00228862	0.002934283

MW-4A

Regression Statistics	
Multiple R	0.795000626
R Square	0.632025995
Adjusted R Square	0.57945828
Standard Error	31.83936641
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	12188.34322	12188.34	12.02308	0.010442077
Residual	7	7096.216776	1013.745		
Total	8	19284.56			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	2174.613184	621.7072096	3.497809	0.010023	704.5092389	3644.71713	704.509239	3644.717129
X Variable 1	-0.0567722	0.016372981	-3.467432	0.010442	-0.095488145	-0.01805625	-0.09548814	-0.01805625

Alkalinity Regression

Mw-4B

Regression Statistics	
Multiple R	0.11267882
R Square	0.012696516
Adjusted R Square	-0.12834684
Standard Error	3.017575017
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.819687104	0.819687	0.090019	0.772867448
Residual	7	63.7403129	9.105759		
Total	8	64.56			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	20.675929	58.92228254	0.350902	0.735986	-118.6531292	160.004987	-118.653129	160.0049872
X Variable 1	-0.00046557	0.001551749	-0.300031	0.772867	-0.004134876	0.00320373	-0.00413488	0.00320373

MW-5A

Regression Statistics	
Multiple R	0.555323784
R Square	0.308384505
Adjusted R Square	0.209582291
Standard Error	47.91277579
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	7165.203632	7165.204	3.121231	0.12061631
Residual	7	16069.43859	2295.634		
Total	8	23234.64222			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-1567.04435	936.2314469	-1.673779	0.138088	-3780.87993	646.791237	-3780.87993	646.7912374
X Variable 1	0.043560535	0.024656434	1.766701	0.120616	-0.014742667	0.10186374	-0.01474267	0.101863737

MW-5B

Regression Statistics	
Multiple R	0.198169973
R Square	0.039271338
Adjusted R Square	-0.09797561
Standard Error	4.007039852
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	4.594310244	4.59431	0.286136	0.609270873
Residual	7	112.3945786	16.05637		
Total	8	116.9888889			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-38.2884284	78.29888076	-0.489004	0.639788	-223.4358607	146.859004	-223.435861	146.8590039
X Variable 1	0.001103034	0.002062066	0.534917	0.609271	-0.003772977	0.00597905	-0.00377298	0.005979046

Alkalinity Regression

MW-6A

Regression Statistics	
Multiple R	0.772281526
R Square	0.596418756
Adjusted R Square	0.538764292
Standard Error	10.85992497
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	1220.034207	1220.034	10.34471	0.014728384
Residual	7	825.5657929	117.938		
Total	8	2045.6			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-643.75797	212.206517	-3.033639	0.019017	-1145.546646	-141.969293	-1145.54665	-141.969293
X Variable 1	0.017974836	0.005588635	3.216319	0.014728	0.004759814	0.03118986	0.00475981	0.031189858

MW-7A

Regression Statistics	
Multiple R	0.076442773
R Square	0.005843498
Adjusted R Square	-0.13617886
Standard Error	13.96189538
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	8.020563969	8.020564	0.041145	0.845028399
Residual	7	1364.541658	194.9345		
Total	8	1372.562222			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-29.7588342	272.6817474	-0.109134	0.916159	-674.5487068	615.031038	-674.548707	615.0310385
X Variable 1	0.001456657	0.007181237	0.202842	0.845028	-0.015524269	0.01843758	-0.01552427	0.018437583

MW-7B

Regression Statistics	
Multiple R	0.178193483
R Square	0.031752917
Adjusted R Square	-0.10656809
Standard Error	20.61221576
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	97.53148482	97.53148	0.22956	0.646456081
Residual	7	2974.044071	424.8634		
Total	8	3071.575556			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	217.9283108	402.5653293	0.541349	0.60506	-733.9874295	1169.84405	-733.987429	1169.844051
X Variable 1	-0.00507957	0.010601798	-0.479124	0.646456	-0.030148843	0.0199897	-0.03014884	0.019989695

MW-8A

Regression Statistics	
Multiple R	0.373961076
R Square	0.139846886
Adjusted R Square	-0.00351197
Standard Error	117.9859344
Observations	8

ANOVA

	df	SS	MS	F	Significance F
Regression	1	13579.6557	13579.66	0.975502	0.361451992
Residual	6	83524.0843	13920.68		
Total	7	97103.74			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	3861.559316	3739.42686	1.032661	0.341579	-5288.488567	13011.6072	-5288.48857	13011.6072
X Variable 1	-0.09681511	0.098023231	-0.987675	0.361452	-0.33666932	0.14303909	-0.33666932	0.143039093

MW-9A

Regression Statistics	
Multiple R	0.484104015
R Square	0.234356697
Adjusted R Square	0.138651284
Standard Error	60.14741395
Observations	10

ANOVA

	df	SS	MS	F	Significance F
Regression	1	8858.797759	8858.798	2.44873	0.156250816
Residual	8	28941.69124	3617.711		
Total	9	37800.489			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	1614.716339	1016.335892	1.588762	0.150777	-728.9584296	3958.39111	-728.95843	3958.391108
X Variable 1	-0.04201226	0.026847611	-1.564842	0.156251	-0.103922964	0.01989844	-0.10392296	0.019898438

MW-10A

Regression Statistics	
Multiple R	0.141036168
R Square	0.019891201
Adjusted R Square	-0.1026224
Standard Error	1.878840938
Observations	10

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.573134731	0.573135	0.162359	0.697547255
Residual	8	28.24034617	3.530043		
Total	9	28.8134809			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	16.22900895	31.7571066	0.511036	0.623127	-57.00301012	89.461028	-57.0030101	89.46102802
X Variable 1	-0.00033803	0.000838903	-0.402938	0.697547	-0.002272539	0.00159649	-0.00227254	0.001596487

MW-11A

Regression Statistics	
Multiple R	0.433634296
R Square	0.188038702
Adjusted R Square	0.08654354
Standard Error	1.501389694
Observations	10

ANOVA

	df	SS	MS	F	Significance F
Regression	1	4.176271883	4.176272	1.852686	0.210570631
Residual	8	18.03336812	2.254171		
Total	9	22.20964			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	39.52178042	25.37723742	1.557371	0.157997	-18.99823397	98.0417948	-18.998234	98.0417948
X Variable 1	-0.00091246	0.000670371	-1.361134	0.210571	-0.002458342	0.00063341	-0.00245834	0.000633413

MW-11B

Regression Statistics	
Multiple R	0.812453937
R Square	0.660081399
Adjusted R Square	0.617591574
Standard Error	53.49711011
Observations	10

ANOVA

	df	SS	MS	F	Significance F
Regression	1	44460.38268	44460.38	15.53505	0.004287144
Residual	8	22895.52632	2861.941		
Total	9	67355.909			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	3635.284685	904.2348364	4.020288	0.00384	1550.115415	5720.45396	1550.11542	5720.453956
X Variable 1	-0.09414738	0.023886469	-3.941452	0.004287	-0.149229674	-0.03906508	-0.14922967	-0.03906508

MW-12A

Regression Statistics	
Multiple R	0.644487201
R Square	0.415363752
Adjusted R Square	0.331844288
Standard Error	12.54421587
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	782.5785378	782.5785	4.973257	0.060963669
Residual	7	1101.501462	157.3574		
Total	8	1884.08			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	536.9396303	234.2021543	2.292633	0.055591	-16.8604633	1090.73972	-16.8604633	1090.739724
X Variable 1	-0.01383422	0.006203462	-2.23008	0.060964	-0.028503072	0.00083464	-0.02850307	0.00083464

MW-13A

Regression Statistics	
Multiple R	0.209548862
R Square	0.043910725
Adjusted R Square	-0.07560043
Standard Error	2.141132427
Observations	10

ANOVA

	df	SS	MS	F	Significance F
Regression	1	1.684415429	1.684415	0.367419	0.56121526
Residual	8	36.67558457	4.584448		
Total	9	38.36			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	25.0436085	36.20786498	0.691662	0.508721	-58.4518778	108.539095	-58.4518778	108.5390948
X Variable 1	-0.00057977	0.000956483	-0.606151	0.561215	-0.002785427	0.00162588	-0.00278543	0.00162588

MW-14A

Regression Statistics	
Multiple R	0.022641933
R Square	0.000512657
Adjusted R Square	-0.16606857
Standard Error	3.123165631
Observations	8

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.030018639	0.030019	0.003078	0.957560882
Residual	6	58.52498136	9.754164		
Total	7	58.555			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	8.822134635	67.55489725	0.130592	0.900366	-156.4787437	174.123013	-156.478744	174.123013
X Variable 1	-9.8957E-05	0.001783801	-0.055475	0.957561	-0.004463762	0.00426585	-0.00446376	0.004265848

Appendix C: Landfill Disposal Airspace Estimate

Geosyntec consultants

APPENDIX C

LANDFILL DISPOSAL AIRSPACE ESTIMATE

Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Total airspace after expansion:	9,440,000	cubic yards
Airspace currently consumed: in Phase 1 Cell A:	280,000	cubic yards
Airspace remaining:	9,160,000	cubic yards
Airspace Utilization Factor (AUF, tons/cy)[(1)]:	0.6	
Budgeted Yearly Tonnage:	400,000	tons
Total Available Permitted Tonnage:	9,160,000	cubic yards
	5,496,000	tons

Year	Total Waste (tons)	Year-End Remaining Permitted Tonnage
2021	400,000	5,096,000
2022	400,000	4,696,000
2023	400,000	4,296,000
2024	400,000	3,896,000
2025	400,000	3,496,000
2026	400,000	3,096,000
2027	400,000	2,696,000
2028	400,000	2,296,000
2029	400,000	1,896,000
2030	400,000	1,496,000
2031	400,000	1,096,000
2032	400,000	696,000
2033	400,000	296,000
2034	296,000	0
2035	0	0

Notes:
1. AUF based on actual airspace utilization to date for the facility.

Geosyntec consultants

Appendix D: Operation and Maintenance Plan

Prepared for:

TOLSON AND ASSOCIATES, LLC

24024 Frederick Road
Clarksburg, Maryland 20871

OPERATION AND MAINTENANCE PLAN

APPENDIX D
PROPOSED VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL: PHASE III REPORT

Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Prepared by:

Geosyntec consultants

10211Wincopin Circle, 4th Floor
Columbia, Maryland 21044

Project Number: ME1606

July 2020

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

1. INTRODUCTION

1.1 Statement of Purpose

This document constitutes the Operation and Maintenance Plan (O&M Plan) for the Tolson Rubble Landfill (TRL) located in Crofton, Anne Arundel County, Maryland. The O&M Plan is designed to meet the requirements set forth in COMAR 26.04.07: Solid Waste Management Regulations. This Plan defines the various operation and maintenance procedures for hazard prevention, personnel, facilities, records, safety, training, environmental monitoring, and emergency procedures during the Tolson Landfill construction, operation, closure and post-closure activities. These activities include waste acceptance and placement, cover placement, management of runoff, leachate, and gas, and post-closure operation.

1.2 Facility Operator

The following entity is responsible for operation and maintenance of the TRL and implementation of this O&M Plan:

Tolson & Associates, LLC
24024 Frederick Road
Clarksburg, Maryland 20871
(301) 428-0800

1.3 Description of the Tolson Facility

The Tolson Facility is located in Anne Arundel County, Maryland, approximately one mile northwest of Maryland Route 3, and accessed via Capitol Raceway Road. The TRL site area comprises 204.6 acres. Of the TRL site area, 203.25 acres are part of a special exception issued by Anne Arundel County, which allows Tolson to operate the landfill and sand and gravel operations under the existing zoning for the property. The existing landfill currently comprises a permitted waste footprint of 72.38 acres with one constructed active waste disposal cell (Phase 1 Cell A). The majority of the site is currently being mined for sand and gravel under various Special Exception permits issued from 1993 to 2016. The south and west of the site is bordered by forested area beyond which is the Little Patuxent River, while the north and east are surrounded by residential and commercial/industrial developments. A vicinity may for the location of TRL is shown in **Figure 1**.

Operational facilities at TRL include the facility entrance and vehicle weighing facilities, communication equipment, maintenance and equipment storage facilities, employee sanitary and safety facilities, and water supply and sewage systems.

1.4 Regulatory Basis for this Operation and Maintenance Plan

This Operation Plan is intended to address the requirements of the following, each of which is identified in Section 2 of the Phase III Report:

- COMAR 26.04.07.16, relating to operation requirements for rubble landfills;
- Conditions that are common to permits at landfills in Maryland, as represented by the operation requirements contained in the current TRL permit (No. 2019-WRF-0580); and
- Guidance from MDE regarding the recommended contents for Operation Plans.

1.5 Organization of this Operation and Maintenance Plan

A summary of planned operation and maintenance procedures is presented in this section. These procedures ensure that the landfill is operated and maintained in an environmentally-sound, cost-effective, and reliable manner throughout the active, closure and post-closure periods. The operating procedures that follow describe the inspection and placement plan for waste disposal, along with outlining operating details for the stormwater, leachate and landfill gas management systems. The maintenance procedures prescribe the necessary steps to provide a well-maintained waste disposal facility by placing emphasis on preventive maintenance. In addition, information is presented relative to the means for preventing hazards, and describing the safety, training, recordkeeping, and environmental monitoring programs to ensure a safe and efficient facility.

2. SERVICE INFORMATION

2.1 Municipalities Served

The TRL will receive rubble and other acceptable wastes (e.g., construction debris, land clearing debris, demolition debris) from any municipality, industry, collection or transportation entity that demonstrates that the waste intended for disposal meets the criteria for acceptable waste types identified in the final Refuse Disposal Permit issued for the facility (see **Attachment 1**). The facility will primarily serve Anne Arundel County and surrounding areas, but may also receive acceptable waste from outside of the area without geographic limitations.

2.2 Acceptable Waste Types

The TRL facility will be restricted to receiving only nonhazardous rubble waste. This includes construction debris, land clearing debris, and demolition debris.

2.3 Unacceptable Waste Types

The TRL facility will be restricted from receiving hazardous waste. Therefore, landfill personnel will be trained in the visual examination of waste to detect the presence of hazardous material, and the delineation of the components of a hazardous waste as described in Section 5.3. Additional unacceptable waste types include animal carcasses and infectious wastes of any kind.

2.4 Design Capacity and Waste Stream Projections

The TRL expansion is designed with a total design disposal volume of 9,440,000 cubic yards. As of the December 2019 Annual Report, approximately 283,000 CY of waste had been landfilled to date in Cell A. Assuming an annual acceptance rate of 400,000 tons of waste per year and an airspace utilization factor of 0.6 tons per cubic yard, TRL will operate until 2034.

2.5 Recyclable Materials

Recycling of various waste products will occur at the TRL. Waste materials that may be considered for recycling/salvaging include wood products, concrete/asphalt/masonry, metal, paper products, plastics and used tires. Any additional permits (e.g., air permits, wood waste processing permits) required to conduct recycling/salvaging operations would be obtained, as necessary at the time when such operations are determined necessary and the equipment train is identified. The processing of recyclable materials is described in Section 5.10.

3. PERSONNEL

3.1 General

A staff of qualified and trained personnel will be required to operate and maintain the TRL safely, efficiently, and in an environmentally-acceptable manner. Compliance with state regulations and public acceptance of the facility will depend to a large degree on the performance of the landfill personnel. Therefore, landfill personnel will be carefully selected.

3.2 Personnel Requirements

The minimum staff positions that will be required at the TRL facility include the following:

- Landfill Supervisor;
- Equipment Operators;
- Laborers; and,
- Scale House Attendant.

The landfill operational staff will consist of a landfill supervisor (who is a qualified equipment operator), equipment operators, laborers, and a scale house attendant. The scale attendants will be on site during operating hours to monitor and measure incoming waste and direct traffic. Ultimate responsibility for accepting/rejecting waste shall rest with the Landfill Supervisor.

The operation of the landfill must be directed by a responsible, knowledgeable person for the proper implementation of the plans and specifications. A supervisor must be able to: (i) communicate with landfill personnel, administrators and haulers; (ii) understand and implement the intent of plans and specifications; (iii) maintain all components of the landfill in a fully operational posture; and (iv) have a working knowledge of construction, engineering and equipment, sequence of operations, grading, and all other operations related to the development of the landfill.

3.3 Qualifications

Job descriptions list responsibilities and qualifications for each landfill staff position. Job descriptions will be used for selecting key personnel and will be useful when staff expansion or reorganization is mandated. Each staff member will be trained on site in his/her job function prior to unsupervised performance.

Descriptions of each of the staff positions identified above and their typical duties are presented below:

Landfill Supervisor

The Landfill Supervisor will be responsible for environmental compliance and the overall operation of the TRL, including the ancillary buildings and operational functions. The Landfill Supervisor will be responsible for the safety, training, supervision, and performance of the other employees.

He/she will also serve as the primary Emergency Coordinator for the operation of the site. The Landfill Supervisor will be trained in rubble landfill operation and basic technical aspects of the environmental systems incorporated into the landfill design. The Landfill Supervisor, or an authorized substitute, will be present at the landfill at all times during operation, emphasizing the critical importance of the facility operations to the health and welfare of the general public.

Equipment Operators

Equipment Operators will operate heavy equipment (i.e., compactors, bulldozers, loaders, mass excavators, backhoes, unloading equipment, transport trucks, etc.). Equipment Operators, Laborers, and/or the Scale House Attendant will also direct waste transportation vehicles to the location of the active disposal area where waste is to be unloaded. Thereafter, the Equipment Operators will spread and compact the refuse, and excavate and place cover material. The Equipment Operators and other personnel designated by the Landfill Supervisor will be responsible for fire and dust control equipment and performing miscellaneous site maintenance, such as drainage and roadway repairs.

Laborers

Laborers will be responsible for spotting refuse vehicles at the working face when necessary and assisting in general site maintenance and cleanup activities. Laborers will also be responsible for lawn care, tree and shrub planting and maintenance, and proper care of signs and fencing. Both the Laborers and Equipment Operators will be responsible for monitoring the refuse being received at the facility to verify that only permitted materials are accepted.

Scale House Attendant

The Scale House Attendant will be responsible for operating the scale house, including registering all vehicles that transport waste to the facility, properly logging vehicles into the facility, monitoring site access by personnel, customers and visitors, and recording the waste volume contained in each vehicle. The Scale House Attendant will also maintain the on-site records.

4. SITE PREPARATION

4.1 Facility Development Plan

4.1.1 Filling Sequence

The development for the landfill will utilize the existing topography to provide the most cost-effective, efficient use of available landfill area. The landfill is divided into seven cells, as shown in **Figure 2** (from Drawing 4, prepared subgrade). The landfill will be sequentially filled in seven phases corresponding with filling of each of the seven proposed cells at the facility. Phases 1 through 7 correspond to filling of Cells 1 through 7, respectively. Each cell will be filled to the maximum extent possible prior to moving to the next phase of waste placement. Construction of each new cell will be timed to provide uninterrupted waste acceptance at the facility. As part of waste placement, the waste from the existing cell may be relocated into a new cell in order for the existing cell area to be re-developed as shown in the expansion plans. The approximate peak elevation of waste at the facility is 240 feet above mean sea level.

4.1.2 Cell Construction

Each new cell will be constructed through a combination of excavation and fill to achieve the base grades shown in **Figure 2**. Following preparation of the prepared subgrade and placement of liner in each new cell, a layer of select rubble waste debris with a minimum thickness of four feet will be placed over the floor of the active disposal area within the cell to prepare it for active waste placement. An access ramp of similar material will be constructed to permit truck access from the top of the perimeter berm to the new cell. This access ramp will be surfaced with crushed stone or equivalent material to provide a wearing course for truck traffic.

4.2 Description of Operational Facilities

4.2.1 General

Facilities are provided at the TRL to furnish essential services ancillary to the landfill operation and a suitable working environment for landfill employees. The principal ancillary facility will be the scale house/landfill office. Essential utility services will also be provided, including electricity, telephone, potable water, and sewage disposal.

4.2.2 Scale House/Landfill Office Building

The scale house/landfill office building is a fifty-foot long pre-fabricated structure located near the facility entrance. The scale house is used to weigh vehicles entering and exiting the facility and also provides office space for operations and supervision. The scale house/landfill office building is used to store records associated with the operation and maintenance of the landfill. The facility operator's office, a telephone, bottled water, and a restroom are located in this facility. A storage box, located south of the scale house, is used for storing maintenance supplies and back-up equipment (i.e. submersible pumps).

4.2.3 Utilities

Utilities necessary for the ancillary operation of the landfill will be provided as follows:

- Electric: Baltimore Gas and Electric;
- Telephone: Verizon;
- Water: Well water; and,
- Sewer: Sewage holding tank located adjacent to the existing scale house building.

5. OPERATING PROCEDURES

5.1 Waste Collection and Transportation

Waste will primarily be transported to the landfill using contracted waste transport vehicles. Once the waste arrives at the facility, the waste haulers will be required to follow the waste acceptance procedures discussed in Section 5.3. This procedure will ensure that the landfill staff will have complete control and full responsibility over all waste disposal activities associated with the landfill operation. These procedures will also provide an optimum arrangement for the efficient transport and placement of the waste in the active disposal area.

5.2 Site Access

5.1.1 Overview

Access to the site will be provided via a private, unpaved road that intersects with Capitol Raceway Road southwest of the landfill. A gate is located at the facility entrance to prohibit unauthorized access. Access throughout the facility is provided by all-weather roads. Queuing of trucks will not be permitted on Capitol Raceway Road.

5.1.2 Hours of Operation

The normal operating hours for waste acceptance and disposal at the TRL are Monday through Friday from 7:00 a.m. to 5:00 p.m. Written approval from the Maryland Department of the Environment (MDE) will be obtained prior to conducting operations outside of the normal operating hours set forth in this O&M Plan. Should emergency or unusual conditions occur that require the performance of activities after hours, notification will be provided to the MDE by contacting (410) 537-3315 during normal business hours, or the emergency contact telephone line at (866) 633-4686 at other times, as specified in Part II: Facility Specific Condition A.4 of the Refuse Disposal Permit.

5.1.3 Site Security and Signage

The site is bounded by an undisturbed buffer area and beyond by the residential communities of Four Seasons Estates to the northeast and Piney Orchard to the north; undeveloped land to the northwest; the Little Patuxent River valley to the west; Capitol Raceway Park and Evergreen Road to the south; and commercial/industrial properties and open land to the east. Security fencing and signage will be maintained around the landfill facility, and a gate will be located at the facility entrance to prevent access by unauthorized personnel. The location of the perimeter security fencing is depicted on the Site Plan shown in **Figure 1**. Signs at the site entrance on Capitol Raceway Road will direct traffic to the landfill. On-site traffic signs will be provided, as necessary, to direct waste hauling vehicles to the recycling processing area and the current working face of the landfill and to stipulate the conditions of use, such as speed limits, parking and no-stopping areas.

5.1.4 Inclement Weather Operation

The main entrance and the temporary haul roads at the landfill will be stabilized with crushed stone to permit operations to continue during wet weather. To minimize wet weather operating problems, these roads will require regularly- scheduled inspection and maintenance (see Section 8.2). The maintenance program will consist of "back-dragging" to remove ruts, and the addition of crushed stone in areas of excessive degradation or settlement. No special waste placement procedures are necessary during inclement weather beyond the minimization of the working face area and maintenance of soil cover in order to minimize infiltration and odors. Snow will be removed as necessary to allow the passage of trucks and equipment.

5.3 Waste Acceptance Procedures

5.3.1 Check-In Procedure

A check-in point located inside the main entrance of the facility at the scale house will permit the facility operator to visually inspect and document each truckload of waste transported to the landfill. All vehicles transporting waste to the facility will be weighed at the scale house/landfill office. The scale house attendant will record the type of waste, gross weight of vehicle and waste, and origin of the waste, if known.

5.3.2 Waste Inspection and Acceptance

All facility personnel involved with waste disposal activities will be trained in the visual examination of waste to detect the presence of hazardous material, and the delineation of the components of a hazardous waste. The determination and classification of hazardous waste materials will be made in strict accordance with the (RCRA), as amended by Supplement IV, 1980, and the Hazardous and Solid Waste Amendments of 1984 (HSWA), the Superfund Amendment and Reauthorization Act of 1987 (SARA, Tide III), and the Code of Maryland Regulations (COMAR, Title 26, Subtitle 13). However, a more condensed reference, USEPA regulation 40 CFR 261 entitled: "Identification and Listing of Hazardous Waste", will be used as the basis for determining if a particular waste material should be classified as a hazardous waste.

Hazardous materials, putrescible or municipal waste, animal carcasses, and any form of infectious waste are unacceptable materials and, if encountered, will be immediately removed from the site. Upon arrival at the landfill, waste hauling vehicles will undergo visual inspection to ensure that the waste is acceptable and meets the requirements identified in Section 2.5. Inspection will be conducted using cameras and closed-circuit television (CCTV) monitors located at the scale house/landfill office. Vehicles are untarped at the scale house so that the incoming load can be inspected, but are then re-tarped until reaching the active working face to reduce the potential for the release of litter and debris. Additionally, equipment operators at the working face in the operating cell will provide a second level of screening. The equipment operators will monitor the waste as it is deposited by waste hauling vehicles to ensure that it meets the requirements for acceptable material. Unacceptable materials will be rejected, reloaded onto the hauling vehicle, and removed from the facility. If unacceptable hazardous waste materials are discovered, immediately (within two hours) all incidents must be reported to the MDE at (410) 537-3315 or (866) 633-4686 after working hours and a written report must be submitted to the MDE within five working days following the discovery, including the source of the waste, the transporter of the waste, the circumstances of discovery, a description of efforts to secure and control the waste and pollutants from the waste, the current location and, if known, the final disposition of the waste.

5.3.1 Traffic Routing

Trucks will untarp and discharge their load at the working face as directed by the facility operator. The waste will thereafter be spread and compacted by waste-handling equipment to the proper location within the active disposal area. No trucks or other construction equipment will be permitted to travel over the liner/leachate system for any reason unless the select rubble waste debris layer has been placed in that area, as described in Section 4.1.

As the waste fill advances, the location of the waste unloading point will shift to minimize the distance required for pushing the waste into place along the working face, and to prevent delays in unloading. This may necessitate constructing a temporary haul road, using crushed stone as necessary, over the top of existing intermediate cover and extending from the main access road to the working face. Waste hauling vehicles will be directed from the main access road across the intermediate cover via the temporary haul road to a point where the waste is unloaded in the proximity of the active disposal area. In this manner, the trucks will be further isolated from the waste and the waste will not be inadvertently tracked from the active disposal area on truck tires or undercarriages.

No driver will be allowed to leave their vehicle unattended at any time or for any reason at the facility.

5.5.3 Check-Out Procedures

After the waste hauling vehicles have completed unloading at the active disposal area, the vehicle will be weighed at the scale house to determine the empty tare vehicle weight. The driver of the vehicle will obtain a final ticket from the scale house attendant. This ticket will be used for tracking the waste quantities disposed at the facility.

5.4 Waste Placement

5.4.1 General

This section presents a description of the intended waste placement plan as part of the operation of the landfill. The purpose of a waste placement plan is to establish and maintain a logical, efficient filling sequence that ensures personnel safety and maintains compliance with environmental requirements. The operating procedures discussed below are intended to achieve these objectives.

5.4.2 Filling Procedure

Once the subbase, liner, and temporary access ramp for each cell are prepared and MDE approval has been received, filling operations would commence. To protect the liner and leachate collection systems, an initial lift of select processed waste, with a minimum thickness of four feet, will be placed on the protective cover before subsequent lifts of waste are deposited. This lift would constitute a protective waste layer. The maximum dimension of any item placed during the initial lift will be two feet to assure that the liner/leachate system cannot be punctured by individual waste pieces as the waste is compacted. The select processed waste layer will be placed by pushing material in front of a bulldozer. Under no circumstances shall heavy equipment traverse directly on the liner system.

The material used to construct the select processed waste layer will be obtained by screening the initial loads of rubble waste such that items capable of puncturing the liner or damaging the leachate collection system (i.e. metal rods, lumber, or other structural items greater than two feet in any dimension) are removed and temporarily stockpiled for later disposal. The stockpiled material will be staged in a contained or otherwise protected condition until it can be deposited in the landfill. The screened rubble waste will be supplemented with soil from on site, as necessary, in an effort to expeditiously create the select processed waste layer.

The width of the working face will be minimized to ease control over unloading vehicles and reduce stormwater infiltration and odor. Wastes will be spread in uniform layers and compacted through several passes (perpendicular to the dip of the slope) of the waste-handling equipment. Bulky items would be placed individually in the active disposal area prior to the placement of routine waste and cover material. The working face will be established at a slope sufficiently flat (4 horizontal to 1 vertical or flatter) to allow compaction equipment to move both across the slope as well as perpendicular. Waste lift height will be approximately eight feet, with a maximum height not exceeding ten feet. A layer of intermediate cover not less than one foot in depth will be placed over completed waste lifts no later than one month following completion of that lift. This pattern will also be repeated in the subsequent lifts until the phase design contours are achieved.

5.4.3 Litter and Debris Control

A litter and debris control program will be implemented at the site to collect and prevent windblown litter and debris. The litter and debris control program will include the elements listed below.

Blown litter and debris will be collected as needed by laborers. Incoming refuse hauling vehicles shall remain covered, except for inspection, until they have reached the designated untarping area near the active working face to reduce the potential for the release of litter and debris. In the event that a hauling vehicle enters the site uncovered, the driver of the vehicle will receive a written warning. On a second offense, the waste hauler will no longer be permitted to dispose wastes at TRL.

Netting, screens, or portable litter fencing will be placed immediately downwind of the working face, if needed, to collect windblown litter and to provide separation and prevent cross-contamination from the recycling process area during non-working periods. The fences will be cleaned daily (more frequently during windy days) by operations personnel, and the waste will be redeposited in the active working face.

Blowing Litter. The boundary will be monitored on a daily basis by litter patrol, and the waste that collects along the boundary will be collected as necessary to prevent nuisance conditions. The facility access roads, maintenance facility area, and other active operational areas will have daily inspection for litter and litter will be picked up as needed. Collected waste will be disposed of at the working face.

Debris Control. Debris that falls off trucks or otherwise occurs at the facility will be picked up as discussed above and disposed either in the landfill disposal area or at the recycling or wood waste area, if the debris consists of materials that can be recycled (e.g., wood wastes, concrete, metals, tires, etc.).

5.4.4 Nuisance Control

5.4.4.1 Dust Control

If not properly controlled, dust can be a nuisance and potential health hazard. Whenever dusty conditions are observed, roadways and exposed soil surfaces that are creating dust will be sprayed with water. On-site roads will be treated with water, or calcium chloride, whichever is determined to be most effective. Dust control water will be obtained from the on-site borrow area or erosion and sediment control/stormwater management pond and generally will be hauled and sprayed by a tanker water truck. Additional dust control measures will include the stabilization of soil stockpiles and intermediate and final cover areas through the establishment of vegetation.

5.4.4.2 Vector Control

Because TRL is a rubble fill, putrescible and food wastes that are most attractive to vectors are not present at the landfill. Therefore, vectors issues are anticipated to be much less than with a municipal solid waste landfill. Nonetheless, typically good housekeeping practices will be used to control vectors. Application of cover soil prevents problems associated with rodents, vermin, and birds, since it eliminates hiding and nesting areas as well the potential for scavenging for food. Mosquito control is most effective by preventing development of standing water bodies on site by grading to fill in low spots. Seagulls, which may be attracted to on-site stormwater ponds can be effectively controlled string netting within the stormwater pond. Other common landfill birds, such as vultures and crows, are not expected to be attracted to the rubble fill placed at TRL. Note that air cannons, commonly used to frighten birds at remote landfill sites, will not be used at TRL because of the proximity of residential areas.

If vectors do become a problem, an abatement program will be initiated that is targeted for the vector that has become a nuisance.

5.4.4.3 Odor Control

Odors from the landfill will be controlled primarily through operation of the Landfill Gas Management System and by cover soil, as appropriate. Six inches of cover soil will be placed over exposed waste at the end of each third day of operations. One foot of intermediate soil cover will be placed over all portions of the landfill after placement of each waste lift. Final cover soil material will be placed over disposal areas where final closure grades are achieved.

5.4.4.4 Noise Control

Section 26.02.03.A(2) of the COMAR requires that sound levels must be less than 90 dBA during daytime hours (7:00 a.m. to 10:00 p.m.) and less than 75 dBA during nighttime hours (10:00 p.m. to 7:00 a.m.) at the site boundary. According to Caterpillar, Inc., the medium-sized construction equipment that will likely be used at the landfill facility (e.g., track-mounted bulldozers) emit a sound level of approximately 85 dBA at a distance of 50 feet from the source. Based upon Caterpillar experience, when the distance is doubled to 100 feet, the sound level is reduced to approximately 79 dBA.

The cover system for the proposed landfill will be located no less than 150 feet from the site boundary in all areas. Therefore, the sound level at the site boundary is expected to be less than the regulatory level (90 dBA) under normal landfill operating conditions. The dense forest surrounding the landfill is also expected to significantly reduce noise levels beyond the site boundary during normal operating conditions. In addition, since the landfill will not be operated between the hours of 10:00 p.m. and 7:00 a.m., noise levels will not exceed the regulatory limit

(75 dBA) during nighttime hours. Regular inspection of mufflers on site equipment will take place to prevent excessive sound levels.

5.4.5 Open Burning

Burning of waste will not be allowed at the TRL, except as permitted by the MDE.

5.4.6 Landfill Fire Prevention and Control

In this section, only landfill fire prevention and control is addressed; other types of fires are addressed in Section 14 of the Phase III Report and in the Contingency Plan in Appendix N of the Phase III Report.

The waste to be disposed in the landfill is a combination of combustible and noncombustible materials. The regular placement of cover soil will minimize the potential for fire hazards. Fire extinguishers will be carried on equipment working in or near the working face to control accidental or possible equipment fires. Any fires which may develop that cannot be extinguished using portable fire extinguishers mounted on the operating equipment will be smothered using cover soil stockpiled near the active area. The on-site borrow area and erosion and sediment control/stormwater management pond can also provide water and excess soil that could be used to control fires. Anne Arundel County fire officials will be notified immediately in the event of a major fire. In this case, the Anne Arundel County Fire and Rescue will manage fire control activities upon arrival. MDE will be notified within 48 hours of a major fire that requires County fire officials.

5.4.6 Salvaging and Scavenging

Access to the landfill will be controlled and limited to facility employees, drivers delivering waste materials, and authorized service, site supervisory, and environmental monitoring personnel. Scavenging and salvaging materials at the facility will not be permitted except as directed and controlled during facility operation for recycling purposes.

5.4.7 Placement of Waste in State Waters

Waste will not be placed in any waters of the state.

5.5 Cover Placement

5.5.1 Periodic, Intermediate, and Final Cover

Periodic cover will be applied to the working face of the landfill at the end of each third day’s operations to reduce fire potential and prevent health hazards and nuisances from odor and waste disposal. Cover material will be obtained from either on- or off-site soil borrow sources, the on-going mining area located east of the landfill, on-site soil stockpiles, soil generated during construction or an alternative material as approved by the MDE.

For periodic cover material, a minimum of six (6) inches of clean earthen material will be spread and compacted over the exposed waste on the top and sides of the cell at the end of each third day of operations. Intermediate cover not less than one foot in thickness will be placed over lifts no later than one month following completion of that lift. The top of each lift will be graded and sloped to provide adequate drainage. Final cover will consist of a compacted layer of clean soil not less than two feet in depth placed over the final lifts of waste. Final cover will be placed over final waste lifts not later than 90 days following completion of these lifts.

Soil materials used for periodic, intermediate, final, and routine maintenance activities at the facility will be excavated from the borrow area and stockpiled near the landfill. The stockpile area will contain at least ten days of acceptable cover soil based on the expected usage rate

The final closure system will be installed in accordance with the conditions of Section 26.04.07.21 of the COMAR. This section states that the final closure activities, including installation of a closure cover, must begin not later than 24 months from the date of completion of the final lift of the landfill, and must be completed not later than 36 months from the date of completion of the final lift of the landfill. The conditions under which the final cover will be constructed are discussed in the Closure Plan, Appendix O of the Phase III Engineering Report.

5.5.1 Cover Material Projection

The projected volume of material required for periodic, intermediate, final, and protective cover, including topsoil, is approximately 1,409,000 cubic yards and is based on the approximate 72.1-acre landfill footprint (Appendix K.1). The approximate volume required for each category of cover material is provided below:

Cover Type	Projected Quantity Required (cy)
Periodic (approx. 10% of airspace)	944,000
Intermediate (12 inches)	116,300
Final (12 inches)	116,300
Protective Cover (18 inches)	174,000
Topsoil (6 inches)	58,000
Total	**1,409,000**

The volume of cover material required may vary based on waste disposal rate, fill placement methodology and other operational variables.

5.6 <u>Preventative Procedures, Structures and Equipment</u>

5.6.1 Unloading Operations

Unloading operations will be performed within the appropriate active phase and, thus, environmental hazards stemming from the unloading operation are not anticipated. Accidents, however, are possible during normal unloading operations. Any incidents of this nature will be immediately reported to the facility operator.

5.6.2 Groundwater Quality Protection

Groundwater contamination as a result of landfill operations will be prevented by the perimeter berms, a composite liner system, leachate collection systems, and a run-off control system. At no time will waste be deposited in any area not fully underlain by a liner system. Precipitation falling on exposed waste will be collected and transmitted to the leachate storage tanks. To assure the integrity of the groundwater control and protection measures, groundwater quality will be periodically monitored. The Environmental Monitoring Plan found in Appendix K of the Phase III Engineering Report discusses the groundwater monitoring program.

5.6.3 Equipment and Power Failure

The electrical equipment required for maintaining operation of the landfill includes only the leachate transfer pumps and the associated detection and warning controls. Liquids that accumulate in the leachate collection wet well during a prolonged power failure could, however, be pumped to the leachate storage tank as necessary using an emergency generator and portable pumps.

5.6.4 Safety Procedures

According to national statistics, waste disposal operations have a relatively high accident rate. As a result, it is imperative that employees involved with activities in and around the landfill consider safety of prime importance.

Training and safety programs will be implemented to ensure that operating personnel are properly trained in safety practices, accident prevention and emergency procedures as required by the Occupational Safety and Health Act (OSHA). In addition, all landfill employees will be required to meet the training and safety requirements specified for TRL personnel.

Safeguards will be provided on equipment to reduce the possibility of injury to employees. Heavy equipment at the working face will be provided with enclosed protective cabs to protect the operator from accidents, weather, and flying debris. Personnel will be made aware of the dangers associated with landfill construction and operation, particularly while the unloading of waste is in progress. Differing flows and directions of traffic and operating equipment, and the angle of operation of equipment could pose particular dangers to those working in the vicinity of active disposal operations. Employees will be provided hardhats, safety glasses, gloves, and safety shoes, at a minimum. Respirators and reflective vests may also be required as conditions dictate. Construction and operating equipment will also be equipped with an audible back-up signal and fire extinguishers.

The emergency evacuation procedure will be posted in the landfill office, along with a procedure addressing the discovery of hazardous wastes. Upon discovery of any suspected hazardous waste, the facility operator and emergency coordinator will be notified. In addition to these procedures, emergency telephone numbers, which are discussed in Section 12, will be posted by all telephones.

5.6.5 Communications

A two-way radio system will be provided at the facility to allow communication with personnel located throughout the landfill site. Emergency contact numbers for agencies including, but not limited to, the following will be clearly displayed on a bulletin board next to the front door to the landfill office:

- Anne Arundel County Fire Department;
- Anne Arundel County Sheriff Department;
- Anne Arundel Medical Center;
- Pollution, Toxic Chemical & Oil Spill Control Center;
- Anne Arundel Emergency Management Agency; and,
- MDE.

5.7 <u>Inspection Schedule</u>

5.7.1 General Inspection Requirements

Regular inspections of the landfill will be conducted to identify potential problems, equipment malfunctions, and operator errors that could cause, or lead to adverse effects on the environment or threaten human health. These inspections will be conducted on a routine basis by the landfill facility operator. Inspection records will be retained for a minimum of five years at the landfill office.

5.7.2 Inspection Procedures

Inspections will be conducted in accordance with the information contained on the Facility Inspection Log sheets presented in **Table 1**. The log sheets present a listing of items that will be inspected, a description of typical problems which may be observed, the recommended frequency of inspection, and a trigger level, if applicable, for each item. Individual inspection logs will be developed for items similar in nature and requiring the same frequency of inspection.

Information to be entered on each inspection log includes the inspector's name and title, date and time of inspection, item inspected, frequency of inspection, status of the item, observations, and the date and nature of any required repairs and remedial action. The inspector will be required to indicate on the inspection logs whether the condition of each inspected item is acceptable or unacceptable. If the status of any item proves unacceptable, it will be reported immediately for prompt initiation of repairs and/or remedial action procedures.

5.7.3 Routine Maintenance

Routine and preventative maintenance requirements will be determined by the inspection procedures and recorded on the inspection logs. Required maintenance will be instituted in order to preclude larger, more difficult to manage conditions. Should damage to the facility's monitoring or pollution control systems occur, it will be reported to the MDE at (410) 537- 3315 within 24 hours of the incident, or within 24 hours of discovery of the damage if the damage occurred outside of working hours at (866) 633-4686. If repairs are needed, they will be corrected and completed as soon as practical or as specified by the MDE.

5.8 Runoff, Sedimentation, and Erosion Control

The sedimentation and erosion control provisions have been designed to meet State of Maryland requirements. The control of run-off, sedimentation and erosion will be accomplished through the use of perimeter drainage channels; surface run-off conveyance channels; silt fences; temporary and permanent seeding; a perimeter drainage swale, sediment traps, and a sediment basin/stormwater management pond.

During operations, the top of completed waste lifts will be graded and sloped to prevent ponding and direct run-off to the outside of the perimeter berm. Stormwater run-off across the intermediate cover will not contact waste and will therefore be considered uncontaminated. Run-off is directed to the perimeter stormwater drainage channel and flows to the sediment basin/stormwater management pond or sediment traps. During early stages of waste placement when the waste elevations are lower than the perimeter berm elevation, temporary earthen berms will be constructed inside the landfill and upgradient of the active disposal area to divert stormwater run-off away from exposed waste materials. Diverted run-off will be pumped to the perimeter drainage channel. Precipitation that contacts exposed waste will be considered contaminated and will infiltrate to the waste to be collected by the leachate collection system.

During operations, temporary silt fences will be constructed as necessary to prevent erosion prior to the establishment of a vegetative cover. Temporary and permanent vegetative will be established as soon as practical on permanent or semi-permanent slopes. Stormwater channels and sedimentation control systems will be inspected and sediment removed as needed in order to maintain the sediment control capacity of these structures.

5.9 Post Closure Operation

Post-closure operations at the landfill will consist of monitoring the operation of the leachate collection and transmission systems, gas management system, stormwater management, and groundwater monitoring systems. Post-closure maintenance requirements for the landfill are presented in the Post-Closure Plan, Appendix O of the Phase III Engineering Report.

5.10 Processing of Recyclable Materials

In addition to landfilling activities, recycling of various waste products will occur at the TRL. Materials that may be considered for recycling/salvaging include wood products, uncontaminated concrete/asphalt/masonry, metal, paper products, plastics and used tires. Additional permits (e.g., air permits, wood waste processing permits) required to conduct recycling/salvaging operations would be obtained as necessary at the time when such operations are pursued and the equipment and operational requirements are identified.

5.8.1 Procedures Prior to Unloading

All vehicles entering the facility will be visually inspected and weighed at the scale house/landfill office located inside the main entrance. Vehicles will be directed to one of the following unloading areas:

1. Concrete Processing Area – for concrete and related masonry materials; and,
2. Wood Waste Processing Area – for wood waste, including stumps, trees, woody vegetation, pallets and untreated dimensional lumber.
3. Landfill Working Face – for other recyclable materials, including metal, tires, etc.

5.8.2 Procedures After Unloading at the Recycling Process Area

Following unloading of rubble wastes, manual and mechanical processes will be used to extract recyclable materials from the waste. Recycling and processing areas will be located at a suitable area near the working face. Roll-offs or portable storage containers will be used to store recovered recyclables in the processing areas. Other best management practices to be implemented may include general housekeeping, periodic inspections, employee training and preventive maintenance as documented in the facility Stormwater Pollution Prevention Plan (SWPPP) included in **Attachment 2**. The recycling process area, including the locations for the concrete and wood waste processing subareas, are depicted on **Figure 1**. Areas will be relocated as the landfill is constructed.

5.8.2.1 Landfill Working Face

Loads directed to the landfill working face will be visually inspected by landfill personnel as they are unloaded at the working face. Recyclable items that are observed during unloading will be separated and processed at the working face. Materials such as plastics, paper, cardboard, metals, glass, wood and rubber will be extracted and placed in approved containers or trailers for off-site recycling. "White goods" within the waste stream will be segregated for further processing. Processing, including, but not limited to, recovery of refrigerant and removal of motors, will be performed in accordance with Section 608 of the Clean Air Act and may occur on site or off site. Concrete, rock and masonry products will be extracted and transported to the Concrete Processing Area for further handling. Stumps, trees and other woody vegetation will be extracted and transported to the Wood Waste Processing Area.

5.8.2.2 Concrete Processing

Concrete, rock, and masonry products will be stockpiled adjacent to the concrete processing equipment. Larger materials will undergo initial size reduction with a hydraulic hammer or equivalent to prepare the material for further processing with the concrete crushing equipment. The materials will then be crushed, screened to varying sizes depending on their intended re-use, and stockpiled for final sale.

Tolson has received a permit to construct, with a permit to operate to follow, for the concrete processing operation at the TRL. Dust will be controlled by fitting concrete processing equipment with water misters or other means of applying water during the concrete crushing operation. Additionally, access roads within the recycling process area, will be sprayed with water, if required, for dust control. Dust control water will be obtained from the on-site borrow area or erosion and sediment control/stormwater management pond and will be hauled and sprayed by a tanker water truck. Dust control practices for the concrete processing operation are included in the approved concrete processing permit.

Noise associated with the concrete processing operation is not anticipated to be an issue because of the distance of operations from residential neighborhoods, natural attenuation from the surrounding topography and vegetation and limited operating hours. Nonetheless, equipment associated with the concrete processing operation will be provided with mufflers and other noise control devices.

5.8.2.3 Wood Waste Processing

Stumps, trees, woody vegetation, pallets, dimensional lumber and other unpainted and untreated wood will be stockpiled for processing into mulch, wood chips, compost and firewood in the recycling process area. In the event that the volume of woody debris received at the facility is not sufficient to warrant the full-time operation of a grinding plant, mobile grinding equipment will be mobilized temporarily to the site as needed. Woody debris will be stockpiled until a sufficient volume of material is available to operate the grinding equipment for at least a one-day period, but will not be stored for longer than thirty (30) days before initial processing. The resulting mulch will be used for on- and off-site landscaping operations.

Natural wood waste piles at the facility will comply with the requirements of the local fire prevention codes regarding fire control measures. There will be a twelve (12)-foot minimum buffer between any natural wood waste piles and any building or structure, and a fifty (50)-foot minimum buffer between any natural wood waste piles and the property boundaries. The piles will be a maximum of twenty (20) feet in height, fifty (50) feet in width, and three hundred-fifty (350) feet in length. Adjacent piles will be subdivided by fire lanes that are twenty five (25) feet in width at the base of the piles, allowing emergency vehicles, loaded delivery vehicles or other vehicle transportation to navigate the area.

The natural wood waste will be processed into windrows of wood chips, mulch, compost or firewood. Minimum buffers between the property boundaries and buildings or structures will parallel those for the natural wood piles. Processed wood waste windrows will be a maximum of eighteen (18) feet in height, fifty (50) feet in width, and three hundred-fifty (350) feet in length. Natural wood waste will be removed from the site within one year of the date of initial processing. Natural wood waste receipt and storage, processing activities, and product storage will occur on a prepared surface of the existing ground within the recycling process area (see **Figure 2**). Preparation of the ground surface will consist of minor grading, leveling and compaction to assure positive stormwater run-off.

The following steps will be taken to ensure that aerobic conditions are maintained and controlled throughout the processing of natural wood waste:

1. Turn wood chip/mulch windrows and piles at least monthly;
2. Obtain daily temperature readings and turn the wood chips/mulch windrows and piles when the daily temperature readings reach 140°F; and

3. Obtain weekly oxygen levels and turn the wood chip/mulch windrows and piles when weekly oxygen readings are below 10 percent.

A log will be maintained on site at all times demonstrating the maintenance of temperature and aerobic conditions. The natural wood waste processing area will be operated in a manner to ensure the following:

1. An odor nuisance is not created;
2. The stockpiles are not infested with insects or rodents; and
3. Stormwater and sediments are controlled

Stockpiles will be inspected for evidence of heat buildup and corrective measures, such as spreading the stockpiles, will be implemented immediately if excessive heat is suspected or smoldering is observed. In the event a wood stockpile ignites, fire control measures, as described below and in the Contingency Plan (Appendix N of the Phase III Engineering Report), will be applied and the local fire department will be contacted to provide assistance extinguishing the fire.

Procedures to be followed to prevent the occurrence of, or control a fire on site should one occur, include:

1. The facility will be operated in accordance with the applicable requirements of the Anne Arundel County fire department;
2. Burning of wood waste will not be allowed except, or as otherwise authorized by the MDE;
3. A communications system to notify the local fire department will be available on site at all times; and,
4. Adequate water supply will be available in the event of a fire. Water for fire suppression activities is available in the on-site ponds and a water appropriations permit exists for the withdrawal of water from the Little Patuxent River.

5.8.2.4 Reporting

Information relative to the recycling and processing operations will be included in the annual report submitted to the MDE for the TRL. The following information will be included in this report:

- The quantity of recyclables received by volume or weight;
- The quantities of processed material by volume or weight, and residuals produced by the processing activities; and,

- The quantities of processed materials and residuals removed from the facility by volume or weight.

5.8.3 Scrap Tire Management

Tolson has received their Secondary Scrap Tire Collection Facility License by the MDE. The facility will accept scrap tires received as part of the construction and demolition debris waste stream. Tires will be segregated and placed in designated containers, in accordance with the final conditions of the Secondary Scrap Tire Collection Facility License.

6. LEACHATE MANAGEMENT SYSTEM

6.1 General

This section describes the operation of the leachate management system that will contain, collect, and transfer generated leachate from the landfill. The design and maintenance requirements for the system are discussed below.

6.2 Leachate Collection System

The leachate collection system will consist of approximately 12 laterals aligned in the collection corridor of each of the 7 cells constructed above the liner system. The laterals will drain to a central collection pipe that flows to a single sump located in the southwest corner of the landfill. The laterals will be fabricated from 8-inch perforated HDPE surrounded by No. 57 Stone and a non-woven geotextile fabric within the drainage layer (see Drawing No. 5). The leachate collection system drains by gravity to a sump located in each cell. Leachate is pumped from the sump via a sideslope riser to a valve vault, and the leachate transmission forcemain.

6.3 Leachate Transmission System

Collected leachate will be pumped via a force main to a glass-lined steel above-ground storage tank with a capacity of approximately 200,000 gallons. The tank has secondary containment that can contain at least 110 percent of the storage volume. To guard against a pipe failure or ineffective pipe connections, leachate transmission piping outside the landfill will be double-walled HDPE pipe. From the storage tank, leachate transported to the Washington County Sewage Treatment Facility (WCSTF) for treatment. TRL has an industrial discharge permit with WCSTF for leachate generated at the site. A letter sent to the Washington County Water and Sewer Department confirming acceptance of the leachate is presented in **Attachment 3**.

As indicated in Appendix H – Leachate Calculations, the peak daily leachate flow rates generated by the landfill is estimated to be approximately 71,332 gallons per day, or 50 gallons per minute (gpm). It is anticipated that the actual leachate generation rates will vary, and thus, the leachate transfer pumping operation will discharge on an intermittent, or batch basis. The leachate sump pump is rated for approximately 70 gpm at 116 feet total dynamic head (TDH). One spare pump for both the sump and wet well components of the leachate collection system will be maintained at the site. A flow meter will be installed along the leachate transmission line to record both instantaneous and totalized flow.

The operation of the leachate transmission system will be automatic, based on the liquid level detected in the leachate sumps. Facility operations will perform daily monitoring of the liquid level in the collection system, operation of the sump pumps, and routine inspection and maintenance procedures.

7. LANDFILL GAS MANAGEMENT SYSTEM

7.1 General

Landfill gas (LFG) is generated by anaerobic decomposition of organic materials in the landfill. Since TRL is a rubble landfill, the rate of LFG generation is expected to be well below what is observed in municipal solid waste landfills. However, LFG is expected to be generated and thus it will be managed as described below.

Relief from LFG buildup will be accomplished by active extraction through a gas collection and control system consisting of a series of 8-inch diameter, PVC wells placed at a density of approximately one per two acres. Each well will be centered within a 3-foot diameter borehole backfilled with coarse gravel (No. 5 or 7 aggregate). Individual LFG wells will be connected via HDPE lateral piping (4 or 6-inch diameter) to a larger header (8 to 10-inch diameter), which will convey LFG to a flare for combustion. The locations and details of the gas collection system are conceptually presented on Drawing No. 15.

The final number and layout of wells will be reviewed and a final determination made prior to installation during closure of the facility. Design criteria for the layout of the LFG wells and piping will include:

- waste age;
- waste volume and tonnage in-place;
- landfill geometry;
- estimated moisture content within the waste; and,
- calculated LFG generation rate.

A LFG migration monitoring system will be used to detect the migration or presence of LFG at the facility boundary. The LFG monitoring system consists of soil-gas monitoring points close to the perimeter of the property. Because the landfill is fully-lined with a composite liner, it is unlikely that landfill gases would migrate off-site. However, to document that no gas migrates beyond the property boundaries, a perimeter monitoring system will be established.

Commencing with the initial placement of waste, quarterly monitoring of the perimeter soil-gas monitoring points for methane and oxygen will be conducted. Details for LFG migration monitoring and reporting are discussed in the Monitoring Plan.

7.2 Hazardous Atmospheres

LFG can produce gases, particularly methane and hydrogen sulfide, which can pose hazards to landfill employees. Hazardous atmospheres can be created by gases collecting within enclosed or semi-enclosed areas, such as leachate vaults, leachate storage tanks, and manholes. Routine safety precautions will be exercised whenever entering the leachate collection system vault and manholes for inspection or maintenance. The following procedures will be implemented as applicable.

- Employees will be made familiar with the available safety equipment and the details of its use. At least one person will also be trained CPR, and all personnel will be trained in emergency procedures.
- Employees entering the vault or manholes will work in pairs, and will always use a safety line manned by at least one other employee.
- The vault and manholes will be ventilated thoroughly before entering by opening 15 minutes before entry, or by using an air blower, and monitored for an oxygen-deficient or explosive atmosphere.
- Personnel will not be permitted to smoke, use an open flame, non-spark- proof flashlights, or cause a spark or flame when in or near the manholes or vault.
- No attempts will be made to rescue an individual in distress by entering the same atmosphere without first ascertaining that there is adequate ventilation; second, by wearing suitable respiratory equipment; and third, by wearing a safety line manned from above.
- Safety equipment will be maintained in proper working order.

8. MAINTENANCE PROCEDURES

8.1 General Maintenance Program

A maintenance program will be implemented at the landfill to organize personnel, materials and equipment needed to maintain the facility in an acceptable operating condition. This maintenance program would provide for "preventative" rather than "breakdown" maintenance. Preventative maintenance is a planned program of regular maintenance designed to ensure proper performance of all facility systems.

In order to affect a preventative maintenance program, periodic inspections of site systems will be conducted, as discussed in Section 8.2. These procedures will provide early identification of potential problems so that prompt action can be taken. Inspection logs for use as guidelines in implementing this program are presented in **Table 1**. The following sections provide further discussion of procedures for preventative maintenance of the facility, systems and equipment.

8.2 Site Maintenance

8.2.1 General

The landfill facilities requiring periodic maintenance include the earthen berms, intermediate cover, final cover system, leachate collection/transmission systems, LFG management system, utilities, roads, fences, and stormwater management and drainage systems. Each of these systems are discussed in the following sections.

8.2.2 Berms and Cover Systems

Maintenance of the earthen perimeter berms and cover systems will be initiated by visual inspection. Erosion of the berm slopes will be reduced by establishing suitable vegetative cover. If erosion occurs, the affected area will be re-graded, fertilized, and reseeded as necessary. Areas showing excessive settlement on the landfill will be repaired by placing and compacting additional soil. If required, damaged portions of the final cover will be repaired with materials of similar quality and characteristics; these materials would be installed in accordance with the quality assurance/quality control protocols presented in the Construction Quality Assurance/Quality Control Plan.

8.2.3 Leachate Collection/Transmission Systems

The leachate collection and transmission systems will be inspected monthly for corrosion, damage, or blockage. Repairs will be implemented on an as-need basis. Manholes and cleanouts allow for inspection and cleaning of the piping on a regular basis.

8.2.4 Landfill Gas Management System

After landfill closure, an active LFG management system will be installed and activated. LFG wells, valves, and the flare will be inspected quarterly for needed repairs. The quantity and quality of LFG being produced in the landfill will be monitored monthly at each LFG well. Each well will also be adjusted monthly, as necessary to ensure LFG wells are within acceptable limits and that air intrusion into the landfill s not occurring due to overapplication of vacuum.

8.2.5 Utilities

Utilities serving the landfill will include telephone, water, sewer, and electric. Maintenance of these utilities is the responsibility of the respective utility or service companies.

8.2.6 Roads, Drainage, Sedimentation and Erosion Control

The facility employs all-weather access and temporary haul roads constructed of a combination of asphalt or gravel surfaces. Roads will be maintained to prevent rutting and the ponding of water. Maintenance of gravel roads will consist of dragging the road for purposes of leveling the surface, filling rutted areas and adding additional stone as necessary. Ruts will not be permitted to exceed 8 inches in depth. Resurfacing will consist of placing compacted, dense-graded crushed stone as necessary. Asphalt pavement will be repairs as necessary when potholes develop.

Maintenance of site drainage facilities will consist of routine inspection of the facility components. Ditches and culverts will be visually inspected weekly and after major precipitation events to ascertain the degree of erosion, loss of integrity, accumulation of debris, and other obstructions to flow. Damage to the vegetated or riprap linings of these structures will be repaired and restored to design specifications. Debris or sediment removed from ditches or culverts will be deposited in the active disposal area of the landfill.

Erosion control will be provided by maintaining adequate vegetation on disturbed areas, utilizing run-off conveyance benches and channels down the slopes and a stormwater pond. Slopes will be maintained and regraded as necessary throughout the life of the facility. The stormwater pond will be inspected weekly and after major precipitation events. Maintenance of the sedimentation and erosion control facilities will consist of cleaning hydraulic structures and conveyance ditches whenever sediment accumulation impede the effectiveness of the stricture.

8.3 Facilities and Equipment Maintenance

8.3.1 General

The basic criterion for a maintenance schedule is to maintain proper operation of the equipment, with minimum downtime. The servicing of facility equipment will consist of general inspection, lubrication, adjustments and required repairs. Inspections and lubrication will be based on specific manufacturer-recommended intervals. During routine inspections, adjustments and repairs will be made if any malfunction, wear, or deterioration of parts is detected. Maintenance schedules will be followed to improve the effectiveness of the preventative maintenance program.

Facilities and equipment to be maintained include operating equipment (i.e. bulldozers, loaders, and cover trucks), and the leachate transmission system mechanical equipment. Manufacturer's operation and maintenance (O&M) manuals for equipment will be maintained in the landfill office for reference by landfill personnel.

Minor repairs to landfill equipment will be performed on site by qualified personnel. If major repairs or an overhaul are mandated for a piece of equipment, arrangements can be made for the rental of additional equipment to provide back-up capability, and off-site maintenance may be performed.

8.3.2 Leachate Transmission System Equipment

The leachate transmission system equipment includes pumps, and electro-mechanical control components. Pumps and float switches will be inspected and cleaned regularly; mechanical equipment components will be lubricated in accordance with the manufacturer's instructions. Pump wearing-surface clearances will also be adjusted in accordance with the manufacturer's instructions.

8.3.3 Heavy Equipment

Heavy equipment in the active disposal area requires regular maintenance to maintain proper operation. Because landfill heavy equipment must be reliable and is expensive to repair, a comprehensive scheduled maintenance program will be utilized.

Operating equipment items will be subjected to daily check-list procedures, with "on-the-spot" minor repairs being performed. Routine maintenance will be performed on site when possible, Equipment requiring more than minor or routine maintenance will be scheduled for additional service. Periodically, rigorous and detailed inspections will be performed based upon the equipment's time-in-service, determined by either the engine service meter or by calendar time. **Table 2** provides a list of equipment anticipated for use at the landfill and its maintenance schedule.

9. ENVIRONMENTAL MONITORING AND CONTROL

Environmental monitoring will be conducted throughout the operating life and post-closure care period. Monitoring will be performed for groundwater, surface water, and LFG migration. Details of the environmental monitoring program are provided in the Environmental Monitoring Plan provided in Appendix J of the Phase III Report.

9.1 General Maintenance

The environmental monitoring systems are designed for minimal maintenance during the life of the site. During monitoring events, monitoring personnel will visually inspect the condition of individual monitoring wells. Should well components such as the outer casing or protective bollards indicate damage or wear, appropriate repairs will be scheduled.

10. RECORDS

10.1 General

Written records of operational and maintenance activities at the TRL will be maintained on site and will include the following:

- Health and Safety Compliance Information;
- MDE Solid Waste Permit;
- Equipment/Vehicle Maintenance Repairs;
- Management Reports;
- Facility Inspection Logs;
- MDE Inspections/Notices of Deficiencies; and
- Disposal Monthly and Annual Reports.

The above-listed record types, among others, are discussed in this section, grouped within major categories of operational, safety and permits.

10.2 Operation Records –

Operations records include the types and amounts of waste disposed at the facility and facility inspection. As required in the Contingency Plan (Appendix N of the Phase III Engineering Report), the following two record items will also be maintained as part of the operating records: 1) documentation of coordination agreements for emergency response; and, 2) documentation of incidents requiring Contingency Plan implementation.

10.2.1 Types and Volume of Waste

The types and amounts of waste disposed at the facility by waste hauling vehicles will be recorded and maintained at the scale house/landfill office. The amount of waste deposited at the landfill, in terms of tonnage, will be determined from scale house records.

Records documenting site utilization will include the tonnage versus the volume of disposal space consumed at the facility. The landfill is projected to have an active disposal life of approximately 14 years; however, the actual rate of utilization and life of the landfill may differ from the projections due to potential variability in the quantities and types of wastes received. The rate of utilization will be monitored on an annual basis based on a comparison of topographic contour maps prepared at known time intervals. Topographic mapping may be prepared from aerial photography or land surveying.

The Facility Inspection Logs will be included as part of the complete operating record. These inspection logs, along with all other pertinent records such as accident reports, safety inspection checklists, and training records, will be maintained on site for review by regulatory agencies.

An up-to-date copy of the plans and specifications approved with the MDE landfill permit will be maintained in the facility office. Should additional construction activities be required at the facility, the plans and specifications pertaining to the additional construction will also be maintained.

10.2.2 Personnel

Personnel records will include, but will not be limited to, biographical information, education and special training or work experience, certification or license classification, time of employment, work record, and other pertinent information. Personnel records will be maintained at TRL's off-site management office rather than at the landfill facility.

10.2.3 Equipment Maintenance

Equipment data and maintenance records will be maintained at the facility. Information will include the model and type of equipment, date put into service, operator inspections, routine maintenance, and repairs records.

10.2.4 Inspection

Landfill Inspection Records will be maintained at the facility. Section 8.2 presents detailed information pertaining to inspection procedures and schedules to be utilized at the landfill.

Periodic inspections by MDE personnel may be performed throughout the active life and the post-closure care period for the facility. Records of these inspections will be kept in the Operating Record at the landfill.

10.3 Safety

Records pertaining to safety and medical information are documented as presented in Section 12 - Safety Program. Safety records which provide the required information regulated by state and federal agencies, such as Workers Compensation, will be maintained at the facility operator off-site management office as well as the medical history for employees; safety performance records for on-site personnel will be maintained at the landfill office.

10.4 Permits

Permit records pertaining to development and operation of the facility including the final Refuse Disposal Permit and a copy of the facility development plans will be maintained at the landfill office.

10.5 Reports

An Annual Facility Report for the calendar year ending December 31 will be prepared and submitted to the MDE by March 1 of the following year, in accordance with the final Refuse Disposal Permit. At a minimum, each report will include the following information:

- Quantity of waste received each month during each of the preceding 12 months, expressed in tons and in-place cubic yards;
- Projected date at which the landfill will reach capacity, and the premises upon which this determination is made; and,
- Percentage of total landfill capacity used for emplacement of waste.

The Annual Facility Report will be available at the landfill office for review by the regulatory agencies.

11. TRAINING PROGRAM

The training program will consist of classroom and on-the-job training in order to provide the full range of training necessary for employees to ensure familiarity with both TRL safety procedures, and the use of safety equipment. On-the-job training will be conducted as the opportunities for instruction arise and will be performed by the facility operator. A training file will be maintained for each employee to document and ensure that each person has completed the required training and an annual review course. The files will be maintained in the landfill office.

12. SAFETY PROGRAM

12.1 General

The purpose of an effective safety program is to do the following:

- Make safe work practices mandatory;
- Correct hazardous conditions immediately;
- Provide adequate safety equipment;
- Provide support for safety training and planning;
- Train each employee in the proper and safe operation of each item of equipment before the employee assumes responsibility for its operation; and,
- Develop an adequate emergency response plan (see Section 12.3).

Personnel at the landfill will promote safety by continuously analyzing jobs, work area, and procedures from a safety standpoint so that potentially hazardous actions or conditions can be recognized. When a hazard is noted, immediate steps will be taken to eliminate it by corrective action. If the hazard cannot be corrected, proper warning signs will be posted, safety devices will be installed, and safety procedures will be established to counteract the hazard.

Periodic safety inspections by personnel other than the facility staff will be conducted to identify correctable hazards that may not be apparent to regular employees.

12.2 Safety Training

Safety training sessions will be regularly conducted for personnel regarding overall landfill-specific safety procedures and use of safety equipment as required by the Occupational Safety and Health Act (OSHA). An emergency directory, as presented in **Table 3**, with names and telephone numbers of persons and agencies to be contacted in case of emergency, will be posted at the landfill office.

Safeguards will be provided on equipment to reduce the possibility of injury to employees. All active disposal area operating equipment will be provided with enclosed protective cabs to protect the operator from accidents, weather, and flying debris. Normal safety precautions will be observed while operating or working around heavy equipment. Specific safety measures will be detailed in manuals prepared by the Construction Industry Manufacturers' Association and will be available in the facility operator's office.

12.3 Emergency Response

The safety of all individuals involved in the operation and maintenance of the landfill depends on the ability to quickly identify and react properly in an emergency situation. In addition to the safety elements discussed previously, it is important to be familiar with the basic actions to implement should an emergency arise, such as accidental injury or fire.

Should an emergency arise, the proper emergency response authority will be notified; i.e., facility operator, police department, fire department, ambulance service, etc. (**Table 3**). After the proper authorities have been contacted, the individual handling the emergency will notify the facility operator, if not actively participating in the emergency response action. A detailed written report will be prepared describing the events surrounding such an occurrence. Every accident will be investigated, whether or not injuries occurred. The results of the investigation will be used to prevent a recurrence of the accident type.

TABLES

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TABLE 1

INSPECTION LOG
Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Item	Type of Problem	Frequency of Inspection	Trigger Level (If Applicable)	Status*	Observations	Date & Nature of Repairs/ Remedial
Subbase	Erosion, cracks, depth.	Weekly, until covered.	Desiccation cracks; grade moisture condition, and recompact if cracks exceed 1” in depth.			
HDPE Geomembrane	Tears, holes separation of layers, thin spots, cracks, shrinkage, hardness, excessive permeability, blisters, tightness of seams, excessive exposure to sunlight.	Upon installation and daily until covered.	Any tear or hole.			
Geocomposite	Tears, discontinuities, this spots, cracks, excessive exposure to sunlight.	Upon installation and daily until covered.	Any tear or discontinuity.			
Berms	Erosion, cracks, deterioration, exposure of synthetic membrane to sunlight.	Daily.	Desiccation, cracks, any exposure of membrane to sunlight.			
Cover Material	Uneven settlement, subsidence, erosion, inadequate protective vegetation (where applicable), failure to maintain 3 to 5 percent slope.	Daily.	Greater than 2 tons/acre/year erosion; greater than 10% of area devoid of vegetation; differential settlement in excess of 2 feet in 100 feet.			
Cover Material	Fertilization needed	As required.	During specified seeding seasons.			
Run-off Conveyance Channels	Obstruction to flow, bank erosion, deterioration, excessive silting, inadequate protective vegetation, loose riprap.	Weekly and after storm events.	Any clogging or obstructions to flow; silt buildup in excess of 50% of design freeboard; greater than 10% of area devoid of vegetation.			

* A = Acceptable
U = Unacceptable

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Item	Type of Problem	Frequency of Inspection	Trigger Level (If Applicable)	Status*	Observations	Date & Nature of Repairs/ Remedial
Drainage Channels	Erosion, clogging, obstruction of bank erosion, deterioration, excessive silting, inadequate protective vegetation, loose riprap.	Weekly and after storm events.	Any clogging or obstructions to flow; silt buildup in excess of 50% of design freeboard; greater than 10% of area devoid of vegetation.			
Temporary Haul Roads	Erosion, cracks, deterioration, excessive rutting, loss of aggregate.	Weekly.	Reduction of more than 50% of design thickness.			
Access Ramps	Erosion, cracks, loss of aggregate.	Weekly.	Reduction of more than 50% of design thickness.			
Main Entrance Road	Cracks, deterioration, spalling.	Weekly/as needed.	Reduction of more than 50% of design thickness.			
Pumps for Conveying Collected Leachate to Storage Tank	Power, clogging.	Weekly/as needed.	Any clogs; sustained loss of more than 20% of pumping capacity.			
Flexible Hose with Quick-Couple Fittings	Cracks or holes, fitting stick.	Weekly/as needed.	Any crack or hole.			
Sediment Control Facilities	Passage of sediment.	Weekly and after storm events.	Passage of sediment beyond level permitted by the NPDES permit.			
Liquid Containment Dikes	Erosion, cracks, deterioration, inadequate protective vegetation.	Weekly and after storm events.	Any deterioration that affects structural integrity; greater than 10% of area devoid of vegetation.			
Area Inlets to Storm Water Piping System	Corrosion, deterioration, silting, blockage, clogging.	Weekly.	Any clogs, any deterioration that affects structural integrity.			
Headwalls	Cracks, deterioration, spalling.	Weekly and after storm events.	Any deterioration that affects structural integrity.			
Storm-Water Piping, Final Cover, Drainage Containment	Silting, corrosion, deterioration, blockage, clogging.	Weekly and after storm events.	Any clogs, any deterioration that affects structural integrity; siltation sufficient to impede design flows.			
Valves	Leakage, deterioration, malfunction.	Weekly.	Any leakage, any deterioration that affects structural integrity.			

* A = Acceptable
U = Unacceptable

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Item	Type of Problem	Frequency of Inspection	Trigger Level (If Applicable)	Status*	Observations	Date & Nature of Repairs/ Remedial
Leachate Collection Systems	Broken pipe or connection, clogged perforations in pipe, sediment buildup in pipe angle of drainage, ground water collected.	Monthly.	Any breaks or clogs; any sediment deposits; failure to maintain adequate pipe slope; sudden drop in discharge flows.			
Leachate Manholes, Valve Manholes	Cracks, deterioration, spalling.	Monthly.	Any deterioration that promotes leakage or affects structural integrity.			
Fittings	Leakage, deterioration.	Weekly.	Any leakage; any deterioration that affects structural integrity.			
Standard Aluminum Manhole Steps	Corrosion, structural instability.	Monthly.	Any deterioration that affects structural integrity.			
Liquid Level and Indicator Gauges	Inoperative, sticking, calibration error.	Monthly.	Any deterioration that affects structural integrity.			
Sumps	Cracks, deterioration, spalling.	Bi-weekly.	Any deterioration that affects structural integrity.			
Junction Boxes Pump and Float Cables	Corrosion, non-waterproof.	Bi-weekly.	Any deterioration that affects structural integrity.			
Floats	Inoperative.	Bi-weekly.	Inoperative.			
Valves	Leakage, deterioration, clogging, malfunction.	Bi-weekly.	Any leakage.			
High Water Alarm	Inoperative.	Bi-weekly.	Inoperative.			
Low Water Alarm	Inoperative.	Bi-weekly.	Inoperative.			
Cast Iron Manholes and Covers	Corrosion, deterioration.	Monthly.	Any deterioration that affects structural integrity.			
Force Main	Clogging, deterioration.	Bi-weekly.	Any clogs; any leakage.			
Liquid Level Transmitters	Transmitter signal, electrical circuitry, power.	Bi-weekly.	Inoperative, questionable readings.			
Vents	Odor concentration.	Bi-weekly.	Odors offensive to operating personnel.			
Pumps	Power, clogging.	Bi-weekly.	Any clogs; sustained loss of more than 10% of pumping capacity.			
Concrete Pad for Storage Tank	Cracks, deterioration, spalling.	Monthly.	Any deterioration that promotes leakage or affects structural integrity.			

* A = Acceptable
U = Unacceptable

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Item	Type of Problem	Frequency of Inspection	Trigger Level (If Applicable)	Status*	Observations	Date & Nature of Repairs/ Remedial
Fencing	Corrosion, damage to chain-link fence or barbed wire.	Weekly.	Any breech of links or wire, any washout of fence foundation that affects structural integrity.			
Gates and Locks	Corrosion, damage to chain-link fence or barbed wire.	Weekly	Any breech of links or wire; corroded or broken locks; deterioration that hinders lock operation.			
Warning Signs	Damaged.	Weekly.	Illegible; destroyed by construction or vandalism.			
Two-way Radios	Transmitter or receiver malfunction.	Daily.	Any malfunction			
Locks on Ground-Water Monitoring Wells	Corrosion, broken.	Quarterly	Corroded or broken locks; deterioration that hinders lock operations.			
Operations Equipment	Steering, brakes, excessive oil/fluid leakage, tire/track wear.	Bi-weekly/as needed.	Any deficiency that reduces worker safety, reduces integrity of landfill systems, or threatens the environment.			

* A = Acceptable
U = Unacceptable

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TABLE 2

LANDFILL EQUIPMENT LIST
Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Quantity	Equipment Description
1	25 –Ton Off-Road Truck
1	Landfill Compactor
1	Landfill Dozer
1	Cat 950 Wheel Loader
1	Cat 336 Excavator
1	Bateman Magnet Grapple
1	Tanker Water Truck
1	Roll-off Truck
2	Dewatering Pumps
1	Submersible Pump (stand for leachate collection vault)

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TABLE 3

EMERGENCY RESPONSE CONTACTS
Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Landfill	**Office**	**Mobile**
Facility Emergency Coordinator/Landfill Manager: Charlie Jones	(301) 428-0800	(301) 252-4243
Alternate Emergency Coordinator: Floyd Cosner	(301) 428-0800	(410) 279-2849

Local	**Telephone Number**	**Emergency Number**
Anne Arundel Medical Center 2001 Medical Pkwy Annapolis, MD 21401	(443) 481-1000	911
Anne Arundel County Sheriff	(410) 222-1571	911

In the Event of a Major Spill or Release of Oils or Hazardous Materials Impacts to the Environment

Anne Arundel County Fire and Rescue	(410) 222-8200
Anne Arundel County Sheriff	(41)0 222-7777
Anne Arundel County Health Department	(410) 222-7095
Anne Arundel County Emergency Management	(410) 222-0600

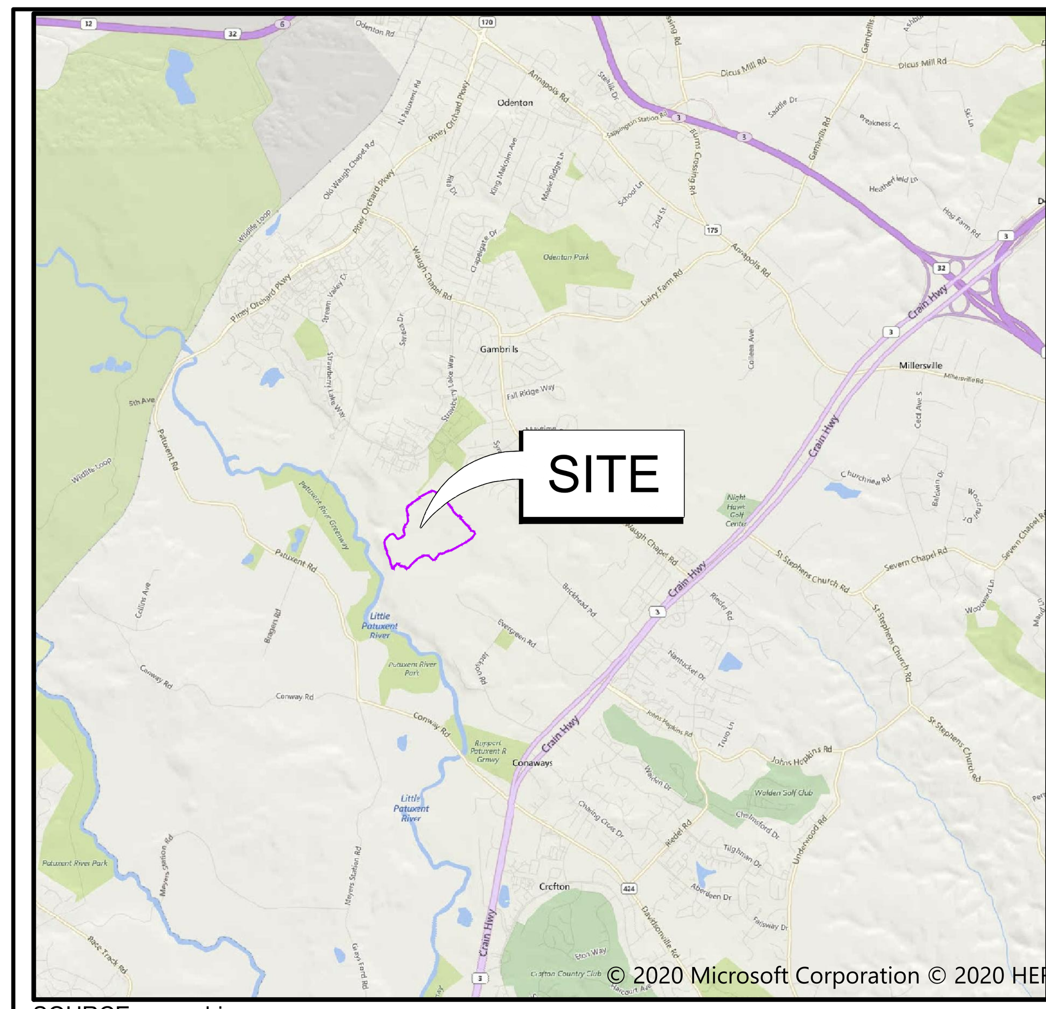
State

Maryland Department of the Environment	(410) 537-3315
Maryland Department of the Environment (after working hours)	(866) 633-4686
Maryland State Police	(301) 387-1101

National

United States Environmental Protection Agency (EPA):	
- National Response Center (to respond to Coast Guard)	(800) 424-8802
- National Response Center	(800) 424-8802
- Region III Philadelphia, PA	(215) 597-9905
United States Coast Guard	(757) 484-8192
Chemtrac (Chemical Transportation Emergency Center)	(800) 424-9300
National Poison Control Center	(800) 222-1222

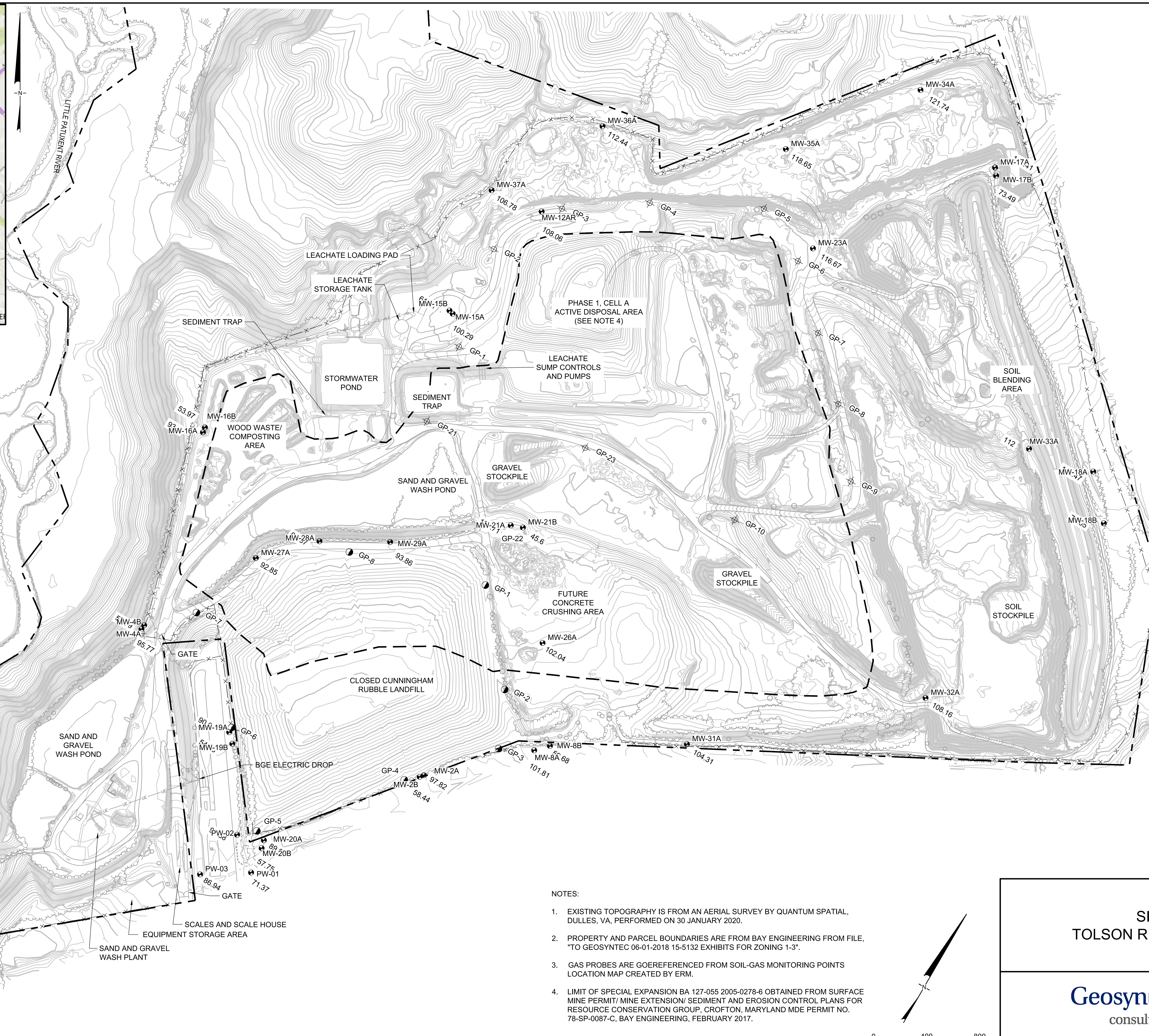
FIGURES



SOURCE: www.bing.com

VICINITY MAP

SCALE: 1" = 1 MILE



LEGEND

170	EXISTING CONTOURS (FEET, MSL)
	PROPERTY BOUNDARY
MW-26A 102.04	MONITORING WELL WITH HIGHEST OBSERVED GROUNDWATER ELEVATION OVER THE PRIOR 12 MONTHS
	EXISTING TREE LINE
	CURRENT PERMITTED WASTE BOUNDARY
	EXISTING WASTE DISPOSAL CELL
—x—x—x—	EXISTING SECURITY FENCE
	EXISTING ELECTRIC POLES
—E—E—E—	EXISTING ELECTRIC LINE
—UE—UE—UE—	EXISTING UNDERGROUND ELECTRIC LINE
	EXISTING ROAD
GP-1	EXISTING TOLSON LANDFILL GAS PROBES
GP-1	EXISTING CUNNINGHAM LANDFILL GAS PROBES

NOTES:

1. EXISTING TOPOGRAPHY IS FROM AN AERIAL SURVEY BY QUANTUM SPATIAL, DULLES, VA, PERFORMED ON 30 JANUARY 2020.
2. PROPERTY AND PARCEL BOUNDARIES ARE FROM BAY ENGINEERING FROM FILE, "TO GEOSYNTEC 06-01-2018 15-5132 EXHIBITS FOR ZONING 1-3".
3. GAS PROBES ARE GOEREFERENCED FROM SOIL-GAS MONITORING POINTS LOCATION MAP CREATED BY ERM.
4. LIMIT OF SPECIAL EXPANSION BA 127-055 2005-0278-6 OBTAINED FROM SURFACE MINE PERMIT/ MINE EXTENSION/ SEDIMENT AND EROSION CONTROL PLANS FOR RESOURCE CONSERVATION GROUP, CROFTON, MARYLAND MDE PERMIT NO. 78-SP-0087-C, BAY ENGINEERING, FEBRUARY 2017.

0 400 800

SCALE IN FEET

SITE MAP
TOLSON RUBBLE LANDFILL

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FIGURE 1

PROJECT NO: ME1606 | JULY 2020

P:\CADD\PROJECTS\T\TOLSON\CONCEPTUAL\FIGURES\ME1606-SITE MAP - Last Saved by: JDuran on 7/31/20

P:\CADD\PROJECTS\T\TOLSON\CONCEPTUAL\FIGURES\ME1606-LANDFILL LAYOUT - Last Saved by: JDuran on 7/31/20

LEGEND

- 55 EXISTING MINOR GRADE CONTOUR
- 50 EXISTING MAJOR GRADE CONTOUR
- EXISTING TREE LINE
- EXISTING ROAD
- PROPERTY LINE
- 118 PROPOSED MINOR GRADE CONTOUR
- 120 PROPOSED MAJOR GRADE CONTOUR
- LEACHATE COLLECTION PIPE
- LEACHATE COLLECTION SUMP
- EXISTING CELL A BOUNDARY

NOTES:

1. EXISTING TOPOGRAPHY IS FROM AN AERIAL SURVEY BY QUANTUM SPATIAL, DULLES, VA, PERFORMED ON 30 JANUARY 2020.
2. GRADE SHOWN IS TOP OF PREPARED SUBBASE.

LANDFILL LAYOUT
TOLSON RUBBLE LANDFILL

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FIGURE 2

PROJECT NO: ME1606

JULY 2020

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ATTACHMENTS

ATTACHMENT 1

Refuse Disposal Permit

December 10, 2019

CERTIFIED MAIL
Return Receipt Requested

Mr. Mike Ensor
Tolson & Associates, LLC
24012 Frederick Road, Suite 200
Clarksburg, Maryland 20871

Dear Mr. Ensor:

Enclosed herewith is the State of Maryland Refuse Disposal Permit No. 2019-WRF-0580, which is being renewed pursuant to the provisions of Title 9 of the Environment Article, Annotated Code of Maryland, and regulations promulgated thereunder for the continued construction and operation of the Tolson & Associates Rubble Landfill located at the end of Capitol Raceway Road, Crofton, Maryland. This permit supersedes and replaces Refuse Disposal Permit No. 2003-WRF-0580.

Please note that this permit is subject to the terms and conditions, which are enclosed. No written response from the permittee regarding this permit ten days following receipt of this letter constitutes acceptance of the terms and conditions contained therein.

If you have any questions regarding this matter, please contact me or Mr. Kassa Kebede at (410) 537-3315 or *kassa.kebede@maryland.gov*.

Sincerely,

Edward M. Dexter, Administrator
Solid Waste Program

Enclosure

cc: Brian Coblentz, Chief, Compliance Division, Land and Materials Administration (LMA) (w/encl.)
Kaley Laleker, Director, LMA
Sara Haile, Project Manager, Construction and Maintenance Section, LMA (w/encl.)

MARYLAND DEPARTMENT OF THE ENVIRONMENT

Land and Materials Administration
Solid Waste Program
1800 Washington Boulevard, Suite 605, Baltimore, Maryland 21230-1719

Larry Hogan
Governor

Ben Grumbles
Secretary

Refuse Disposal Permit

No. 2019-WRF-0580

ISSUE DATE: December 10, 2019 ***EXPIRATION DATE:*** December 9, 2024

Issued to: Tolson & Associates, LLC

Authorizing: the continued construction and operation of the Tolson & Associates Rubble Landfill

Located at: the end of Capitol Raceway Road, Crofton in Anne Arundel County, Maryland

This permit is renewed pursuant to the provisions of Title 9 of the Environment Article, Annotated Code of Maryland, and regulations promulgated thereunder, and is subject to the attached terms and conditions, and compliance with all applicable laws and regulations.

Edward M. Dexter, Administrator
Solid Waste Program

Kaley Laleker, Director
Land and Materials Administration

REFUSE DISPOSAL PERMIT
Permit No. 2019-WRF-0580
Issuance Date: December 10, 2019
Expiration Date: December 9, 2024

STATE OF MARYLAND
DEPARTMENT OF THE ENVIRONMENT
1800 Washington Boulevard
Baltimore, Maryland 21230-1719

This Refuse Disposal Permit is renewed pursuant to the provisions of Title 9 of the Environment Article, Annotated Code of Maryland, by the Maryland Department of the Environment, Land and Materials Administration (the "Department") to:

Tolson & Associates, LLC (the "permittee")
7 Willow Street
Annapolis, Maryland 21401

for the construction and operation of the

Tolson & Associates Rubble Landfill

encompassing a

72.38-acre fill area on a 184.25-acre site

located at

the end of Capitol Raceway Road
Anne Arundel County, Maryland

This permit is granted in accordance with the referenced documents in Part I, and subject to the terms and conditions specified in Parts II, III, IV, and V of this Permit as follows:

Part I: Referenced Materials - permit application, plans and specifications and other pertinent documents submitted to the Department.

Part II: Facility Specific Conditions - conditions which amend all other permit conditions applicable to this facility should any discrepancies or conflicts exist.

Part III: General Conditions - conditions which are generally applicable to solid waste acceptance facilities similar to this facility.

Part IV: Natural Wood Waste Conditions – conditions which are applicable to processing of natural wood waste.

Part V: Standard Conditions - conditions which are generally applicable to all solid waste acceptance facilities.

Part I: Referenced Materials:

A. Operating Documents:

1. A document entitled "Phase I Solid Waste Report, Tolson & Associates, LLC, Refuse Disposal Permit (Rubble Fill) Application", prepared by Environmental Technical Services, Inc., dated March 20, 2003 and received on March 25, 2003.

2. A document entitled "Phase II Geological Report, Rubble Landfill Extension, Capital Raceway Site, Anne Arundel County (Crofton), Maryland", dated January 12, 1995 and received on September 20, 2005.

3. A document entitled "Addendum-Phase II Geological Report, Rubble Landfill Extension, Capitol Raceway Site, Anne Arundel County (Crofton), Maryland", dated March 27, 1995 and received on September 20, 2005.

4. A document entitled "Groundwater Monitoring Data Analysis of Tolson Rubble Landfill, Crofton, Maryland 21114", consisting of Part 1 of 2 and 2 of 2, prepared by KCI Technologies, Inc., dated September 7, 2005 and received on September 20, 2005.

5. A document entitled "Groundwater Monitoring Data Analysis and Supplemental Phase II Site Geology Report of Tolson Rubble Landfill, Crofton, Maryland 21114", prepared by KCI Technologies, Inc., dated September 7, 2005 and received on February 28, 2006.

6. A document entitled "Landfill Gas Collection and Control System Plan", consisting of Sheets 1 through 11, prepared by Environmental Resources Management, Inc., dated May 22, 2015 and received on May 26, 2015.

7. A document entitled "Monitoring Plan, Tolson Rubble Landfill, Crofton, Maryland", prepared by Environmental Resources Management, Inc., dated August 3, 2016 and received on August 4, 2016.

8. A revised document entitled "Phase III Engineering Report, Tolson Rubble Landfill, Crofton, Maryland", consisting of Volume I Design Report and Volume II Drawings, prepared by Environmental Resources Management, Inc., dated May 31, 2016 and received on August 22, 2016.

9. A document entitled "Construction Completion Report, Tolson Rubble Landfill, Phase 1 Cell A, Crofton, Maryland", prepared by Environmental Resources Management, Inc., dated March 13, 2017 and received on March 16, 2017.

10. A Refuse Disposal Permit Renewal Application, dated October 16, 2019 and received on October 21, 2019.

Part II: **<u>Facility Specific Conditions</u>:**

A. Hours of Construction and Operation:

1. The permittee may construct and operate this facility during daylight only between the hours of 7:00 a.m. and 5:00 p.m. Monday through Friday. Operations may be performed during these hours after sunset or before sunrise if artificial light adequate to perform the activity in a safe and acceptable manner is provided to the satisfaction of the Department.

2. These specified hours may be changed upon written approval by the Department. For approval, a letter requesting the change of hours and a letter from the appropriate local government office stating that the change is consistent with local zoning and land use requirements must be submitted with such a request.

3. A statement of the days and hours of operation shall be posted at the entrance to the facility.

4. Emergency conditions or unusual circumstances that require the performance of the activities authorized under A.1 after hours, shall be reported to the Department at (410) 537-3315 during normal business hours, or via the Department's Emergency line at (866) 633-4686 at other times.

5. The Department may authorize an extension of the facility's hours of operation in emergency conditions. This approval does not authorize any infringement of federal, State or local laws or regulations, such as local zoning and land-use requirements.

B. Queuing of Trucks:

There shall be no queuing of trucks on Capitol Raceway Road waiting to enter the Tolson Landfill for waste disposal.

C. Liner Leak Testing:

Liner leak testing shall be performed by qualified personnel using industry approved methods after placement of the synthetic liner and prior to placement of the leachate collection system. Certified liner leak test results shall be submitted to the Department prior to placement of the leachate collection system.

D. Plans and Specifications:

Approved plans and specifications under Part I and Part II will satisfy the requirements under Part III General Conditions, Part IV Natural Wood Waste Conditions, and Part V Standard Conditions of the permit. The approved plans and specifications override the requirements under these conditions to the extent that they do not conflict with applicable laws or regulations unless a variance has been granted under the Code of Maryland Regulations (COMAR) 26.04.07.26. However, these conditions do remain valid and enforceable.

Part III: <u>General Conditions (Applicable to the Lined Rubble Landfills):</u>

A. Waste Restrictions:

1. The permittee may only accept solid waste as specified in this facility's Refuse Disposal Permit Application and its supporting documents identified in Part I of this permit, except as restricted or prohibited in this condition.

2. If the permittee accepts the following classes of waste as defined below, the acceptance of these materials is subject to the exceptions noted:

   a. Land clearing waste including waste derived from the clearing of silvicultural or agricultural land:

      i. Acceptable land clearing waste includes earthen material such as clays, sands, gravels, silts, topsoil, tree stumps, root mats, brush and limbs, logs, vegetation, and rock; and

      ii. Unacceptable land clearing waste include, but is not limited to, the following materials in greater than de minimus quantities: animal manure, pesticides, herbicides, animal bedding, agricultural produce, animal feed, putrescible waste, and fertilizers.

   b. Demolition debris may include waste associated with the razing of buildings, roads, bridges and other structures:

      i. Acceptable demolition debris shall include structural steel, concrete, bricks (excluding refractory type), lumber, plaster and plasterboard, insulation material, cement, shingles and roofing material, floor and wall tiles, asphalt, pipes, wires, and other materials physically attached to the structure, including appliances if they have been or will be compacted to their smallest practical volume; and

      ii. Unacceptable demolition debris shall include, but is not limited to, industrial waste or by-products, any waste materials contained within the structure or on the grounds of the structure being demolished that are not physically part of the structure, or which are comprised of or contain materials that pose an undue risk to public health or the environment.

   c. Construction debris is limited to structural building materials:

i. Acceptable construction debris shall include cement, concrete, bricks (excluding refractory type), lumber, plaster and plasterboard, insulation, shingles, floor, wall, and ceiling tile, pipes, glass, wires, carpet, wallpaper, roofing, felt, or other structural fabrics. Paper or cardboard packaging, spacing, or building materials from construction sites may be accepted at the rubble landfill. Paint containers, caulk containers, or glaze containers are acceptable provided that they are empty, and any residual material is dried before acceptance at the rubble fill; and

ii. Unacceptable construction debris shall include commercial, domestic, or industrial wastes or by-products, paint, tar or tar containers, caulking compounds, glazing compounds, paint thinner or other solvents or their containers, creosote or other preservatives or their containers, tile adhesives, paneling adhesives, carpet adhesives, or other adhesives, and other solid waste which may contain an unacceptable waste or substance as may be determined by the Department to be unacceptable.

d. Household appliances and white goods may be accepted at the facility, provided that any refrigerant is removed from the appliances before burial and handled in accordance with Section 608 of the Federal Clean Air Act.

e. Friable asbestos waste provided that the material that is received is packaged and labeled as specified in Code of Maryland Regulations (COMAR) 26.11.21.08A and is managed in the following manner:

i. Prior notification to the landfill supervisor is required;

ii. The waste asbestos is unloaded carefully to prevent emission of fibers into the air as required in the NESHAPS 40 CFR Part 61 and specified in COMAR 26.11.21.06;

iii. The area used for burial of asbestos shall be restricted to the working face of the landfill, or a separate cell dedicated solely to asbestos disposal;

iv. The waste shall be completely covered with earth or other refuse and may not be compacted or driven over until sufficient cover has been applied to prevent the release of asbestos fibers to the atmosphere during compaction or application of other cover material; and

v. When managing friable asbestos waste, operators at the landfill shall wear respiratory protection as specified in COMAR 26.11.21.05A, and wear protective clothing and use the equipment specified in COMAR 26.11.21.05D.

3. The following waste materials are specifically prohibited from being accepted at this site, regardless of their origin or type:

a. Controlled hazardous substances, defined as hazardous waste in COMAR 26.13.02, unless specifically authorized by a valid permit issued under COMAR 26.13.07;

b. Liquid waste or any waste containing free liquids, as determined by the EPA method 9095 Paint Filter Liquids test, as outlined in the EPA Publication SW-846 "Test Methods for Evaluating Solid Waste, Volume One, Section C: Laboratory Manual Physical/Chemical Methods", Third Edition, dated November 1986;

c. Special medical wastes as defined in COMAR 26.13.11.02.B(11);

d. Radioactive hazardous substances as defined in COMAR 26.15.02;

e. Automobiles;

f. Putrescibles;

g. Drums or tanks, unless empty and flattened or crushed with the ends removed; drums or tanks that have held hazardous waste shall be emptied properly in accordance with COMAR 26.13.02.07;

h. Animal carcasses resulting from medical research activities or destruction of diseased animals harboring diseases transmittable to humans, unless acceptance of the carcass(es) is ordered by the local county health officer, and the carcasses shall be covered with soil immediately upon deposition at the working face of the landfill;

i. Untreated septage or sewage scavenger waste;

j. Chemical or petroleum spill cleanup material;

k. Incineration ash material;

l. Truckloads of separately collected yard waste for final disposal, unless the permittee provides for the composting or mulching of the yard waste; and

m. Scrap tires, unless the Department authorizes the acceptance and processing of scrap tires as required in COMAR 26.04.08.

4. If sewage sludge, processed sewage sludge, or any other product containing these materials is proposed for storage, handling, or utilization at the landfill site, a separate application shall be submitted to the Biosolids Division for a sewage sludge utilization permit. That permit must be issued prior to the acceptance on site of any sewage sludge.

5. The Department, upon written request of the permittee, may amend the list in General Condition III.A. If the Department denies the permittee's request or unilaterally determines to limit or exclude a waste stream from being disposed of at the landfill, the permittee will be notified of the Department's decision in writing and will be provided an opportunity for a hearing in accordance with the Administrative Procedure Act.

B. Cell Floor Construction:

1. The permittee shall notify the Department in writing five working days prior to the anticipated start of each phase of floor construction including floor grading and compaction, liner installation, and leachate collection system installation.

2. No waste emplacement may commence in any area of the landfill, unless said area of the cell floor has been constructed and graded in accordance with the approved plans and specifications.

3. During construction of each area of the landfill, the edges of each landfill cell or subcell shall be marked to indicate where the edge of the permitted disposal area is located:

   a. For the exterior edges of cells, which delineate the boundary of the area permitted for solid waste acceptance and disposal, a permanent means of marking such as durable posts set in concrete shall be placed around the boundary every 250 feet. The posts shall be placed as close to the solid waste boundary as is possible without causing damage to the liner or other pollution control systems, and if more than 1 foot away shall have a durable marking indicating the amount of offset from the permitted disposal area. In no case shall the post be more than 5 feet away from the solid waste boundary unless otherwise approved by the Department;

b. For the interior edges of subcells, where a new waste disposal area will eventually be constructed contiguous to an existing solid waste disposal area, a semipermanent method of demarking the prepared disposal area such as wooden or fiberglass stakes shall be installed at least every 100 feet, and at every corner or significant change in direction. These stakes shall be placed within 1 foot of the edge of the prepared area, and shall be checked and replaced as necessary. The marking may only be removed in accordance with an approved schedule for construction of the adjacent subcell. Care must be taken to insure that the liner, leachate collection system, and other pollution control systems are not damaged by the installation of the markers;

c. Posts, stakes or other approved methods must be maintained in a serviceable condition at all times, and repaired as necessary; and

d. Alternative means may be substituted if approved by the Department.

4. No liner and leachate collection system installation may commence in any cell unless and until the following requirements are fulfilled:

a. The design of the liner and leachate collection system shall comply with the minimum requirements specified under COMAR 26.04.07.16. The design of the liner and leachate collection system shall be approved by the Department before installation begins;

b. A plan for the installation of synthetic membrane sections, illustrating overlap and seams, and sequence of installation shall be prepared and submitted to the Department at least ten days prior to the start of liner installation;

c. The sub-base for the synthetic membrane must be cleared of tree stumps, roots, vegetation, rubble, debris, angular rocks or stones, sharp-edged objects, and any material that may puncture or damage the overlying synthetic membrane to a maximum particle size established in accordance with the manufacturer's recommendations;

d. Sub-base construction must be conducted in lifts not to exceed 6 inches in thickness and compacted to the required density prior to addition of another lift; and

e. To ensure that the highest quality sub-base layer and synthetic membrane field seams are produced, continuous monitoring of all sub-base construction and synthetic membrane seaming operations shall be conducted by trained, experienced construction quality assurance monitors. In addition, undisturbed samples of the sub-base shall be tested for as-constructed permeability and 100 percent of all field seams shall be field tested (using an approved test method) as part of the liner installer's construction quality control activities. A quality assurance/quality control plan shall be submitted to the Department for review and approval. Quality assurance/quality control shall be performed by an independent contractor not associated with the construction contractor.

5. Synthetic membrane other than that specified in the approved plans and specifications may be used upon prior written approval from the Department.

6. The synthetic membrane sheets shall be properly seamed in accordance with the manufacturer's recommendations. All field seams shall be visually inspected and tested using the vacuum chamber method, air lance method or other nondestructive testing methods as recommended by the manufacturer. Construction verification tests including seam integrity verification, liner thickness, liner and seam strength, and other parameters shall be included in the quality assurance/quality control plan approved by the Department. Any imperfect seams, holes, punctures, and damaged areas shall be completely repaired or replaced as necessary to ensure the liner integrity. All factory seams shall be checked visually.

7. Any method of liner and leachate collection system construction which departs or varies in any way from those methods described in the approved plans and specifications or the procedures specified herein must be approved in writing by the Department before construction.

8. An independent engineer or the manufacturer of the perforated and un-perforated pipes and fittings used in construction of the leachate collection system shall certify that:

   a. The material meets the required standards and specifications as addressed in the approved plans and specifications;

   b. The pipes have a maximum 7.5% allowable ring deflection, unless otherwise specified in the approved plans;

c. The pipes have factors of safety against crushing and buckling of 2 or greater under dynamic (short duration) loading and 24 hour stationary (long duration) loading from landfill equipment and vehicles; and

d. The pipes are new and not defective.

9. All piping projections through the synthetic membrane liner shall be properly installed in accordance with the plans and specifications.

10. Each leachate collection pipe shall be inspected prior to installation, and tested to ensure that no clogging exists, that it is a properly manufactured pipe, and that it was not damaged in transit.

11. The leachate collection pipes, storage unit(s), and sumps shall be tested for leaks after installation.

12. The permittee must obtain certification from the manufacturer(s) that the synthetic membrane to be used as liner has thickness as specified in the approved plans and specifications with a permeability less than or equal to 1×10^{-10} cm/sec, and meets all of the applicable ASTM standards. A copy of the certification must be appended to the approved plan for the facility and provided to the Department within 60 days of receipt of the certification.

13. Following the satisfactory installation of the cell floor liners, the overlying layer shall be placed as soon as is practical for the protection of the liner.

14. No waste placement may commence in any cell unless and until the following requirements are fulfilled:

a. All monitoring wells have been installed, sampled and analyzed by the permittee in accordance with the approved monitoring program for the establishment of background water quality;

b. The cell floor liner and leachate collection system have been installed in accordance with the approved plans and specifications, and the requirements of this permit;

c. A minimum of 2 feet of pea gravel or other approved drainage material shall be placed to provide for the free passage of leachate to the liner and to serve as a protective layer for the liner and leachate collection system; and

d. Representatives of the Department have inspected and approved the construction of the cell floor.

C. Protection of Liner and Leachate Collection System:

A minimum of 4 feet of select waste containing no long pipes, boards, or other materials that could damage the liner and leachate collection system must be placed over the protective layer before compaction, to minimize the risk of damage to the liner and leachate collection system. No refuse hauling vehicles, equipment used for landfilling operations, or any heavy equipment shall operate over the leachate collection pipes and liner on the floor and side of the cell slopes until there is at least 4 feet of select waste placed upon the protective drainage layer. The permittee must notify the Department prior to the placement of the select waste.

D. Leachate:

1. All ponded leachate occurring in areas that are not part of an approved leachate collection or treatment system shall be collected and treated in accordance with this permit.

2. Untreated leachate or contaminated liquid may not be discharged to the waters of the State, without prior approval of the Department. The permittee must notify the Department within 1 hour of becoming aware of any leachate or contaminated liquid discharge leaving the site or having the potential of being released off-site.

3. All leachate collected in the leachate collection system shall be stored in the leachate storage unit(s) as specified in the approved engineering plans and specifications (also known as the Phase III Report) referenced in Part I of this permit. Leachate shall be discharged to the sanitary sewer system or an approved waste water treatment plant in compliance with the provisions of COMAR 26.08.08 unless other methods of disposal are permitted by the Department.

4. Leachate or other contaminated liquids shall not be discharged, recirculated, or treated on site without prior approval of the Department. Any approved modifications to plans and specifications will be incorporated by reference as part of this landfill's permit.

5. The permittee shall monitor the leak detection unit, if any, at least twice each month and include the results in the semiannual report on water quality, referenced in this permit.

6. Except for a leachate collection system relying solely on free gravity drainage to prevent leachate from ponding on the cell floor, the level of leachate in the leachate collection system shall be monitored a minimum of twice each day except Sundays and holidays. The data shall be recorded and initialed by the person performing the monitoring. Results are to be included in each semiannual report on water quality referenced in this permit.

7. To ensure the integrity and proper operation of the landfill's leachate storage unit(s), all leachate storage unit(s):

   a. Shall be either tested annually, be equipped with a release detection system, or have some other method of determining leakage that is approved by the Department; and

   b. Shall be equipped with a level sensor that will, if the storage unit is nearly full, activate an audible alarm in the landfill office and a red light that is visible from the public road at all times of the year. The alarm and light shall be tested weekly and the results of these tests included in the semiannual report on water quality referenced in this permit. A sign shall be posted at the gate with instructions to notify the appropriate local and State emergency numbers, including the Department's phone number, if the light is on when the site is closed. Upon request, the Department may approve alternative alarm notification systems.

8. Commencing on the day that solid waste is received at the landfill, the permittee shall monitor the quantity of leachate and other contaminated liquids collected each and every calendar month. The results of this monitoring shall be included in the semiannual report on water quality as required by the landfill's permit. The report shall include:

   a. The volume of leachate or other contaminated liquid collected monthly. Quantities shall be reported in gallons or cubic feet;

   b. The method used to measure the quantities of leachate coming from the leachate collection systems;

   c. The volume of liquid discharged to a sanitary sewer. Quantities shall be reported in gallons or cubic feet;

   d. The volume of liquid disposed of by any means other than that specified in (c). Quantities shall be reported in gallons or cubic feet;

e. The results of any chemical analyses performed on the collected liquid; and

f. The estimated total amount of cumulative precipitation received at the landfill based on local climatological data. Quantities shall be reported in inches and the source of the data shall be stated in the report.

9. If applicable, means for separating and diverting uncontaminated storm water from the leachate collection system within lined landfill cells may be proposed by the permittee. If approved by the Department, the plans and specifications for the separation and diversion of uncontaminated storm water shall be incorporated into and become as part of this permit. Until such plans are approved, all water collected from cells containing refuse shall be treated as leachate.

10. Should a force main be constructed to convey leachate to a sewer system, the following conditions shall be met:

a. All pretreatment requirements established in COMAR 26.08.08 shall be met;

b. A flow meter shall be installed, with results to be recorded daily and included in the semiannual reports on water quality referenced in this permit. Upon request, the Department may approve alternative accurate flow measurement method; and

c. The force main shall be pressure tested prior to use, by a method to be proposed to and approved by the Department.

E. Water Level Measurement:

1. The water elevations in all existing monitoring wells and piezometers shall be measured monthly and the readings shall be included in the semiannual water quality report referenced in this permit.

2. If examination of this information by either the permittee or the Department indicates that groundwater elevations have risen to encroach upon any existing or proposed cell floors, the bottom elevations of all subsequently constructed cell areas shall be raised. Except as permitted by the regulations, the increase in elevation shall be sufficient to insure a minimum buffer of 3 vertical feet between the base of any unconstructed fill areas, as well as the base of any unfilled areas of the waste cell currently being filled, and the highest observed or expected water level. A revised plan and specifications of all cell floors to be constructed, depicting these changes, must be submitted to the Department for review and approval prior to commencement of construction of any cell area.

F. Written Reports on Water Quality Analysis:

1. Within 90 days of the effective date of this permit, the permittee shall submit a hard copy and a searchable electronic/digital copy to the Department for review and approval a Groundwater and Surface Water Monitoring (G&SWM) Plan. The Plan shall be prepared in accordance with COMAR 26.04.07.16A(14) and (15), and with the guidelines established by the Department.

2. a. The permittee shall submit to the Department a semiannual report on water quality containing summary and interpretative discussion of all analyses of the chemical quality of groundwater from all of the monitoring wells and all of the surface water monitoring points specified in the approved G&SWM Plan;

   b. The semiannual report on water quality shall be submitted to the Department within 90 days of the close of every first and third calendar quarters unless an alternative schedule is specified in the approved G&SWM Plan;

   c. Sampling shall occur during the period between January through March and July through September of each year unless an alternative schedule is included in the G&SWM Plan and approved by the Department;

   d. The permittee shall arrange for a qualified groundwater scientist to sample, or to oversee qualified environmental technicians who sample the wells twice annually at the intervals specified in the approved G&SWM Plan;

   e. The parameters to be measured and their Practical Quantitation Limits (PQL) are listed in Tables I and II of this permit. The Department may approve an alternative list of parameters or an alternative PQL for any parameter;

   f. The sampling, sample handling, analyses and reporting of analytical parameters shall be performed in accordance with the approved G&SWM Plan;

   g. A qualified independent laboratory certified for water quality analysis by the Department or which is otherwise acceptable to the Department shall perform the analyses;

h. A qualified groundwater scientist or professional shall evaluate the results and advise the permittee of any changes in water quality or any exceedance of the State and federal Maximum Contaminant Level (MCL), Action Level or other health standard;

i. A complete copy of the laboratory data, and the qualified groundwater scientist or professional's interpretive findings shall be included in each semiannual report on water quality referenced in this permit;

j. If analytical results from samples collected from any sources associated with the landfill or surrounding properties exceed MCL, Action Level, or other health standard for the first time, the permittee must notify the Department in writing within 24 hours of receipt of the analytical data detecting this occurrence. Thereafter, if there is any significant increases above the MCL, Action Level, or other health standard, the permittee must notify the Department in writing within 24 hours of receipt of the analytical data detecting this occurrence;

k. Upon detection of the exceedance of an MCL, Action Level or other health standard for the first time, the monitoring point(s) in which the standard was exceeded must be immediately resampled to verify the initial detection. This resampling must occur as soon as possible, and no later than 30 days following receipt of the analytical data by the permittee or the qualified groundwater scientist or professional who is reviewing the analytical data which indicated the exceedance. If the permittee accepts the initial sampling result as a valid result, then the permittee can elect to not resample the monitoring point(s);

l. All data for each well must be summarized and presented in time series format. The data for each well must be presented in a spreadsheet so that the water quality data for each parameter for each well can be observed simultaneously; and

m. All "J" values must be reported. "J" values are analytical results that are below the PQL but can be estimated.

TABLE I
MONITORING PARAMETERS

VOLATILE ORGANIC COMPOUNDS	PQL (ppb)	VOLATILE ORGANIC COMPOUNDS	PQL (ppb)
Acetone	5.0	Cis-1,2-Dichloroethene	1.0
Acrylonitrile	5.0	Trans-1,2-Dichloroethene	1.0
Benzene	1.0	Methylene Chloride	1.0
Bromochloromethane	1.0	1,2-Dichloropropane	1.0
Bromodichloromethane	1.0	Trans-1,3-Dichloropropene	1.0
Bromoform	1.0	Cis-1,3-Dichloropropene	1.0
Bromomethane	1.0	Ethylbenzene	1.0
2-Butanone	5.0	2-Hexanone	5.0
Carbon Disulfide	1.0	Iodomethane	1.0
Carbon Tetrachloride	1.0	4-Methyl-2-pentanone	5.0
Chlorobenzene	1.0	Methyl Tertiary Butyl Ether	2.0
Chloroethane	1.0	Styrene	1.0
Chloroform	1.0	1,1,1,2-Tetrachloroethane	1.0
Chloromethane	1.0	1,1,2,2-Tetrachloroethane	1.0
Dibromochloromethane	1.0	Tetrachloroethene	1.0
1,2-Dibromo-3-chloropropane	1.0	Toluene	1.0
1,2 – Dibromoethane (EDB)	1.0	1,1,1-Trichloroethane	1.0
Dibromomethane	1.0	1,1,2-Trichloroethane	1.0
1,2 – Dichlorobenzene	1.0	Trichloroethene	1.0
1,4 – Dichlorobenzene	1.0	Trichlorofluoromethane	1.0
Trans-1,4-dichloro-2-butene	5.0	1,2,3-Trichloropropane	1.0
1,1-Dichloroethane	1.0	Vinyl Acetate	1.0
1,2-Dichloroethane	1.0	Vinyl Chloride	1.0
1,1-Dichloroethene	1.0	Xylene	1.0

TABLE II
MONITORING PARAMETERS

ELEMENTS AND INDICATOR PARAMETERS	PQL (ppm)	ELEMENTS AND INDICATOR PARAMETERS	PQL (ppm)
Total Antimony	0.0020	Total Silver	0.0100
Total Arsenic	0.0020	Total Sodium	0.2
Total Barium	0.0100	Total Thallium	0.0020
Total Beryllium	0.0020	Total Vanadium	0.0100
Total Cadmium	0.0040	Total Zinc	0.0100
Total Chromium	0.0100	PH	0.1 (SU)
Total Calcium	0.08	Alkalinity	1
Total Cobalt	0.0100	Hardness	0.5
Total Copper	0.0100	Chloride	0.39
Total Iron	0.005	Specific Conductance	1
Total Lead	0.0020	Nitrate	0.06
Total Nickel	0.0110	Chemical Oxygen Demand	10
Total Magnesium	0.004	Turbidity	0.11 (NTU)
Total Manganese	0.0100	Ammonia	1
Total Mercury	0.0002	Sulfate	0.38
Total Potassium	0.39	Total Dissolved Solids	10
Total Selenium	0.035		

3. The semiannual report on water quality must include a time series analysis of the data. The historical data from each well should be presented in a tabular form in each semiannual report. The discussion should emphasize historical trends in the data.

4. A copy of the most current topographic map generated by a survey performed as required in this permit shall be included in each semiannual report on water quality and shall depict the location of all monitoring wells and piezometers in existence at the time of the survey.

5. A copy of a current groundwater contour map depicting the location of all monitoring wells from which groundwater data is collected shall be included in each semiannual report on water quality. Multiple aquifers shall be depicted on separate groundwater contour maps.

G. Spreading and Compaction:

Solid waste shall be spread in uniform layers and compacted to its smallest practicable volume before application of cover material.

H. Solid Waste Lifts:

A lift of solid waste may not exceed 8 feet in height except as specifically authorized in writing by the Department.

I. Periodic Cover:

A uniform compacted layer of clean earth at least 6 inches in depth, or an approved cover material of a thickness specified by the Department, shall be placed over exposed solid waste by the end of the third day's operation, or more frequently as may be determined by the Department. However, all waste shall be covered by the end of the last workday of the week or before a holiday when the landfill will not be operating. To meet approval, the cover material may not:

1. Contain free liquids, putrescibles, or toxic materials. Moisture, which is present in the cover material solely as a result of precipitation, is not free liquid;

2. Create a dust or odor problem;

3. Attract or harbor vectors; and

4. Impede compaction of wastes by standard landfill equipment.

J. Intermediate Cover:

Weather permitting, a uniform, compacted layer of clean earth not less than 1 foot in depth shall be placed over each portion of a lift not later than 1 month following completion of that lift. The intermediate cover layer may not be removed without written authorization from the Department.

K. Final Cover:

1. A uniform compacted layer of earthen material not less than 2 feet in depth shall be placed over any part of the final lift of refuse not later than 90 days following completion of that final lift.

2. Areas which have received final cover shall be mowed at least once a year, or more often if necessary, to control growth of woody vegetation and to allow facility personnel to inspect for signs of erosion, settlement, ponding of water, and leachate seeps.

L. Grading and Drainage:

The disposal site shall be graded and drained to:

1. Minimize runoff onto the fill area of the sanitary landfill;

2. Prevent erosion and ponding within the fill areas; and

3. Drain water from the surface of the sanitary landfill.

M. Erosion and Sediment Control Plan:

The permittee shall have a signed copy of a valid Erosion and Sediment Control Plan prepared in accordance with the requirements of COMAR 26.17.01 and approved by the appropriate approving authority prior to the construction of the landfill as authorized by this permit. An approved plan as required under COMAR 26.17.01 that covers all areas of the permitted facility must be maintained at all times during the life of this permit.

N. Storm Water Management Plan:

1. The permittee shall have a signed copy of a valid Storm Water Management Plan prepared in accordance with the requirement of COMAR 26.17.02 and approved by the appropriate approving authority prior to the construction of the landfill as authorized by this permit.

2. Means for separating and diverting uncontaminated storm water from the landfill cells may be proposed by the permittee. If approved by the Department, the plans and specifications for the separation and diversion of uncontaminated storm water shall be incorporated into and become as part of this permit.

O. Water Supply Contingency Plan:

1. If a risk to public health due to contamination of the groundwater by the landfill has developed to the extent that provision for an alternative water supply for offsite water users may become necessary, the Department will require the permittee to draft a detailed engineering design plan describing the manner in which alternative water supplies will be provided to potentially affected areas around the landfill. This plan must be developed and submitted to the Department for review and approval. The draft plan shall be submitted to the Department for review within 1 year of notification by the Department. The plan shall be revised in accordance with any reasonable requirement of the Department. The level of detail of the plan shall be sufficient to serve as construction and implementation documents for the proposed water supply. The plan shall also include a schedule of all activities necessary to implement the plan, including activities to be performed by the permittee to bid, oversee, and implement the plan, and all activities by contractors.

2. The area which the plan must contemplate for water supplies must, at a minimum, include all areas within 1/2 mile of the property boundary of the landfill as depicted in the reports referenced in Part I of this permit, and any other groundwater use located downgradient of the landfill. The plan must also contain provisions for expansion of the area of impact should it become necessary to protect the public health. The plan may also contain provisions for partial or staggered implementation, based on specific information about the cause and extent of the triggering event, which is available at the time of implementation.

3. Upon approval by the Department, the water supply contingency plan shall become attached as a part of this permit, by reference.

4. Should the Department determine that migration of contaminants from the property on which the landfill is located has occurred or is likely to occur, the permittee shall immediately implement the water supply contingency plan in accordance with the approved schedule.

P. Closure and Post-Closure:

When the design capacity has been exhausted, the permittee shall cap the landfill in accordance with the requirements of COMAR 26.04.07.21. Furthermore, at least 6 months prior to cessation of landfilling operations, a closure plan shall be submitted to the Department. The plan shall contain the following elements:

1. A description of the methods to be used in closing out and capping the facility in an environmentally sound manner;

2. A description of the facility's post-closure activities including groundwater monitoring and maintenance of the closed facility as specified in COMAR 26.04.07.22;

3. A description of the future use of the facility upon closure; and

4. A deadline for the submission of a map based on an actual field survey, which depicts the final topography of the site upon closure.

Q. Wetlands and Wildlife Protection:

1. Landfill construction and operation may not impact any regulated wetlands area until necessary authorization is received from the applicable State and federal wetland authorities. This includes construction of access roads, landfill cells, or other land disturbance, and pertains to wetlands regulated by the State of Maryland and/or the U.S. Army Corps of Engineers.

2. Landfill construction and facility operations, which may impact upon State or federally regulated endangered species, may not begin unless all necessary permits or authorizations are obtained from the applicable State or federal wildlife regulatory agencies.

Part IV: <u>Natural Wood Waste Conditions (Applicable to Processing of Natural Wood Waste)</u>

A. Natural Wood Waste Authorization:

The permittee is also authorized to process, chip and store only natural wood waste, as defined in Code of Maryland Regulations (COMAR) 26.04.09.02, including tree stumps, brush and limbs, root mats, logs, unadulterated wood wastes and other natural vegetative materials. Natural wood waste does not include yard waste. Yard waste as defined in Section 9-1701(n)(2) of the Environment Article, <u>Annotated Code of Maryland</u>, includes leaves, garden waste, lawn cuttings, weeds and prunings. The permittee is authorized to process the wood waste into recyclable products, such as mulch, wood chips, compost, and firewood.

B. Natural Wood Waste Storage Piles:

1. The permittee shall comply with the requirements of the local fire prevention codes regarding fire control measures for the storage of the natural wood waste piles at the facility.

2. Natural wood waste shall be stored on site for no longer than 30 days before it is initially processed.

3. The buffer between natural wood waste piles and any buildings or structures shall be a minimum of 12 feet of clear space.

4. The buffer between natural wood waste piles and property boundaries shall be a minimum of 50 feet.

5. Natural wood waste piles shall not exceed 20 feet in height, 50 feet in width, and three hundred 350 feet in length.

6. Natural wood waste piles shall be subdivided by fire lanes having at least 25 feet of clear space at the base of the piles negotiable by emergency vehicles, loaded delivery vehicles or other vehicle transportation.

C. Processed Natural Wood Waste Windrows:

1. The permittee may process natural wood waste into windrows of wood chips, mulch, compost or firewood.

2. The buffer between processed natural wood waste windrows and property boundaries shall be a minimum of 50 feet.

3. The buffer between processed natural wood waste windrows and any buildings or structures shall be a minimum of 12 feet of clear space.

4. Processed natural wood waste windrows shall not exceed 18 feet in height, 50 feet in width, and 350 feet in length.

5. Processed natural wood waste windrows shall be subdivided by fire lanes having at least 25 feet of clear space at the base of the windrows negotiable by emergency vehicles, loaded delivery vehicles or other vehicle transportation.

D. Operating Procedures:

1. To ensure that aerobic conditions are maintained and controlled during processing of natural wood waste, unless another method is approved by the Department, the permittee shall:

   a. turn wood chip/mulch windrows and piles at least monthly;

   b. take daily temperature readings and turn the wood chip/mulch windrows and piles when daily temperature readings reach 140° F; and

   c. take weekly oxygen level readings and turn wood chip/mulch windrows and piles when weekly oxygen readings go below 10 percent.

2. The permittee shall maintain on site at all times a log demonstrating maintenance of temperature and aerobic conditions as required in this permit.

3. Any additives used in processing natural wood waste must be approved by the Department before use.

4. The permittee shall remove all natural wood waste from the site within one year of date of initial processing.

E. Processing Conditions:

1. All natural wood waste processing areas shall be located at least 50 feet from any property line.

2. The permittee shall identify available markets for the raw material or products produced.

3. If, at any time, natural wood waste, wood chips, mulch or other wood wastes accumulate outside the areas designated in this permit, then the permittee shall cease accepting natural wood waste and other recyclable materials until the stockpiles are reduced to the acceptable levels.

4. The permittee shall take steps to control dust resulting from this facility at all times.

5. The permittee shall confine all wood waste to the approved unloading, processing, or storage areas at this facility.

6. All raw material receipt and storage, processing activities, and product storage shall occur on suitable ground surfaces. No operations shall occur on filled land unless approved by the Department.

F. Operational Restrictions and Procedures:

The permittee shall not operate this facility in such a manner as to:

1. Create a nuisance;

2. Be conducive to insect and rodent infestation or the harboring of animals;

3. Cause a discharge of constituents derived from natural wood waste into the air unless otherwise permitted by the Department;

4. Cause a discharge of constituents derived from natural wood waste to waters of the State unless otherwise permitted by the Department; and

5. Create other hazards to public health, safety or comfort as may be determined by the Department.

G. Emergency Preparedness Manual:

1. The permittee shall maintain an emergency preparedness manual approved by the Department at this facility at all times.

2. The permittee shall update the emergency preparedness manual if a change in the operation occurs, or if the Department requires an update. The emergency preparedness manual shall, at a minimum, contain:

    a. A list of names and telephone numbers of the persons to contact in the event of a fire, flood, or other emergency situation at this facility;

    b. A list of emergency response equipment available for use at this facility, the location of the equipment, and how the equipment shall be used in the event of a fire or other emergency;

    c. Procedures for personnel to follow from discovery of an emergency until the situation is corrected, including measures to minimize the occurrence, recurrence, or spread of fires, explosions, and releases;

d. Location of known water supplies, fire hydrants, dry chemical extinguishers, or other materials that may be used for fire fighting purposes;

e. Provision for reporting emergency situations to the Department without delay;

f. Provision for familiarizing all employees with the requirements of the emergency preparedness manual;

g. Methods used to prevent mud, soil, and debris from this facility from entering the public roadways; and

h. Other contingency plans applicable to the operation including control of oil spills, etc.

H. Fire Control:

1. The permittee shall operate this facility in accordance with the applicable requirements of the local and State Fire Marshal's office.

2. The permittee shall take suitable measures to prevent and to control fires that may occur during operation of this facility.

3. Burning of wood waste shall not be allowed except or as authorized by the Department.

4. A means to notify the local fire department must be available on-site at all times (e.g. telephone and two way radio).

5. Adequate water supply must be available in case of a fire. The Department, local fire department or the State Fire Marshal may direct that the permittee install, alter or expand the volume and manner of water supply or water storage capacity available at the site, and shall specify a time frame for compliance with that directive. Compliance within the specific time is a condition of compliance with this permit.

Part V: Standard Conditions (Applicable to All Solid Waste Acceptance Facilities):

A. Supervision:

This facility shall be under the supervision of a responsible individual present at the disposal site at all times during the operation.

B. Right of Entry:

The permittee shall allow the Department's authorized representatives, at reasonable times and upon presentation of credentials:

1. To enter this facility covered under this permit or where any records are required to be kept under the terms and conditions of this permit.

2. To have access to and copy any records required to be kept under the terms and conditions of this permit.

3. To inspect any equipment or process required in this permit.

4. To inspect any collection, treatment, pollution management or control facilities, or transport vehicles, required by this permit.

5. To sample any waste, groundwater, surface water, soil or vegetation on the site.

6. To obtain photographic documentation or evidence.

C. Controlled Access:

Access to this facility shall be controlled at all times. Gates, fencing, and other ingress/egress controls around the perimeter of this facility shall be adequate to control access when this facility is not in operation. All gates shall be locked when this facility is unattended. Access shall be limited to those times when authorized personnel are on duty at this facility.

D. Overall Operation:

The permittee shall take all measures necessary to control pollution, health hazards or nuisances. This facility shall be operated and maintained in such a manner as to prevent air, land, or water pollution, public health hazards or nuisances.

E. As-Built Plans:

The permittee shall submit to the Department 2 copies of certified as-built plans no later than 90 days after completion of the work under this permit.

F. Inspection of Incoming Waste:

1. The permittee shall inspect all incoming loads of solid waste material to insure that no unacceptable waste types, as herein defined in Part III of this permit, are included in the load. The permittee may conduct this inspection by observing wastes as they are deposited, transferred or processed.

2. If an unacceptable solid waste is identified during the tipping and/or inspection process, the permittee shall reject the unacceptable solid waste and advise the generator or hauler of the reason for rejection.

3. If the source of an unacceptable solid waste is unknown, the permittee shall dispose off-site all discovered unacceptable solid waste in a manner consistent with all applicable laws and/or regulations.

4. The permittee shall immediately (within 2 hours) report to the Department at (410) 537-3315 or (866) 633-4686 after working hours all incidents of discovery of any unacceptable hazardous waste materials in a load of waste. The permittee shall then submit to the Department a written report within 5 working days following the discovery. When the source of waste is known, the written report shall include the source of the waste, the transporter of the waste, the circumstances of discovery, a description of efforts to secure and control the waste and any release of pollutants from the waste, the current location and if known, the final disposition of the waste. If the source of waste is unknown, the written report shall include the circumstances of discovery, a description of efforts to secure and control the waste and any release of pollutants from the waste, and the current location and final disposition of the waste. If the source of unacceptable hazardous waste is known, the permittee shall reject the waste material and advise the generator or hauler of the reason of rejection. If the source of unacceptable hazardous waste is unknown, the permittee shall separate and handle the waste material in accordance with the applicable requirements of COMAR 26.13.02 "Disposal of Controlled Hazardous Substances".

G. Personnel, Equipment and Maintenance:

The permittee shall provide adequate personnel and equipment to insure proper construction and operation of this facility. Provisions shall be made for equipment repair or replacement as required. Substitute equipment shall be obtained when breakdown or maintenance renders essential operating equipment inoperative for a period in excess of 24 hours during days of operation.

H. Roads:

1. The permittee shall provide all-weather access roads to the disposal site or receiving area, and to all required pollution control and monitoring systems and devices.

2. Roads shall be maintained in a serviceable manner to allow passage by a waste hauling, emergency, or inspection vehicle, and to prevent the tracking of soil, ash, or waste onto any public road and/or to cause a public nuisance. If necessary, vehicles shall be cleaned prior to leaving this facility. Additional actions or facilities may be required at the discretion of the Department in order to control sediment tracking.

I. Dust and Noise Control:

1. Dust shall be controlled through the application of water to roads, operational procedures designed to limit disturbance of bare soils, and other practices approved by the Department. No chemical, oil or petroleum product shall be used for the control of dust without prior written approval from the Department.

2. Operations of the facility shall be conducted in a manner that conforms to the applicable noise provisions of COMAR 26.02.03. This permit does not authorize the violation of any local noise control laws or ordinances which may be enforced by the local government.

J. Litter Control:

1. Scattering of wastes by wind or other means shall be controlled by fencing or other barriers that are engineered and maintained in a manner that prevents litter from leaving the permitted facility.

2. The entire site shall be policed daily or more often, as needed, to prevent nuisance conditions. Litter that has scattered beyond the disposal site or receiving area, entered drainage features or surface water features, or has accumulated along litter fencing or other barriers, shall be picked up daily and placed in the disposal site or receiving area.

K. Liquids Management:

1. Under no circumstances may any collected contaminated liquids be discharged by any means, except to the sanitary sewerage system or any permitted treatment facility, without written authorization from the Department. Any discharge to a sanitary sewerage system shall comply with the applicable provisions of the state's pretreatment program, as described in COMAR 26.08.08.

2. Storm water management at this facility shall be in accordance with the requirements of COMAR 26.17.02. Any point source discharge of pollutants to waters of the state is prohibited unless permitted by the Department. Any pollutants from the handling, transfer, or storage of wastes, including accidental spills and rainfall events, shall be collected or disposed of in a manner approved by the Department.

L. Fuel Storage:

Fueling of equipment and vehicles shall be conducted with care to avoid spilling or overfilling. The storage tanks and fuel distribution facilities shall be installed and maintained in accordance with the applicable requirements of COMAR 26.10.01 through COMAR 26.10.11 inclusive, and with the requirements of local fire prevention agencies. Any spilled fuel shall be cleaned up immediately. Disposal of spilled fuel may only take place at an incinerator, municipal landfill or oil handling facility permitted to accept this material.

M. Fire Control:

1. Solid waste may not be burned at this facility except as permitted by the Department.

2. The permittee shall take suitable measures to control and prevent fires that may occur during the operation of this facility.

N. Removed Pollutant Substances:

Unless previous written approval for disposal has been given by the Department, wastes such as solids, sludge, or other materials removed from or resulting from the treatment or control of waste waters or facility operations, shall be disposed of at a facility approved to accept such materials, and in a manner to prevent any removed substances or runoff from such substances from entering or from being placed in a location where they may enter the waters of the state.

O. Pollution Monitoring and Control Device Requirements:

1. All pollution control and ground and surface water monitoring systems (including storm water management and sediment control systems) shall be installed in accordance with the manufacturer's recommendations and plans and specifications approved by the Department. All pollution control and ground and surface water monitoring systems shall remain operational and shall be maintained in accordance with the provisions of the approved plans and specifications.

2. Any incidence of damage to this facility's monitoring or pollution control systems shall be reported to the Department at (410) 537-3315 within 2 hours of the incident, or within 2 hours of the discovery of the damage if the damage occurred outside of working hours. All repairs needed to correct the damage shall be completed as soon as practical or as specified by the Department.

3. During construction and operation of this facility, the sediment and storm water basins shall be cleaned out whenever (a) a clean-out elevation is reached; (b) construction is completed; (c) the amount of sediment reaches 50% capacity, and/or (d) as specified by the approved Sediment and Erosion Control Plan.

P. Penalties for Tampering:

Section 9-343 of the Environment Article, Annotated Code of Maryland, provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by fines, or by imprisonment, or by both.

Q. Records Retention:

1. All records and information resulting from the monitoring activities required by this permit, including all records of analyses performed, calibration and maintenance of instrumentation, original recordings from continuous monitoring instrumentation, and inspection results shall be retained by the permitee on-site or at another location upon written approval of the Department, for a minimum period of 5 years.

2. All documents listed in Part I: A. Operating Documents of this permit shall be retained by the permittee on-site for the life of the permit. Historical documents listed in Part I may be retained at an off-site location.

R. Annual Report:

An annual report shall be submitted to the Department concerning the operation and status of this facility for each calendar year that this facility is in operation. The annual report shall be for the calendar year ending December 31 and shall be submitted by March 1 of the following year on the form provided by the Department.

S. Duty to Provide Information:

The permittee shall furnish to the Department within a reasonable time, any information that the Department may request, to determine whether cause exists for modifying, revoking, reissuing, or terminating this permit, or to determine compliance with this permit.

T. **Alterations:**

Any modification to this facility or its operating plans must be approved in writing by the Department prior to implementation. Modifications include, but are not limited to, any changes that alter a significant structural feature, operational procedure, element of design, type of equipment or method of construction described in the approved plans and specifications for this facility and defined herein.

U. **Operation and Maintenance Manual:**

The permittee shall review the Operation and Maintenance Manual (O&M) for this facility prior to permit renewal. If a change has occurred to the operation or maintenance of the facility, the permittee shall submit to the Department an addendum to the O&M to reflect the change.

V. **Application for Renewal:**

1. At least 2 weeks before the expiration date of this permit, unless permission for a later date has been granted by the Department, the permittee shall submit a new application for renewal of the authorization to continue to operate under the provision of this permit or notify the Department of the intent to cease operating by the expiration date. In the case of landfill systems, the application shall be submitted in accordance with Section 9-213 of the Environment Article, Annotated Code of Maryland. In the event that a timely and sufficient reapplication has been submitted and the Department is unable, through no fault of the permittee, to renew this permit before its expiration date, the terms and conditions of this permit are automatically continued and remain fully effective and enforceable.

2. The Department may refuse to renew this permit if the permittee violates the terms or conditions of this permit or state law and regulations, in accordance with Section 9-214 of the Environment Article, Annotated Code of Maryland.

W. **Closure:**

1. When operations end, the permittee shall close this facility in a manner that prevents erosion, health and safety hazards, nuisances, and pollution.

2. All remaining solid wastes, not properly disposed of, shall be transferred to a permitted facility for proper disposal.

3. If applicable, the surety bond for this facility as specified in Sections 9-211 or 9-211.1 of the Environment Article, Annotated Code of Maryland or other financial assurance required by State, federal, or local regulations, shall be utilized to the extent necessary to remediate the facility if the permittee does not close this facility in a proper manner, and the Department:

   a. Notifies the permittee and corporate surety on the bond that the facility is not properly closed;

   b. Specifies in the notice, the deficiencies that must be addressed;

   c. Gives the permittee and the corporate surety a reasonable opportunity to correct the deficiencies and close the facility in accordance with the regulations of the Department; and

   d. Authorizes the local governing body or other agency to use the surety bond to close the facility in accordance with the regulations of the Department.

X. Transfer of Permit or Ownership:

1. This permit is valid only for the permittee named and may not be transferred to another entity without first obtaining a new Refuse Disposal Permit from the Department for the new entity.

2. In the event of any change in control or ownership of the property, the permittee shall notify the succeeding owner by certified mail, of the existence of this permit and of any outstanding permit noncompliance, a minimum of 30 days prior to transfer. A copy of this notification shall also be forwarded to the Department at the same time.

Y. Compliance:

1. The permittee shall comply with the terms and conditions of this permit, and with all applicable federal, local and State laws and regulations.

2. If for any reason the permittee does not comply or is unable to comply with any of the terms and conditions of this permit, the permittee shall notify the Department at (410) 537-3315 on the same day or on the next working day, following any noncompliance. Within 5 working days after this notification, the permittee shall provide the Department with the following information in writing:

   a. Descriptions of the noncompliance, including dates, time, and type of noncompliance;

   b. Cause of noncompliance;

c. Anticipated time the noncompliance is expected to continue or if such condition has been corrected;

d. Steps taken by the permittee to correct the noncompliance; and

e. Steps to be taken by the permittee to prevent recurrence of the noncompliance.

Z. Local Solid Waste Management Plan/Zoning and Land Use Requirements:

1. Nothing in this permit authorizes the construction or the operation of this facility when it is not in conformance with the local solid waste management plan, or zoning or land use requirements. The issuance of this permit does not prevent any duly authorized local authority from taking action to enforce applicable zoning, planning and land use requirements, or provisions of the local solid waste management plan.

2. This permit may be suspended or revoked upon a final, unreviewable determination that the permittee lacks, or is in violation of, any federal, State or local approval necessary to conduct the activity authorized by this permit.

AA. Civil and Criminal Liability:

Nothing in this permit shall be construed to neither preclude the institution of any legal action nor relieve the permittee from civil or criminal responsibilities and/or penalties for non-compliance with Title 9 of the Environment Article, Annotated Code of Maryland, or any federal, local or other State laws or regulations.

BB. Penalties for Violations of Permit Conditions:

Section 9-268 of the Environment Article, Annotated Code of Maryland, provides that, except for violations of Part III of that subtitle and violations enforced under Section 9-267 of that subtitle, the provisions of Sections 9-334 through 9-342 of Subtitle 3 of that title shall be used and shall apply to enforce violations of:

1. That subtitle;

2. Any regulation adopted under that subtitle; or

3. Any permit issued under that subtitle.

CC. Property Rights:

The issuance of this permit does not intend to convey any property rights in either real or personal property, or any exclusive privilege or franchise, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, State or local laws or regulations.

DD. Severability:

If any provision of this permit shall be held invalid for any reason, the remaining provisions shall remain in full force and effect, and such invalid provision shall be considered severed and deleted from this permit.

EE. Signatory Requirements:

All applications, request for alterations, renewal requests, or monitoring reports submitted to the Department shall be signed and verified in accordance with Section 1-201 of the Environment Article, Annotated Code of Maryland, by the permittee or authorized representative of this facility as being true.

Geosyntec consultants

ATTACHMENT 2

Leachate Acceptance Letter

MICHAEL R. ROBLYER, P.A.
ATTORNEY AND COUNSELLOR AT LAW
7 WILLOW STREET
ANNAPOLIS, MARYLAND 21401-3112

MICHAEL R. ROBLYER

TELEPHONES
(410) 266-5533 ANNAPOLIS
(410) 841-6617 BALTIMORE
(301) 261-8135 WASHINGTON
(410) 266-5516 TELECOPIER

January 8, 1999

Via Facsimile and Regular Mail

Gregory B. Murray, Director → TEL # (301) 223-9416
Water and Sewer Operations
Washington County
Water and Sewer Department
Public Works Annex Building
16232 Elliott Parkway
Williamsport, MD 21795

Re: Cunningham Excavating, Inc.
Our File No. 93056/MRR

Dear Mr. Murray:

This office represents Cunningham Excavating, Inc. in its permit process with the Maryland Department of the Environment to obtain a permit to operate a Rubble Landfill on property in Crofton, Maryland.

One of the requirements of the process is for Cunningham to indicate to the Department where it will dispose of the leachate that will accumulate in the Landfill due to the required liner that will be installed at the bottom of the fill.

In that regard, I have been discussing with Greg Larson of your Department the disposal of the leachate in the Washington County Sewage Treatment Facility. He indicated to me that Washington County would accept the leachate as long as it has the capacity to receive and treat leachate.

Therefore, I am writing to you to confirm that we will be indicating to the Maryland Department of the Environment that Cunningham, if issued a permit, will dispose of the leachate generated at the Cunningham Rubble Landfill in the Washington County Sewage Treatment Facility.

Of course, this is not a binding contract on either party, but only an agreement that at this time your facility accepts leachate and that there is capacity. As is true with any governmental facility, if the capacity changes, the ability to accept leachate will change, and Cunningham will have to seek another site at which to dispose of the leachate.

The Department will require your confirmation of the above by your signature. Therefore, please fax and mail to me a copy of the letter signed at the bottom indicating your confirmation of the above.

Thank you for your help in this matter.

Very truly yours,

Michael R. Roblyer

MRR:tr
enclosure

cc: Mr. and Mrs. James E. Cunningham

This is to confirm this 13th day of January, 1999, the contents of this letter.

Washington County
Water and Sewer Department

Gregory B. Murray, Director
Water and Sewer Operations

Cunningham #1 (1999)\
Landfill\Murray1.ltr

Geosyntec consultants

ATTACHMENT 3

Tolson Stormwater Pollution Prevention Plan

Stormwater Pollution Prevention Plan (SWPPP)

for:

Tolson And Associates, LLC
1451 Capitol Raceway Road
Crofton, MD 21114
(410) 721-0403

SWPPP Preparation Date:

9/22/2017

Contents

1. FACILITY DESCRIPTION AND CONTACT INFORMATION

This Stormwater Pollution Prevention Plan (SWPPP) has been prepared for Tolson And Associates, LLC (Tolson) for the Tolson And Associates Pit (the Facility) located at 1451 Capitol Raceway Road in Crofton, Maryland in Anne Arundel County. The facility is owned and operated by Tolson And Associates, LLC. The facility is located on a 203.75 acre site, west of Route 3 along the Little Patuxent River.

1.1. Facility Information

Facility Information

Name of Facility: Tolson And Associates Pit

Street: 1451 Capitol Raceway Rd

City: Crofton State: MD ZIP Code: 21114

County: Anne Arundel

Permit Registration Number:

Latitude/Longitude (Use decimal format)

Latitude:	Longitude:
1. 39.0336º N	1. -76.7043º W

Estimated area of industrial activity at site exposed to stormwater: 170.08 acres

Primary SIC Code or 2-letter Activity Code: 1442/4953

Identify your applicable sector and subsector:
Sector J: Mineral Mining and Dressing-Construction Sand and Gravel
Sector L: Landfills and Land Application Sites
(co-located)

Name and 8 digit identifier of the receiving water body: 02131105 (Little Patuxent River)

Are any of your discharges directly into any segment of an "impaired" water? ☒ Yes ☐ No

If Yes, identify name of the impaired water (and segment, if applicable): Little Patuxent River

Identify the pollutant(s) causing the impairment: Sedimentation/Siltation, Chlorides

For pollutants identified, which do you have reason to believe will be present in your discharge?

Sedimentation/Siltation

For pollutants identified, which have a completed TMDL? Sedimentation/Siltation

Do you discharge into a high quality receiving water designated as a Tier 2 water? ☐ Yes ☒ No

Do you discharge into a high quality receiving water designated as Use III or Use IV? ☐ Yes ☒ No

1.2. Contact Information/Responsible Parties

Facility Operator (s):
Name: Charlie Jones, Supervisor
Address: 1451 Capitol Raceway Road
City, State, Zip Code: Crofton, MD 21114
Telephone Number: (301) 252-4243

Facility Owner (s):
Name: Tolson And Associates, LLC
Address: 24024 Frederick Road
City, State, Zip Code: Clarksburg, MD 20871
Telephone Number: (301) 428-0800
Contact: Mike Ensor
Email address: mensor@pleasants.org

SWPPP Contact:
Name: Charlie Jones
Telephone number: (301) 252-4243

1.3. Stormwater Pollution Prevention Team

Staff Names	Individual Responsibilities
Charlie Jones, Supervisor	Pollution Team Leader
Floyd Cosner, Foreman	Pollution Prevention Team

1.4. Activities at the Facility

The list below outlines the typical activities that take place at the Tolson And Associates Pit:

- Sand and gravel mining and washing
- Construction and Demolition Landfill waste disposal and operations
- Natural wood waste and mulching operation

1.5. General Location Map

Refer to Appendix A for General Location Map (Figure 1) extending at least 0.25 mil beyond the Facility. The following features are shown on Figure 1:

- Approximate facility location
- Surface water bodies receiving storm water discharges

1.6. Site Map

Refer to Appendix B for the Site Map (Figure 2). The following features are shown on Figure 2:

- Size of the property in acres
- Location and extent of significant structures and impervious surfaces
- Direction of stormwater flow
- Locations of all existing structural control measures
- Locations of all receiving waters in the immediate vicinity of the facility
- Locations of all stormwater conveyances (ditches, pipes and swales)
- Locations of potential pollutant sources
- Locations where significant spills or leaks have occurred (none)
- Locations of stormwater monitoring points
- Locations of stormwater inlet and outfalls (with a unique identifier for each outfall)
- Locations and descriptions of all non-stormwater discharges
- Locations of the following:
    - Fueling stations
    - Vehicle and equipment maintenance and/or cleaning areas
    - Loading/unloading areas
    - Waste treatment, storage and/or disposal areas
    - Liquid storage tanks
    - Processing and storage areas
    - Access roads used by carriers of raw materials, manufactured products, waste materials, or by-products of the facility
    - Transfer areas for substances in bulk
    - Machinery

2. POTENTIAL POLLUTANT SOURCES

2.1. Industrial Activity and Associated Pollutants

Industrial Activity	Associated Pollutants
Sand and Gravel Mining	Sediment
Active waste disposal and daily cover	Sediment and solid waste.
Leachate collection and storage	Leachate
Vehicle Maintenance	Fuel, oil, antifreeze, brake fluid. Note all maintenance is performed on-site by a licensed contractor. The contractor takes all fluids and byproducts off-site for disposal.
Vehicle Fueling	Fuel. Note all equipment fueling is performed by mobile fuel truck.
Vehicle Site Access	Fluids from trucks and vehicles.
Outdoor Storage	Scrap materials.

2.2. Spills and Leaks

Areas of Site Where Potential Spills/Leaks Could Occur

Location	Outfalls
Site Wide – Vehicle Fueling and Vehicle Site Access	1
Mining Area	1
Leachate Collection Tank	1
Active Landfill	1

Description of Past Spills/Leaks

Date	Description	Outfalls
Spring 2015	Fuel spill at abandoned Maintenance Building	N/A

2.3. Non-Stormwater Discharges Documentation

The Tolson And Associates Pit was visually inspected for non-stormwater discharges and illicit connection to surface drainages. No non-stormwater discharges were identified.

2.4. Salt Storage

The facility does not currently store salt or brine.

2.5. Visual Monitoring Summary

Visual assessment of the site did not indicate any potential stormwater issues.

3. STORMWATER CONTROL MEASURES

3.1. Minimize Exposure

The Tolson And Associates Pit uses BMPs to minimize the exposure of potential pollutants to stormwater. A series of forebays and sediment basins are being used to manage stormwater and prevent sediment from the active landfill and sand/gravel mining operation from leaving the site. The sediment basins are regularly inspected and maintained as necessary to ensure they are in proper working order. Sediment controls as shown on the approved Erosion and Sediment Control Plans are in place and regularly inspected and maintained to ensure they are in proper working order.

3.2. Good Housekeeping

Good housekeeping practices require that the facility is maintained in a clean and orderly manner. In general, a clean and orderly work area reduces the possibility of accidental spills caused by mishandling of chemicals, petroleum products, and equipment. This is accomplished through instilling proper employee work habits and by training and checking the progress through visual inspections. Good housekeeping assures that:

- spill response equipment is properly located, in adequate supply and working order, and the location(s) are known to all employees;
- spills and leaks are promptly cleaned up and any spent sorbent and recovered material is properly disposed;
- traffic patterns are clearly marked on the pavement for deliveries, and mirrors or other systems are in good condition to minimize the chance of an accident during material delivery or pickup; and
- all paved and vegetated areas are routinely maintained clear of litter and debris, and are properly maintained.

Good housekeeping practices for the facility include removing debris and clogging material from the sediment basin and outfall structures. The slopes of the mine areas and basins will be maintained in accordance with established maintenance procedures and the Anne Arundel Soil Conservation District approved Sediment and Erosion Control Plan.

Sorbents are materials that are capable of cleaning up spills through the physical/chemical processes of adsorption and absorption. Typical sorbent materials that can be applied to a spill on paved surfaces include clays, sand, “kitty litter”, and sorbent booms, matting and pads. Sorbent booms should be used to absorb spills on unpaved areas. For absorbent materials to be effective, they must be applied immediately onto the spilled area, and cleanup should proceed immediately. Proper disposal of the used absorbent material is necessary.

An up-to-date inventory of all materials stored in the on-site storage container will be maintained. Materials will be stored and handled in accordance with Occupational Health and Safety Act (OSHA) regulations. Drums in which materials are stored will be stored indoors and elevated or placed in waterproof containment devices to prevent contact with water. Good housekeeping also involves cleaning up spills immediately after they occur and identifying equipment for evidence of drips or leaks, and including routinely cleaning-up litter and debris that may accumulate. Repairs and cleanup will be performed immediately after a leak or spill is identified.

3.3. Maintenance

Maintenance procedures must be established for industrial equipment to avoid spills and leaks:
Mining and Landfill Equipment: Preventative maintenance includes inspection and maintenance of vehicles and equipment used and stored at the facility that could results in a discharge of pollutants to stormwater in the event of equipment failure. Inspection and maintenance is generally conducted as recommended by the equipment manufacturers. All maintenance is performed by a licensed contractor on-site and all fluids and by-products are taken off-site by the contractor.
Mining Area and Landfill Maintenance: Mining area and landfill maintenance practices include a comprehensive inspection, maintenance monitoring, and repair schedule. Maintenance will be performed to ensure the proper function of the mining area and landfill control features, and to provide adequate levels of environmental protection. Upon identifying a maintenance need or deficiency, appropriate measures will be promptly taken.

- Run-on and Runoff Control Structures: Routine maintenance for run-on and runoff control structures typically involves cleaning sediment from structures such as ditches, culverts, sediment ponds and pond inlets and outlets. Equipment such as backhoes, dump trucks, bulldozers, and scrapers will be required to perform these activities. Materials such as silt fence, straw bales, and soil will be kept on site to implement short term remedial repairs while waiting to do permanent repairs. Repairs or replacement of riprap will be made as needed. The rationale for performing maintenance will be based on visual observations.

Leachate Management Equipment: Leachate management equipment and other mechanical equipment associated with leachate management are operated and maintained in accordance with manufacturer recommendations to the extent practical. Inspection and service reports for each piece of equipment are kept on-site, as well as logs of any faulty operation or incidents.

3.4. Spill Prevention and Response

Spill prevention and response procedures are established at the facility to reduce the number of accidental spills of potential stormwater pollutants, initiate immediate and proper cleanup of spills, and perform proper notification to the appropriate regulatory agencies. The main roadways are where spills and leaks are most likely to occur. An inventory of materials used to clean-up spills in these areas is inspected monthly and during the annual comprehensive site compliance evaluation. The filling procedures for tanks, equipment, and vehicles will utilize practices that minimize spills, including not over-topping tanks when refueling and providing basins or other devices for pouring waste oil and antifreeze. Performing good housekeeping and preventive maintenance practices on a routine basis in the waste management areas will also prevent spills from occurring.

In the event of a spill or release, employees are trained to first attempt to stop the spill or release, where manageable without harm or injury. Once the employee has attempted to stop the spill or release, they are trained to immediately contact management personnel to notify them of the event. Management personnel will assess the situation and determine whether outside notification (e.g., MDE, USEPA) or assistance (e.g., Fire Department, Hazardous Materials Response Team) is appropriate.

In the case of spilled petroleum fluids, the spill will immediately be contained by either placing sorbent materials over the spilled material/fluid (in the case of small spills) or by constructing a trench and berm around the spill (in the case of large spills). Brooms, shovels, squeegees, and absorbent materials will be used to confine the spilled material. The source of the spill or leak will immediately be identified and eliminated or controlled. If the spilled material drains to a vegetative or mechanically stabilized area, the soils, gravel, and/or vegetation that absorbed the spilled material will be removed as soon as possible, but in all cases before the next storm event, properly disposed, and the disturbed area vegetatively or mechanically stabilized. Additional safety equipment such as fire extinguishers will be stationed at convenient locations and will be readily available. Following any spill, the spill prevention plan will be re-evaluated to identify any areas in the response procedures that could be improved. Vegetation and mechanically stabilized surfaces will also be re-established in areas where soils have been removed.

In the event that spill prevention measures fail, a rapid response is required to prevent potential pollutants from mixing with stormwater. Emergency response telephone numbers and spill response procedures are readily available at the facility to all on-site personnel.

3.5. Erosion and Sediment Controls

The primary means of sediment and erosion control at the facility includes vegetative and mechanical stabilization and collection and settlement of stormwater runoff in sediment basins, forebays, and drainage swales to regulated outfalls. The purpose of sediment basins and forebays is to manage stormwater runoff by addressing quantity and quality. The outfall structures address these criteria by controlling the release of captured runoff and allowing ample time for the larger sediment particles suspended in the runoff to settle. The sediment basins are cleaned out whenever sediment in the structure accumulates to the cleanout elevation. The outfall structure is inspected and cleaned, if necessary, to ensure proper functioning. As necessary, maintenance will be performed on the inside banks of the basins, and on the outfall structure when significant erosion or sedimentation has occurred. The outfall structures will be inspected routinely for leaks, cracks, holes and woody vegetation, and timely corrective measurements should be performed as necessary. Areas at the facility subject to a high volume of traffic (e.g. parking lot and access roads) are wetted as is necessary to control dust. Requirements related to the sand and gravel mining operations are covered under the approved Sediment and Erosion Control Plans for the facility. The property is inspected for signs of erosion or sedimentation during routine inspections and after significant rainfall events. Areas of stressed vegetation or erosion will be addressed by appropriate technical or management personnel as necessary.

3.6. Management of Runoff

The majority of the stormwater runoff at the facility is conveyed via overland flow to sediment basins and forebays, which removes the larger sediment particles suspended in the runoff. The forebay and sediment basin ultimately discharge into the Little Patuxent River (Outfall 001). The remainder of the water drains to the wash ponds and is used in the sand and gravel washing process. The sand and gravel wash area all drains to the wash ponds so the entire operation is contained. There is no outfall on the wash ponds. Buildings at the facility are equipped with storm gutters that direct stormwater to vegetated areas, ditches, and eventually to the wash ponds. Positive drainage is maintained on-site to prevent stormwater from ponding (except in forebays and sediment basins) and potentially mixing with pollutants. Refer to Figure 2 in Attachment B for drainage pathways and outfall location.

3.7. Salt Storage Piles or Piles Containing Salt

The Maryland NPDES permit requires that salt storage areas be covered or enclosed to prevent exposure to precipitation. The Facility does not currently store salt or brine. In the event salt or brine is brought on site, salt storage areas will be covered or enclosed.

3.8. Employee Training

Members of the PPT are responsible for participating in employee training programs. The PPT team leader is responsible for providing the required training. The employee training programs are designed to inform personnel at all levels of responsibility of the components and goals of the SWPPP. Training sessions address topics such as spill prevention and response, preventive maintenance, good housekeeping, storage practices, visual inspections, updates to this SWPPP, and recordkeeping and reporting. At a minimum, formal training sessions are conducted annually. Topics discussed in the training session and a roster of employees who attend the training sessions are recorded and retained in the SWPPP file. Informal training in the form of one-on-one communications regarding the importance of pollution prevention occurs during visual inspections by members of the PPT. This allows members of the PPT to point out potential pollutants and to verify that the information addressed in the training sessions has been communicated effectively. The information described in this SWPPP regarding facility drainage characteristics, potential pollution sources, and stormwater management controls/BMPs are distributed to all employees whose work influences stormwater or includes a potential pollution source. At a minimum, this includes maintenance personnel, equipment and vehicle operators, and any individual who handles or oversees the transfer of fuel or other granular or liquid materials into and out of the facility. Employee training includes four core subjects:

- Good Housekeeping: Employees are required to maintain a clean and orderly work environment. The routine sweeping of floors and the prompt cleanup of spilled material is discussed. The location of shovels, brooms, absorbents, and any other spill response equipment are identified. Employees are informed to regularly inspect for leaks and spills from storage tanks and drums. Housekeeping issues are addressed during regular safety meetings.
- Spill Prevention and Response: Employees are made aware of potential spill areas, drainage routes, and to whom a spill should be reported. Specific material handling procedures to avoid spills and response procedures in the event of a spill are also discussed.
- Loading and Unloading Procedures: Employees are instructed to provide constant supervision during all outdoor fuel transfer and material handling operations and to ensure that all containers are properly sealed prior to handling.
- Preventive Maintenance: Employees are instructed to provide constant care to ensure that the equipment and mine are maintained properly.

An annual employee training log is provided herein as Attachment D. This schedule is updated each year as an activity under the Annual Comprehensive Site Compliance review. All employee training records are maintained on file in the office building.

3.9. Non-Stormwater Discharges

Non-stormwater discharges include any discharge from the facility that is not generated by rainfall runoff. All stormwater discharge locations are inspected for the presence of non-stormwater discharges,

The following non-stormwater discharges are allowable under the terms of this permit:

- Water used to fight active fires
- Uncontaminated condensate from air conditioners, coolers and other compressors and from the outside storage of refrigerated gases or liquids
- Irrigation drainage
- Landscape watering, provided all pesticides, herbicides and fertilizer have been applied in accordance with the approved labeling
- Pavement wash waters where no detergents are used and no spills or leaks of toxic or hazardous materials have occurred
- Routine external building wash down that does not use detergents and any dislodged paint chips are filtered
- Uncontaminated ground water or spring water
- Foundation or footing drains where flows are not contaminated with process materials

The following non-stormwater discharges are not permitted:

- Leachate
- Gas collection system condensate
- Drained free liquids
- Contaminated groundwater

3.10. Waste, Garbage and Floatable Debris

Waste and garbage are not stored in open areas, in order to prevent the transport of windblown and floatable debris. All acceptable forms of waste are directed to a designated area for drop-off and interment. The size of the working face is kept to a minimum to prevent wind-blown waste that could potentially pollute stormwater or become floatable debris. Observation of waste or debris in these areas will be identified during routine site inspections and disposed of.

3.11. Dust Generation and Vehicle Tracking of Industrial Materials

Dust is controlled on the access roads by the application of water or another suitable dust-control agent. A water tank truck, equipped with a spray attachment, is used to apply the water in regulated quantities. The frequency of application of water for dust control depends on site conditions and specific operations being performed. In addition, the establishment of vegetative cover on completed areas minimizes the potential of dust nuisance.

3.12. Security

The landfill is only open during posted hours of operation, otherwise it is closed and not accessible to the public. The main access road to the landfill is secured by locked gates at the entrance of the facility. A permanent fence is located around the perimeter of the facility.

4. SCHEDULES AND PROCEDURES FOR MONITORING

Benchmark monitoring is to be conducted quarterly for 4 quarters at Outfall 001. The benchmark monitoring limit for this facility is 100 mg/L total suspended solids (TSS). Benchmark concentrations are not effluent limitations, and exceedances do not constitute a violation of the terms of this permit. Benchmark monitoring is to be used to assess the effectiveness of the facility's control measures and stormwater pollution prevention procedures. After collection of 4 quarterly samples, if the average does not exceed the benchmark limit, monitoring requirements have been fulfilled for the permit term and no additional sampling is required. If the average of the 4 samples does exceed the benchmark, the control measures shall be evaluated for effectiveness and necessary modifications shall be made. If there are no further technologically feasible and economically practicable reductions to be made, sampling will continue on an annual basis.

A grab sample shall be taken during the first 30 minutes of a measurable storm event at Outfall 001. A measurable storm event is defined as one that results in actual discharge from the site. A qualifying measurable storm event (for collecting samples) will be at least 72 hours after the previous measurable storm event.

The following information shall be recorded for each sample:

- The exact place, date and time of sampling
- The person(s) who performed the sampling
- The dates and times the analyses were performed
- The person(s) who performed the analyses
- The analytical techniques or methods used
- The results of all required analyses

The table below provides a summary of the information above:

Monitoring Type	Sample Location	Monitoring Schedule	Benchmark & Pollutant	Procedures
Benchmark Monitoring	Outfall 001	Quarterly	100 mg/L TSS	Grab sample within 30 minutes 4 quarters

5. INSPECTIONS

The table below indicates the location, schedule personnel and documentation required for inspections and monitoring.

Monitoring Type	Location	Monitoring Schedule	Personnel	Documentation
Routine Facility Inspection	Site	Twice Annually	Pollution Prevention Team Member	Routine Facility Inspection Form (Attachment E)
Comprehensive Site Compliance Evaluation	Site	Once Annually	Pollution Prevention Team Member; Signed by Engineer, Owner's Agent or Site Supervisor	Comprehensive Site Compliance Evaluation Form (Attachment F) Report as Described in Section V.A.2.b of permit
Quarterly Visual Monitoring	Outfall 001	Quarterly	Pollution Prevention Team Member	Quarterly Visual Monitoring Form (Attachment G)
Corrective Action Report	Site	As Necessary Within 24 hours of incident	Pollution Prevention Team Member	Identification Description Date

All records and information resulting from inspections and monitoring activities (including records of analyses, calibration and maintenance of instrumentation, original recording from continuous monitoring instrumentation) shall be retained on-site for a minimum of three (3) years.

Routing Facility Inspection

A site assessment will review the effectiveness of the SWPPP. At least once a year, the inspection will be conducted during a period when stormwater discharge is occurring. The inspection must will documented by qualified personnel including a member of the stormwater pollution prevention team. Any deficiencies shall be recorded and necessary follow-up actions taken.

Comprehensive Site Compliance Evaluation

Comprehensive Site Compliance Evaluation shall be performed by a contractor or a member of the stormwater pollution prevention team who is qualified to identify conditions and activities that could impact stormwater quality at the site. The annual comprehensive site compliance evaluation can be used as one of the two routine facility inspections. A report of the evaluation shall be prepared including a certification that the site is in compliance with the SWPPP. Any deficiencies shall be recorded and necessary follow-up actions taken.

Quarterly Visual Monitoring

Quarterly visual monitoring will begin in the first full quarter after coverage under the permit has been granted. Quarterly a grab sample shall be taken during the first 30 minutes of a measurable storm event at Outfall 001. A measurable storm event is defined as one that results in actual discharge from the site. A qualifying measurable storm event (for collecting samples) will be at least 72 hours after the previous measurable storm event. The quarterly visual monitoring form is to be filled out for each sample

Corrective Action Report

A corrective action report is to be filed if any of the following conditions are identified:

- An unauthorized release or discharge
- A discharge violates a numeric effluent limit
- The department provides a written determination or someone on-site becomes aware that control measures are not stringent enough for the discharge to meet applicable water quality standards
- A written notice or written inspection or evaluation report by a Department official indicates modifications to control measures are necessary to meet non-numeric effluent limits
- The routine facility inspection, quarterly visual inspection or comprehensive site inspection indicates that control measures are not being properly operated and maintained

Within 24 hours of identification of one of the above conditions, the following information must be documented:

- Identification of condition triggering the need for corrective action
- Description of the problem identified
- Date the problem was identified

Within 14 days of identification of one of the above conditions, the following information must be documented:

- Summary of corrective action taken or to be taken
- Notice of whether SWPPP modifications are required
- Date corrective action initiated
- Date corrective action completed or expected to be completed

6. SWPPP CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

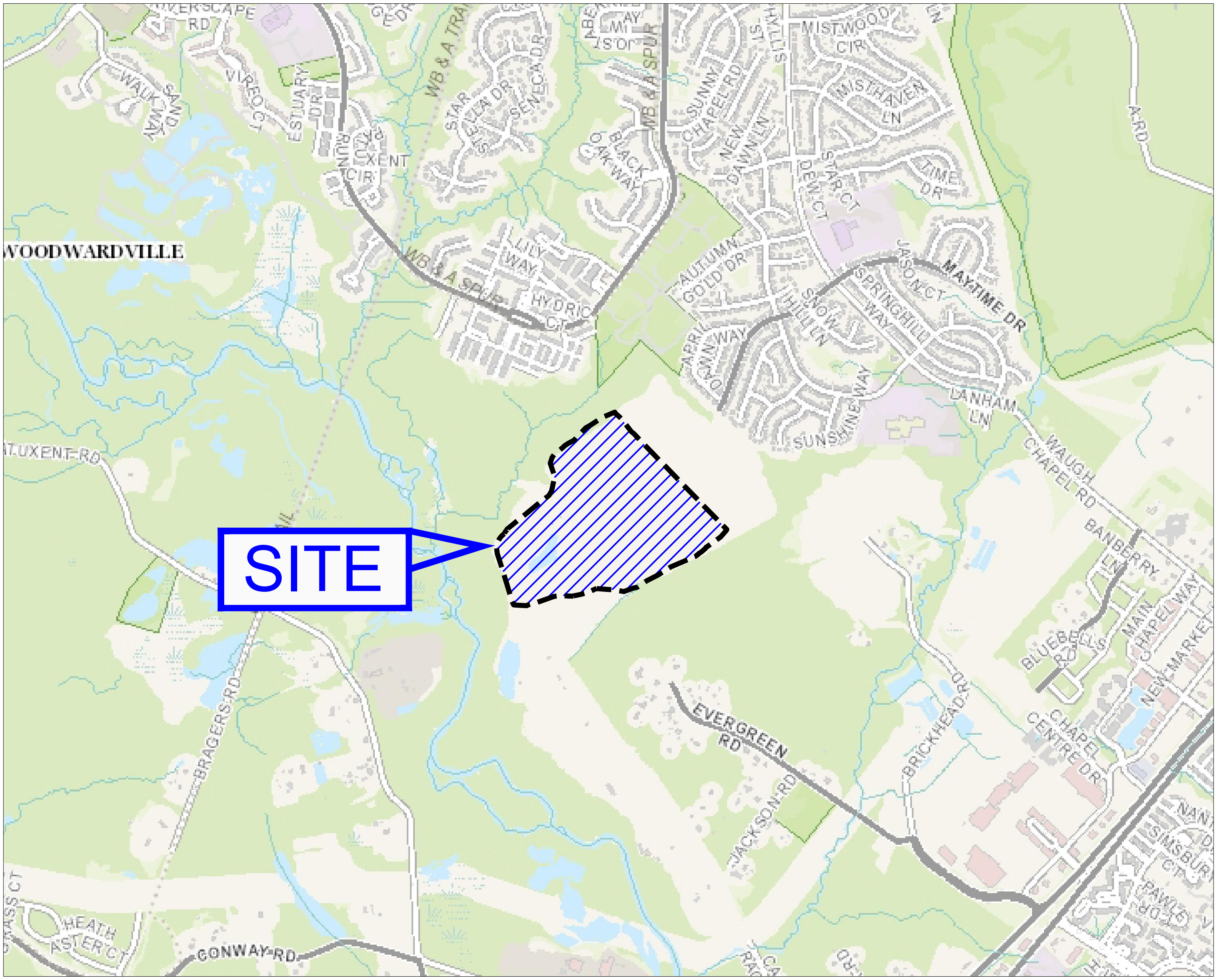
Name: E. MICHAEL ENSOR Title: AGENT

Signature: [signature] Date: 9/28/17

7. SWPPP MODIFICATIONS

The SWPPP shall be updated, as necessary, upon changes to facility operations and/or applicable regulations. The SWPPP shall be reviewed once annually, at minimum, and shall be updated if necessary. The certification statement (Section 0.0 above) must be resigned upon revision of the SWPPP. Revisions to the SWPPP are to be recorded in the log below:

Rev. #	Description of Revision	Date	Revised By (Name and Title)
1			
2			
3			
4			
5			
6			
7			
8			



0 2000 4000 6000

SCALE IN FEET

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Site Location Map

Tolson And Associates Pit
Stormwater Pollution Prevention Plan

September 2017	Scale: 1" = 2000'	170266

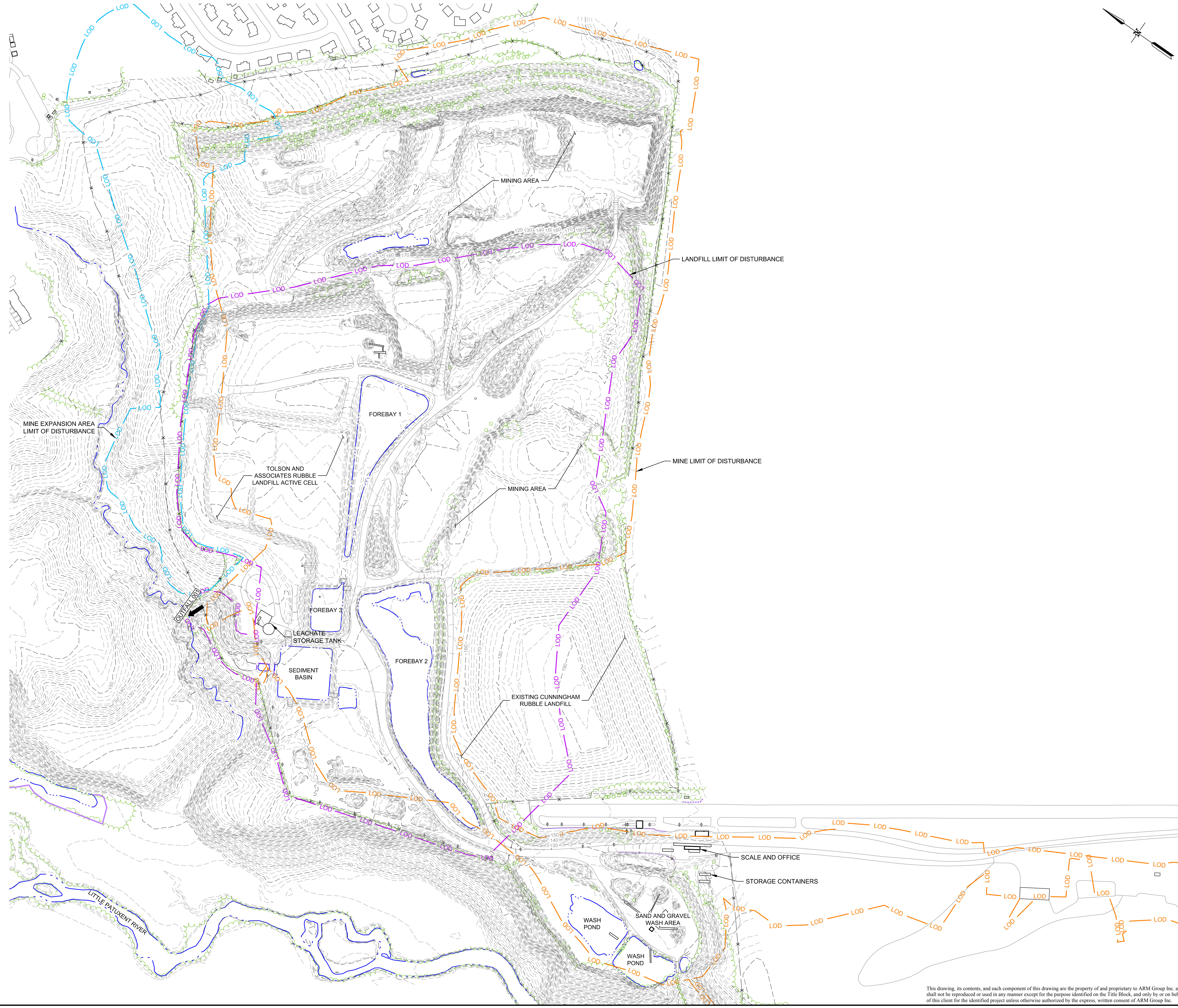
ARM Group Inc.
Earth Resource Engineers and Consultants
www.armgroup.net

Figure 1

\\armgroup.lcl\CorpData\Projects\Pleasants\170266 Tolson Rubble Landfill\Drwg\Production\Figures\SWPPP\Location Map.dwg Plotted: September 27, 2017

LEGEND

- EXISTING MAJOR CONTOUR (10')
- EXISTING MINOR CONTOUR (2')
- EXISTING GROUNDWATER CONTOUR
- EXISTING BUILDING
- EXISTING ACCESS ROAD
- EXISTING DRIVEWAY
- EXISTING GRAVEL ROAD
- EXISTING PAVED ROAD
- EXISTING FENCE
- EXISTING POND
- EXISTING STREAM
- EXISTING SWALE
- EXISTING TREELINE
- EXISTING WETLAND
- EXISTING WALL
- EXISTING PIPE
- EXISTING MINE LIMIT OF DISTURBANCE — LOD — LOD
- EXISTING MINE EXPANSION LIMIT OF DISTURBANCE — LOD — LOD
- EXISTING LANDFILL LIMIT OF DISTURBANCE — LOD — LOD



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No.	Revision	Date	By

designed	JMA
checked	DNF
drawn	JMA
scale	1" = 100'
date	9/27/2017
project no.	170266

graphic scale: 0 100 200 300 SCALE IN FEET

drawing title: SITE MAP

project title: TOLSON AND ASSOCIATES PIT STORMWATER POLLUTION PREVENTION PLAN

TOLSON AND ASSOCIATES, LLC.
ANNE ARUNDEL COUNTY, MARYLAND

Sheet 2

Maryland
Department of
the Environment

Larry Hogan
Governor

Boyd Rutherford
Lieutenant Governor

Ben Grumbles
Secretary

GENERAL PERMIT FOR DISCHARGES FROM MINERAL MINES, QUARRIES, BORROW PITS AND CONCRETE AND ASPHALT PLANTS

GENERAL DISCHARGE PERMIT NO. 15MM **NPDES PERMIT NO. MDG49**

FINAL

Effective Date: **May 1, 2017** **Expiration Date:** **April 30, 2022**

PART I. PERMIT APPLICABILITY

By this permit and the appendixes herein incorporated, the Maryland Department of the Environment (the Department) authorizes the discharge of stormwater and certain wastewater to waters of the state. This authorization is only for facilities covered (Part I.B) located in the state of Maryland, who have submitted a notice of intent (NOI) and received written approval from the Department to discharge in accordance with the eligibility requirements and other conditions in this permit and consistent with your NOI, as on file with the Department. This authorization is pursuant to the provisions of Title 9 of the Environment Article, Annotated Code of Maryland, and the provisions of the Federal Clean Water Act (CWA), 33 U.S.C. §1251 *et seq.* and implementing regulations in COMAR 26.08.04.09 and 40 CFR Parts 122, 123, 124, and 125. "You" and "Your" are used in this permit to refer to the permittee or the permit applicant, as the context indicates, and that party's facility or responsibilities.

A. Geographic Coverage

This permit applies to facilities operating within the state of Maryland.

B. Facilities Covered

To be eligible to discharge under this permit you must either (1) have been covered under previous permit 10-MM or (2) have a stormwater discharge associated with industrial activity, as defined in Appendix E, and/or a process water discharge, from a primary industrial activity included in Appendix A or (3) be notified by the Department that you are eligible for coverage under Sector AD: Non-Classified Facilities, as defined in Appendix A.

C. Limitations on Coverage

The following stormwater discharges are not eligible for coverage under this permit. Additional limitations on coverage for each sector covered under this permit are listed in Appendix D. You must determine which sector(s) your industrial activities are defined as in Appendix A to determine which additional limitations from Appendix D apply.

1. Stormwater discharges associated with construction activity, as defined in Appendix E, disturbing one acre or more, or that are part of a larger common plan of development or sale if the larger common plan will ultimately disturb one acre or more, are not eligible for coverage under this permit, unless in conjunction with mining activities as specified in Sector J, or unless for a portable batch plant located at the construction site as defined in Sectors D or E;

2. Stormwater discharges subject to effluent limitations guidelines, other than those listed in Part I.E.3;

3. Stormwater discharges that are mixed with non-stormwater, other than those non-stormwater discharges listed in Part I.E.4 or Part I.E.5;

4. Stormwater discharges containing the following toxic pollutants, which are limited by effluent standards in 40 CFR Subchapter D Part 129: Aldrin/Dieldrin, DDT, Endrin, Toxaphene, Benzidine, or Polychlorinated Biphenyls (PCBs);

5. Stormwater discharges for which a National Pollutant Discharge Elimination System (NPDES) permit has been terminated (other than at your request) or denied, or those for which the Department requires an individual permit to address stormwater discharges or an alternative general permit (Part I.G.3);

6. New discharger discharging to water quality "impaired waters," as defined in Appendix E, are not eligible for coverage under this permit unless you:
a. prevent all exposure to stormwater of the pollutant(s) for which the waterbody is impaired, and retain documentation of procedures taken to prevent exposure onsite with your SWPPP; or
b. document that the pollutant(s) for which the waterbody is impaired is not present at your site, and retain documentation of this finding with your SWPPP; or
c. in advance of submitting your NOI, provide to the Department data to support a showing that the discharge is not expected to cause or contribute to an exceedance of a water quality standard, and retain such data onsite with your SWPPP. To do this, you must provide data and other technical information to the Department sufficient to demonstrate:
i.) For discharges to waters without a EPA approved or established TMDL, that the discharge of the pollutant for which the water is impaired will meet in-stream water quality criteria at the point of discharge to the waterbody; or
ii.) For discharges to waters with an EPA approved or established TMDL, that there are sufficient remaining wasteload allocations in an EPA approved or established TMDL to allow your discharge and that existing dischargers to the waterbody are subject to compliance schedules designed to bring the waterbody into attainment with water quality standards.
You are eligible to discharge to impaired waters if you receive an affirmative determination from the Department that your discharge will not contribute to the existing impairment, in which case you must maintain such determination onsite with your SWPPP.

D. Prohibited Stormwater Discharges
If you are covered under this permit, a discharge to waters of the State that contributes to a violation of a water quality standard is a permit violation and subject to corrective actions (see Part IV).

E. Eligible Discharges
Unless otherwise ineligible under Part I.C, the following discharges may be covered under this permit:

1. Stormwater discharges associated with industrial activity for any primary industrial activities and co-located industrial activities if that activity is listed in Appendix A, or discharges previously covered under permit 10-MM;

2. Industrial stormwater discharges per the Department's discretion under Sector AD in Appendix A, or on a site specific basis as determined by the Department;

3. Discharges subject to any of the national stormwater-specific effluent limitations guidelines listed in Table 1-1;

Table 1-1. Stormwater-specific Effluent Limitations Guidelines

Regulated Discharge	40 CFR Section	15-MM Sector
Discharges resulting from spray down or intentional wetting of logs at wet deck storage areas	Part 429, Subpart I	A
Runoff from asphalt emulsion facilities	Part 443, Subpart A	D
Runoff from material storage piles at cement manufacturing facilities	Part 411, Subpart C	E
Mine dewatering discharges at crushed stone, construction sand and gravel, or industrial sand mining facilities	Part 436, Subparts B, C, and D	J

4. Non-stormwater discharges from:
a. water used to fight active fires (not from fire system cleaning or testing),
b. pavement wash waters where no detergents are used and no spills or leaks of toxic or hazardous materials have occurred (unless all spilled material has been removed);
c. landscape watering, only if all pesticides, herbicides, and fertilizer have been applied in accordance with the approved labeling;
d. routine external building wash down that does not use detergents and any dislodged paint chips are filtered;
e. uncontaminated condensate from air conditioners, coolers, and other compressors and from the outside storage of refrigerated gases or liquids;
f. irrigation drainage;
g. uncontaminated ground water or spring water;
h. foundation or footing drains where flows are not contaminated with process materials;
i. incidental windblown mist from cooling towers that collects on rooftops or adjacent portions of your facility, but not intentional discharges from the cooling tower (e.g., "piped" cooling tower blowdown or drains);
j. discharges for earth-disturbing activities conducted prior to active mining activities for Sector J (appendix D limits apply) when conducted prior to active mining activities, as defined in Appendix D Part J.3.2.
k. process generated wastewater from mining operations under Sector J (appendix D limits apply);
l. process generated wastewater from hydrodemolition operations to ground waters (appendix D limits apply);
m. waste wash water at concrete plant operations from hosing down vehicles, including washing concrete mixer trucks, mixing equipment, and moulds or forms, to surface or ground waters (appendix D limits apply); and
n. miscellaneous wastewater from spillage at ready-mix plants and concrete manufacturing plants to surface or ground waters.

5. Use of any chemical additives (defined in Appendix E) requires prior notice, indicating your intent to use them on your NOI and listing the additives in your SWPPP. In addition, the use of any cationic chemical additives that will mix with stormwater or that might otherwise become part of the effluent discharged, is prohibited without prior approval. To obtain approval you must provide the Department's Wastewater Permits Program (Part II.E.2) conclusive data showing that, as used, and at the concentration discharged, the cationic chemical additive is not toxic to aquatic life. The conclusive data must include a list of cationic chemicals composing the additive and aquatic toxicity data. This information is usually found on the manufacturer's material safety data sheet (SDS). You'll also need to include a description of how the product will be used and the expected concentration that will exist in the effluent. This information can be submitted along with your Notice of Intent (NOI) using the cationic chemical additive request form (Part II.A.1), or in a separate letter regarding the use of these additives. The Department shall review this information and return a determination, in writing, if use of the chemical is acceptable based on aquatic toxicity and applicable water quality standards. Any substances not approved by the Department are prohibited.

6. Discharges that are not otherwise required to obtain NPDES permit authorization but are commingled with discharges that are authorized under this permit.

F. No Exposure Certification

If you are eligible for coverage by this permit, and meet the requirements for a no exposure exclusion from permitting under 40 CFR 122.26(g), you may file a No Exposure Certification. Upon written notice from the Department that you have met the requirements, you are no longer required to have a permit.

- To qualify for this certification, you must first verify that there is no potential for the stormwater discharged from your facility to waters of the State to be exposed to pollutants in accordance with the criteria established by the Department on form MDE/WMA/PER.067 (found on MDE's website at http://www.mde.state.md.us/ or at the link http://bit.ly/MDE_NEC).
- You shall also obtain written certification by either a Professional Engineer, a Certified Professional in Storm Water Quality (CPSWQ), a Certified Hazardous Materials Manager (CHMM), a Certified Professional Environmental Auditor (CEPA), a Registered Architect, a Landscape Architect, or other professional as approved by the Department, that you meet the requirements of no exposure.
- If you qualify, you will submit the completed and appropriately signed form to the Department, along with the required written certification according to the deadlines of this permit (Part II.B).
- The exemption is non-transferable and is only valid while this permit is in effect at which point a new exemption is required. However you must submit a No Exposure Certification to the Department at least once every five years.
- You must notify the Municipal Separate Storm Sewer System (MS4) if your facility is exempted from obtaining an NPDES permit for stormwater associated with industrial activity.

G. Alternative Permit Coverage

The Department may require you to obtain, or you may also request, an individual permit or coverage under another general permit as described below, even though you may be eligible for coverage under this permit. If the Department requires you to apply for and obtain an alternative permit and you do not apply as required, the Department may terminate your coverage under this permit. This termination is effective at the end of the day that the Department specified for the application or Notice of Intent (NOI) to be submitted, after which you must cease discharges that were covered by this permit.

1. If the Department determines that a discharge may cause water quality standards to be exceeded in the receiving water, then the Department may require you to take additional actions. You may be required to obtain an individual NPDES discharge permit or coverage under another general permit. The Department may process an NOI as an application for an individual permit if site specific conditions do not allow the facility to be covered under the general permit without compromising water quality. This could occur if, for example, a permittee proposes to discharge to impaired waters, with or without an existing Total Daily Maximum Load (TMDL), or for discharges to high quality waters.

2. For discharges subject to stormwater effluent limitation guidelines under 40 CFR, Subchapter N, only those stormwater discharges identified in Table 1-1 are eligible for coverage under this permit. If any stormwater discharges at your facility are subject to any other effluent limitations guidelines or new source performance standards under 40 CFR Subchapter N, then you must apply for an individual NPDES permit or coverage under an industry-specific general permit for those stormwater discharges. This permit may cover parts of your facilities not covered by effluent limitation guidelines or new source performance standards. For a complete list of current effluent guidelines by industry, see the indicated 40 CFR part on the Environmental Protection Agency's (EPA) website for Industrial Regulations (http://www.epa.gov/waterscience/guide/industry.html). If your industry is included in this list then you should review the applicable 40 CFR part to determine if you are subject to effluent limitation guidelines for stormwater.

3. If the Department has issued an industry-specific general permit addressing stormwater and wastewater discharges from your primary industrial activity, you should apply for coverage (including stormwater) under that permit. Currently, those specific permits are:
   - ***i.)*** General Discharge Permit For Discharges from Stormwater Associated with Industrial Activity: (General Permit No. 12-SW or replacement),
   - ***ii.)*** General Permit for Discharges from Surface Coal Mines and Related Facilities: (General Discharge Permit No. 06-CM or replacement).

4. You may request to be excluded from coverage under this permit by applying for an individual state NPDES discharge permit or submitting an NOI for coverage under another general permit. The Department may grant your request if the Department determines your reasons are adequate. If you are issued an individual NPDES permit or apply for coverage under an industry-specific general permit, the Department may terminate your coverage under this permit.

H. Continuation of an Expired General Permit
Unless your permit or authorization is revoked or terminated by the Department, the terms and conditions of this permit and its authorized dischargers are automatically continued and remain fully effective and enforceable upon expiration of this permit until the date(s) specified under a reissued general permit.

PART II. AUTHORIZATION UNDER THIS PERMIT

A. How to Obtain Authorization
If you are eligible for coverage under this permit, per PART I, to obtain authorization you must
- Select, design, install, and implement control measures prior to discharge in accordance with Part III to meet numeric and non-numeric effluent limits;
- Submit a complete and accurate Notice of Intent (NOI) or Permit Transfer Request with Permit Fee as indicated below; and
- Develop and submit to the Department, a Stormwater Pollution Prevention Plan (SWPPP) according to the requirements in Part III.C of this permit.

Based on a review of your NOI or Transfer Request, the Department may delay your authorization for further review or deny coverage under this permit and require submission of an application for an individual NPDES permit. In these instances, the Department will notify you in writing of the delay, or of the request for submission of an individual NPDES permit application or alternative general permit NOI.

1. Notice of Intent (NOI) and Transfer Requests

a. Notice of Intent (NOI)

You must complete all information required on this permit's corresponding NOI form (MDE-WMA-PER004), or an equivalent electronic form provided by the Department. Detailed instructions are included on the NOI form. If you operate multiple facilities you must submit an NOI for each noncontiguous site. When submitting electronically, verification that you meet the signature requirements is required. When submitting paper forms, send your signed copy of the NOI to the following address:

Maryland Department of the Environment
P.O. Box 2057
Baltimore MD 21203-2057

You are required to provide the following information on the appropriate NOI form.

- Facility Operator Information including your name, mailing address, email address, telephone number, IRS Employer Identification Number (EIN) and Worker's Comp Insurance company and policy.
- Facility Information including the facility location, including physical address and coordinates in degrees decimal; the primary and any subsequent co-located Standard Industrial Classification (SIC) codes relevant to this permit, verification if this is a new discharger or if there is any preexisting NPDES permit number for stormwater coverage, the total acres of property at that address and whether the facility is presently inactive and unstaffed.
- Information on the receiving waters of the industrial stormwater. Identify the receiving water body(s) and 8 digit identifier for your discharges, including whether they qualify as high quality Tier 2, and identification of any impairments. Specify the MS4 jurisdiction you operate in.
- Identify who has prepared the Stormwater Pollution Prevention Plan (SWPPP), including email and phone number, along with how you have provided the SWPPP to the Department.
- Document discharge type and flow (expressed as gallons per day) for each outfall and describe each outfall and monitoring point.
- Identify which industry sector benchmarks, process waste water numeric limits and effluent limitation guidelines apply to the operation.
- Clarify which limits apply for each specific outfall at your operation.
- Provide information regarding any chemical additive (defined in Appendix E) which you intend to use (Part I.E.5) in your SWPPP (Part III.B.1.b.v) and indicate your intent to use them on the NOI. The use of cationic chemical additives, require approval by the Department, which you apply for by filing the Cationic Chemical Additive form along with your NOI, or in a separate letter.
- Selection of either annual payments, or an upfront payment for 5 years and annual payments thereafter, or if you are exempt.
- Provide the signatory name, title, contact information and their signature. Provide the NOI preparer information, including phone number and email address.

b. Transfer of Authorization.

For transfer of ownership, you can complete the Permit Transfer Request Form for General NPDES Permits referred to as MDE/WMA/PER.079 found on the Department's website or at http://bit.ly/MDE_Transfer_Request. Detailed instructions are included with the form. If you operate multiple facilities you must submit a Transfer Request for each noncontiguous site. The authorization under this permit is not transferable to any person except in accordance with this section. Authorization to discharge under this permit may be transferred to another person if:

- The current permittee notifies the Department in writing of the proposed transfer.
- A written agreement, indicating the specific date of the proposed transfer of permit coverage and acknowledging the responsibilities of the current and new permittee for compliance with the terms and conditions of this permit, is submitted to the Department.
- The new permittee either confirms in writing that the type of discharge, number of outfalls, and other information given on the original NOI remain correct or updates this information.
- The new permittee confirms in writing that either they will follow the existing stormwater pollution prevention plan or that they have developed a new plan.
- Neither the current permittee nor the new permittee receives notification from the Department, within 30 days of receipt of items above, of intent to terminate coverage under this permit.

2. Permit Fee

a. You must submit the initial permit fee to the Department with the NOI form for the fee in effect at the time that the payment is due as specified in COMAR 26.08.04.09-1(F)(2)(b). Certain exemptions from the fee do exist, including mineral mines, quarries, and borrow pits which discharge mining wastewater, process generated wastewater, and stormwater to ground water only are exempt from the permit fee.

b. If the fee is being paid by check it must be made payable to the Maryland Department of the Environment and sent with the completed NOI to:

Maryland Department of the Environment
P.O. Box 2057
Baltimore, MD 21203-2057

c. If you pay the NOI fee by a check that does not clear for any reason, you will have 30 calendar days to make proper payment, including any interest and other charges. If payment is not received by the 31st calendar day, your coverage under this permit must be considered void from the outset. You should save the cancelled check, a copy of the completed NOI, and the letter confirming your authorization from the Department. These documents must be provided to the Department upon request.

d. A new owner of a facility as a result of a transfer of ownership is responsible for any fees unpaid by the former owned.

e. Any permittee making facility modifications to reduce water discharged may be entitled to a fee reduction equivalent to the reductions achieved each year after the first year of the permit. The permittee shall submit before and after photographs and site plans documenting changes made to the Department at least 90 days before the anniversary date of the permit.

f. Any changes in operations that may increase fees are required to give notice as described in Part II.F.

3. SWPPP

Proper formats for submitting your SWPPP are provided below.

a. You should not include any confidential information in your submitted SWPPP, which will be a public document available for review by the public.

b. You must submit an electronic copy of the SWPPP to the Department and maintain a copy available onsite. If the updated SWPPP is maintained only in hardcopy, a scanned version of this is acceptable. Your electronic copy (PDF, JPEG or Word) of the SWPPP must be provided to the Department by one of these methods.

i.) Including a file on electronic media (CD, DVD, USB drive, or other approved media) along with your mailed copy of the NOI.

ii.) Emailing the file to swppp.permit@maryland.gov when you send your NOI to the Department. The email cannot exceed 25 MB and so you may need to use more than one email to deliver the entire file. The email subject line should include "15MM", your previous registration number (if you did have previous coverage under 10MM) and your facility name.

iii.) Posting a copy of the SWPPP using your NetDMR account when you send your NOI to the Department.

iv.) Providing the Department a link (URL) to your document on your NOI, which provides access to your SWPPP on a publicly available company website.

v.) Other electronic means that you make accessible to the Department such as a link to DropBox, Google Drive, SkyDrive, etc.

B. Deadlines for Coverage

If you have missed the deadline as provided in the following table to submit your i) No Exposure Certification, or ii) an NOI, SWPPP and fee payment or iii) transfer request, any and all discharges from your industrial activities will continue to be unauthorized under the CWA until they are covered by this or a different NPDES permit. The Department may take enforcement action for any unpermitted discharges that occur between the commencement of discharging and discharge authorization. Late submittals will be accepted, but authorization to discharge will not be retroactive.

Category	Coverage Submittal Deadline
Existing Dischargers – in operation as of the effective date of this permit and previously authorized for coverage under 10-MM.	Within 6 months after the effective date of this permit. Authorization to discharge under 10-MM continues in the interim.
New Dischargers or New Sources	A minimum of 60 days prior to commencing discharge.
New Owner/Operator of Existing Discharger - transfer of ownership and/or operation of a facility whose discharge is authorized under this permit	A minimum of 30 days prior to date that the transfer will take place to the new owner/operator.
Other Eligible Dischargers – in operation prior to permit effective date, but not covered under the 10-MM or another NPDES permit.	Immediately, to minimize the time discharges from the facility will continue to be unauthorized.

C. Required Signatures

1. Any person signing documents in accordance with part II.C.2 and II.C.3 below must include the following certification: *"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and* *complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."*

2. All applications, including NOIs, transfer requests, and No Exposure Certifications must be signed by a Signatory as follows:

a. *For a corporation*: By a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:

i.) a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy- or decision-making functions for the corporation; or

ii.) the manager of one or more properties belonging to the owner, provided the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

b. *For a partnership or sole proprietorship:* By a general partner or the proprietor, respectively; or

c. *For a municipality, State, Federal, or other public agency:* By either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes:

i.) the chief executive officer of the agency; or

ii.) a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of the EPA).

3. Your SWPPP, including changes to your SWPPP to document any corrective actions taken as required by Part IV, and all reports submitted to the Department, must be signed by a person described in Part II.C.2 above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

a. the authorization is made in writing by a Signatory;

b. the authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, or a position of equivalent responsibility or an individual or position having overall responsibility for environmental matters for the company (a duly authorized representative may thus be either a named individual or any individual occupying a named position); and

c. the signed and dated written authorization is included in the SWPPP and made available to the Department upon request.

4. If an authorization for a representative is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of PART II.C.2 must be submitted to the Department prior to submitting or with any reports, information or applications that must be signed by a duly authorized representative.

D. Failure to Notify

If you (1) engage in an activity covered under this permit, (2) fail to notify the Department of your intent (Part II.A) to be covered under this permit within the deadlines established in this permit (Part II.B), and (3) discharge to waters of the state without an appropriate NPDES discharge permit, then you are in violation of the Federal Clean Water Act and of the Environment Article, Annotated Code of Maryland, and may be subject to penalties.

E. Additional Notification

1. Municipal Separate Storm Sewer System (MS4)
If stormwater from your facility discharges into a Municipal Separate Storm Sewer System (MS4) you must notify the MS4 that you are registered under this permit if the system is regulated by a NPDES permit. If the MS4 notifies you of additional requirements that you must meet to discharge into that system then you must comply with those requirements to stay eligible for this permit.

2. Wastewater Permits Program
When directed to contact the Department's Wastewater Permits Program use this address and phone number:

Maryland Department of the Environment
Wastewater Permits Program
1800 Washington Blvd, Suite 455
Baltimore, MD 21230
Phone: 410-537-3323

3. Compliance Program
When directed to contact the Department's Compliance Program use one of the following addresses and phone numbers as applicable for your operations. To determine which Sector applies to your facility, refer to Appendix A.

For mining operations (Primary Activity in Sectors J):
Maryland Department of the Environment
LMA - Mining Program
1800 Washington Blvd., Suite 655
Baltimore MD 21230
Phone: 410-537-3557

For non-mining operations (All Primary Activity in Sectors other than J):
Maryland Department of the Environment
WMA – Compliance Program
1800 Washington Blvd., Suite 425
Baltimore, MD 21230
Phone: 410-537-3510

F. Changes in Permit Coverage

Certain planned changes in stormwater discharge or termination of permit coverage, both described below in this section, require notification to the Department's Wastewater Permits Program (Part II.E.2):

1. Planned Changes
You must give written notice to Department's Wastewater Permits Program (Part II.E.2) as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when one of the following conditions exist.

a. The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in 40 CFR 122.29(b).

b. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements under 40 CFR 122.42(a)(1).

c. The alteration either adds or removes outfalls subject to this permit.

d. The alteration either adds or removes process water which requires changes in monitoring or reporting.

2. <u>Termination of Permit Coverage</u>

a. Submitting a Notice of Termination
To terminate permit coverage, you must submit a complete and accurate Notice of Termination (NOT) http://www.mde.maryland.gov/assets/document/permit/MDE-WMA-PER005.pdf to the Department's Wastewater Permits Program (Part II.E.2). Your authorization to discharge under this permit terminates at midnight of the day that a complete Notice of Termination is processed and acknowledged by the Department. If you submit a Notice of Termination without meeting one or more of the conditions identified in the Part b below, then your Notice of Termination is not valid. You are responsible for meeting the terms of this permit until your authorization is terminated.

b. When to Submit a Notice of Termination
You must submit a Notice of Termination within 30 days after one or more of the following conditions have been met:

i.) all operations at your facility have permanently ceased and there will be no further exposure of stormwater to any industrial activity, process, material or transport at the facility, and you have already implemented necessary sediment and erosion controls as required by Part III.B.1.b.v; or

ii.) you move your operation to a new location (After submitting an NOT you must then apply for coverage at the new location per Part II.); or

iii.) a new owner or operator has taken over responsibility for the facility; or

iv.) you have obtained coverage under an individual or alternative general permit for all discharges required to be covered by an NPDES permit, unless the Department has required that you obtain such coverage under Part I.E.4, in which case coverage under this permit will terminate automatically.

c. The Department may terminate your coverage under this general permit if the Department finds good cause to do so.

3. <u>Notification of the Discharge of a Pollutant Not Limited in This Permit</u>
The permittee shall notify the Department as soon as it is known or suspected that any toxic pollutants which are not specifically limited by this permit have been discharged at levels specified in the 40 CFR § 122.42.

PART III. STORMWATER MANAGEMENT REQUIREMENTS

A. [Reserved]

B. Control Measures and Effluent Limits

In the technology-based limits included in Part III.B.1 and in Appendix D, the term "minimize" means reduce and/or eliminate to the extent achievable using control measures (including best management practices) that are technologically available and economically practicable and achievable in light of best industry practice.

1. <u>Control Measures</u>
Considering the control measure selection and design considerations, you must select, design, install, and implement control measures (including best management practices)

to meet the non-numeric effluent limits as described below, meet limits contained in applicable process water numeric limits and effluent limitations guidelines in Appendix D, and water quality based effluent limitations in Part III.B.2. The selection, design, installation, and implementation of these control measures must be in accordance with good engineering practices and manufacturer's specifications. Note that you may deviate from such manufacturer's specifications where you provide justification for such deviation and include documentation of your rationale in the part of your SWPPP that describes your control measures. If you find that your control measures are not achieving their intended effect of minimizing pollutant discharges, you must modify these control measures as expeditiously as practicable. Regulated stormwater discharges from your facility include stormwater run-on that commingles with stormwater discharges associated with industrial activity at your facility.

a. *Control Measure Selection and Design Considerations*

You must consider the following when selecting and designing control measures:

i.) preventing stormwater from coming into contact with polluting materials is generally more effective, and less costly, than trying to remove pollutants from stormwater;

ii.) using control measures in combination is more effective than using control measures in isolation for minimizing pollutants in your stormwater discharge;

iii.) assessing the type and quantity of pollutants, including their potential to impact receiving water quality, is critical to designing effective control measures that will achieve the limits in this permit;

iv.) minimizing impervious areas at your facility and infiltrating runoff onsite (including bioretention cells, green roofs, and pervious pavement, among other approaches) can reduce runoff and improve groundwater recharge and stream base flows in local streams, although care must be taken to avoid ground water contamination;

v.) attenuating flow using open vegetated swales and natural depressions can reduce in-stream impacts of erosive flows;

vi.) conserving and/or restoring riparian buffers will help protect streams from stormwater runoff and improve water quality; and

vii.) using treatment interceptors (e.g., swirl separators and sand filters) may be appropriate in some instances to minimize the discharge of pollutants.

b. *Non-Numeric Technology-Based Effluent Limits (BPT/BAT/BCT)*

i.) *Minimize Exposure.* You must minimize the exposure of manufacturing, processing, and material storage areas (including loading and unloading, storage, disposal, cleaning, maintenance, and fueling operations) to rain, snow, snowmelt, and runoff by either locating these industrial materials and activities inside or protecting them with storm resistant coverings (although significant enlargement of impervious surface area is not recommended). In minimizing exposure, you should pay particular attention to the following:

- use grading, berming, or curbing to prevent runoff of contaminated flows and divert run-on away from these areas;
- locate materials, equipment, and activities so that leaks are contained in existing containment and diversion systems (confine the storage of leaky or leak-prone vehicles and equipment awaiting maintenance to protected areas);
- clean up spills and leaks promptly using dry methods (e.g., absorbents) to prevent the discharge of pollutants;
- use drip pans and absorbents under or around leaky vehicles and equipment or store indoors where feasible;
- use spill/overflow protection equipment;
- drain fluids from equipment and vehicles prior to onsite storage or disposal;

- perform all cleaning operations indoors, under cover, or in bermed areas that prevent runoff and run-on and also that capture any overspray; and
- ensure that all washwater not covered by this permit (Part I.E.4) drains to a proper collection system (i.e., not the stormwater drainage system).

The discharge of wastewater from steam cleaning or cleaning with detergents of vehicle and equipment, including tank cleaning operations, is not authorized by this permit. These wastewaters must be covered under a separate NPDES permit, discharged to a sanitary sewer in accordance with applicable industrial pretreatment requirements, or disposed of otherwise in accordance with applicable law.

Note: Industrial materials do not need to be enclosed or covered if stormwater runoff from affected areas will not be discharged to receiving waters or if discharges are authorized under another NPDES permit.

ii.) *Good Housekeeping.* You must keep clean all exposed areas that are potential sources of pollutants, using such measures as sweeping at regular intervals, keeping materials orderly and labeled, and storing materials in appropriate containers. A good practice for ensuring housekeeping activities are performed at regular intervals would be keeping a schedule for routine grounds maintenance and cleanup.

iii.) *Maintenance.* You must regularly inspect, test, maintain, and repair all industrial equipment and systems to avoid situations that may result in leaks, spills, and other releases of pollutants in stormwater discharged to receiving waters. You must clean catch basins when the depth of debris reaches two-thirds (2/3) of the sump depth and keep the debris surface at least six inches below the lowest outlet pipe. You must also maintain all control measures that are used to achieve the effluent limits required by this permit in effective operating condition. Particular care should be taken to inspect compaction dumpsters to prevent debris around or under the dumpster as well as prevent hydraulic fluid leakage. Nonstructural control measures must also be diligently maintained (e.g., spill response supplies available, personnel appropriately trained). If you find that your control measures need to be replaced or repaired, you must make the necessary repairs or modifications as expeditiously as practicable.

iv.) *Spill Prevention and Response Procedures.* You must minimize the potential for leaks, spills and other releases that may be exposed to stormwater and develop plans for effective response to such spills if or when they occur. These procedures are complementary to and do not replace any requirements of RCRA (42 U.S.C. §6901), the Department's Land Management Administration Oil Control Program, NFPA 30 Flammable and Combustible Liquids Code or the Spill Prevention, Control and Countermeasure (SPCC) Plan (as a requirement of 40 CFR § 112). At a minimum, you must implement:

- Procedures for plainly labeling containers (e.g., "Used Oil," "Spent Solvents," "Fertilizers and Pesticides," etc.) that could be susceptible to spillage or leakage to encourage proper handling and facilitate rapid response if spills or leaks occur;
- Monthly inspection procedures for above ground storage tanks containing oil and quarterly inspection procedures for all other containers that are susceptible to spillage or leakage (e.g., used oil) to ensure the containment structures have no leaks/cracks, and that the outlets are properly sealed. Check that plugs are properly affixed, that valves are in working condition, and that neither are leaking;
- Procedure for the discharge of any stormwater from a containment structure, requiring a visual observation to ensure that no visible or odorous pollutants are discharged. If a visual observation identifies a visible sheen, floating

solids or a noxious smell, then you must discharge the remaining wastewater to a sanitary sewer system or haul it to a recycler or TSDF (Treatment Storage & Disposal Facilities) or disposal facility;

- Preventative measures such as barriers between material storage and traffic areas, secondary containment provisions, and procedures for material storage and handling;
- Procedures for expeditiously stopping, containing, and cleaning up leaks, spills, and other releases. Employees who may cause, detect, or respond to a spill or leak must be trained in these procedures and have necessary spill response equipment available. If possible, one of these individuals should be a member of your stormwater pollution prevention team as described in Part III.C.1; and
- Procedures for notification of appropriate facility personnel, emergency response agencies, and regulatory agencies. Where a leak, spill, or other release containing a hazardous substance or oil in an amount equal to or in excess of a reportable quantity established under either 40 CFR Part 110, 40 CFR Part 117, or 40 CFR Part 302, occurs during a 24-hour period, you must notify the Department's Emergency Spill Response number at (866) 633-4686 and EPA's National Response Center (NRC) at (800) 424-8802 or, in the Washington, DC, metropolitan area, call (202) 267-2675 in accordance with the requirements of 40 CFR Part 110, 40 CFR Part 117, and 40 CFR Part 302 as soon as you have knowledge of the discharge. Local requirements may necessitate reporting spills or discharges to local emergency response, public health, or drinking water supply agencies. Contact information must be in locations that are readily accessible and available. In addition, you must submit to the Department a written description within 10 working days of knowledge of the incident including: the type and estimate of the amount of material released, the date it occurred, the circumstances leading to it, and any other information as required by COMAR 26.10.01.03

v.) *Erosion and Sediment Controls.* You must minimize erosion a) consistent with the facility's approved erosion and sediment control (E&SC) plan or b) by stabilizing exposed soils at your facility in order to minimize pollutant discharges and placing flow velocity dissipation devices at discharge locations to minimize channel and streambank erosion and scour in the immediate vicinity of discharge points. These requirements include timeframes for the temporary and permanent stabilization of all inactive, disturbed areas; which are either identified on your E&SC plan or if you don't have an approved ES&C, then stabilization is to be completed within three (3) calendar days for perimeter sediment controls and slopes steeper than 3:1 and seven (7) calendar days for all other areas not under active grading. You must also use structural and non-structural control measures to minimize the discharge of sediment. In selecting, designing, installing, and implementing appropriate control measures, you are encouraged to consult with the Department's Soil Erosion & Sediment Control resources (http://bit.ly/MDE_Sediment_Erosion_and_Control).

If you are using chemical additives (defined in Appendix E) at your site, you must comply with the following minimum requirements:

- Use conventional erosion and sediment controls prior to and after the application of chemical additives. Use conventional erosion and sediment controls prior to (up gradient of) chemical addition to ensure effective treatment. Additives may only be applied where treated stormwater is directed to a sediment control (e.g., sediment basin, perimeter control) prior to discharge.

- Additives must be selected that are certified under ANSI/NSF Standard 60 for drinking water and only discharged in concentrations that are nontoxic to aquatic life. The additives must be appropriately suited to the types of soils likely to be exposed during construction and discharged, to locations where chemicals will be applied, and to the expected turbidity, pH, and flow rate of stormwater flowing into the chemical treatment system or area.
- You must minimize discharge from stored chemicals.
- You must comply with relevant local requirements affecting the use of chemical additives. If requested by the E&SC plan approval authority, provide an SDS with your E&SC plan.
- You must use chemical additives and chemical treatment systems in accordance with good engineering practices, and with dosing specifications and sediment removal design specifications provided by the provider/supplier of the applicable chemicals, or document specific departures from these practices or specifications and how they reflect good engineering practice.
- Ensure that all persons who handle and use chemical additives at the site are provided with appropriate, product-specific training. Among other things, the training must cover proper dosing requirements and safe handling practices.
  - If you plan to use cationic chemical additives (as defined in Appendix E), you are ineligible for coverage under this permit unless you notify the Department's Industrial and General Permits Division at least 30 days in advance and the Department authorizes coverage under this permit. To receive authorization under this permit, you must provide appropriate controls and implementation procedures (including where the chemical is applied, description of active treatment systems required, dosing, filtering, pH monitoring, etc.) designed to ensure that your use of cationic additives chemicals will not lead to a violation of water quality standards. You are required to comply with all such requirements if you have been authorized to use cationic chemicals at your site by the Department.
  - Authorization is conditioned on your compliance with additional requirements necessary to ensure that the use of such chemicals will not cause an exceedance of water quality standards. If you use polymers and/or other chemical treatments as part of your controls, you must identify the polymers and/or chemicals used and the purpose in your SWPPP.

vi.) *Management of Runoff.* You must divert, infiltrate, reuse, contain, or otherwise reduce stormwater runoff, to minimize pollutants in your discharges. In selecting, designing, installing, and implementing appropriate control measures, you are encouraged to consult with the Department's Design Manual, EPA's internet-based resources relating to runoff management, including the sector-specific Industrial Stormwater Fact Sheet Series (http://bit.ly/MDE_industrial_stormwater).

vii.) *Salt Storage Piles or Piles Containing Salt.* You must enclose or cover storage piles of salt, or piles containing salt, used for deicing or other commercial or industrial purposes, including maintenance of paved surfaces. You must implement appropriate measures (e.g., good housekeeping, diversions, containment) to minimize exposure resulting from adding to or removing materials from the pile. Piles do not need to be enclosed or covered if stormwater runoff from the piles is not discharged or if discharges from the piles are authorized under another NPDES or State discharge permit.

viii.) *Sector Specific Non-Numeric Effluent Limits.* Appendix A of this permit identifies your specific Industry Sector. You must achieve any additional non-numeric limits stipulated in the relevant sector-specific section(s) of Appendix D: Sector-Specific Requirements for Industrial Activity.

ix.) *Employee Training.* You must train all employees who work in areas where industrial materials or activities are exposed to stormwater, or who are responsible for implementing activities necessary to meet the conditions of this permit (e.g., inspectors, maintenance personnel), including all members of your stormwater pollution prevention team described in Part III.C.1, below. Training must cover the specific control measures used to achieve the effluent limits in this part, and monitoring, inspection, planning, reporting, and documentation requirements in other parts of this permit. As part of the employee training program you must address, at a minimum, the following activities (as applicable): used oil management, spent solvent and paint management, disposal of spent abrasives (e.g., blasting materials, etc.), spill prevention and control, fueling procedures, general good housekeeping practices (e.g., dumpster/debris removal), used battery management, waste recycling (e.g., metals, plastics), used container controls (e.g., re-banding barrels, plugging drums), etc. The Department recommends training be conducted at least annually (or more often if employee turnover is high).

x.) *Non-Stormwater Discharges.* You must eliminate non-stormwater discharges not authorized by a NPDES or State discharge permit. See Part I.E for a list of non-stormwater discharges authorized by this permit.

xi.) *Waste, Garbage and Floatable Debris.* You must ensure that waste, garbage, and floatable debris are not discharged to receiving waters by keeping exposed areas free of such materials or by intercepting them before they are discharged. The Department recommends practices including placing garbage or recycling containers at traffic areas, and identifying a schedule for personnel to walk site for trash and litter daily/weekly/monthly, etc.

xii.) *Dust Generation and Vehicle Tracking of Industrial Materials.* You must minimize generation of dust and offsite tracking of raw, final, or waste materials.

2. Water Quality-Based Effluent Limitations

a. *Water Quality Standards*

Your discharge must be controlled as necessary to meet applicable water quality standards. The Department expects that compliance with the other conditions in this permit will control discharges as necessary to meet applicable water quality standards. There shall be no discharge that causes visible oil sheen, and no discharge of floating solids or persistent foam in other than trace amounts. Persistent foam is foam that does not dissipate within one half-hour of point of discharge. If at any time you become aware, or the Department determines, that your discharge causes or contributes to an exceedance of applicable water quality standards, then you must (1) take corrective action, (2) document the corrective actions, and (3) report the corrective actions to the Department's Compliance Program (Part II.E.3) as required by Part IV. Additionally, if information in your NOI or required reports or if information from other sources indicates that your discharge is not controlled as necessary to meet applicable water quality standards, the Department may impose additional water quality-based limitations on a site-specific basis or require you to obtain coverage under an individual permit.

b. *Discharges to Water Quality Impaired Waters*

If you discharge to an impaired water, the Department will inform you if any additional monitoring, limits or controls are necessary for your discharge to be consistent with the assumptions of any available wasteload allocation in an EPA Approved TMDL, or if coverage under an individual permit is necessary in accordance with Part I.G. For any additional control requested by the Department you must include a plan to implement BMPs to address the pollutant of concern in your SWPPP.

c. *Tier 2 Antidegradation Requirements for New or Increased Dischargers*
If you are a new discharger or are required to notify the Department of a modified discharge (Part II.F.1), and you discharge directly to waters designated by the State as Tier 2 for antidegradation purposes under 40 CFR 131.12(a), the Department may notify you that additional analyses, control measures, or other permit conditions are necessary to comply with the applicable antidegradation requirements, or notify you that an individual permit application is necessary in accordance with Part I.G.

d. *Criteria Selection*
Any additional numerical water quality based limits for any specific discharger under Part III.B.2 of the permit shall be based solely on Maryland's Numeric Water Criteria for Designated Uses in COMAR 26.08.02.03-3 and Maryland's Criteria for Toxic Substances in Surface Waters in COMAR 26.08.02.03-2, applied at end of pipe, or the applicable wasteload allocation in a final approved TMDL.

C. Stormwater Pollution Prevention Plan (SWPPP) Requirements

The SWPPP is intended to document the selection, design, and installation of control measures. The SWPPP does not contain effluent limitations; the limitations are contained in Part III.B of the permit, and, for some Industry Sectors, Appendix D of the permit.

Your SWPPP must contain all of the following elements, as described below.

1. <u>Stormwater Pollution Prevention Team</u>
You must identify the staff members (by name or title) that comprise the facility's stormwater pollution prevention team as well as their individual responsibilities. Your stormwater pollution prevention team is responsible for assisting the facility manager in developing and revising the facility's SWPPP as well as maintaining control measures and taking corrective actions where required. Each member of the stormwater pollution prevention team must have ready access to either an electronic or paper copy of applicable portions of this permit and your SWPPP.

2. <u>Site Description</u>
Your SWPPP must include the following:

a. *Activities at the Facility.* Provide a description of the nature of the industrial activities at your facility.

b. *General location map.* Provide a general location map (e.g., U.S. Geological Survey (USGS) quadrangle map) with enough detail to identify the location of your facility. Ideally this map will extend one-quarter of a mile beyond the property boundaries of the facility and identify any water body where discharge is conveyed. At least one public roadway must be identified on the map.

c. *Site map(s).* Provide a map (or alternatively several overlay maps) showing:

i.) the size of the property in acres;
ii.) the location and extent of significant structures and impervious surfaces;
iii.) directions of stormwater flow (use arrows);
iv.) locations of all existing structural control measures or BMPs;
v.) locations of all receiving waters in the immediate vicinity of your facility;
vi.) locations of all stormwater conveyances including ditches, pipes, and swales;
vii.) locations of potential pollutant sources identified under Part III.C.3;
viii.) locations where significant spills or leaks identified under Part III.C.3 have

occurred;

ix.) locations of all stormwater monitoring points;

x.) locations of stormwater inlets and outfalls, with a unique identification code for each outfall (e.g., Outfall No. 1, No. 2, etc), indicating if you are treating one or more outfalls as substantially identical, and an approximate outline of the areas draining to each outfall;

xi.) municipal separate storm sewer systems, where your stormwater discharges to them;

xii.) locations and descriptions of all non-stormwater discharges identified under Part I.E.3;

xiii.) locations of the following activities where such activities are exposed to precipitation: fueling stations; vehicle and equipment maintenance and/or cleaning areas; loading/unloading areas; locations used for the treatment, storage, or disposal of wastes; liquid storage tanks; processing and storage areas; immediate access roads and rail lines used or traveled by carriers of raw materials, manufactured products, waste material, or by-products used or created by the facility; transfer areas for substances in bulk; machinery; and manufacturing buildings; and

xiv.) locations and sources of run-on to your site from adjacent property that contains significant quantities of pollutants.

3. Summary of Potential Pollutant Sources

You must document areas at your facility where industrial materials or activities are exposed to stormwater and from which allowable non-stormwater discharges are released. Industrial materials or activities include, but are not limited to: material handling equipment or activities; industrial machinery; raw materials; industrial production and processes; and intermediate products, by-products, final products, and waste products. Material handling activities include, but are not limited to: the storage, loading and unloading, transportation, disposal, or conveyance of any raw material, intermediate product, final product or waste product. For each area identified, the description must include:

a. *Activities in the area.* A list of the industrial activities exposed to stormwater (e.g., material storage; equipment fueling, maintenance, and cleaning; cutting steel beams).

b. *Pollutants.* A list of the pollutant(s) or pollutant constituents (e.g., admixtures, crankcase oil, zinc, sulfuric acid, and cleaning solvents) associated with each identified activity. The pollutant list must include all significant materials that have been handled, treated, stored, or disposed, and that have been exposed to stormwater in the 3 years prior to the date you prepare or amend your SWPPP.

c. *Spills and Leaks.* You must document where potential spills and leaks could occur that could contribute pollutants to stormwater discharges, and the corresponding outfall(s) that would be affected by such spills and leaks. You must document all significant spills and leaks of oil or toxic or hazardous pollutants that actually occurred at exposed areas, or that drained to a stormwater conveyance, in the 3 years prior to the date you prepare or amend your SWPPP. The plan may refer to applicable portions of other existing plans, such as Spill Prevention, Control, and Countermeasure (SPCC) plans required under 40 CFR Part 112. Discharges of precipitation from containment areas containing used oil must also be in accordance with applicable sections of 40 CFR Part 112.

Note: Significant spills and leaks include, but are not limited to, releases of oil or hazardous substances in excess of quantities that are reportable under CWA Section 311 (see 40 CFR 110.6 and 40 CFR 117.21) or Section 102 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 USC §9602. This permit does not relieve you of the reporting requirements of 40 CFR 110, 40

CFR 117, and 40 CFR 302 relating to spills or other releases of oils or hazardous substances.

d. *Non-Stormwater Discharges.* You must document that you have evaluated for the presence of non-stormwater discharges and that all unauthorized discharges have been eliminated. Documentation of your evaluation must include:

- ***i.)*** The date of any evaluation;
- ***ii.)*** A description of the evaluation criteria used;
- ***iii.)*** A list of the outfalls or onsite drainage points that were directly observed during the evaluation;
- ***iv.)*** The different types of non-stormwater discharge(s) and source locations; and
- ***v.)*** The action(s) taken, such as a list of control measures used to eliminate unauthorized discharge(s), if any were identified. For example, a floor drain was sealed, a sink drain was re-routed to sanitary sewer, wash water is collected and hauled away, or an NPDES permit application was submitted for an unauthorized cooling water discharge.

e. *Salt Storage.* You must document the location of any storage piles containing salt used for deicing or other commercial or industrial purposes.

4. Description of Control Measures to Meet Effluent Limits

You must document the location and type of control measures you have installed and implemented at your site to achieve the non-numeric effluent limits in Part III.B.1.b and, where applicable, in Appendix D Sector-Specific Requirements for Industrial Activity, and the water quality-based effluent limits in Part III.B.2, and describe how you are addressing the control measure selection and design considerations. This documentation must describe how the control measures at your site address both the pollutant sources identified in Part III.C.3 and any stormwater run-on that commingles with any discharges covered under this permit.

5. Schedules and Procedures

a. Pertaining to Control Measures Used to Comply with the Effluent Limits in Part III.B. The following must be documented in your SWPPP:

- ***i.)*** *Good Housekeeping (See Part III.B.1.b.ii or Appendix D)* – A schedule for regular pickup and disposal of waste materials, along with routine inspections for leaks and conditions of drums, tanks and containers;
- ***ii.)*** *Maintenance (See Part III.B.1.b.iii or Appendix D)* – Preventative maintenance procedures, including regular inspections, testing, maintenance, and repair of all industrial equipment and systems, and control measures, to avoid situations that may result in leaks, spills, and other releases, and any back-up practices in place should a runoff event occur while a control measure is off-line;
- ***iii.)*** *Spill Prevention and Response Procedures (See Part III.B.1.b.iv or Appendix D)* – Procedures for preventing and responding to spills and leaks. You may reference the existence of other plans for Spill Prevention Control and Countermeasure (SPCC) developed for the facility under Section 311 of the CWA or BMP programs otherwise required by a NPDES permit for the facility, provided that you keep a copy of that other plan onsite and make it available for review consistent with Part III.C.8; and
- ***iv.)*** *Employee Training (See Part III.B.1.b.ix or Appendix D)* – The SWPPP must identify how often training will take place. All training must be held at least once per calendar year (or more often if employee turnover is high).

b. *Pertaining to Inspection and Monitoring*

- ***i.)*** You must document in your SWPPP your procedures for performing, as appropriate, the three types of inspections specified by this permit, including:
  - Routine facility inspections (see Part V.A.1);

- Quarterly visual assessment of stormwater discharges (see Part V.A.3); and
- Comprehensive site inspections (see Part V.A.2).

ii.) For each type of inspection performed, your SWPPP must identify:

- Person(s) or positions of person(s) responsible for inspection; and
- Specific items to be covered by the inspection, including schedules for specific outfalls.

iii.) If numeric or benchmark monitoring is required for your industry or industries, per Appendix D your SWPPP must document:

- Locations where samples are collected, including any determination that two or more outfalls are substantially identical;
- Parameters for sampling and the frequency of sampling for each parameter;
- Schedules for monitoring at your facility;
- Schedules and procedures for periodic calibration and maintenance of any monitoring and analytical instrumentation to insure accuracy of measurements;
- Any numeric control values (benchmarks, TMDL-related requirements, or other requirements) applicable to discharges from each outfall; and
- Procedures (e.g., responsible staff, logistics, laboratory to be used, etc.) for gathering storm event data, as specified in Part V.C.

iv.) You must document the following in your SWPPP if you plan to use the substantially identical outfall exception for your quarterly visual assessment requirements in Part V.A.3 or your benchmark monitoring requirements in Part V.B:

- Location of each of the substantially identical outfalls;
- Description of the general industrial activities conducted in the drainage area of each outfall;
- Description of the control measures implemented in the drainage area of each outfall;
- Description of the exposed materials located in the drainage area of each outfall that are likely to be significant contributors of pollutants to stormwater discharges;
- An estimate of the runoff coefficient of the drainage areas (low = under 40%; medium = 40 to 65%; high = above 65%); and
- Why the outfalls are expected to discharge substantially identical effluents.

v.) If you are invoking the exception for inactive and unstaffed sites relating to routine facility inspections and quarterly visual assessments, you must include in your SWPPP the information to support this claim as required by Parts V.A.4. If you are invoking the exception for inactive and unstaffed sites for benchmark monitoring, you must include in your SWPPP the information to support this claim as required by Part V.B.5.

6. <u>Signature Requirements</u>
You must sign and date your SWPPP in accordance with Part II.C, including the date of signature.

7. <u>Required SWPPP Modifications</u>
You must modify your SWPPP whenever necessary to address any of the triggering conditions for corrective action in Part IV and to ensure that they do not reoccur, or to reflect changes implemented when a review following the triggering conditions in Part IV.B indicates that changes to your control measures are necessary to meet the effluent limits in this permit. Changes to your SWPPP document must be made in accordance

with the corrective action deadlines in Parts IV.C and IV.D, and must be signed and dated in accordance with Part II.C.

8. Documentation Requirements

You must retain a copy of the current SWPPP required by this permit at your facility, and it must be immediately available to the Department (an electronic copy easily available to personnel is also acceptable). In cases where there is no office to store documentation, an alternative central location may be used for storing documents, as long as personnel at the permitted facility are aware of the plan and have access to critical information to ensure compliance. The Department encourages you to post your SWPPP online and provide the website address on your NOI. You are required to keep the following inspection, monitoring, and certification records with your SWPPP (or in accessible Environmental Management System (EMS)) that together keep your records complete and up-to-date, and demonstrate your full compliance with the conditions of this permit:

a. A copy of the NOI submitted to the Department along with any correspondence exchanged between you and the Department specific to coverage under this permit;

b. A copy of this permit (an electronic copy easily available to SWPPP personnel is also acceptable);

c. A copy of the relevant portion of any other facility document referred to in your SWPPP, such as a Spill Prevention, Control and Countermeasure (SPCC) Plan;

d. Descriptions and dates of any incidences of significant spills, leaks, or other releases that resulted in discharges of pollutants to waters of the U.S., through stormwater or otherwise; the circumstances leading to the release and actions taken in response to the release; and measures taken to prevent the recurrence of such releases (see Part III.B.1.b.iv);

e. Records of employee training, including date training received (see Part III.B.1.b.ix);

f. Documentation of maintenance and repairs of control measures, including the date(s) of regular maintenance, date(s) of discovery of areas in need of repair/replacement, and for repairs, date(s) that the control measure(s) returned to full function, and the justification for any extended maintenance/repair schedules (see Part III.B.1.b.iii);

g. All inspection and discharge monitoring reports (an electronic copy easily available is also acceptable), including the Routine Facility Inspection documentation (see Part V.A.1), the Quarterly Visual Monitoring Form in Appendix B, and the Comprehensive Site Inspection reports (see Part V.A.2);

h. Description of any deviations from the schedule for visual assessments and/or monitoring, and the reason for the deviations (e.g., adverse weather or it was impracticable to collect samples within the first 30 minutes of a measurable storm event) (see Parts V.C.5);

i. Description of any corrective action taken at your site, including triggering event and dates when problems were discovered and modifications occurred;

j. Documentation of any benchmark exceedances and how they were responded to, including either (1) corrective action taken, (2) a finding that the exceedence was due to natural background pollutant levels, or (3) a finding that no further pollutant reductions were technologically available and economically practicable and achievable in light of best industry practice consistent with Part V.B.3;

k. Documentation to support any determination that pollutants of concern are not expected to be present above natural background levels if you discharge directly to impaired waters, and that such pollutants were not detected in your discharge or were solely attributable to natural background sources.

If during the term of this permit, your site becomes inactive, you must contact the Department immediately and provide, in writing, the date of inactivity, the facility contact phone number and the location of the SWPPP and additional documentation. These must be made available during normal working hours. Note inactivity does not refer to seasonal closures.

9. Facilities Subject To SARA Title III, Section 313 Requirements
If you are subject to SARA Title III, Section 313 (42 U.S.C. 11023) reporting requirements, in addition to the requirements of this Part, provide additional narrative on the preventive measures used to eliminate the exposure of these chemicals to stormwater run-on or run-off. To identify if your facility is subject to this requirement, visit the Maryland Department of the Environment's Community Right-to-Know website (http://www.mde.state.md.us). A list of the Section 313 chemicals can be found at the EPA's LIST OF LISTS Consolidated List of Chemicals Subject to the Emergency Planning and Community Right-To-Know Act (EPCRA) and Section 112(r) of the Clean Air Act (http://www.epa.gov/). Additionally, SARA Title III, Section 313 water priority chemicals are often identified on Material Data Safety Sheets (MSDS).

PART IV. CORRECTIVE ACTIONS

A. Conditions Requiring Review and Revision to Eliminate Problem
If any of the following conditions occur, you must review and revise the selection, design, installation, and implementation of your control measures to ensure that the condition is eliminated and will not be repeated in the future:

1. an unauthorized release or discharge (e.g., spill, leak, or discharge of non-stormwater not authorized by this or another NPDES permit) occurs at your facility;

2. a discharge violates a numeric effluent limit;

3. you become aware, or the Department provides a written determination, that your control measures are not stringent enough for the discharge to meet applicable water quality standards;

4. a written notice or a written inspection or evaluation report of your facility by a Department official, is provided to you that indicates modifications to the control measures are necessary to meet the non-numeric effluent limits in this permit; or

5. you find in your routine facility inspection (Part V.A.1), quarterly visual assessment (Part V.A.3), or comprehensive site inspection (Part V.A.2) that your control measures are not being properly operated and maintained.

B. Conditions Requiring Review to Determine if Modifications Are Necessary
If any of the following conditions occur, you must review the selection, design, installation, and implementation of your control measures to determine if modifications are necessary to meet the effluent limits in this permit:

1. construction or a change in design, operation, or maintenance at your facility significantly changes the nature of pollutants discharged in stormwater from your facility, or significantly increases the quantity of pollutants discharged; or

2. the average of 4 quarterly sampling results exceeds an applicable benchmark. If less than 4 benchmark samples have been taken, but the results are such that an exceedence of the 4 quarter average is mathematically certain (i.e., if the sum of quarterly sample results to date is more than 4 times the benchmark level) this is considered a benchmark exceedence, triggering this review.

C. Corrective Action Deadlines

You must document your discovery of any of the conditions listed in parts IV.A and IV.B within 24 hours of making such discovery, and in cases of a numeric limit violation, notify the Department as specified in Part IV.D. Subsequently, within 14 days of such discovery, you must document any corrective action(s) to be taken to eliminate or further investigate the deficiency, or if no corrective action is needed, the basis for that determination. Specific documentation required within 24 hours and 14 days is detailed in part IV.D. If you determine that changes are necessary following your review, any modifications to your control measures must be made before the next storm event if possible, or as soon as practicable following that storm event. In the event that a deficiency cannot be addressed fully within 30 days, you must call the Department's Compliance Program (Part II.E.3) and make the Department aware of the situation. These time intervals are not grace periods, but are schedules considered reasonable for documenting your findings and for making repairs and improvements. They are included in this permit to ensure that the conditions prompting the need for these repairs and improvements are not allowed to persist indefinitely.

D. Corrective Action Report

1. Within 24 hours of discovery of any condition listed in parts IV.A and IV.B, you must document the following information:
   - **a.** identification of the condition triggering the need for corrective action review;
   - **b.** description of the problem identified; and
   - **c.** date the problem was identified.

2. In cases where this condition is a failure to comply with any of the numeric effluent limitations in this permit which may endanger human health or the environment, you must call the Department's Compliance Program (Part II.E.3) within 24 hours and provide a written report within five (5) calendar days thereafter. You must provide the following information with those results as an attachment:
   - **a.** A description of the noncompliant discharge, including its impact on the receiving water;
   - **b.** The cause of the noncompliance;
   - **c.** The anticipated time the cause of the noncompliance is expected to continue, or, if the condition has been corrected, the duration of the period of the noncompliance;
   - **d.** Steps taken by the permittee to eliminate the noncompliant discharge;
   - **e.** Steps planned or implemented by the permittee to prevent the recurrence of the noncompliance;
   - **f.** A description of the permittee's accelerated or additional monitoring to determine the nature and impact of the noncompliant discharge.

3. Within 14 days (or up to 30 days if 14 days is infeasible) of discovery of any condition listed in parts IV.A and IV.B, above, you must document the following information:
   - **a.** summary of corrective action taken or to be taken (or, for triggering events identified in Part IV.B where you determine that corrective action is not necessary, the basis for this determination);
   - **b.** notice of whether SWPPP modifications are required as a result of this discovery or corrective action;
   - **c.** date corrective action initiated; and

d. date corrective action completed or expected to be completed.

4. You must include this documentation with the annual report required in Part V.A.2.b.

E. Effect of Corrective Action
If the event triggering the review is a permit violation (e.g., non-compliance with an effluent limit), correcting it does not remove the original violation. Additionally, failing to take corrective action in accordance with this section is an additional permit violation. The Department may consider the appropriateness and promptness of corrective action in determining enforcement responses to permit violations. The taking of a Corrective Action by itself is not evidence that a violation has occurred.

F. Substantially Identical Outfalls
If the event triggering corrective action is linked to an outfall that represents other substantially identical outfalls, your review must assess the need for corrective action for each outfall represented by the outfall that triggered the review. Any necessary changes to control measures that affect these other outfalls must also be made before the next storm event if possible, or as soon as practicable following that storm event.

PART V. INSPECTIONS, MONITORING, AND REPORTING

A. Site Inspections and Evaluations
You must conduct the following inspections or evaluations at your facility in accordance with the monitoring procedures outlined in Part V.C. You must keep a copy of the documentation from all inspections and evaluations with your SWPPP per Part III.C.8.g. Records may also be kept in an Environmental Management System (EMS) that is accessible by site personnel.

1. Routine Facility Inspection
At least two times a year, you must conduct a site assessment that will review the effectiveness of the SWPPP. At least once each calendar year, the routine facility inspection must be conducted during a period when a stormwater discharge is happening. The facility inspections must be documented with a checklist or other summary signed in accordance with Part II.C.3 of this permit, by qualified personnel, with at least one member of your stormwater pollution prevention team participating. The checklist must include a record of the deficiencies and necessary follow up actions. Refer to Part IV.C Corrective Action Deadlines and Part IV.D. Corrective Action Report for appropriate time frames.

2. Comprehensive Site Compliance Evaluation
You must conduct comprehensive site compliance evaluations once a year. The evaluations must be performed by qualified personnel who possess the knowledge and skills to assess conditions and activities that could impact stormwater quality at the facility and who can evaluate the effectiveness of all existing BMPs. The personnel conducting the evaluations may be either facility employees (such as pollution prevention team members) or contractors you hire. If a scheduled compliance evaluation overlaps with a routine facility inspection, the annual compliance evaluation may be used as one of the two routine facility inspections.

a. Evaluations must include all areas where industrial materials or activities are exposed to stormwater, at a minimum:

i.) Industrial materials, residue or trash that may have or could come into contact with stormwater;

- ***ii.)*** Leaks or spills from industrial equipment, drums, barrels, tanks or other containers that have occurred within the past three years;
- ***iii.)*** Offsite tracking of industrial or waste materials or sediment where vehicles enter or exit the site;
- ***iv.)*** Tracking or blowing of raw, final, or waste materials from areas of no exposure to exposed areas;
- ***v.)*** Evidence of, or the potential for, pollutants entering the drainage system;
- ***vi.)*** Evidence of pollutants discharging to surface waters at all facility outfalls;
- ***vii.)*** The condition of and around any outfall, including flow dissipation measures to prevent scouring;
- ***viii.)*** Training performed, inspections completed, maintenance performed, quarterly visual examinations, and effective operation of BMPs; and
- ***ix.)*** Visual and analytical monitoring results from the past year.

b. A report must be written summarizing the scope of the evaluation, name(s) of personnel performing the evaluation, the date of the evaluation, and all observations relating to the implementation of the SWPPP. The report, which must be signed in accordance with Part II.C.3 of this permit, must include a certification that the site is in compliance with the SWPPP. Based on the results of the evaluation, the SWPPP must be modified as necessary. Refer to Part IV.C Corrective Action Deadlines and Part IV.D. Corrective Action Report for appropriate time frames.

3. Quarterly Visual Monitoring

You are required to begin visual monitoring in the first full quarter after you have been notified that you are covered by this permit. For example, if you obtain permit coverage in June, then your first monitoring quarter is July 1 - September 30 of that year. Once each quarter, you must collect a stormwater sample from each outfall (except in adverse weather conditions, substantially identical outfalls, winter shutdown as described in Appendix D for Sector D or inactive and unstaffed sites as noted below) and assess the sample visually. Samples may be taken during any precipitation event (except as noted in Areas Subject to Snow below) where there is a measurable discharge and must be sampled within the first 30 minutes of the storm event. If it is not possible to collect the sample within the first 30 minutes of discharge, the sample must be collected as soon as practicable after the first 30 minutes and you must document why it was not possible to take the sample within the first 30 minutes. In the case of snowmelt, samples must be taken during a period with a measurable discharge from your site. These samples are not required to be collected consistent with 40 CFR 136 procedures but should be collected in such a manner that the samples are representative of the stormwater discharge.

a. The Quarterly Visual Monitoring Form found in Appendix B of this permit must be completed for each sample. If no sample is possible, the form may be filled out to reflect no discharge. Documentation of the rationale for no visual assessment for the quarter must be included in SWPPP records (or in an Environmental Management System (EMS) that is accessible by site personnel).

b. Adverse Weather Conditions are those that are dangerous or create inaccessibility for personnel, such as local flooding, high winds, or electrical storms, or situations that otherwise make sampling impractical, such as drought or extended frozen conditions. When adverse weather conditions prevent the collection of samples during the quarter, a substitute sample must be taken during the next qualifying storm event.

c. *Areas Subject to Snow:* In areas subject to snow, at least one quarterly visual assessment shall attempt, if possible, to capture snowmelt discharge. The assessment should identify the date when the sample was taken.

d. *Substantially identical outfalls:* If your facility has two or more outfalls that you believe discharge substantially identical effluents, as documented in Part III.C.5.b, you may conduct quarterly visual assessments of the discharge at just one of the outfalls and report that the results also apply to the substantially identical outfall(s) provided that you perform visual assessments on a rotating basis of each substantially identical outfall throughout the period of your coverage under this permit. If stormwater contamination is identified through visual assessment performed at a substantially identical outfall, you must assess and modify your control measures as appropriate for each outfall represented by the monitored outfall.

4. Inactive and Unstaffed Sites Exceptions to Routine Facility Inspections.
The requirement to conduct routine facility inspections twice a year and visual monitoring on a quarterly basis does not apply at a facility that is inactive and unstaffed, as long as there are no industrial materials or activities exposed to stormwater. Such a facility is only required to conduct an annual comprehensive site inspection in accordance with the requirements of Part V.A.2. To invoke this exception, you must maintain a statement in your SWPPP pursuant to Part III.C.5.b.v indicating that the site is inactive and unstaffed, and that there are no industrial materials or activities exposed to precipitation, in accordance with the substantive requirements in 40 CFR 122.26(g)(4)(iii). The statement must be signed and certified in accordance with Part II.C. If circumstances change and industrial materials or activities become exposed to stormwater or your facility becomes active and/or staffed, this exception no longer applies and you must immediately resume quarterly facility inspections. If you are not qualified for this exception at the time you are authorized under this permit, but during the permit term you become qualified because your facility is inactive and unstaffed, and there are no industrial materials or activities that are exposed to stormwater, then you must include the same signed and certified statement as above and retain it with your records pursuant to Part III.C.5.b.v.

B. Required Numeric Monitoring

This permit specifies various numeric criteria for your operations. These include numeric limits and benchmarks.

- The numeric limits are for process water, washwater and stormwater subject to Effluent Limitation Guidelines in Appendix D according to your industry sector. Exceedances of these numeric limits is a permit violation.
- This permit also stipulates pollutant benchmark concentrations that may be applicable to your discharge. You must conduct benchmark monitoring quarterly for four (4) full quarters. The benchmark concentrations are not effluent limitations; a benchmark exceedance, therefore, is not a permit violation. Benchmark monitoring data are primarily for your use to determine the overall effectiveness of your control measures and to assist you in knowing when additional corrective action(s) may be necessary to comply with the effluent limitations in Part III.B.

Samples and measurements taken for the purpose of monitoring must be representative of the volume and nature of the monitored activity.

1. Applicability of Monitoring

You must monitor for any numeric or benchmark parameters specified for the industrial sector(s), both primary industrial activity and any co-located industrial activities, applicable to your discharge. Applicable concentrations are listed in the sector-specific sections of Appendix D. If your facility is in one of the industrial sectors subject to a hardness-dependent benchmark, you are required to submit to the Department with your first discharge monitoring report (Part V.B.4) a hardness value, established consistent with the procedures in Appendix C, which is representative of your receiving water.

Samples must be analyzed consistent with 40 CFR Part 136 analytical methods and using test procedures with quantitation limits at or below concentrations specified for all monitored parameters for which you are required to sample.

When more than one type of monitoring for the same parameter at the same outfall applies (e.g., total suspended solids once per month for an effluent numeric limit and once per quarter for benchmark monitoring at a given outfall), you may use a single sample to satisfy both monitoring requirements (i.e., one sample satisfying both the monthly effluent limit sample and one of the 4 quarterly benchmark monitoring samples).

2. Monitoring Schedule

Your required monitoring frequency varies based on your activity. The tables in Appendix D specify how often that activity must take place. Your monitoring will start the first full quarter (found in Part V.C.7) that occurs three (3) months after registering under this permit. For example, if you obtain permit coverage in June, three months later is September, then your monitoring starts on October 1.

3. Required Responses to Benchmark Monitoring Results

a. *Data not exceeding benchmarks:*

After collection of 4 quarterly samples, if the average of the 4 monitoring values for any parameter does not exceed the benchmark, you have fulfilled your monitoring requirements for that parameter for the permit term. For averaging purposes, use a value of zero for any individual sample parameter, analyzed using procedures consistent with Part V.B.1, which is determined to be less than the method detection limit. For sample values that fall between the method detection level and the quantitation limit (i.e., a confirmed detection but below the level that can be reliably quantified), use a value halfway between zero and the quantitation limit. If you have met the requirements and plan to stop benchmark monitoring for a parameter, you must provide written notification to the Department's Compliance Program (Part II.E.3) of this determination with your benchmark monitoring report and modify your SWPPP.

b. *Data exceeding benchmarks:*

After collection of 4 quarterly samples, if the average of the 4 monitoring values for any parameter exceeds the benchmark, you must review the selection, design, installation, and implementation of selected control measures to determine if modifications are necessary to meet the effluent limits in this permit, and either:

i.) Make the necessary modifications and continue quarterly monitoring until you have completed 4 additional quarters of monitoring for which the average does not exceed the benchmark; or

ii.) Make a determination that no further pollutant reductions are technologically available and economically practicable and achievable in light of best industry practice to meet the technology-based effluent limits or are necessary to meet the water-quality-based effluent limitations in Part III.B of this permit, in which case you must continue monitoring once per year. You must also document your rationale for concluding that no further pollutant reductions are achievable, and retain all records related to this documentation with your SWPPP. You must provide written notification to the Department's Compliance Program of this determination with your next benchmark monitoring report.

In accordance with Part V.B, you must review your control measures and perform any required corrective action immediately (or document why no corrective action is required), without waiting for the full 4 quarters of monitoring data, if an exceedance of the 4 quarter average is mathematically certain. If after modifying your control measures and conducting 4 additional quarters of monitoring, your average still exceeds the benchmark (or if an exceedance of the benchmark by the 4 quarter average is mathematically certain prior to conducting the full 4 additional quarters of monitoring), you must again review your control measures and take one of the two actions above.

c. *Natural Background Pollutant Levels:*
Following the first 4 quarters of benchmark monitoring (or sooner if the exceedance is triggered by less than 4 quarters of data, see above), if the average concentration of a pollutant exceeds a benchmark value, and you determine that exceedance of the benchmark is attributable solely to the presence of that pollutant in the natural background, you are not required to perform corrective action or additional benchmark monitoring provided that:

i.) The average concentration of your benchmark monitoring results is less than or equal to the concentration of that pollutant in the natural background;

ii.) You must document and maintain with the SWPPP (or in an Environmental Management System (EMS) that is accessible by site personnel) your supporting rationale for concluding that benchmark exceedances are in fact attributable solely to natural background pollutant levels. You must include in your supporting rationale any data previously collected by you or others (including literature studies) that describe the levels of natural background pollutants in your stormwater discharge; and

iii.) You notify the Department's Compliance Program (Part II.E.3) on your final quarterly benchmark monitoring report that the benchmark exceedances are attributable solely to natural background pollutant levels.

Natural background pollutants include those substances that are naturally occurring in soils or groundwater. Natural background pollutants do not include legacy pollutants from earlier activity on your site, or pollutants in run-on from neighboring sources which are not naturally occurring. Note: When run-on to your facility causes a benchmark exceedance, in addition to reviewing and revising, as appropriate, your SWPPP, you should notify the other operators contributing run-on to your discharges to abate their pollutant contribution. Where the other operators fail to take action to address the stormwater run-on, the Department may allow you to discontinue benchmark monitoring.

4. Submitting Discharge Monitoring Reports (DMRs)

You must summarize and submit monitoring information electronically using NetDMR once you are granted access to this tool, unless you demonstrate a reasonable basis that precludes the use of NetDMR. Specific requirements regarding submittal of data and reports in hard copy form and for submittal using NetDMR are described below:

a. NetDMR is a U.S. EPA tool allowing regulated Clean Water Act permittees to submit monitoring reports electronically via a secure Internet application. You must apply for access to NetDMR at www.epa.gov/netdmr and register for a NetDMR Webinar. Before you can submit official DMRs using NetDMR you must attend a training Webinar and successfully set-up and submit test monitoring results electronically. You must complete all requirements to gain access to NetDMR within one (1) month of authorization under this permit.

b. The permittee may be eligible for a temporary waiver by MDE from NPDES electronic reporting requirements if the permittee has no current internet access and is physically located in a geographic area (i.e., zip code) that is identified as under-served for broadband internet access in the most recent National Broadband Map from the Federal Communications Commission (FCC); or if the permittee can demonstrate that such electronic reporting of the monitoring data and reports would pose an unreasonable burden or expense to the NPDES-permitted facility. Waiver requests must be submitted in writing to the Department for written approval at least 120 days prior to the date the permittee would be required under this permit to begin using NetDMR. This demonstration shall be valid for one (1) year from the date of the Department approval and shall thereupon expire. At such time, DMRs and reports shall be submitted electronically to the Department unless the permittee submits a renewed waiver request and such request is approved by the Department. The application form for a waiver from electronic reporting requirements can be found at http://bit.ly/NetDMR-Waiver. All subsequent hardcopy DMRs shall be sent to the following address:

Attention: DMRs
Maryland Department of the Environment
WMA – Compliance Program
1800 Washington Blvd., Suite 425
Baltimore, MD 21230-1708

c. If you are required to perform benchmark or other numeric discharge monitoring for specific pollutants you must report the data at least quarterly, no later than 28 days following the Monitoring Period (Part V.C.7), and according to the other Monitoring Procedures (Part V.C).

5. Exception for Inactive and Unstaffed Sites

The requirement for benchmark monitoring does not apply at a facility that is inactive and unstaffed, as long as there are no industrial materials or activities exposed to stormwater. To invoke this exception, you must do the following:

- Maintain a statement onsite with your SWPPP stating that the site is inactive and unstaffed, and that there are no industrial materials or activities exposed to stormwater in accordance with the substantive requirements in 40 CFR 122.26(g) and sign and certify the statement in accordance with Part II.C; and
- If circumstances change and industrial materials or activities become exposed to stormwater or your facility becomes active and/or staffed, this exception no longer applies and you must immediately begin complying with the applicable benchmark monitoring requirements under Part V.B as if you were in your first year of permit coverage. You must indicate in your first benchmark monitoring report that your facility has materials or activities exposed to stormwater or has become active and/or staffed.
- If you are not qualified for this exception at the time you are authorized under this permit, but during the permit term you become qualified because your facility is inactive and unstaffed, and there are no industrial materials or activities that are exposed to stormwater, then you must provide written notification to the Department's Compliance Program (Part II.E.3) of this change in your next benchmark monitoring report. You may discontinue benchmark monitoring once you have notified the Department, and prepared and signed the certification statement described above concerning your facility's qualification for this special exception.

6. Substantially identical outfalls

If your facility has two or more outfalls that you believe discharge substantially identical effluents, as documented in Part III.C.5.b, you may perform benchmark monitoring of the discharge at just one of the outfalls and report that the results also apply to the substantially identical outfall(s) provided that you perform benchmark monitoring on a rotating basis of each substantially identical outfall throughout the period you are required to under this permit. If stormwater contamination is identified through benchmark monitoring performed at a substantially identical outfall, you must assess and modify your control measures as appropriate for each outfall represented by the monitored outfall. The substantially identical outfall monitoring provisions are not available for numeric effluent limits monitoring.

7. Exception for Discharges to Groundwater
For discharges to groundwater via treatment, holding, or seepage facilities that are designed with no means for overflow, the associated surface water discharge monitoring and limits (Part V.B and Appendix D) are waived.

8. Flow Monitoring
Reporting of measured flow may be required for your facility as specified in Appendix D. In lieu of providing measured flow, the permittee may estimate flows and submit the following information with the NOI, and with the discharge monitoring report in the first quarter of each calendar year:

a. A description of the methodology used to estimate flow at each outfall where flow measurement equipment is not present;

b. Documentation appropriate to the methodology utilized which provides information necessary to support the validity of the reported flow estimate. If actual measurements or observations are made, a description of typical sampling times, location, and persons performing the measurements/observation should also be provided; and

c. A description of the factors (e.g. batch discharges, intermittent operation, etc) which cause flow at the outfall to fluctuate significantly from the estimate provided.

C. Monitoring Procedures

You must collect and analyze discharges associated with effluent limitations guidelines, process water monitoring, as well as quarterly stormwater benchmark samples and document monitoring activities for the monitoring consistently with the procedures described in this section and the industry specific monitoring requirements of Appendix D. When more than one type of monitoring for the same parameter at the same outfall applies (e.g., total suspended solids once per month for an effluent limit and once per quarter for benchmark monitoring at a given outfall), you may use a single sample to satisfy both monitoring requirements (i.e., one sample satisfying both the monthly effluent limit sample and one of the 4 quarterly benchmark monitoring samples).

1. Monitored Outfalls
You must conduct monitoring as required by this permit at each outfall authorized by this permit, except benchmark monitoring for an outfall exempt from monitoring as a substantially identical outfall. In the case of benchmark monitoring, if your facility has two or more outfalls that you believe discharge substantially identical effluents, based on the similarities of the general industrial activities and control measures, exposed materials that may significantly contribute pollutants to stormwater, and runoff coefficients of their drainage areas, you may monitor the effluent of just one of the outfalls and report that the results also apply to the substantially identical outfall(s). As required in Part III.C.5, your SWPPP must identify each outfall authorized by this permit and describe the rationale for any substantially identical outfall determinations.

2. Commingled Discharges
If discharges authorized by this permit commingle with discharges not authorized under this permit, any required sampling of the authorized discharges must be performed at a point before they mix with other waste streams, to the extent practicable. The following are some examples of mixed water source situations that should not be sampled.

a. A common ditch that carries stormwater from properties upstream. In this case, the stormwater from the permitted facility is mixed with other water. You should find a location or locations where your facility's stormwater alone can be sampled.
b. A partially submerged storm sewer pipe where it discharges into the receiving water body. In this case, this final discharge point should not be used as a sampling point because the stormwater flow is mixed with the receiving water.
c. A manhole that carries stormwater not only from the permitted facility but from other stormwater sources as well. If taking a grab sample from a manhole, you should make sure that the flow in that pipe is entirely from your facility.

3. Measurable Storm Events

All required stormwater related monitoring must be performed on a storm event that results in an actual discharge from your site ("measurable storm event") that follows the preceding measurable storm event by at least 72 hours (3 days). The 72-hour (3-day) storm interval does not apply if you are able to document that less than a 72-hour (3-day) interval is representative for local storm events during the sampling period. In the case of snowmelt, the monitoring must be performed at a time when a measurable discharge occurs at your site.

For each monitoring event, except snowmelt monitoring, you must identify the date and duration (in hours) of the rainfall event, rainfall total (in inches) for that rainfall event, and time (in days) since the previous measurable storm event. For snowmelt monitoring, you must identify the date of the sampling event.

4. Sample Type

Grab samples for process water or washwater are taken at your selected Outfall during a time of discharge. For stormwater related samples, you must take a minimum of one grab sample from a discharge resulting from a measurable storm event as described above. Samples must be collected within the first 30 minutes of a measurable storm event. However, the Department does not advocate impractical or potentially unsafe sampling methods during periods of adverse weather conditions. Therefore, if it is not possible to collect the sample within the first 30 minutes of a measurable storm event, the sample must be collected as soon as practicable after the first 30 minutes and documentation must be kept with the SWPPP (or in an Environmental Management System (EMS) that is accessible by site personnel) explaining why it was not possible to take samples within the first 30 minutes. In the case of snowmelt, samples must be taken during a period with a measurable discharge.

5. Adverse Weather Conditions

When adverse weather conditions, as described in Part V.A.3.b, prevent the collection of samples according to the relevant monitoring schedule, you must take a substitute sample during the next qualifying storm event. Adverse weather does not exempt you from having to file a benchmark monitoring report in accordance with your sampling schedule. You must keep a record with your SWPPP (or in an Environmental Management System (EMS) that is accessible by site personnel) of any failure to monitor as specified, indicating the basis for not sampling during the usual reporting period.

6. Representative Sampling

You must take all required samples and measurements at times to be representative of the quantity and quality of the discharges during the specified monitoring periods. At a minimum, samples must be taken once every quarter unless otherwise specified.

The sampling and analytical methods used must conform to procedures for the analysis of pollutants as identified in 40 CFR 136 - "Guidelines Establishing Test Procedures for the Analysis of Pollutants" except for visual monitoring which is not subject to 40 CFR 136, or unless otherwise specified.

7. Monitoring Periods
Visual (Part V.A.3) and benchmark (Part V.B.2) monitoring are required on a quarterly basis, and process water and washwater monitoring occurs either monthly or quarterly based on the industry specific requirements in Appendix D. Quarterly monitoring follows these 3-month intervals:

- ***i.)*** January 1 – March 31;
- ***ii.)*** April 1 – June 30;
- ***iii.)*** July 1 – September 30; and
- ***iv.)*** October 1 – December 31.

8. Data Recording Requirements
If you are required to perform monitoring, you must record the following information for each sample:

- **a.** The exact place, date, and time of sampling or measurement;
- **b.** The person(s) who performed the sampling or measurement;
- **c.** The dates and times the analyses were performed;
- **d.** The person(s) who performed the analyses;
- **e.** The analytical techniques or methods used; and
- **f.** The results of all required analyses.

D. Records Retention

You must retain all records and information resulting from the monitoring activities required by this permit, including all records of analyses performed, calibration and maintenance of instrumentation, and original recordings from continuous monitoring instrumentation, for a minimum of three (3) years. This period shall be extended automatically during the course of litigation, or when requested by the Department.

PART VI. STANDARD PERMIT CONDITIONS

A. Facility Operation and Maintenance

You must at all times properly operate and maintain all facilities and systems of treatment and control which are installed or used to achieve compliance with the conditions of the permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or a similar system that you have installed only when the operation is necessary to achieve compliance with the conditions of the permit.

B. Submitting Additional or Corrected Information

When you become aware that you failed to submit any relevant facts or submitted incorrect information in the NOI or in any other report to the Department, you must submit the facts or information to the Department within 30 days.

C. Adverse Impact

The permittee shall take all reasonable steps to minimize or prevent any adverse impact to waters of the State or to human health resulting from noncompliance with any effluent limitations specified in this permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

D. Bypass

Any bypass of treatment facilities necessary to maintain compliance with the terms and conditions of this permit is prohibited unless:

1. the bypass is unavoidable to prevent a loss of life, personal injury or substantial physical damage to property, damage to the treatment facilities which would cause them to become inoperable, or substantial and permanent loss of natural resources;
2. there are no feasible alternatives;
3. notification is received by the Department within 24 hours (if orally notified, then followed by a written submission within five calendar days of the permittee's becoming aware of the bypass). Where the need for a bypass is known (or should have been known) in advance, this notification shall be submitted to the Department for approval at least ten calendar days before the date of bypass or at the earliest possible date if the period of advance knowledge is less than ten calendar days; and
4. the bypass is allowed under conditions determined by the Department to be necessary to minimize adverse effects.

E. Conditions Necessary for Demonstration of an Upset

An upset shall constitute an affirmative defense to an action brought for noncompliance with technology-based effluent limitations only if the permittee demonstrates, through properly signed, contemporaneous operating logs, or other relevant evidence, that:

1. an upset occurred and that the permittee can identify the specific cause(s) of the upset;
2. the permitted facility was at the time being operated in a prudent and workman-like manner and in compliance with proper operation and maintenance procedures;
3. the permittee submitted a 24-hour notification of upset in accordance with the reporting requirements of Corrective Actions above;
4. the permittee submitted, within five (5) calendar days of becoming aware of the upset, documentation to support and justify the upset; and
5. the permittee complied with any remedial measures required to minimize adverse impact.

F. Removed Substances

Wastes such as solids, sludges, or other pollutants removed from or resulting from treatment or control of wastewaters or facility operations, must be disposed of in a manner to prevent any wastes or runoff from wastes from contacting waters of the State.

G. Right of Entry

You must permit the Secretary of the Department, the Regional Administrator for the EPA, or their authorized representatives, upon the presentation of credentials, to:

1. enter upon your premises where a discharges' source is located or where any records are required to be kept under the terms and conditions of this permit;
2. access and copy, at reasonable times, any records required to be kept under the terms and conditions of this permit;
3. inspect, at reasonable times, any monitoring equipment or monitoring method required in this permit;
4. inspect, at reasonable times, any collection, treatment, pollution management, or discharge facilities required under this permit;
5. sample, at reasonable times, any discharge of pollutants; and
6. take photographs (which may require direction for reasons of national security).

H. Availability of Reports

Except for data determined to be confidential under the Maryland Public Information Act and/or Section 308 of the Clean Water Act, 33 U.S.C. § 1318, all submitted data must be available for public inspection at the offices of the Department and the Regional Administrator of the Environmental Protection Agency.

I. Permit Modification
The Department may revoke this permit or modify this permit to include different limitations and requirements, in accordance with the procedures contained in COMAR 26.08.04.10 and 40 C.F.R. §§ 122.62, 122.63, 122.64 and 124.5.

J. Total Maximum Daily Load (TMDL)
The permit may be reopened in accordance with Maryland's Administrative Procedures Act to incorporate future Total Maximum Daily Load requirements.

K. Toxic Pollutants
You must comply with effluent standards or prohibitions for toxic pollutants established under the Federal Clean Water Act, or under Section 9-314 and Sections 9-322 to 9-328 of the Environment Article, Annotated Code of Maryland. You must be in compliance within the time provided in the regulations that establish these standards or prohibitions, even if this permit has not yet been modified to incorporate the requirement.

L. Oil and Hazardous Substances Prohibited
Nothing in this permit shall be construed to preclude the institution of any legal action or relieve you from any responsibility, liability, or penalties to which the permittee may be subject under Section 311 of the Clean Water Act (33. U.S.C. § 1321), or under the Annotated Code of Maryland.

M. Civil and Criminal Liability
Nothing in this permit shall be construed to preclude the institution of any legal action nor relieve you from any civil or criminal responsibilities, liabilities, and/or penalties for noncompliance with Title 9 of the Environment Article, Annotated Code of Maryland or any federal, local or other state law or regulation.

N. Property Rights/Compliance with Other Requirements
The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations.

O. Severability
The provisions of this permit are severable. If any provisions of this permit must be held invalid for any reason, the remaining provisions must remain in full force and effect. If the application of any provision of this permit to any circumstances is held invalid, its application to other circumstances must not be affected.

P. Water Construction and Obstruction
This permit does not authorize you to construct or place physical structures, facilities, or debris or undertake related activities in any waters of the State.

Q. Compliance with this General Permit and Water Pollution Abatement Statutes
You must comply at all times with the terms and conditions of this permit, the provisions of the Environment Article, Title 7, Subtitle 2 and Title 9, Subtitles 2 and 3 of the Annotated Code of Maryland, and the Clean Water Act, 33 U.S.C. § 1251 et seq. Any noncompliance with any of the requirements of this permit constitutes a violation of the Clean Water Act.

As detailed in Part IV (Corrective Actions) of this permit, failure to take any required corrective actions constitute an independent, additional violation of this permit and the Clean Water Act. As such, any actions and time periods specified for remedying noncompliance do not absolve parties of the initial underlying noncompliance. However, where corrective action is triggered by an event that does not itself constitute permit noncompliance, such as an exceedance of an applicable benchmark, there is no permit violation provided you take the required corrective action within the relevant deadlines established in Part IV.C.

R. Action on Violations

The issuance or reissuance of this permit does not constitute a decision by the State not to proceed in an administrative, civil, or criminal action for any violations of State law or regulations occurring before the issuance or re-issuance of this permit, nor a waiver of the State's right to do so.

S. Civil Penalties for Violations of Permit Conditions

In addition to civil penalties for violations of State water pollution control laws set forth in Section 9-342 of the Environment Article, Annotated Code of Maryland, the Clean Water Act provides that any person who violates Section 301, 302, 306, 307, 308, 318, or 405 of the Act, or any permit condition or limitation implementing any of such sections in a permit issued under Section 402 of the Act or in a permit issued under Section 404 of the Act, is subject to a civil penalty not to exceed $37,500 per day for each violation. Statutory penalties of the CWA are subject to the Civil Monetary Penalty Inflation Adjustment Rule (40 CFR 19.4).

T. Criminal Penalties for Violations of Permit Conditions

In addition to criminal penalties for violations of State water pollution control laws set forth in Section 9-343 of the Environment Article, Annotated Code of Maryland, the Clean Water Act provides that:

1. Any person who negligently violates Section 301, 302, 306, 307, 308, 318, or 405 of the Act, or any permit condition or limitation implementing any of such sections in a permit issued under Section 402 of the Act, or in a permit issued under Section 404 of the Act, is subject to a fine of not less than $2,500 nor more than $25,000 per day of violation, or by imprisonment for not more than one (1) year, or by both.
2. Any person who knowingly violates Section 301, 302, 306, 307, 308, 318, or 405 of the Act, or any permit condition or limitation implementing any of such sections in a permit issued under Section 402 of the Act, or in a permit issued under Section 404 of the Act, is subject to a fine of not less than $5,000 nor more than $50,000 per day of violation, or by imprisonment for not more than three (3) years, or by both.
3. Any person who knowingly violates Section 301, 302, 306, 307, 308, 318, or 405 of the Act, or any permit condition or limitation implementing any of such sections in a permit issued under Section 402 of the Act, or in a permit issued under Section 404 of the Act, and who knows at that time that he thereby places another person in imminent danger of death or serious bodily injury, is subject to a fine of not more than $250,000 or imprisonment of not more than fifteen (15) years, or both. A person that is a corporation, must, upon conviction, be subject to a penalty of not more than $1,000,000.
4. Any person who knowingly makes any false material statement, representation, or certification in any application, record, report, plan, or other document filed or required to be maintained under the Act or who knowingly falsifies, tampers with or renders inaccurate any monitoring device or method required to be maintained under the Act, is subject to a fine of not more than $10,000 or by imprisonment for not more than two (2) years, or by both.

U. Duty to Provide Information

You must provide within a reasonable time, any information which the Department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit to the Department. You must also provide copies of records required to be kept by this permit to the Department, upon request.

V. Reopener Clause for Permits

This permit must be modified, or alternatively, revoked and reissued, to comply with any applicable effluent standard or limitation issued or approved under Sections 301, 304, and 307 of the Clean Water Act [33 USCS §§ 1311, 1314, 1317] if the effluent standard or limitation issued or approved:

1. contains different conditions or is otherwise more stringent than any effluent limitation in this permit; or
2. controls any pollutant not limited in this permit. This permit, as modified or reissued under this section, must also contain any other requirements of the Act then applicable.

Part VII. AUTHORITY TO ISSUE GENERAL NPDES PERMITS

On September 5, 1974, the Administrator of the EPA approved the proposal submitted by the State of Maryland for the operation of a permit program for discharges into navigable waters under Section §402 of the federal Clean Water Act, 33 U.S.C. §Section 1342. On September 30, 1990, the Administrator of the EPA approved the proposal submitted by the State of Maryland for the operation of a general permit program. Under the approvals described above, this general discharge permit is both a State of Maryland general discharge permit and an NPDES general discharge permit.

D. Lee Currey, Acting Director
Water Management Administration

Appendix A:
Industry Specific Sectors

These Industry Sector descriptions are categorized by Standard Industrial Classification (SIC), and in a few cases by "Activity Code". More detailed descriptions of the SIC codes can be found at Department of Labor's - Occupation, Safety and Health Administration (OSHA) website (http://www.osha.gov/pls/imis/sicsearch.html). References to "sectors" in this permit (e.g., sector-specific monitoring requirements) refer to these groupings. Since there is overlap between this permit and the Industrial Stormwater Permit, this table is in two sections. The first section indicates which primary activities are covered with this permit. If your primary industrial activity is in this first table, you would request coverage under this permit.

SIC Code or Activity Code	Primary or Co-Located Industrial Activity Represented
SECTOR D: ASPHALT PAVING AND ROOFING MATERIALS AND LUBRICANTS	
2951, 2952	(Subsector D1) Asphalt Paving and Roofing Materials
2992, 2999	Miscellaneous Products of Petroleum and Coal
SECTOR E: GLASS, CLAY, CEMENT, CONCRETE, AND GYPSUM PRODUCTS	
3211	Flat Glass
3221, 3229	Glass and Glassware, Pressed or Blown
3231	Glass Products Made of Purchased Glass
3241	Hydraulic Cement
3251-3259	Structural Clay Products
3261-3269	Pottery and Related Products
3271-3275	Concrete, Gypsum & Plaster Products (This includes portable concrete plants.)
3281	Cut Stone and Stone Products
3291-3299	Abrasive, Asbestos, and Miscellaneous Nonmetallic Mineral Products
SECTOR G: [Reserved]	
SECTOR J: MINERAL MINING AND DRESSING	
1411	Dimension Stone
1422-1429	Crushed and Broken Stone, Including Rip Rap
1442	Construction Sand and Gravel
1446	Industrial Sand
1455, 1459	Clay, Ceramic, and Refractory Materials
1474-1479	Chemical and Fertilizer Mineral Mining
1481	Nonmetallic Minerals Services, Except Fuels
1499	Miscellaneous Nonmetallic Minerals, Except Fuels
SECTOR L: LANDFILLS AND LAND APPLICATION SITES	
4953	(Subsector L4) Recycling Facility "Concrete or Asphalt Recycling" are facilities that primarily receive and stockpile a mix of dirt, concrete or asphalt and crush concrete or asphalt for re-use.
SECTOR AD.c: HYDRODEMOLITION	
HD	Operations involved in using water to remove old concrete, rock or cement referred to as Hydrodemolition, which discharge to groundwater.
SECTOR AD: NON-CLASSIFIED FACILITIES	
AD	Other stormwater discharges to waters of the state designated by the Department as needing a permit (see 40 CFR 122.26.(a)(9)(i)(C) & (D)) or any facility discharging stormwater associated with industrial activity not described by any Sectors A-AC. NOTE: Facilities may not elect to be covered under Sector AD. Only the Department may assign a facility to Sector AD.

These additional co-located industrial activities may also be covered by this permit, in cases where your primary industrial activity is listed in the previous section of this Appendix A.

SIC Code or Activity Code	Co-located Industrial Activities Represented
SECTOR A: TIMBER PRODUCTS	
2411	(Subsector A3) Log Storage Areas
2499	(Subsector A4) Wood Products, Not Elsewhere Classified (Natural Wood Waste)
SECTOR C: CHEMICALS AND ALLIED PRODUCTS	
2874 - 2875	Agricultural Chemicals (Fertilizer, Composting)
SECTOR F: PRIMARY METALS	
3398, 3399	Miscellaneous Primary Metal Products
SECTOR P: LAND TRANSPORTATION AND WAREHOUSING	
4212-4231 (except 4221-4226)	Motor Freight Transportation and Warehousing *
	* Only those facilities which have vehicle maintenance shops (including vehicle rehabilitation, mechanical repairs, painting, fueling, and lubrication) or equipment cleaning operations are included for the facilities specified above in this Sector.
4221-4226	Storage facilities must include stormwater discharges from all areas (except access roads and rail lines) where material handling, equipment, or activities, raw materials, intermediate products, final products, waste materials, by-products, or industrial machinery are exposed to stormwater. Material handling activities include the storage, loading and unloading, transportation, or conveyance of any raw material, intermediate produce, finished product, by-product, or waste product.

Appendix B: **Quarterly Visual Monitoring Form**

Fill out a separate form for each outfall sampled.

Sample Location					
Quarter / Year:		**Date / Time Collected:**		**Date / Time Examined:**	
Qualifying Storm Event?	Yes No	**Runoff Source:**	Rainfall Snowmelt		
Collector's Name & Title					
Examiner's Name & Title					

Parameter	Parameter Description	Parameter Characteristics
1. **Color**	Does the stormwater appear to have any color? **Yes** **No (Clear)**	If Yes, describe: *Yellow Brown Red Gray* *Other*:
2. **Clarity**	Is the stormwater not clear? **Yes** **No**	If not clear, which of the following best describes the clarity of the stormwater? *Suspended Solids Milky/Cloudy Opaque* *Other:*
3. **Oil Sheen**	Can you see a rainbow effect or sheen on the water surface? **Yes** **No**	Which best describes the sheen? *Rainbow sheet Floating oil globules* *Other:*
4. **Odor**	Does the sample have an odor? **Yes** **No**	If Yes, describe: *Chemical Musty Rotten Eggs Sewage Sour Milk Oil/Petroleum* *Other:*
5. **Floating Solids**	Is there anything on the surface of the sample? **Yes** **No**	If Yes, describe: *Suds Oily Film Garbage Sewage Water Fowl Excrement* *Other:*
6. **Suspended Solids**	Is there anything suspended in the sample? **Yes** **No**	Describe:
******Leave sample undisturbed for 30 minutes.******		
7. **Settled Solids**	Is there anything settled on the bottom of the sample? **Yes** **No**	Describe: (*note type, size and material after sample is not disturbed for 30 minutes)*
8. **Foam**	Does foam or material form on the top of the sample surface if you shake it? **Yes** **No**	Describe:

9. **If there are any visible indicators of pollution identify (1) where the pollution may come from and (2) any corrective actions taken.**

Stormwater Collector's Signature and Date:

Stormwater Examiner's Signature and Date:

Note – Sample should be collected and analyzed in a colorless glass or plastic bottle.

Instructions for Completing the Visual Monitoring Form

Per PART V. INSPECTIONS, MONITORING, AND REPORTING, you must collect a stormwater sample from each outfall once each quarter for the entire permit term and conduct a visual assessment of each sample. You must follow the monitoring procedures outlined in Part V.C. These samples should be collected in such a manner that they are representative of the stormwater discharge from that outfall. Each assessment must be kept onsite with your SWPPP and available for inspection and review by the Department at anytime.

First, fill out all information on the top of the visual monitoring form. A qualifying storm event is any storm where there is a measurable discharge. Then, take a grab sample in a clear container. Evaluate the sample in a well-lit area for the following parameters:

1. **Color:** Record the best description of the sample color in the appropriate space on the form.
2. **Clarity**: This parameter refers to how cloudy the sample is. It is *usually* an indication of fewer pollutants in the water if the sample is clear or transparent. If the clarity has changed since the last sample, try to identify what might have caused this to happen.
   - **Clear** – Sample doesn't block any light; can be seen through regardless of color.
   - **Cloudy** – Sample blocks some light; objects not clear but can be identified looking through the sample.
   - **Very Cloudy** – Sample blocks most light; objects cannot be identified looking through the sample.
   - **Opaque** – Sample blocks all light; objects cannot be seen when looking through the sample.
3. **Oil Sheen:** Record whether an oil sheen is present. If a film of iridescent color is noted on the surface of the sample or a rainbow effect appears to be floating on the surface of the water, this indicates oil is present.
4. **Odor:** If sample has no odor other than natural rainwater or snowmelt, write "NO" on the visual monitoring form. Note the presence of any of the following odors if detected, such as gasoline, diesel, oil, solvents (WD-40, other petroleum products, etc.), garbage, fishy, sweet/sugary, any other unusual odors not normally present in clean runoff from the area sampled.
5. **Floating Solids:** A contaminated flow may contain solids or liquids floating on the surface. Identifying floatables can aid in finding the source of the contamination. Examples of floatables are spoiled food products, oils, plant parts, solvents, sawdust, foams and fuel. Give a general description of the type of floating solids present (wood chips, leaf debris, algae, etc) in the general comments section for each sample. Identify amount of floating solids as described below.
   - **High** – More than 20% of the surface of the sample is covered with floating solids.
   - **Moderate** – Less than 20% of the surface of the sample is covered with floating solids.
   - **Slight** – Only a few floating particles observed on the surface of the sample.
   - **None** – No floating solids present on the surface of the sample.
6. **Suspended solids:** Record whether or not suspended solids are present in the sample. Suspended solids are particles floating inside the column of water, not on top, and may contribute to changes in water color or clarity. Cracked or deteriorated concrete or peeling surface paint at an outfall usually indicates the presence of severely contaminated discharges. Contaminants causing this type of damage are usually very acidic or basic.

------------------------------------ WAIT 30 MINUTES ------------------------------------

Leave the sample undisturbed for 30 minutes to allow the water and anything in it to settle.

7. **Settled Solids:** After 30 minutes has passed, give a general description of the type of settled solids present (sand, decayed plant matter, rust particles, etc.) in the general comments section.
8. **Foam:** After completing #7, shake the bottle gently. Record foam results on the form as they most closely match one of the descriptions listed below.
   - **None** – Most bubbles break down within ten (10) seconds of shaking; only a few large bubbles persist longer than ten (10) seconds.
   - **Moderate** – Many small bubbles are present but these bubbles persist for less than two (minutes) after shaking.
   - **High** – Many small bubbles are present and they persist longer than two (2) minutes after shaking.
9. Detail any concerns, corrective actions taken and any other indicators of pollution present in the sample. This should include the identified source if there are visible indicators present in the sample. The person performing test must sign and date each form.

Appendix C: [RESERVED]

Appendix D: Sector-Specific Requirements for Industrial Activity

Table of Contents

You must comply with Appendix D sector-specific requirements associated with your primary industrial activity and any co-located industrial activities, as defined in Appendix A. The sector-specific requirements apply to those areas of your facility where those sector-specific activities occur. These sector-specific requirements are in addition to any requirements specified elsewhere in this permit.

Sector A – Timber Products.

A.1 Covered Stormwater Discharges.

The requirements in Sector A apply to stormwater discharges and certain non-stormwater discharges (Part A.7) associated with industrial activity from Timber Products facilities as identified by the SIC Codes specified under Sector A in Appendix A of the permit.

A.2 Limitation on Coverage

A.2.1 *Prohibition of Discharges.* (See also Part I.C) Not covered by this permit: stormwater discharges from areas where there may be contact with the chemical formulations sprayed to provide surface protection. These discharges must be covered by a separate NPDES permit.

A.2.2 *Authorized Non-Stormwater Discharges.* (See also Part I.E) Also authorized by this permit, provided the non-stormwater component of the discharge is in compliance with the requirements in Part III.B.1 (Non-Numeric Effluent Limits): discharges from the spray down of lumber and wood product storage yards where no chemical additives are used in the spray-down waters and no chemicals are applied to the wood during storage.

A.3 Additional Technology-Based Effluent Limits.

A.3.1 *Good Housekeeping.* (See also Part III.B.1.b.ii) In areas where storage, loading and unloading, and material handling occur, perform good housekeeping to limit the discharge of wood debris, minimize the leachate generated from decaying wood materials, and minimize the generation of dust.

A.4 Additional SWPPP Requirements.

A.4.1 *Drainage Area Site Map.* (See also Part III.C.2) Document in your SWPPP where any of the following may be exposed to precipitation or surface runoff: processing areas, treatment chemical storage areas, treated wood and residue storage areas, wet decking areas, dry decking areas, untreated wood and residue storage areas, and treatment equipment storage areas.

A.4.2 *Inventory of Exposed Materials.* (See also Part III.C.3) Where such information exists, if your facility has used chlorophenolic, creosote, or chromium-copper-arsenic formulations for wood surface protection or preserving, document in your SWPPP the following: areas where contaminated soils, treatment equipment, and stored materials still remain and the management practices employed to minimize the contact of these materials with stormwater runoff.

A.4.3 *Description of Stormwater Management Controls.* (See also Part III.C.4) Document measures implemented to address the following activities and sources: log, lumber, and wood product storage areas; residue storage areas; loading and unloading areas; material handling areas; chemical storage areas; and equipment and vehicle maintenance, storage, and repair areas. If your facility performs wood surface protection and preservation activities, address the specific control measures, including any BMPs, for these activities.

A.5 Additional Inspection Requirements.

See also Part V.A. If your facility performs wood surface protection and preservation activities, inspect processing areas, transport areas, and treated wood storage areas monthly to assess the usefulness of practices to minimize the deposit of treatment chemicals on unprotected soils and in areas that will come in contact with stormwater discharges.

A.6 Sector-Specific Benchmarks

Table A-1 and A-2 identify benchmarks that apply to the specific subsectors of Sector A. These benchmarks apply to both your primary industrial activity and any co-located industrial activities, which describe your site activities. You may be subject to requirements for more than one sector/subsector.

Table A-1 Sector A3 Benchmarks (Log Storage and Handling Facilities SIC 2411)

Parameter	Benchmark	Units	Frequency	Sample Type
Total Suspended Solids (TSS)	100.0	mg/L	1/quarter	Grab

Table A-2 Sector A4 Benchmarks (Natural Woodwaste Facilities SIC 2499)

Parameter	Benchmark	Units	Frequency	Sample Type
Chemical Oxygen Demand (COD)	120.0	mg/L	1/quarter	Grab
Total Suspended Solids (TSS)	100.0	mg/L	1/quarter	Grab

A.7 Effluent Limitations Based on Effluent Limitations Guidelines. (See also Part V.B and Part V.C of the permit.)

Table A-3 identifies effluent limits that apply to the discharges resulting from spray down or intentional wetting of logs at wet deck storage areas. Compliance with these effluent limits is to be determined based on discharges from these industrial activities independent of commingling with any other waste streams that may be covered under this permit.

Table A-3 Numeric Limits for Discharges from Wet Deck Storage Areas

PARAMETER	Effluent Limit	Units	Frequency	Sample Type
pH	6.0 - 9.0	s.u.	1/month	Grab
Debris (woody material such as bark, twigs, branches, heartwood, or sapwood)	No Discharge of debris that will not pass through a 2.54 cm (1 inch) diameter round opening	lbs	1/month	Grab

Sector C – Chemical & Allied Products Manufacturing, and Refining.

C.1 Covered Stormwater Discharges.

The requirements in Sector C apply to stormwater discharges associated with industrial activity from Chemical and Allied Products Manufacturing, and Refining facilities, as identified by the SIC Codes specified under Sector C of Appendix A of the permit.

C.2 Limitations on Coverage.

C.2.1 *Prohibition of Non-Stormwater Discharges.* (See also Part I.C) The following are not covered by this permit: non-stormwater discharges containing inks, paints, or substances (hazardous, nonhazardous, etc.) resulting from an onsite spill, including materials collected in drip pans; washwater from material handling and processing areas; and washwater from drum, tank, or container rinsing and cleaning.

C.3 Sector-Specific Benchmarks

Table C-1 identifies benchmarks that apply to the specific subsector of Sector C. These benchmarks apply to both your primary industrial activity and any co-located industrial activities. You may be subject to requirements for more than one sector/subsector.

Table C-1 Subsector C1 Benchmarks (Composting Facilities SIC Code 2875)

PARAMETER	Benchmark	Units	Frequency	Sample Type
Nitrate plus Nitrite Nitrogen[1]	0.68	mg/L	1/quarter	Grab
Total Lead[2]	0.082	mg/L	1/quarter	Grab
Total Iron	1.0	mg/L	1/quarter	Grab
Total Zinc[2]	0.014	mg/L	1/quarter	Grab
Phosphorus	2.0	mg/L	1/quarter	Grab

Notes:
(1) The benchmark values for nitrate plus nitrite nitrogen may be reported as either the concentration in the discharge, or as a net concentration calculated by subtracting the concentration of nitrate plus nitrite nitrogen in a contemporaneous sample of rainwater from the concentration in the discharge.
(2) The benchmark values of some metals are dependent on water hardness. For these parameters, you must determine the hardness of the receiving water per Table C-2.

Table C-2. Hardness Ranges to Be Used to Determine Benchmark Values.

All Units mg/L	Benchmark Values (mg/L, total)	
	Lead	Zinc
0-24.99 mg/L	0.014	0.04
25-49.99 mg/L	0.023	0.05
50-74.99 mg/L	0.045	0.08
75-99.99 mg/L	0.069	0.11
100-124.99 mg/L	0.095	0.13
125-149.99 mg/L	0.122	0.16
150-174.99 mg/L	0.151	0.18
175-199.99 mg/L	0.182	0.20
200-224.99 mg/L	0.213	0.23
225-249.99 mg/L	0.246	0.25
250+ mg/L	0.262	0.26

C.4 Effluent Limitations Based on Effluent Limitations Guidelines. (See also Part V.B and Part V.C of the permit.)

Table C-3 identifies effluent limits that apply to the runoff from phosphate fertilizer manufacturing facilities that comes into contact with any raw materials, finished product, by-products or waste products. Compliance with these effluent limits is to be determined based on discharges from these industrial activities independent of commingling with any other waste streams that may be covered under this permit.

Table C-3 Numeric Limits for Discharges from Phosphate Fertilizer Manufacturing (SIC 2874)

PARAMETER	Effluent Limit	Units	Frequency	Sample Type
Total Phosphorus (as P)	105.0, daily maximum 35, 30-day avg.	mg/L	1/month	Grab
Fluoride	75.0, daily maximum 25.0, 30-day avg.	mg/L	1/month	Grab

Sector D – Asphalt Paving and Roofing Materials and Lubricant Manufacturing.

D.1 Covered Stormwater Discharges.

The requirements in Sector D apply to stormwater discharges associated with industrial activity from Asphalt Paving and Roofing Materials and Lubricant Manufacturing facilities, as identified by the SIC Codes specified under Sector D of Appendix A of the permit.

D.2 Limitations on Coverage.

The following stormwater discharges associated with industrial activity are not authorized by this permit (See also Part I.C)
D.2.1 Discharges from petroleum refining facilities, including those that manufacture asphalt or asphalt products, that are subject to nationally established effluent limitation guidelines found in 40 CFR Part 419 (Petroleum Refining); or
D.2.2 Discharges from oil recycling facilities; or
D.2.3 Discharges associated with fats and oils rendering.

D.3 Additional SWPPP Requirements.

D.3.1 *Drainage Area Site Map.* (See also Part III.C.2) For portable batch plants at construction sites, the area of influence must be clearly delineated in the SWPPP's site map.

D.4 Sector-Specific Benchmarks and Visual Monitoring

Table D-1 identifies benchmarks that apply to the specific subsectors of Sector D. These benchmarks apply to both your primary industrial activity and any co-located industrial activities, which describe your site activities. Asphalt plants shutdown during winter months should note on the visual monitoring form for that quarter that no samples were taken due to the seasonal shutdown.

Table D-1 Subsector D1 Benchmarks (Asphalt Paving and Roofing Materials SIC 2951, 2952)

PARAMETER	Benchmark	Units	Frequency	Sample Type
Total Suspended Solids (TSS)	100	mg/L	1/quarter[1]	Grab

(1) For asphalt plants shutdown during the winter months, use report code "NODI-9" on your Discharge Monitoring Report (DMR) to indicate that quarter discharge benchmark will not be evaluated.

D.5 Effluent Limitations Based on Effluent Limitations Guidelines (See also Part V.B and V.C)

Table D-2 identifies effluent limits that apply to the industrial activities described below. Compliance with these effluent limits is to be determined based on discharges from these industrial activities independent of commingling with any other wastestreams that may be covered under this permit.

Table D-2 Numeric Limits for Discharges from Asphalt Emulsion Facilities

PARAMETER	Effluent Limit	Units	Frequency	Sample Type
Total Suspended Solids (TSS)	23.0 daily maximum, 15.0 30-day avg.	mg/L	1/month	Grab
pH (monthly average)	6.5 - 8.5	s.u.	1/month	Grab
pH (daily maximum)	6.0 - 9.0	s.u.	1/month	Grab
Oil and Grease	15.0 daily maximum, 10.0 30-day avg.	mg/L	1/month	Grab

Sector E – Glass, Clay, Cement, Concrete, and Gypsum Products.

E.1 Covered Stormwater Discharges.

The requirements in Sector E apply to stormwater and certain wastewater (Part E.6) discharges associated with industrial activity from Glass, Clay, Cement, Concrete, and Gypsum Products facilities, as identified by the SIC Codes specified under Sector E in Appendix A of the permit.

E.2 Additional Technology-Based Effluent Limits.

E.2.1 *Good Housekeeping Measures.* (See also Part III.B.1.b.ii) As part of your good housekeeping program, prevent or minimize the discharge of spilled cement, aggregate (including sand or gravel), kiln dust, fly ash, settled dust, or other significant material in stormwater from paved portions of the site that are exposed to stormwater. Sweep or vacuum paved surfaces of the site that are exposed to stormwater at regular intervals or use other equivalent measures (e.g., wash down the area and collect and/or treat and properly dispose of the washdown water) to minimize the potential discharge of these materials in stormwater. Indicate in your SWPPP the frequency of sweeping, vacuuming or other equivalent measures. Determine the frequency based on the amount of industrial activity occurring in the area and the frequency of precipitation, but it must be performed at least once a week in areas where cement, aggregate, kiln dust, fly ash or settled dust are being handled or processed and may be discharged in stormwater. You must also prevent the exposure of fine granular solids (e.g., cement, fly ash, kiln dust) to stormwater, where practicable, by storing these materials in enclosed silos, hoppers, buildings or under other covering.

E.3 Additional SWPPP Requirements.

E.3.1 *Drainage Area Site Map.* (See also Part III.C.2) Document in the SWPPP the locations of the following, as applicable: bag house or other dust control device; recycle/sedimentation pond, clarifier, or other device used for the treatment of process wastewater; and the areas that drain to the treatment device. For batch plants at construction sites, the area of influence must be clearly delineated in the site map.

E.3.2 *Certification.* (See also Part III.B.1.b.x) For facilities producing ready-mix concrete, concrete block, brick, or similar products, include in the non-stormwater discharge certification a description of measures that ensure that process waste waters resulting from washing trucks, mixers, transport buckets, forms, or other equipment are discharged in accordance with numeric limits in Part E.6 of this Appendix or are recycled.

E.4 Sector-Specific Benchmarks.

Tables E-1 and E-2 identify benchmarks that apply to the specific subsectors of Sector E. These benchmarks apply to both your primary industrial activity and any co-located industrial activities, which describe your site activities. You may be subject to requirements for more than one sector/subsector.

Table E-1 Subsector E1 Benchmarks (Clay Product Manufacturers SIC 3251-3259, 3261-3269)

PARAMETER	Benchmark	Units	Frequency	Sample Type
Total Aluminum	0.75	mg/L	1/quarter	Grab

Table E-2 Subsector E2 Benchmarks (Concrete and Gypsum Product Manufacturers SIC 3271-3275)

PARAMETER	Benchmark	Units	Frequency	Sample Type
Total Suspended Solids (TSS)	100	mg/L	1/quarter	Grab

E.5 Effluent Limitations Based on Effluent Limitations Guidelines (See also Part V.B and Part V.C of the permit.)

Table E-3 identifies effluent limits that apply to the industrial activities described below. Compliance with these limits is to be determined based on discharges from these industrial activities independent of commingling with any other wastestreams that may be covered under this permit.

Table E-3 Numeric Limits for Material Storage Pile Runoff at Cement Manufacturing Facilities

PARAMETER	Effluent Limit	Units	Frequency	Sample Type
Total Suspended Solids (TSS)	50 daily maximum[1]	mg/L	1/month	Grab
pH (daily maximum)	6.0 - 9.0[1]	s.u.	1/month	Grab

Notes:
(1) Any untreated overflow from facilities designed, constructed and operated to treat the volume of runoff from materials storage piles which is associated with a 10-year, 24-hour rainfall event shall not be subject to the pH and TSS limitations (40 CFR 411.32(b)).

E.6 Washwater from concrete plant operations.

E.6.1 *Vehicle Wash Prohibitions.* You are prohibited from discharging or causing to be discharged any automotive fluids (i.e. waste oil, fuels, grease, antifreeze such as ethylene glycol, organic solvents, or paint) or washwater from engine or under-carriage cleaning. Additionally, the use of soaps to wash vehicles is prohibited if it results in a surface water discharge.

E.6.2 *Additional Technology-Based Effluent Limits.* You must design, select and implement an appropriate wastewater treatment system to meet the limits of this permit. The system must include the following components.

E.6.2.1 Dedicated Area.
Your concrete washout and/or vehicle washing must be performed in an area dedicated to the washing activity and must be separate from any area where vehicle maintenance work is performed. This dedicated area must be identified as a dedicated washing area with signage. If this area may be used by anyone not trained on your practices, include any prohibitions on the signage to aid in compliance with this permit.

E.6.2.2 Inspection and Maintenance.
You must inspect components of any wastewater treatment system - including grit traps, floor drains, oil/water separators, and drainfield, as part of your routine facility inspections. You must remove waste materials from these components before such material would cause the discharge of pollutants, but not less than once per year.

E.6.2.3 Required Documentation.
You must maintain a record of following:

- any observations of a visible oil sheen and description of any resulting actions that may have been taken to resolve; and
- calculations of your water use.

E.6.3 *Groundwater Discharges.* Wastewater containing oil and grease from the use of moulds and vehicle washwater shall be observed for oil and grease prior to being allowed to infiltrate into ground waters. If either a visible oil sheen or evidence of oil and grease exists (Note Part V.D), you shall contain and dispose of this wastewater to a sanitary sewer in accordance with applicable industrial pretreatment requirements, or dispose otherwise in accordance with applicable law.

E.6.4 *Surface Water Discharges.*

E.6.4.1 Concrete Washout

All surface water discharges from washing concrete mixer trucks, moulds, or equipment and of excess feed water shall be monitored by the permittee at each discharge point associated with the wash water and limited as specified below in Table E-4. This includes routine vehicle wash water, if mixed with the concrete washout.

Table E-4 Numeric Limits for Concrete Washout from Concrete Mixer Trucks, Moulds, or Equipment.

PARAMETER	Limits			Monitoring Frequency	Sample Type
	Monthly Average	Daily Maximum	UNITS		
Flow	REPORT	REPORT	gpd	1/month	measured
pH	6.5 – 8.5	6.0 – 9.0	s.u.		grab
Total Suspended Solids (TSS)	30	60	mg/L		
Oil & Grease		15[(a)]	mg/L		

No visible sheen is permissible on any water discharging from the facility.

Notes:

(a) Pertains to SIC 3272 concrete plants using molds.

E.6.4.2 Vehicle Wash Water

All surface water discharges exclusively containing vehicle wash water shall be monitored by the permittee at each discharge point associated and limited as specified below in Table E-5.

Table E-5 Numeric Reporting and Limits for Vehicle Wash Water.

PARAMETER	Limits				Monitoring Frequency	Sample Type
	Daily Minimum	Monthly Average	Daily Maximum	UNITS		
Flow		REPORT	REPORT	gpd	1/month	measured

No visible sheen is permissible on any water discharging from the facility.

Sector F – Primary Metals.

F.1 Covered Stormwater Discharges.

The requirements in Sector F apply to stormwater discharges associated with industrial activity from Primary Metals facilities, as identified by the SIC Codes specified under Sector F in Appendix A of the permit.

F.2 Additional Technology-Based Effluent Limits

F.2.1 *Good Housekeeping Measures*. (See also Part III.B.1.b.ii) As part of your good housekeeping program, include a cleaning and maintenance program for all impervious areas of the facility where particulate matter, dust, or debris may accumulate, especially areas where material loading and unloading, storage, handling, and processing occur; and, where practicable, the paving of areas where vehicle traffic or material storage occur but where vegetative or other stabilization methods are not practicable (institute a sweeping program in these areas too). For unstabilized areas where sweeping is not practicable, consider using stormwater management devices such as sediment traps, vegetative buffer strips, filter fabric fence, sediment filtering boom, gravel outlet protection, or other equivalent measures that effectively trap or remove sediment.

F.3 Additional SWPPP Requirements.

F.3.1 *Drainage Area Site Map*. (See also Part III.C.2) Identify in the SWPPP where any of the following activities may be exposed to precipitation or surface runoff: storage or disposal of wastes such as spent solvents and baths, sand, slag and dross; liquid storage tanks and drums; processing areas including pollution control equipment (e.g., baghouses); and storage areas of raw material such as coal, coke, scrap, sand, fluxes, refractories, or metal in any form. In addition, indicate where an accumulation of significant amounts of particulate matter could occur from such sources as furnace or oven emissions, losses from coal and coke handling operations, etc., and could result in a discharge of pollutants to waters of the United States.
F.3.2 *Inventory of Exposed Material*. (See also Part III.C.3) Include in the inventory of materials handled at the site that potentially may be exposed to precipitation or runoff, areas where deposition of particulate matter from process air emissions or losses during material-handling activities are possible.

F.4 Additional Inspection Requirements. (See also Part V.A)

As part of conducting your quarterly routine facility inspections, address all potential sources of pollutants, including (if applicable) air pollution control equipment (e.g., baghouses, electrostatic precipitators, scrubbers, and cyclones), for any signs of degradation (e.g., leaks, corrosion, or improper operation) that could limit their efficiency and lead to excessive emissions. Consider monitoring air flow at inlets and outlets (or use equivalent measures) to check for leaks (e.g., particulate deposition) or blockage in ducts. Also inspect all process and material handling equipment (e.g., conveyors, cranes, and vehicles) for leaks, drips, or the potential loss of material; and material storage areas (e.g., piles, bins, or hoppers for storing coke, coal, scrap, or slag, as well as chemicals stored in tanks and drums) for signs of material losses due to wind or stormwater runoff.

F.5 Intentionally Left Blank

Sector G – [Reserved].

Sector J – Non-Metallic Mineral Mining and Dressing.

Note: Where compliance with a requirement in a separate exploration permit, mining permit, reclamation plan, Surface Mining Control and Reclamation Act (SMCRA) requirements, etc. will result in you fully meeting any requirement in this Subpart, you are considered to have complied with the relevant requirement in this Subpart. You must include documentation in your SWPPP describing your rationale for concluding that any particular action on your part is sufficient to comply with the corresponding requirement in this Subpart.

J.1 Covered Stormwater Discharges.

The requirements in Sector J apply to stormwater and certain process water discharges associated with industrial activity from Active and Inactive Non-Metallic Mineral Mining and Dressing facilities as identified by the SIC Codes specified under Sector J in Appendix A of the permit.

J.1.1 *Covered Discharges from Inactive Facilities.* All stormwater discharges.

J.1.2 *Covered Discharges from Active and Temporarily Inactive Facilities.* All stormwater discharges, except for most stormwater discharges subject to the existing effluent limitation guideline at 40 CFR Part 436. Mine dewatering discharges composed entirely of stormwater or uncontaminated ground water seepage from: construction sand and gravel, industrial sand, and crushed stone mining facilities.

J.1.3 *Covered Discharges from Exploration and Construction of Non-Metallic Mineral Mining Facilities.* All stormwater discharges.

J.1.4 *Covered Discharges from Sites Undergoing Reclamation.* All stormwater discharges.

J.2 Limitations on Coverage.

Most stormwater discharges subject to an existing effluent limitation guideline at 40 CFR Part 436 are not authorized by this permit. The exceptions to this limitation, which are covered by this permit, are mine dewatering discharges composed entirely of stormwater or uncontaminated ground water seepage from construction sand and gravel, industrial sand, and crushed stone mining facilities. This coverage doesn't include industrial sand and gravel that use hydrofluoric acid flotation (HF).

J.3 Definitions.

The following definitions are not intended to supersede the definitions of active and inactive mining facilities established by 40 CFR 122.26(b)(14)(iii).

J.3.1 ***Mining operations*** – For this permit, mining operations are grouped into two distinct categories, with distinct effluent limits and requirements applicable to each: a) earth-disturbing activities conducted prior to active mining activities; and b) active mining activities, which includes reclamation. "Mining operations" can occur at both inactive mining facilities and temporarily inactive mining facilities.

J.3.2 ***Earth-disturbing activities conducted prior to active mining activities*** – Consists of two classes of earth-disturbing (i.e., clearing, grading and excavation) activities:

a. activities performed for purposes of mine site preparation, including: cutting new rights of way (except when related to access road construction); providing access to a mine site for vehicles and equipment (except when related to access road construction); other earth disturbances associated with site preparation activities on any areas where active mining activities have not yet commenced (e.g., for heap leach pads, waste rock facilities, tailings impoundments, wastewater treatment plants); and
b. construction of staging areas to prepare for erecting structures such as to house project personnel and equipment, mill buildings, etc., and construction of access roads. Earth-

disturbing activities associated with the construction of staging areas and the construction of access roads conducted prior to active mining are considered to be “construction” and have additional effluent limits in Part J.4.2.

J.3.3 ***Active mining activities*** – Activities related to the extraction, removal or recovery, and benefication of non-metallic minerals from the earth; removal of overburden and waste rock to expose mineable minerals; and site reclamation and closure activities. All such activities occur within the “active mining area.” Reclamation involves activities undertaken, in compliance with applicable mined land reclamation requirements, to return the land to an appropriate post-mining contour and land use in order to meet applicable federal and state reclamation requirements. In addition, once earth-disturbing activities conducted prior to active mining activities have ceased and all related requirements in Part J.4 have been met, and a well-delineated “active mining area” has been established, all activities (including any clearing, grading, and excavation) that occur within the active mining area are “active mining activities

J.3.4 ***Active mining area*** – A place where work or other activity related to the extraction, removal or recovery of non-metallic minerals is being conducted, except, with respect to surface mines, any area of land on or in which grading has been completed to return the earth to desired contour and reclamation work has begun.
Note: Earth-disturbing activities described in the definition in Part J.3.2 that occur on areas outside the active mining area (e.g., for expansion of the mine into undeveloped territory) are considered “earth-disturbing conducted prior to active mining activities”, and must comply with the requirements in Part J.4.

J.3.5 ***Inactive mineral mining facility*** – A site or portion of a site where mineral mining and/or milling occurred in the past but there are no active mining activities occurring as defined above, and where the inactive portion is not covered by an active mining permit issued by the applicable state or federal agency. An inactive mineral mining facility has an identifiable owner / operator. Sites where mining claims are being maintained prior to disturbances associated with the extraction, beneficiation, or processing of mined materials, and sites where minimal activities are undertaken for the sole purpose of maintaining a mining claim are not considered either active or inactive mining facilities and do not require an NPDES industrial stormwater permit.

J.3.6 ***Temporarily inactive mineral mining facility*** – A site or portion of a site where non-metallic mineral mining and/or milling occurred in the past but currently are not being actively undertaken, and the facility is covered by an active mining permit issued by the applicable state or federal agency.

J.4 Requirements Applicable to Earth-Disturbing Activities Conducted Prior to Active Mining Activities.

Stormwater discharges from earth-disturbing activities conducted prior to active mining activities (defined in Part J.3.2) are covered under this permit. You cannot begin discharging stormwater associated with that portion of the operation until you have been issued a mining permit, and an updated and approved erosion & sediment control plan.

J.5 Technology-Based Effluent Limits for Active Mining Activities.

Note: These requirements do not apply for any discharges from earth-disturbing activities conducted prior to active-mining as defined in J.3.2(a) or J.3.2(b).

J.5.1 *Employee Training.* Conduct employee training at least annually at active and temporarily inactive sites. (See also Part III.C.1.b.ix)

J.5.2 *Stormwater Controls*. Apart from the control measures you implement to meet your Part III.B effluent limits, where necessary to minimize pollutant discharges, implement the following control measures at your site. The potential pollutants identified in Part J.5.3 shall determine the priority and appropriateness of the control measures selected.

Stormwater Diversions: Divert stormwater away from potential pollutant sources through implementation of control measures such as the following, where determined to be feasible (list not exclusive): interceptor or diversion controls (e.g., dikes, swales, curbs, berms); pipe slope drains; subsurface drains; conveyance systems (e.g., channels or gutters, open-top box culverts, and waterbars; rolling dips and road sloping; roadway surface water deflector and culverts); or their equivalents. For mines subject to dust control requirements under state or county air quality permits, provided the requirements are equivalent, compliance with such air permit dust requirements shall constitute compliance with the dust control effluent limit in Part III.B.1.b.xii.

Capping: When capping is necessary to minimize pollutant discharges in stormwater, identify the source being capped and the material used to construct the cap.

Treatment: If treatment of stormwater (e.g., chemical or physical systems, oil and water separators, artificial wetlands) is necessary to protect water quality, describe the type and location of treatment used. Passive and/or active treatment of stormwater runoff is encouraged. Treated runoff may be discharged as a stormwater source regulated under this permit provided the discharge is not combined with discharges subject to effluent limitation guidelines for the Mineral Mining and Processing Point Source Category (40 CFR Part 436).

J.5.3 *Discharge Testing.* (See also Part III.C.3.d) Test or evaluate all outfalls covered under this permit for the presence of specific mining-related but unauthorized non-stormwater discharges such as discharges subject to effluent limitations guidelines (e.g., 40 CFR Part 436). Alternatively (if applicable), you may keep a certification with your SWPPP, per Part J.6.6.

J.6 Additional SWPPP Requirements.

The requirements in Part J.6 are not applicable to inactive mineral mining facilities.

J.6.1 *Nature of Industrial Activities.* (See also Part III.C.2) Document in your SWPPP the mining and associated activities that can potentially affect the stormwater discharges covered by this permit, including a general description of the location of the site relative to major transportation routes and communities.

J.6.2 *Site Map.* (See also Part III.C.2) Document in your SWPPP the locations of the following (as appropriate): mining or milling site boundaries; access and haul roads; outline of the drainage areas of each stormwater outfall within the facility with indications of the types of discharges from the drainage areas; location(s) of all permitted discharges covered under an individual NPDES permit, outdoor equipment storage, fueling, and maintenance areas; materials handling areas; outdoor manufacturing, outdoor storage, and material disposal areas; outdoor chemicals and explosives storage areas; overburden, materials, soils, or waste storage areas; location of mine drainage dewatering or other process water; heap leach pads; off-site points of discharge for mine dewatering and process water; surface waters; boundary of tributary areas that are subject to effluent limitations guidelines; and location(s) of reclaimed areas.

J.6.3 *Potential Pollutant Sources.* (See also Part III.C.3) For each area of the mine or mill site where stormwater discharges associated with industrial activities occur, document in your SWPPP (or in an Environmental Management System (EMS) accessible by site personnel) the types of pollutants (e.g., heavy metals, sediment) likely to be present in significant amounts. For example, phosphate mining facilities will likely need to document pollutants such as selenium, which can be present in significant amounts in their discharges. Consider these factors: the mineralogy of the waste rock (e.g., acid forming); toxicity and quantity of chemicals used, produced, or discharged; the likelihood of contact with stormwater; vegetation of site (if any); and history of significant leaks or spills of toxic or hazardous pollutants. Also include a summary of any existing waste rock or overburden characterization data and test results for potential generation of acid rock drainage.

J.6.4 *Documentation of Control Measures.* To the extent that you use any of the control measures in Part J.5.2, document them in your SWPPP pursuant to Part III.C.4. If control measures are implemented or planned but are not listed here (e.g., substituting a less toxic chemical for a more toxic one), include descriptions of them in your SWPPP. If you are in compliance with dust control requirements under state or county air quality permits, you must state (or summarize, as necessary) what the state or county air quality permit dust control requirements are and how you've achieved compliance with them.

J.6.5 *Employee Training.* All employee training(s) conducted in accordance with Part J.5.1 must be documented with the SWPPP (or in an Environmental Management System (EMS) accessible by site personnel).

J.6.6 *Certification of Permit Coverage for Commingled Non-Stormwater Discharges.* If you determine that you are able to certify, consistent with Part J.5.3, that a particular discharge composed of commingled stormwater and non-stormwater is covered under a separate NPDES permit, and that permit subjects the non-stormwater portion to effluent limitations prior to any commingling, you must retain such certification with your SWPPP. This certification must identify the non-stormwater discharges, the applicable NPDES permit(s), the effluent limitations placed on the non-stormwater discharge by the permit(s), and the points at which the limitations are applied.

J.7 Additional Inspection Requirements.

Except for earth-disturbing activities conducted prior to active mining activities as defined in Part J.3.2(a) and J.3.2(b), perform inspections at least quarterly unless adverse weather conditions make the site inaccessible. Sites which discharge to waters which are designated as Tier 2 or waters which are impaired for sediment must be inspected monthly. See Part J.8.1 for inspection requirements for inactive and unstaffed sites.

J.8 Sector-Specific Benchmarks

Tables J-1 identifies benchmarks that apply to the specific subsectors of Sector J. These benchmarks apply to both your primary industrial activity and any co-located industrial activities, which describe your site activities. You may be subject to requirements for more than one sector/subsector. Note: There are no Part J.8 monitoring and reporting or impaired waters monitoring requirements for inactive and unstaffed sites.

Table J-1 Sector J1 Benchmarks Sand and Gravel Mining (SIC 1442-1446) and Stone and Minerals (SIC 1411, 1422-1429, 1481, 1499)

Parameter	Benchmark	Units	Frequency	Sample Type
Total Suspended Solids (TSS)	100	mg/L	1/quarter	Grab

J.8.1 Inactive and Unstaffed Sites – Conditional Exemption from No Exposure Requirement for Routine Inspections, Quarterly Visual Assessments, and Benchmark Monitoring and Impaired Waters Monitoring. As a Sector J facility, if you are seeking to exercise a waiver from either the routine inspection, quarterly visual assessment or the benchmark and/or impaired monitoring requirements for inactive and unstaffed sites (including temporarily inactive sites), you are conditionally exempt from the requirement to certify that "there are no industrial materials or activities exposed to stormwater" in Parts V.A.4 and V.B.5, respectively. This exemption is conditioned on the following:

- If circumstances change and your facility becomes active and/or staffed, this exception no longer applies and you must immediately begin complying with the applicable benchmark monitoring requirements as if you were in your first year of permit coverage, and the quarterly visual assessment requirements; and
- The Department retains the authority to revoke this exemption and/or the monitoring waiver where it is determined that the discharge causes, has a reasonable potential to cause, or contributes to an instream excursion above an applicable water quality standard, including designated uses.

Subject to the two conditions above, if your facility is inactive and unstaffed, you are waived from the requirement to conduct routine facility inspections, quarterly visual assessments, and benchmark and impaired waters monitoring. You must still conduct an annual site inspection in accordance with Part V.A.2. You are encouraged to inspect your site more frequently where you have reason to believe that severe weather or natural disasters may have damaged control measures or increased discharges.

J.9 Effluent Limitations Process Water and Dewatering Based on Effluent Limitations Guidelines for Dewatering (See also Part V.B and Part V.C of the permit)

Tables J-2 through J-5 identify effluent limits that apply to the industrial activities described below during dry weather conditions. Compliance with these effluent limits is to be determined based on discharges from these industrial activities independent of commingling with any other wastestreams that may be covered under this permit.

Table J-2 Numeric Limits for dewatering and/or process water discharges at crushed or broken limestone mining facilities (SIC 1422)

Parameter	Effluent Limit	Units	Frequency	Sample Type
Flow	REPORT monthly avg, and daily maximum	gpd	1/month	Measured
pH (daily maximum)	6.0 - 9.0	s.u.	1/month	Grab
pH (monthly average)	6.5 – 8.5	s.u.	1/month	Grab
Total Suspended Solids (TSS) – Dewatering Only	15 monthly avg, 31 daily maximum	mg/L	1/month	Grab (a)
Total Suspended Solids (TSS) – Dewatering and Process Water	17 monthly avg, 37 daily maximum	mg/L	1/month	Grab (a)
Temperature – Summer	REPORT	ºF	1/month	i-s (b)
Temperature Difference	0 maximum	ºF	1/month	Calculated (b, c)

Notes:

(a) Monthly average limits apply to every facility that discharges three or more times during the month. A discharge beginning one day and lasting into a second day is considered two discharges when determining whether or not the monthly average limit applies.

(b) For discharges to Use III or Use IV streams during June, July, August and September. Samples to be taken at the beginning of discharge and midway through discharge.

(c) Temperature Difference is determined by following the steps below until you verify you are either demonstrating compliance or noncompliance.

i) If the effluent temperature <= 68°F (Use III) or <= 75°F (Use IV), then report "Temperature Difference" = 0, demonstrating compliance. Otherwise proceed to the next step.

ii) Calculate “Temperature Difference” = effluent temperature - receiving water temperature upstream of the discharge. If the result is “<= 0” then report the negative value which is compliant. If it is “> 0” proceed to the next step.
iii) Calculate “Temperature Difference” = edge of mixing zone temperature (50 feet downstream of discharge) - [68°F (Use III) or 75°F (Use IV)]. If the result is “<= 0” then report the negative value which is compliant. If it is “>0” proceed to the next step.
iv) Calculate “Temperature Difference” = edge of mixing zone temperature (50 feet downstream of discharge) - receiving water temperature upstream of the discharge. If the result is “<= 0” then report the negative value which is compliant. If it is “>0” then report the positive value which is a permit violation.

Table J-3 Numeric Limits for dewatering discharges at crushed stone mining facilities (SIC 1423 – 1429)

Parameter	Effluent Limit	Units	Frequency	Sample Type
Flow	REPORT monthly avg, and daily maximum	gpd	1/month	Measured
pH (daily maximum)	6.0 - 9.0	s.u.	1/month	Grab
pH (monthly average)	6.5 – 8.5	s.u.	1/month	Grab
Total Suspended Solids (TSS) – Dewatering Only	30 monthly avg, 66 daily maximum	mg/L	1/month	Grab
Total Suspended Solids (TSS) – Dewatering and Process Water	45 monthly avg, 60 daily maximum	mg/L	1/month	Grab (a)
Temperature – Summer	REPORT	ºF	1/month	i-s (b)
Temperature Difference	0 maximum	ºF	1/month	Calculated (b, c)

Notes:

(a) Monthly average limits apply to every facility that discharges three or more times during the month. A discharge beginning one day and lasting into a second day is considered two discharges when determining whether or not the monthly average limit applies.

(b) For discharges to Use III or Use IV streams during June, July, August and September. Samples to be taken at the beginning of discharge and midway through discharge.

(c) Temperature Difference is determined by following the steps below until you verify you are either demonstrating compliance or noncompliance.
i) If the effluent temperature <= 68°F (Use III) or <= 75°F (Use IV), then report “Temperature Difference” = 0, demonstrating compliance. Otherwise proceed to the next step.
ii) Calculate “Temperature Difference” = effluent temperature - receiving water temperature upstream of the discharge. If the result is “<= 0” then report the negative value which is compliant. If it is “> 0” proceed to the next step.
iii) Calculate “Temperature Difference” = edge of mixing zone temperature (50 feet downstream of discharge) - [68°F (Use III) or 75°F (Use IV)]. If the result is “<= 0” then report the negative value which is compliant. If it is “>0” proceed to the next step.
iv) Calculate “Temperature Difference” = edge of mixing zone temperature (50 feet downstream of discharge) - receiving water temperature upstream of the discharge. If the result is “<= 0” then report the negative value which is compliant. If it is “>0” then report the positive value which is a permit violation.

Table J-4 Numeric Limits for dewatering discharges at construction sand and gravel mining facilities (SIC 1442) and clay mines (SIC 1455-1459)

Parameter	Effluent Limit	Units	Frequency	Sample Type
Flow	REPORT monthly avg, and daily maximum	gpd	1/month	Measured
pH (daily maximum)	6.0 - 9.0	s.u.	1/month	Grab
pH (monthly average)	6.5 – 8.5	s.u.	1/month	Grab
Total Suspended Solids (TSS) – Dewatering and/or Process Water	30 monthly avg, 60 daily maximum	mg/L	1/month	Grab (a)
Temperature – Summer	REPORT	ºF	1/month	i-s (b)
Temperature Difference	0 maximum	ºF	1/month	Calculated (b, c)

Notes:

(a) Monthly average limits apply to every facility that discharges three or more times during the month. A discharge beginning one day and lasting into a second day is considered two discharges when determining whether or not the monthly average limit applies.

(b) For discharges to Use III or Use IV streams during June, July, August and September. Samples to be taken at the beginning of discharge and midway through discharge.

(c) Temperature Difference is determined by following the steps below until you verify you are either demonstrating compliance or noncompliance.

i) If the effluent temperature <= 68°F (Use III) or <= 75°F (Use IV), then report "Temperature Difference" = 0, demonstrating compliance. Otherwise proceed to the next step.

ii) Calculate "Temperature Difference" = effluent temperature - receiving water temperature upstream of the discharge. If the result is "<= 0" then report the negative value which is compliant. If it is "> 0" proceed to the next step.

iii) Calculate "Temperature Difference" = edge of mixing zone temperature (50 feet downstream of discharge) - [68°F (Use III) or 75°F (Use IV)]. If the result is "<= 0" then report the negative value which is compliant. If it is ">0" proceed to the next step.

iv) Calculate "Temperature Difference" = edge of mixing zone temperature (50 feet downstream of discharge) - receiving water temperature upstream of the discharge. If the result is "<= 0" then report the negative value which is compliant. If it is ">0" then report the positive value which is a permit violation.

Table J-5 Numeric Limits for dewatering discharges at industrial sand mining facilities (SIC 1446)

Parameter	Effluent Limit	Units	Frequency	Sample Type
Flow	REPORT monthly avg, and daily maximum	gpd	1/month	Measured
Total Suspended Solids (TSS) – Dewatering and/or Process Water	25 monthly avg. 45 daily maximum	mg/L	1/month	Grab (a)
pH (daily maximum)	6.0 - 9.0	s.u.	1/month	Grab
pH (monthly average)	6.5 – 8.5	s.u.	1/month	Grab

Notes:

(a) Monthly average limits apply to every facility that discharges three or more times during the month. A discharge beginning one day and lasting into a second day is considered two discharges when determining whether or not the monthly average limit applies.

J.10 Vehicle washwater from mining operations.

Washwater from mining operations may be comingled with the other process water from the mining activity with the following restrictions.

J.10.1 *Vehicle Wash Prohibitions.* You are prohibited from discharging or causing to be discharged any automotive fluids (i.e. waste oil, fuels, grease, antifreeze such as ethylene glycol, organic solvents, or paint) or washwater from engine or under-carriage cleaning. Additionally, the use of soaps to wash vehicles is prohibited if it results in a surface water discharge.

J.10.2 *Additional Technology-Based Effluent Limits.* You must design, select and implement an appropriate wastewater treatment system to meet the limits of this permit. The system must include the following components.

J.10.2.1 Dedicated Area.
Your vehicle washing must be performed in an area dedicated to the exterior washing of vehicles and must be separate from any area where vehicle maintenance work is performed. This dedicated area must be identified as a dedicated washing area with signage. If this area may be used by anyone not trained on your practices, include any prohibitions on the signage to aid in compliance with this permit.

J.10.2.2 Inspection and Maintenance.
You must inspect components of any wastewater treatment system - including grit traps, floor drains, oil/water separators, and drainfield, as part of your routine facility inspections. You must remove waste materials from these components before such material would cause the discharge of pollutants, but not less than once per year.

J.10.2.3 Required Documentation.
You must maintain a record of the following:

- any observations of a visible oil sheen and description of any resulting actions that may have been taken to resolve; and
- calculations of your water use.

J.10.3 Groundwater Discharges.
Wastewater containing oil and grease from the vehicle washwater shall be observed for oil and grease prior to being allowed to infiltrate into ground waters. If either a visible oil sheen or evidence of oil and grease exists (Note Part V.D), you shall contain and dispose of this wastewater to a sanitary sewer in accordance with applicable industrial pretreatment requirements, or dispose otherwise in accordance with applicable law.

J.10.4 Vehicle Wash Water
All surface water discharges exclusively containing vehicle wash water shall be monitored by the permittee at each discharge point associated and limited as specified below in Table J-6.

Table J-6 Numeric Reporting and Limits for Vehicle Wash Water

PARAMETER	Limits				Monitoring Frequency	Sample Type
	Daily Minimum	Monthly Average	Daily Maximum	UNITS		
Flow		REPORT	REPORT	gpd	1/month	measured

No visible sheen is permissible on any water discharging from the facility. The permittee shall observe any vehicle or wheel washwater on each day the facility is in operation to verify compliance with this requirement.

J.11 Termination of Permit Coverage

J.11.1 *Termination of Permit Coverage for Sites Reclaimed After December 17, 1990.* A site or a portion of a site that has been released from applicable state or federal reclamation requirements after December 17, 1990, is no longer required to maintain coverage under this permit. If the site or portion of a site reclaimed after December 17, 1990, was not subject to reclamation requirements, the site or portion of the site is no longer required to maintain coverage under this permit if the site or portion of the site has been reclaimed as defined in Part J.3.5.

J.11.2 *Termination of Permit Coverage for Sites Reclaimed Before December 17, 1990.* A site or portion of a site that was released from applicable state or federal reclamation requirements before December 17, 1990, or that was otherwise reclaimed before December 17, 1990, is no longer required to maintain coverage under this permit if the site or portion of the site has been reclaimed. A site or portion of a site is considered to have been reclaimed if: (1) stormwater runoff that comes into contact with raw materials, intermediate byproducts, finished products, and waste products does not have the potential to cause or contribute to violations of state water quality standards, (2) soil disturbing activities related to mining at the sites or portion of the site have been completed, (3) the site or portion of the site has been stabilized to minimize soil erosion, and (4) as appropriate depending on location, size, and the potential to contribute pollutants to stormwater discharges, the site or portion of the site has been revegetated, will be amenable to natural revegetation, or will be left in a condition consistent with the post-mining land use.

Sector L – Landfills and Land Application Sites.

L.1 Covered Stormwater Discharges.

The requirements in Sector L apply to stormwater discharges associated with industrial activity from Landfills and Land Application Sites as identified by the Activity Code specified under Sector L in Appendix A of the permit.

L.2 Industrial Activities Covered by Sector L.

This permit may authorize stormwater discharges for Sector L facilities associated with waste disposal at landfills and land application sites that receive or have received industrial waste, including sites subject to regulation under Subtitle D of RCRA. This permit does not cover discharges from landfills that receive only municipal wastes.

L.3 Limitations on Coverage.

L.3.1 Prohibition of Non-Stormwater Discharges. (See also Part I.C Limitations on Coverage) The following discharges are not authorized by this permit: leachate, gas collection condensate, drained free liquids, contaminated ground water, laboratory wastewater, and contact washwater from washing truck and railcar exteriors and surface areas that have come in direct contact with solid waste at the landfill facility.

L.4 Definitions.

L.4.1 *Contaminated stormwater* - stormwater that comes into direct contact with landfill wastes, the waste handling and treatment areas, or landfill wastewater. Some areas of a landfill that may produce contaminated stormwater include (but are not limited to) the open face of an active landfill with exposed waste (no cover added); the areas around wastewater treatment operations; trucks, equipment, or machinery that has been in direct contact with the waste; and waste dumping areas.

L.4.2 *Drained free liquids* - aqueous wastes drained from waste containers (e.g., drums) prior to landfilling.

L.4.3 *Landfill wastewater* - as defined in 40 CFR Part 445 (Landfills Point Source Category) all wastewater associated with, or produced by, landfilling activities except for sanitary wastewater, non-contaminated stormwater, contaminated groundwater, and wastewater from recovery pumping wells. Landfill process wastewater includes, but is not limited to, leachate; gas collection condensate; drained free liquids; laboratory derived wastewater; contaminated stormwater; and contact washwater from washing truck, equipment, and railcar exteriors and surface areas that have come in direct contact with solid waste at the landfill facility.

L.4.4 *Non-contaminated stormwater* - stormwater that does not come into direct contact with landfill wastes, the waste handling and treatment areas, or landfill wastewater. Non-contaminated stormwater includes stormwater that flows off the cap, cover, intermediate cover, daily cover, and/or final cover of the landfill.

L.5 Additional Technology-Based Effluent Limits. [Reserved]

L.6 Additional SWPPP Requirements.

L.6.1 *Drainage Area Site Map.* (See also Part III.C.2) Document in your SWPPP where any of the following may be exposed to precipitation or surface runoff: active and closed landfill cells or trenches, active and closed land application areas, locations where open dumping is occurring or has occurred, locations of any known leachate springs or other areas where uncontrolled leachate may commingle with runoff, and leachate collection and handling systems.

L.6.2 *Summary of Potential Pollutant Sources.* (See also Part III.C.3) Document in your SWPPP the following sources and activities that have potential pollutants associated with them: fertilizer, herbicide, and pesticide application; earth and soil moving; waste hauling and loading or unloading; outdoor storage of significant materials, including daily, interim, and final cover material stockpiles as well as temporary waste storage areas; exposure of active and inactive landfill and land application areas; uncontrolled leachate flows; and failure or leaks from leachate collection and treatment systems.

L.7 Additional Inspection Requirements. (See also Part V.A)

L.7.1 *Inspections of Active Sites.* Except in arid and semi-arid climates, inspect operating landfills and land application sites at least once every 7 days. Focus on areas of landfills that have not yet been finally stabilized; active land application areas, areas used for storage of material and wastes that are exposed to precipitation, stabilization, and structural control measures; leachate collection and treatment systems; and locations where equipment and waste trucks enter and exit the site. Ensure that sediment and erosion control measures are operating properly. For stabilized sites and areas where land application has been completed, or where the climate is arid or semi-arid, conduct inspections at least once every month.

L.7.2 *Inspections of Inactive Sites.* Inspect inactive landfills and land application sites at least quarterly. Qualified personnel must inspect landfill stabilization and structural erosion control measures, leachate collection and treatment systems, and all closed land application areas.

L.8 Additional Post-Authorization Documentation Requirements.

L.8.1 *Recordkeeping and Internal Reporting.* Keep records with your SWPPP of the types of wastes disposed of in each cell or trench of a landfill or open dump. For land application sites, track the types and quantities of wastes applied in specific areas.

L.9 Sector-Specific Benchmarks

Table L-1L-2 identify benchmarks that may apply to your specific subsectors of Sector L. These benchmarks apply to both your primary industrial activity and any co-located industrial activities.

Table L-1 - Subsector L4 Benchmarks – Concrete Crushing With or Without Asphalt Recycling

Parameter	Benchmark	Units	Frequency	Sample Type
pH	6.0 - 9.0	s.u.	1/quarter	Grab
Total Suspended Solids (TSS)	100	mg/L	1/quarter	Grab

Table L-2 - Subsector L4 Benchmarks - Asphalt Recycling Only

Parameter	Benchmark	Units	Frequency	Sample Type
Total Suspended Solids (TSS)	100	mg/L	1/quarter	Grab

L.10. Effluent Limitations Based on Effluent Limitations Guidelines.

Discharges from non-hazardous waste landfills are required to meet specific effluent limits (40 CFR Part 445, Subpart B) and are therefore not covered by this permit. You must obtain an individual discharge permit to discharge this type of effluent.

Subpart P – Sector P – Land Transportation and Warehousing.

P.1 Covered Stormwater Discharges.

The requirements in Sector P apply to stormwater discharges associated with industrial activity from Land Transportation and Warehousing facilities as identified by the SIC Codes specified under Sector P in Appendix A of the permit.

P.2 Limitation on Coverage

P.2.1 Prohibited Discharges (see also Parts I.C) This permit does not authorize the discharge of vehicle/equipment/surface washwater, including tank cleaning operations. Such discharges must be authorized under a separate NPDES permit, discharged to a sanitary sewer in accordance with applicable industrial pretreatment requirements, or recycled on-site.

P.3 Additional Technology-Based Effluent Limits.

P.3.1 Good Housekeeping Measures. (See also Part III.B.1.b.ii) In addition to the Good Housekeeping requirements in Part III.B.1.b.ii, you must do the following. Recommended control measures are discussed as indicated:

P.3.1.1 Vehicle and Equipment Storage Areas. Minimize the potential for stormwater exposure to leaky or leak-prone vehicles/equipment awaiting maintenance. Consider the following (or other equivalent measures): use of drip pans under vehicles/equipment, indoor storage of vehicles and equipment, installation of berms or dikes, use of absorbents, roofing or covering storage areas, and cleaning pavement surfaces to remove oil and grease.

P.3.1.2 Fueling Areas. Minimize contamination of stormwater runoff from fueling areas. Consider the following (or other equivalent measures): Covering the fueling area; using spill/overflow protection and cleanup equipment; minimizing stormwater run-on/runoff to the fueling area; using dry cleanup methods; and treating and/or recycling collected stormwater runoff.

P.3.1.3 Material Storage Areas. Maintain all material storage vessels (e.g., for used oil/oil filters, spent solvents, paint wastes, hydraulic fluids) to prevent contamination of stormwater and plainly label them (e.g., “Used Oil,” “Spent Solvents,” etc.). Consider the following (or other equivalent measures): storing the materials indoors; installing berms/dikes around the areas; minimizing runoff of stormwater to the areas; using dry cleanup methods; and treating and/or recycling collected stormwater runoff.

P.3.1.4 Vehicle and Equipment Cleaning Areas. Minimize contamination of stormwater runoff from all areas used for vehicle/equipment cleaning. Consider the following (or other equivalent measures): performing all cleaning operations indoors; covering the cleaning operation, ensuring that all washwater drains to a proper collection system (i.e., not the stormwater drainage system); treating and/or recycling collected washwater, or other equivalent measures.

P.3.1.5 Vehicle and Equipment Maintenance Areas. Minimize contamination of stormwater runoff from all areas used for vehicle/equipment maintenance. Consider the following (or other equivalent measures): performing maintenance activities indoors; using drip pans; keeping an organized inventory of materials used in the shop; draining all parts of fluid prior to disposal; prohibiting wet clean up practices if these practices would result in the discharge of pollutants to stormwater drainage systems; using dry cleanup methods; treating and/or recycling collected stormwater runoff, minimizing run on/runoff of stormwater to maintenance areas.

P.3.1.6 Locomotive Sanding (Loading Sand for Traction) Areas. Consider the following (or other equivalent measures): covering sanding areas; minimizing stormwater run on/runoff; or appropriate sediment removal practices to minimize the offsite transport of sanding material by stormwater.

P.3.2 Employee Training. (See also Part III.C.1.b.ix) Train personnel at least once a year and address the following activities, as applicable: used oil and spent solvent management; fueling procedures; general good housekeeping practices; proper painting procedures; and used battery management.

P.4 Additional SWPPP Requirements.

P.4.1 Drainage Area Site Map. (See also Part III.C.2) Identify in the SWPPP the following areas of the facility and indicate whether activities occurring there may be exposed to precipitation/surface runoff: Fueling stations; vehicle/equipment maintenance or cleaning areas; storage areas for vehicle/equipment with actual or potential fluid leaks; loading/unloading areas; areas where treatment, storage or disposal of wastes occur; liquid storage tanks; processing areas; and storage areas.

P.4.2 Potential Pollutant Sources. (See also Part III.C.3) Assess the potential for the following activities and facility areas to contribute pollutants to stormwater discharges: Onsite waste storage or disposal; dirt/gravel parking areas for vehicles awaiting maintenance; illicit plumbing connections between shop floor drains and the stormwater conveyance system(s); and fueling areas. Describe these activities in the SWPPP.

P.4.3 Description of Good Housekeeping Measures. You must document in your SWPPP the good housekeeping measures you implement consistent with Part P.3.

P.4.4 Vehicle and Equipment Washwater Requirements. If applicable, attach to or reference in your SWPPP, a copy of the NPDES permit issued for vehicle/equipment washwater or, if an NPDES permit has not been issued, a copy of the pending application. These permit documents may alternatively be kept in an Environmental Management System (EMS) that is accessible by site personnel. If an industrial user permit is issued under a local pretreatment program, attach a copy to your SWPPP. In any case, implement all non-stormwater discharge permit conditions or pretreatment conditions in your SWPPP. If washwater is handled in another manner (e.g., hauled offsite), describe the disposal method and attach all pertinent documentation/information (e.g., frequency, volume, destination, etc.) in the plan.

P.5 Additional Inspection Requirements. (See also Part V.A)

Inspect all the following areas/activities: storage areas for vehicles/equipment awaiting maintenance, fueling areas, indoor and outdoor vehicle/equipment maintenance areas, material storage areas, vehicle/equipment cleaning areas and loading/unloading areas.

Sector AD.c – Hydrodemolition Operations.

AD.c.1 Covered Stormwater Discharges.

The requirements are for the Hydrodemolition Operations in Sector AD.c apply to stormwater and process water discharges associated with operation of hydrodemolition equipment as identified under Sector AD.c in Appendix A of the permit. This permit authorizes stormwater discharges for the hydrodemolition operation and the onsite treatment and discharge of wastewater generated from the hydrodemolition of Portland Cement Concrete (PCC) bridge decks to groundwater via land application/inflitration.

AD.c.2 Limitation on Coverage - Prohibited Discharges (see also Parts I.C).

- This permit does not authorize the discharge of hydrodemolition wastewater to surface waters, or process wastewater resulting from hydrodemolition of concrete surfaces that contain paint or other coatings, or that is mixed with any other wastewater that is not hydrodemolition wastewater or stormwater.
- The following hazardous wastes are prohibited from being discharged onsite to the ground surface or to surface waters: tetrachloroethylene, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, 1,1,2 – trichloroethane, chlorobenzene, ortho-dichlorobenzene, carbon tetrachloride, chlorinated fluorocarbons, toluene, methylethyl ketone, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol, and 2-nitropane.

AD.c.3 Additional Technology-Based Effluent Limits.

During the bridge restoration, you are responsible for:

- the containment, collection, sampling, treatment and discharge by land application of the hydrodemolition wastewater; or
- if land application is not possible, then you are responsible for contracting for appropriate offsite treatment and disposal of the hydrodemolition wastewater.

AD.c.3.1 *Wastewater Containment, Collection, Sampling, Recordkeeping, Treatment, and Land Application Disposal System Requirements.* You must design and implement measures for the containment, collection, sampling, treatment and discharge via land application/infiltration of treated hydrodemolition wastewater. This design should include at a minimum the following:

AD.c.3.1.1 *Wastewater Containment and Collection System.* This system shall be able to adequately contain, collect and convey all hydrodemolition wastewater to the treatment and land application/infiltration disposal system. These requirements must be met:

- total containment of the hydro-demolition wastewater is required;
- hydrodemolition Wastewater shall not be allowed to enter storm sewers, bridge drainage downspouts or bridge approach downspouts, ditches, surface waters, floodplains or wetlands; and
- bridge deck joints, drains and other potential outlets to shall be sealed in order to prevent the release of hydrodemolition wastewater to the ground surface or surface waters.

AD.c.3.1.2 *Hydrodemolition Wastewater Treatment System.* The hydrodemolition wastewater must be treated before it is land applied and meet the following requirements. As specified below, all discharges from hydrodemolition operations to ground waters shall be monitored by the permittee at each point of discharge.

Table AD.C-1 Numeric Limits for Wastewater from Hydrodemolition Operations

Parameter	Limits				Monitoring Frequency	Sample Type	**Parameter Specific Requirements**
	Daily Minimum	Monthly Average	Daily Maximum	UNITS			
Flow		REPORT	REPORT	gpd	1/month	measured	
pH	2.0		12.5	s.u.		grab	*The pH shall be maintained as close to 7.0 as possible.*

All residual solids that result through settling, filtering or other water treatment must be removed from the site. The wastewater to be land applied shall display no visual presence of solids. The permittee shall observe any discharge water on each day the facility is in operation to verify compliance with this requirement.

AD.c.3.1.3 *Land Application Disposal System Requirements.* Land application of hydro-demolition wastewater shall be done only on land contained within publically owned right-of-ways and land that is specifically approved and designated in writing for this use by the public right-of-way approving authority or alternatively on private land with the express approval of the land owner. Documentation of approval of use of a publically owned right-of-way or private land for land application must be submitted with the SWPPP. All land application activities shall be performed in accordance with the following:

- all drains or stormwater catch basins shall be identified, flagged or blocked off prior to land applying hydrodemolition wastewater;
- there shall be no discharge of hydrodemolition wastewater to surface waters including intermittent streams and tax and other drainage ditches;
- land application of hydro-demolition wastewater shall not cause ponding or runoff;
- land application of the treated wastewater is prohibited during inclement weather such as during periods of precipitation, high winds, freezing conditions, on snow-covered ground or when soils are saturated; and
- setbacks.
  i. Surface Waters. Hydrodemolition wastewater shall not be land applied closer than 100 feet to surface water bodies unless a 35 foot vegetated buffer is established from the proposed wetted edge of the land application area. Surface waters include streams, lakes, ponds, drainage and tax ditches and any other conduit, natural or manmade to such waters.
  ii. Ground Waters. Hydrodemolition wastewater shall not be land applied within 100 feet of drinking water wells or sinkholes, or within 300 feet of springs.

AD.c.3.1.4 *Recordkeeping.* The permittee shall maintain a logbook with daily records of hydro-demolition activities. These records shall be onsite and available for review upon request by Department personnel. These records shall be retained by the permittee for one year following the last day of land application of hydrodemolition wastewater. The logbook shall record each day, at minimum, the following information:

- date;
- amount of hydro-demolition wastewater applied;
- weather:
- land application field conditions;
- pH testing results; and
- amount and type of treatment chemicals added.

AD.c.3.1.5 *Department Notification.* The Department's Compliance Program (Part II.D.3) must be notified within 48 hours of the planned start of the hydrodemolition wastewater discharge via land application.

AD.c.3.1.6 *Offsite Transport.* Hydrodemolition wastewater that does not fall within a pH range of greater than pH 2.0 and less than pH 12.5 must be transported offsite by a licensed hazardous waste hauler to a licensed hazardous waste facility treatment and disposal facility.

AD.c.4 Additional SWPPP Requirements.

The plan for the implementation of the containment, collection, treatment, and discharge of the hydrodemolition wastewater must be reviewed and approved by a Professional Engineer registered in the State of Maryland. Describe operation in the narrative and identify location of any treatment devices on site map, including bag filters or other devices used to adjust pH. These plans shall include at a minimum:

AD.c.4.1 Detailed plans of the processes that will generate, collect, and treat the hydrodemolition wastewater. These plans shall include at a minimum:

- clearly identify each major process unit in sufficient detail to allow the Department to have a clear understanding of the types and quantities of pollutants that may be generated;
- identify the average and maximum daily flow rates (in gallons per day) for each major process unit that generates hydrodemolition wastewater;
- detail how the hydro-demolition wastewater will be monitored, treated and adjusted to meet pH and suspended sediment treatment requirements; and
- a map showing the area where the hydrodeomolition will occur, including calculations on square feet of area that will be processed.

AD.c.4.2 *Land Application Plan.* A Land Application Plan that details how the treated hydrodemolition wastewater will be land applied. This Plan shall include at a minimum:

- equipment to be used for the land application disposal system;
- the expected amount of wastewater to be land applied;
- a map identifying the public land to be utilized for land application;
- authorization letter to use the identified public land from the appropriate authorities; and
- location of all storm sewers, surface waters, and stormwater basins in the land application area.

AD.c.4.3 *Spill contingency plan.* Include a spill contingency plan for hydro-demolition wastewater.

AD.c.4.4 *Alternatives Plan.* A plan for managing the hydrodemolition wastewater if the hydrodemolition wastewater cannot meet the discharge treatment standards for pH and solids or if site conditions make land application not possible. This plan shall include the names of licensed hazardous waste hauling and treatment/disposal services that can accommodate the potential quantity and quality of generated hydrodemolition wastewater.

AD.c.4.5 *pH Control plan.* The pH Control Plan shall include at a minimum:

- details of the method(s) to be used to monitor, sample, and test (including frequency of testing) the pH of the hydro-demolition wastewater;
- details of the method(s) to be used to treat the hydrodemolition wastewater so that the pH is maintained greater than pH 2.0 and less than pH 12.5 prior to discharge via land application;
- description of the actions to be taken in order to ensure that the discharged hydrodemolition wastewater meets the pH and solids requirements, including but not limited to work stoppage.

Sector AD – Stormwater Discharges Designated by the Director as Requiring Permits.

You must comply with sector-specific requirements associated with your primary industrial activity and any co-located industrial activities, as defined in Appendix A. The sector specific requirements apply to those areas of your facility where those sector-specific activities occur. These sector-specific requirements are in addition to any requirements specified elsewhere in this permit.

AD.1 Covered Stormwater Discharges.

Sector AD is used to provide permit coverage for facilities designated by the Director as needing a stormwater permit, and any discharges of stormwater associated with industrial activity that do not meet the description of an industrial activity covered by Sectors A-P.

AD.1.1 Eligibility for Permit Coverage. Because this sector is primarily intended for use by discharges designated by the Director as needing a stormwater permit (which is an atypical circumstance), and your facility may or may not normally be discharging stormwater associated with industrial activity, you must obtain the Director's written permission to use this permit prior to submitting an NOI. If you are authorized to use this permit, you will still be required to ensure that your discharges meet the basic eligibility provisions of this permit at Part I.D.

AD.2 Sector-Specific Benchmarks and Effluent Limits. (See also Part V of the permit.)

The Director will establish any additional monitoring and reporting requirements for your facility prior to authorizing you to be covered by this permit. Additional monitoring requirements would be based on the nature of activities at your facility and your stormwater discharges.

Appendix E: Definitions, Abbreviations and Acronyms

Action Area – all areas to be affected directly or indirectly by the stormwater discharges, allowable non-stormwater discharges, and stormwater discharge-related activities, and not merely the immediate area involved in these discharges and activities.

Additive - waste water treatment chemicals or products added to water prior to discharge, such as polymers or flocculants at a sand and gravel facility. Additives are added to the water so that the discharge water is in compliance with the permit limits.

Asphalt - bituminous concrete

BAT – Best Available Technology Economically Achievable

Best Management Practices (BMPs) – schedules of activities, practices (and prohibitions of practices),structures, vegetation, maintenance procedures, and other management practices to prevent or reduce the discharge of pollutants to waters of the State. BMPs also include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage. See 40 CFR 122.2.

BPT – Best Practicable Control Technology Currently Available

Bypass - the intentional diversion of wastes from any portion of a treatment facility.

Cationic Chemical Additive – Additives that contain an overall positive charge. Among other things, they are used to reduce turbidity in stormwater discharges by chemically bonding to the overall negative charge of suspended silts and other soil materials and causing them to bind together and settle out. Common examples of cationic treatment chemicals are chitosan and cationic PAM.

CFR - Code of Federal Regulations

Chemical Additive – Refer to Additive definition.

Co-located Industrial Activities – Any industrial activities, excluding your primary industrial activity(ies), located on-site that are defined by the stormwater regulations at 122.26(b)(14)(i)-(ix) and (xi). An activity at a facility is not considered co-located if the activity, when considered separately, does not meet the description of a category of industrial activity covered by the stormwater regulations or identified by the SIC code list in Appendix A.

COMAR - Code of Maryland Regulations

Concrete Plant - a facility at which concrete is mixed for use on or off site, and includes any area where concrete and other related products are made (corresponding to Industrial Sector E in the MSGP for glass, clay, cement, concrete, and gypsum products).

Concrete Washout - After concrete is poured at a construction site, the chutes of ready mixed concrete trucks and hoppers of concrete pump trucks are washed out to remove the remaining concrete before it hardens. Equipment such as wheelbarrows and hand tools also are washed down. Additionally, at the end of each work day, drums of concrete trucks, mixer truck barrels or concrete moulds or forms, are washed out. These activities collectively produce process water commonly referred to as concrete washout.

Control Measure – refers to any BMP or other method (including narrative effluent limitations) used to prevent or reduce the discharge of pollutants to waters of the State.

CWA – Clean Water Act (or the Federal Water Pollution Control Act, 33 U.S.C. §1251 et seq)

Corrective Action – for the purposes of the permit, any action taken, or required to be taken, to (1) repair, modify, or replace any stormwater control used at the site; (2) clean up and dispose of spills, releases, or other deposits found on the site; and (3) remedy a permit violation.

Department - the Maryland Department of the Environment. Unless stated otherwise, all submissions to the Department shall be directed to the attention of the Wastewater Permits Program.

Detergent - a cleaner including surfactants, dispersants, or emulsifiers, designed to act as a wetting agent and made from chemical compounds rather than from fats and lye.

Dewatering, Mine - any water that is impounded or that collects in the mine and is pumped, drained or otherwise removed from the mine through the efforts of the mine operator. This term shall also include wet pit overflows caused solely by direct rainfall and ground water seepage. However, if a mine is also used for treatment of process generated waste water, discharges of commingled water from the facilities shall be deemed discharges of process generated waste water.

Discharge – when used without qualification, means the "discharge of a pollutant." See 40 CFR 122.2.

Discharge of a pollutant – any addition of any “pollutant” or combination of pollutants to “waters of this State” from any “point source,” or any addition of any pollutant or combination of pollutants to the waters of the “contiguous zone” or the ocean from any point source other than a vessel or other floating craft which is being used as a means of transportation. This includes additions of pollutants into waters of this State from: surface runoff which is collected or channeled by man; discharges through pipes, sewers, or other conveyances, leading into privately owned treatment works. See 40 CFR 122.2.

Discharge-related activities – activities that cause, contribute to, or result in stormwater and allowable non-stormwater point source discharges, and measures such as the siting, construction and operation of BMPs to control, reduce, or prevent pollution in the discharges.

Dry weather – Discharges occurring between periods of wet weather, usually associated with ground water or process generated water.

DMR – Discharge Monitoring Report, which is a report submitted by a permittee to the Department summarizing the effluent monitoring results obtained by the permittee over periods of time as specified in the permit.

Effluent limitation - any restriction or prohibition that:

1. Is established under federal law or a law of this State;
2. Specifies quantities, rates or concentrations of chemical, physical, biological, or other constituents that are discharged into the waters of this State;
3. Includes:
   a. Parameters for the discharge of toxic and nontoxic substances, and
   b. Standards of performance for new sources.

Effluent Limitations Guideline (ELG) – defined in 40 CFR § 122.2 as a regulation published by the Administrator under section 304(b) of CWA to adopt or revise effluent limitations.

EPA – U. S. Environmental Protection Agency

EPA Approved or Established TMDLs – “EPA Approved TMDLs” are those that are developed by a State and approved by EPA. “EPA Established TMDLs” are those that are developed by EPA.

Existing Discharger – an operator applying for coverage under this permit for discharges authorized previously under an NPDES general or individual permit.

Facility or Activity – any NPDES “point source” (including land or appurtenances thereto) that is subject to regulation under the NPDES program. See 40 CFR 122.2.

Federal Act - the federal Water Pollution Control Act (33 U.S.C. §1251 et seq.), its amendments, and all rules and regulations adopted under the Act.

Freeboard - the height above the water level and below the overflow level of a pond or other structure.

Grab sample - an individual sample collected in less than 15 minutes. Grab samples for pH shall be analyzed within 15 minutes of sample collection.

Groundwater - underground water in a zone of saturation.

Hardness Dependent - refers to benchmark values for some metals that are determined as a function of hardness (in units of mg/L) in water. For these parameters, permittees whose discharges exceed the lowest benchmark level of the metal must determine the hardness of the receiving water, to identify the benchmark value applicable to their facility.

Hazardous Materials or Hazardous Substances or Hazardous or Toxic Waste – for the purposes of this permit, any liquid, solid, or contained gas that contain properties that are dangerous or potentially harmful to human health or the environment. See also 40 CFR §261.2.

Hydrodemolition – a concrete removal technique which utilizes high-pressure water to remove deteriorated and sound concrete as well as asphalt and grout.

Immersion-stabilization (i.s.) - a calibrated device immersed in the effluent stream or other measuring location until the reading is stabilized.

Impaired Water (or "**Water Quality Impaired Water**") – a body of water identified by the Department or EPA pursuant to Section 303(d) of the Clean Water Act as not meeting applicable State water quality standards (these waters are called "water quality limited segments" under 40 CFR 30.2(j)). Impaired waters include both waters with approved or established TMDLs, and those for which a TMDL has not yet been approved or established. Impaired waters compilations are included in Maryland's most current List of Impaired Surface Waters as Category 4a, 4b, 4c or 5 waterbodies.

Impervious surface - any surface that does not allow stormwater to infiltrate into the ground, including any area that is paved or used for vehicular storage or traffic, building rooftops, sidewalks, driveways, etc.

Includes or including - includes or including by way of illustration and not by way of limitation.

Industrial Stormwater – Stormwater Discharges Associated with Industrial Activity.

Infeasible – there is a site-specific constraint making it not technologically possible, or not economically practicable and achievable in light of best industry practices, to achievethe required control measures on-site. The burden is on the permittee to demonstrate to the permitting authority that the requirement is infeasible.

Leachate – liquid that has passed through or emerged from solid waste and contains soluble, suspended, or miscible materials removed from such waste.

Measured flow - any method of liquid volume measurement; the accuracy of which has been previously demonstrated in engineering practice, or for which a relationship to absolute volume has been obtained.

Mine - an area of land, surface or underground, actively mined for the production of crushed, broken, and dimension stone, sand, clay, shale, and fill dirt from natural deposits. For the purposes of this permit, mine does not include coal mine facilities regulated by 40 CFR 434.

Minerals - any solid material, aggregate, or substance of commercial value, whether consolidated or loose, found in natural deposits on or in the earth, including clay, diatomaceous earth, gravel, marl, metallic ores, sand, shell, soil, and stone. The term does not include coal.

Minimize – to reduce and/or eliminate to the extent achievable using control measures (including best management practices) that are technologically available and economically practicable and achievable in light of best industry practice

Municipal Separate Storm Sewer – a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains): 1) Owned or operated by a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law) having jurisdiction over disposal of sewage, industrial wastes, stormwater, or other wastes, including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the CWA that discharges to waters of the United States; 2) Designed or used for collecting or conveying stormwater; 3) Which is not a combined sewer; and 4) Which is not part of a Publicly Owned Treatment Works (POTW) as defined at 40 CFR 122.2. See 40 CFR 122.26(b)(4) and (b)(7).

Municipal Separate Storm Sewer System (MS4) – in Maryland we have several MS4 NPDES Permits. The following are a summary of how they are broken down by size. For a full listing and explanation, visit the Department website for "Maryland's NPDES Municipal Separate Storm Sewer System (MS4) Permits" or at this link http://bit.ly/MDE_MS4.

- Phase I MS4s are for large jurisdictions, which are municipalities with populations of greater than 250,000, amd medium jurisdictions, which are municiapalities with populations between 100,000 and 250,000. The large Phase I MS4 jurisdictions are Anne Arundel County, Baltimore County, Baltimore City, Montgomery County, and Prince George's County. The medium Phase I MS4 jurisdictions are Carroll County, Charles County, Frederick County, Harford County, and Howard County. One statewide MS4 under this category has been issued to the State Highway Administration.
- Phase II MS4s include smaller jurisdictions or approximately 60 cities and towns in Maryland with populations greater than 1,000. They also include State and Federal facilities.

NetDMR – a nationally-available electronic reporting tool, initially designed by states and later adapted for national use by EPA, which can be used by NPDES-regulated facilities to submit discharge monitoring reports (DMRs) electronically to EPA through a secure Internet application over the National Environmental Information Exchange Network (NEIEN). EPA can then share this information with authorized states, tribes, and territories.

New Discharger – a facility from which there is a discharge, that did not commence the discharge at a particular site prior to August 13, 1979, which is not a new source, and which has never received a finally effective NPDES permit for discharges at that site. See 40 CFR 122.2.

New Source – any source, the construction of which is commenced after the publication by the EPA of proposed regulations prescribing a standard of performance which will be applicable to the source if the standard is promulgated.

New Source Performance Standards (NSPS) – technology-based standards for facilities that qualify as new sources under 40 CFR 122.2 and 40 CFR 122.29.

No exposure – all industrial materials or activities are protected by a storm-resistant shelter to prevent exposure to rain, snow, snowmelt, and/or runoff. See 40 CFR 122.26(g).

Noncoal Mining - Refers to minerals extracted by surface mining.

Non-Stormwater Discharges – discharges that do not originate from storm events.

NPDES – National Pollutant Discharge Elimination System

Operator – any entity with a stormwater discharge associated with industrial activity that meets either of the following two criteria:

1. The entity has operational control over industrial activities, including the ability to make modifications to those activities; or
2. The entity has day-to-day operational control of activities at a facility necessary to ensure compliance with the permit (e.g., the entity is authorized to direct workers at a facility to carry out activities required by the permit).

Outfall – locations where collected and concentrated stormwater flows are discharged from the facility, including pipes, ditches, swales, and other structures that transport stormwater.

Owner - a person who has a legal interest in the facility or in the property on which the facility is located, or the owner's agent.

Permittee - the person holding a permit issued by the Department, or authorized for coverage under a general permit by the department.

Person – an individual, association, partnership, corporation, municipality, State or Federal agency, or an agent or employee thereof. See 40 CFR 122.2.

Pervious - vegetative area that is not used for the storage of vehicles or heavy equipment and is not open to vehicular traffic.

Point source – any discernible, confined and discrete conveyance, including any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, large animal feeding operation, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are, or may be, discharged.

Pollutant – dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal and agricultural waste discharged into water. See 40 CFR 122.2.

Pollutant of concern – A pollutant which causes or contributes to a violation of a water quality standard, including a pollutant which is identified as causing an impairment in a state's 303(d) list.

Pollution – means any contamination or other alteration of the physical, chemical, or biological properties of any waters of this State, including a change in temperature, taste, color, turbidity, or odor of the waters or the discharge or deposit of any organic matter, harmful organism, or liquid, gaseous, solid, radioactive, or other substance into any waters of this State that will render the waters harmful, or detrimental, to:

(a) Public health, safety, or welfare;

(b) Domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses;

(c) Livestock, wild animals, birds; or

(d) Fish or other aquatic life.

Polymers – for the purposes of this permit, coagulants and flocculants used to control erosion on soil or to enhance the sediment removal capabilities of sediment traps or basins. Common construction site polymers include polyacrylamide (PAM), chitosan, alum, polyaluminum chloride, and gypsum.

POTW – Publicly Owned Treatment Works

Primary industrial activity – includes any activities performed on-site which are (1) identified by the facility's primary SIC code; or (2) included in the narrative descriptions of 122.26(b)(14)(i), (iv), (v), or (vii), and (ix). [For co-located activities covered by multiple SIC codes, it is recommended that the primary industrial determination be based on the value of receipts or revenues or, if such information is not available for a particular facility, the number of employees or production rate for each process may be compared. The operation that generates the most revenue or employs the most personnel is the operation in which the facility is primarily engaged. In situations where the vast majority of on-site activity falls within one SIC code, that activity may be the primary industrial activity.] Narrative descriptions in 40 CFR 122.26(b)(14) identified above include: (i) activities subject to stormwater effluent limitations guidelines, new source performance standards, or toxic pollutant effluent standards; (iv) hazardous waste treatment storage, or disposal facilities including those that are operating under interim status or a permit under subtitle C of the Resource Conservation and Recovery Act (RCRA); (v) landfills, land application sites and open dumps that receive or have received industrial wastes; (vii) steam electric power generating facilities; and (ix) sewage treatment works with a design flow of 1.0 mgd or more.

Process generated wastewater - any wastewater used in the slurry transport of mined material, dust control, or processing, including product preparation and washing, exclusive of mining. The term shall also include any other water which becomes commingled with such wastewater in a pit, pond, lagoon, mine, or other facility used for treatment of such wastewater.

Qualified Personnel – Qualified personnel are those who possess the knowledge and skills to assess conditions and activities that could impact stormwater quality at your facility, and who can also evaluate the effectiveness of control measures.

RCRA – Resource Conservation and Recovery Act

Reportable Quantity Release – a release of a hazardous substance at or above the established legal threshold that requires emergency notification. Refer to 40 CFR Parts 110, 117, and 302 for complete definitions and reportable quantities for which notification is required.

Runoff - that portion of stormwater that, once having fallen to the ground, is in excess of the evaporative or infiltrative capacity of soils, and the retentive capacity of surface features, which flows or will flow off the land by surface runoff to waters of the State.

Runoff coefficient – the fraction of total rainfall that will appear at the conveyance as runoff. See 40 CFR 122.26(b)(11).

Run-on - water from outside the industrial stormwater area that flows into the area. Run-on includes stormwater from rainfall or the melting of snow or ice that falls directly on the unit, as well as the water that drains from adjoining areas.

SARA – Superfund Amendments and Reauthorization Act

SDS – Material Safety Data Sheet

Section 313 water priority chemical - a chemical or chemical categories that: 1) are listed at 40 CFR 372.65 pursuant to Section 313 of Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986, also titled the Emergency Planning and Community Right-to-Know Act of 1986; 2) are present at or above threshold levels at a facility subject to SARA Title III, Section 313 reporting requirements; and 3) that meet at least one of the following criteria: (i) are listed in Appendix D of 40 CFR 122 on either Table II (organic priority pollutants), Table III (certain metals, cyanides, and phenols) or Table V (certain toxic pollutants and hazardous substances); (ii) are listed as a hazardous substance pursuant to Section 311(b)(2)(A) of the Clean Water Act at 40 CFR 116.4; or (iii) are pollutants for which EPA has published acute or chronic water quality criteria.

SIC – Standard Industrial Classification

Significant materials – includes, but is not limited to: raw materials; fuels; materials such as solvents, detergents, and plastic pellets; finished materials such as metallic products; raw materials used in food processing or production; hazardous substances designated under section 101(14) of CERCLA, commonly known as Superfund; any chemical the facility is required to report pursuant to section 313 of Title III of SARA; fertilizers; pesticides; and waste products such as ashes, slag and sludge that have the potential to be released with stormwater discharges. See 40 CFR 122.26(b)(12).

Significant spills - includes, but is not limited to, releases of oil or hazardous substances in excess of reportable quantities under Section 311 of the Clean Water Act (40 CFR 110.10 and 40 CFR 117.21) or Section 102 of CERCLA (40 CFR 302.4).

State discharge permit - the discharge permit issued under the Environment Article, Title 9, Subtitle 3, Annotated Code of Maryland.

Stormwater – stormwater runoff, snow melt runoff, and surface runoff and drainage. See 40 CFR 122.26(b)(13).

Stormwater Discharges Associated with Construction Activity – a discharge of pollutants in stormwater runoff from areas where soil disturbing activities (e.g., clearing, grading, or excavating), construction materials, or equipment storage or maintenance (e.g., fill piles, concrete truck washout, fueling), or other industrial stormwater directly related to the construction process are located. See 40 CFR 122.26(b)(14)(x) and 40 CFR 122.26(b)(15) .

Stormwater Discharges Associated with Industrial Activity – the discharge from any conveyance that is used for collecting and conveying stormwater and that is directly related to manufacturing, processing or raw materials storage areas at an industrial plant. The term does not include discharges from facilities or activities excluded from the NPDES program under Part 122. For the categories of industries identified in this section, the term includes, but is not limited to, stormwater discharges from industrial plant yards; immediate access roads and rail lines used or traveled by carriers of raw materials, manufactured products, waste material, or by-products used or created by the facility; material handling sites; refuse sites; sites used for the application or disposal of process waste waters; sites used for the storage and maintenance of material handling equipment; sites used for residual treatment, storage, or disposal; shipping and receiving areas; manufacturing buildings; storage areas (including tank farms) for raw materials, and intermediate and final products; and areas where industrial activity has taken place in the past and significant materials remain and are exposed to stormwater. For the purposes of this paragraph, material handling activities include storage, loading and unloading, transportation, or conveyance of any raw material, intermediate product, final product, by-product or waste product. The term excludes areas located on plant lands separate from the plant's industrial activities, such as office buildings and accompanying parking lots as long as the drainage from the excluded areas is not mixed with stormwater drained from the above described areas. Industrial facilities include those that are federally, State, or municipally owned or operated that meet the description of the facilities listed in 40 CFR 122.26(b)(14). The term also includes those facilities designated under the provisions of 40 CFR 122.26(a)(1)(v). See 40 CFR 122.26(b)(14).

Storm Event – a precipitation event that results in a measurable amount of precipitation.

Surface Mining - means all of the following:

a. The breaking of the surface soil in order to facilitate or accomplish the extraction or removal of minerals;

b. Any activity or process constituting all or part of a process for the extraction or removal of minerals from their original location; or

c. The extraction of sand, gravel, rock, stone, earth, or fill from borrow pits for highway construction purposes or other public facilities.

Surface waters - all waters of this State which are not groundwaters.

Thermal mixing zone - for streams wider than 50 feet, an area extending 50 feet radially from the point of discharge. The mixing zone may not form a thermal barrier to aquatic life.

Ten-year frequency 24-hour storm – For purposes of this permit, the 10-year, 24-hour storm, is defined as a storm resulting in cumulative rain over a 24 hour period, that is equal to the following values based on the location of the facility.

Ten-Year, 24-Hour Storm by County

County	Inches	County	Inches	County	Inches
Allegany	4.5	Dorchester	5.4	Queen Anne’s	5.3
Anne Arundel	5.2	Frederick	5.0	St. Mary’s	5.4
Baltimore (and City)	5.1	Garrett	4.3	Somerset	5.6
Calvert	5.3	Harford	5.1	Talbot	5.3
Caroline	5.3	Howard	5.1	Washington	4.8
Carroll	5.0	Kent	5.2	Wicomico	5.6
Cecil	5.1	Montgomery	5.1	Worcester	5.6
Charles	5.3	Prince George’s	5.3		

Tier 2 Waters – For antidegradation purposes, pursuant to 40 CFR 131.12(a)(2), Tier 2 waters are characterized as having water quality that exceeds the levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water.

Total Maximum Daily Loads (TMDLs) – A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources. A TMDL includes wasteload allocations (WLAs) for point source discharges; load allocations (LAs) for nonpoint sources and/or natural background, and must include a margin of safety (MOS) and account for seasonal variations. (See section 303(d) of the Clean Water Act and 40 CFR 130.2 and 130.7).

Upset - the exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

Vehicle Wash Water - The routine washing of vehicle exteriors to remove sediment and to make them presentable in the public.

Wastewater - any:

1. liquid waste substance derived from industrial, commercial, municipal, residential, agricultural, recreational, or other operations or establishments; and
2. other liquid waste substance containing liquid, gaseous or solid matter and having characteristics that will pollute any waters of the State.

Water Quality Impaired – See 'Impaired Water'.

Water Quality Standards – A water quality standard defines the water quality goals of a water body, or portion thereof, by designating the use or uses to be made of the water and by setting criteria necessary to protect the uses. The Department as promulgated in COMAR 26.08.02 (http://www.dsd.state.md.us/comar/) and EPA adopt water quality standards to protect public health or welfare, enhance the quality of water and serve the purposes of the Clean Water Act (See CWA sections 101(a)2 and 303(c)). Water quality standards also include an antidegradation policy. See P.U.D. o. 1 of Jefferson County et al v. Wash Dept of Ecology et al, 511 US 701, 705 (1994).

Waters of this State – includes:

1. both surface and underground waters within the boundaries of this State subject to its jurisdiction, including that part of the Atlantic Ocean within the boundaries of this State, the Chesapeake Bay and its tributaries, and all ponds, lakes, rivers, streams, tidal and nontidal wetlands, public ditches, tax ditches, and public drainage systems within this State, other than those designed and used to collect, convey, or dispose of sanitary sewage; and
2. the flood plain of free-flowing waters determined by the Department of Natural Resources on the basis of the 100-year flood frequency.

Wet weather - the period during which precipitation or melting snow causes visible runoff from the facility that results in discharge from an outfall.

Employee Training Log

Instructions: Keep records of employee training, including the date of the training. For in-person training, use the tables below to document your employee trainings. For computer-based or other types of training, keep similar records on who was trained and the type of training conducted.

Training Date:	**Trainer:**
Training Description:	
Employee(s) trained	**Employee signature**

Training Date:	**Trainer:**
Training Description:	
Employee(s) trained	**Employee signature**

Training Date:	**Trainer:**
Training Description:	
Employee(s) trained	**Employee signature**

Stormwater Industrial Routine Facility Inspection Report

General Information			
Facility Name	Tolson And Associates Pit		
NPDES Tracking No.			
Date of Inspection		**Start/End Time**	
Inspector's Name(s)			
Inspector's Title(s)			
Inspector's Contact Information			
Inspector's Qualifications			

Weather Information
Weather at time of this inspection? ❑ Clear ❑Cloudy ❑ Rain ❑ Sleet ❑ Fog ❑ Snow ❑ High Winds ❑ Other: Temperature:
Have any previously unidentified discharges of pollutants occurred since the last inspection? ❑Yes ❑No **If yes, describe:**
Are there any discharges occurring at the time of inspection? ❑Yes ❑No **If yes, describe:**

Control Measures

- *Number the structural stormwater control measures identified in your SWPPP on your site map and list them below (add as many control measures as are implemented on-site). Carry a copy of the numbered site map with you during your inspections. This list will ensure that you are inspecting all required control measures at your facility.*
- *Describe corrective actions initiated, date completed, and note the person that completed the work in the Corrective Action Log.*

	Structural Control Measure	**Control Measure is Operating Effectively?**	**If No, In Need of Maintenance, Repair, or Replacement?**	**Corrective Action Needed and Notes** (Identify needed maintenance and repairs, or any failed control measures that need replacement)
1		❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	
2		❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	
3		❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	
4		❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	
5		❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	
6		❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	
7		❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	
8		❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	
9		❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	
10		❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	

Areas of Industrial Materials or Activities exposed to stormwater

Below are some general areas that should be assessed during routine inspections. Customize this list as needed for the specific types of industrial materials or activities at your facility.

	Area/Activity	Inspected?	Controls Adequate (appropriate, effective, and operating)?	Corrective Action Needed and Notes
1		❑Yes ❑No ❑ N/A	❑Yes ❑No	
2		❑Yes ❑No ❑ N/A	❑Yes ❑No	
3		❑Yes ❑No ❑ N/A	❑Yes ❑No	
4		❑Yes ❑No ❑ N/A	❑Yes ❑No	
5		❑Yes ❑No ❑ N/A	❑Yes ❑No	
6		❑Yes ❑No ❑ N/A	❑Yes ❑No	
7		❑Yes ❑No ❑ N/A	❑Yes ❑No	
8		❑Yes ❑No ❑ N/A	❑Yes ❑No	
9		❑Yes ❑No ❑ N/A	❑Yes ❑No	
10		❑Yes ❑No ❑ N/A	❑Yes ❑No	

Non-Compliance

Describe any incidents of non-compliance observed and not described above:

Additional Control Measures

Describe any additional control measures needed to comply with the permit requirements:

Notes

Use this space for any additional notes or observations from the inspection:

CERTIFICATION STATEMENT

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Print name and title: ____

Signature:______________________________________**Date:**_______________________

Comprehensive Annual Site Inspection Report

General Information			
Facility Name			
NPDES Tracking No.			
Date of Inspection		**Start/End Time**	
Inspector's Name(s)			
Inspector's Title(s)			
Inspector's Contact Information			
Inspector's Qualifications			

Weather Information
Weather at time of this inspection? ❑ Clear ❑Cloudy ❑ Rain ❑ Sleet ❑ Fog ❑ Snow ❑ High Winds ❑ Other: Temperature:
Have any previously unidentified discharges of pollutants occurred since the last inspection? ❑Yes ❑No **If yes, describe:**
Are there any discharges occurring at the time of inspection? ❑Yes ❑No **If yes, describe:**

Summary of Scope	
Method(s) of Inspection:	
List areas inspected:	

Control Measures

- *Number the structural stormwater control measures identified in your SWPPP on your site map and list them below (add as many control measures as are implemented on-site). Carry a copy of the numbered site map with you during your inspections. This list will ensure that you are inspecting all required control measures at your facility.*
- *Describe corrective actions initiated, date completed, and note the person that completed the work in the Corrective Action Log.*

	Structural Control Measure	Control Measure is Operating Effectively?	If No, In Need of Maintenance, Repair, or Replacement?	**Corrective Action Needed and Notes** (Identify needed maintenance and repairs, or any failed control measures that need replacement)
1		❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	
2		❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	
3		❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	
4		❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	
5		❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	
6		❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	
7		❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	
8		❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	
9		❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	
10		❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	

Areas of Industrial Materials or Activities exposed to stormwater

Below are some general areas that should be assessed during routine inspections. Customize this list as needed for the specific types of industrial materials or activities at your facility.

	Area/Activity	Inspected?	Controls Adequate (appropriate, effective, and operating)?	Corrective Action Needed and Notes
1		❑Yes ❑No ❑ N/A	❑Yes ❑No	
2		❑Yes ❑No ❑ N/A	❑Yes ❑No	
3		❑Yes ❑No ❑ N/A	❑Yes ❑No	
4		❑Yes ❑No ❑ N/A	❑Yes ❑No	
5		❑Yes ❑No ❑ N/A	❑Yes ❑No	
6		❑Yes ❑No ❑ N/A	❑Yes ❑No	
7		❑Yes ❑No ❑ N/A	❑Yes ❑No	
8		❑Yes ❑No ❑ N/A	❑Yes ❑No	
9		❑Yes ❑No ❑ N/A	❑Yes ❑No	

Comprehensive Site Inspection Areas

Below are some general areas that should be assessed during comprehensive inspections. Customize this list as needed for the specific types of industrial materials or activities at your facility.

	Area/Activity	Inspected?	Controls Adequate (appropriate, effective, and operating)?	Corrective Action Needed and Notes
1		❑Yes ❑No ❑ N/A	❑Yes ❑No	
2		❑Yes ❑No ❑ N/A	❑Yes ❑No	
3		❑Yes ❑No ❑ N/A	❑Yes ❑No	
4		❑Yes ❑No ❑ N/A	❑Yes ❑No	
5		❑Yes ❑No ❑ N/A	❑Yes ❑No	
6		❑Yes ❑No ❑ N/A	❑Yes ❑No	
7		❑Yes ❑No ❑ N/A	❑Yes ❑No	
8		❑Yes ❑No ❑ N/A	❑Yes ❑No	
9		❑Yes ❑No ❑ N/A	❑Yes ❑No	
10		❑Yes ❑No ❑ N/A	❑Yes ❑No	
11		❑Yes ❑No ❑ N/A	❑Yes ❑No	
12		❑Yes ❑No ❑ N/A	❑Yes ❑No	

Non-Compliance

Describe any incidents of non-compliance observed and not described above:

Additional Control Measures

Describe any additional control measures needed to comply with the permit requirements:

Notes

Use this space for any additional notes or observations from the inspection:

CERTIFICATION STATEMENT

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Print name and title: ____

Signature:____Date:_____________________________

Visual Monitoring Form

Fill out a separate form for each outfall sampled.
Samples should be collected and analyzed in a colorless glass or plastic bottle.
See attached Instructions for completing this form.

Sample Location:		
Date/Time Collected:		
Date/Time Examined:		
Has it been at least 72 hours since the last storm event?		☐ Yes
Runoff Source		☐ Rainfall ☐ Snowmelt
Collector's Name and Title		
Examiner's Name and Title		
Parameter	**Parameter Description**	**Parameter Characteristics**
1. Color	Does the stormwater appear to have any color? ☐ Yes ☐ No	If Yes, describe: *Yellow, Brown, Red, Gray, Other:*
2. Clarity	Is the stormwater clear? ☐ Yes ☐ No	If not clear, which of the following best describes the clarity of the storm water? *Suspended Solids, Milky/Cloudy, Opaque, Other:*
3. Oil Sheen	Can you see a rainbow effect or sheen on the water surface? ☐ Yes ☐ No	Which best describes the sheen? *Rainbow sheet, Floating oil globules, Other:*
4. Odor	Does the sample have an odor? ☐ Yes ☐ No	If Yes, describe: *Chemical, Musty, Rotten Eggs, Sewage, Sour Milk, Oil/Petroleum, Other:*
5. Floating Solids	Is there anything on the surface of the sample? ☐ Yes ☐ No	If Yes, describe: *Suds, Oily Film, Garbage, Sewage, Water Fowl Excrement, Other:*
6. Suspended Solids	Is there anything suspended in the sample? ☐ Yes ☐ No	Describe:
*****Leave Sample Undisturbed for 30 minutes. *****		
7. Settled Solids	Is there anything settled on the bottom of the sample? ☐ Yes ☐ No	Describe: (*note type, size and material after sample is not disturbed for 30 minutes*)
8. Foam	Does foam or material form on the top of the sample surface if you shake it? ☐ Yes ☐ No	Describe:
9. If there are any visible indicators of pollution identify (1) where the pollution may come from and (2) any corrective actions taken:		
Stormwater Collector's Signature:		**Date:**
Stormwater Examiner's Signature:		**Date:**

Instructions for Completing the Visual Monitoring Form

You must collect a storm water sample from each outfall once each quarter for the entire permit term and conduct a visual assessment of each sample. You must follow the monitoring procedures outlined in Part V.C, including sampling at a point before the stormwater discharge mixes with other waste streams, to the extent practicable. These samples should be collected in such a manner that they are representative of the storm water discharge from that outfall. All inspections must be performed during daylight hours, and collected within 30 minutes of a storm event. Each assessment must be kept onsite with your SWPPP and available for inspection and review by the Department at anytime.

First, fill out all information on the top of the visual monitoring form. A qualifying storm event is any storm with greater than ½ inch precipitation. Then, take a grab sample in a clear container. Evaluate the sample in a well-lit area for the following parameters:

1. Color: Record the best description of the sample color in the appropriate space on the form.

2. Clarity: This parameter refers to how cloudy the sample is. It is *usually* an indication of fewer pollutants in the water if the sample is clear or transparent. If the clarity has changed since the last sample, try to identify what might have caused this to happen.

- **Clear** – Sample doesn't block any light; can be seen through regardless of color.
- **Cloudy** – Sample blocks some light; objects not clear but can be identified looking through the sample.
- **Very Cloudy** – Sample blocks most light; objects cannot be identified looking through the sample.
- **Opaque** – Sample blocks all light; objects cannot be seen when looking through the sample.

3. Oil Sheen: Record whether or not an oil sheen is present. If a film of iridescent color is noted on the surface of the sample or a rainbow effect appears to be floating on the surface of the water, this usually indicates oil is present.

4. Odor: If sample has no odor other than natural rainwater or snowmelt, write "NO" on the visual monitoring form. Note the presence of any of the following odors if detected, such as gasoline, diesel, oil, solvents (WD-40, other petroleum products, etc.), garbage, fishy, sweet/sugary, any other unusual odors not normally present in clean runoff from the area sampled.

5. Floating Solids: A contaminated flow may contain solids or liquids floating on the surface. Identifying floatables can aid in finding the source of the contamination. Examples of floatables are spoiled food products, oils, plant parts, solvents, sawdust, foams and fuel. Give a general description of the type of floating solids present (wood chips, leaf debris, algae, etc) in the general comments section for each sample. Identify amount of floating solids as described below.

- **High** – More than 20% of the surface of the sample is covered with floating solids.
- **Moderate** – Less than 20% of the surface of the sample is covered with floating solids.
- **Slight** – Only a few floating particles observed on the surface of the sample.
- **None** – No floating solids present on the surface of the sample.

6. Suspended solids: Record whether or not suspended solids are present in the sample. Suspended solids are particles floating inside the column of water, not on top, and may contribute to changes in water color or clarity. Cracked or deteriorated concrete or peeling surface paint at an outfall usually indicates the presence of severely contaminated discharges. Contaminants causing this type of damage are usually very acidic or basic.

------------------------------------ WAIT 30 MINUTES ------------------------------------

Leave the sample undisturbed for 30 minutes to allow the water and anything in it to settle.

7. Settled Solids: After 30 minutes has passed, give a general description of the type of settled solids present (sand, decayed plant matter, rust particles, etc.) in the general comments section.

8. Foam: After completing #7, shake the bottle gently. Record foam results on the form as they most closely match one of the descriptions listed below.

- **None** – Most bubbles break down within ten (10) seconds of shaking; only a few large bubbles persist longer than ten (10) seconds.
- **Moderate** – Many small bubbles are present but these bubbles persist for less than two (minutes) after shaking.
- **High** – Many small bubbles are present and they persist longer than two (2) minutes after shaking.

9. Detail any concerns, corrective actions taken and any other indicators of pollution present in the sample. This should include the identified source if there are visible indicators present in the sample. The person performing test must sign and date each form**.**

Appendix E: Liner Design Analysis

Appendix E.1: Liner Settlement Analysis

Geosyntec consultants

COMPUTATION COVER SHEET

Client: Tolson & Associates **Project:** TRL Vertical Expansion **Project/Proposal #:** ME1606 **Task:** 03

TITLE OF COMPUTATIONS: Liner Settlement Analysis

COMPUTATIONS BY: Signature July 7, 2020 DATE

Printed Name and Title: Julia Roberts, Professional

ASSUMPTIONS AND PROCEDURES CHECKED BY: (Peer Reviewer) Signature July 7, 2020 DATE

Printed Name and Title: Jenny Ramirez, Professional

COMPUTATIONS CHECKED BY: Signature July 7, 2020 DATE

Printed Name and Title: Jenny Ramirez, Professional

COMPUTATIONS BACKCHECKED BY: (Originator) Signature July 8, 2020 DATE

Printed Name and Title: Julia Roberts, Professional

APPROVED BY: (PM or Designate) Signature July 10, 2020 DATE

Printed Name and Title: R. David Espinoza, P.E., Senior Principal

APPROVAL NOTES:

REVISIONS: (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

LINER SETTLEMENT ANALYSIS
TOLSON RUBBLE LANDFILL EXPANSION LINER DESIGN

PURPOSE

The objective of this calculation package is to evaluate settlement of the liner system for the proposed Tolson Rubble Landfill (TRL) Expansion located in Crofton, Anne Arundel County, Maryland. This analysis estimates settlement of the expanded TRL liner system under the weight of waste to be placed in the future. Calculated settlements are used to determine if the minimum specified slopes for the drainage layer and the leachate collection pipes are adequate to provide positive drainage throughout the life of the facility. Additionally, strains in the high-density polyethylene (HDPE) geomembrane due to differential settlement of the liner system are calculated and checked against accepted tolerable strains for HDPE geomembrane.

EXISTING CONDITIONS

The subsurface stratigraphy beneath the proposed TRL expansion is inferred from recent and historical borings (Geosyntec, 2019; ERM, 2006; ERM, 2016). Boring logs are presented in Appendix B of the Phase II Report (Geosyntec, 2019). The following subsurface strata were encountered during these investigations:

- The Magothy Upper Aquifer (0-50 ft thick) was identified in all boring locations. While much of this layer has been excavated due to mining activities at the Site, the lower area of the Magothy Formation remains, and is characterized by interbedded layers of sand and white to light gray clay, with some coarse gravel.
- Four discontinuous layers of clay to clayey sands (~0-5 ft thick) were identified in many boring locations within the Magothy Upper Aquifer at elevations of approximately 100-130 feet above mean sea level (ft-msl). These layers are characteristic of the lower area of the Magothy Formation.
- The Patapsco Formation (~0-200+ ft thick; Confining Unit and Lower Aquifer) was encountered in many deeper boreholes. This formation is the upper-most layer of three lithographic layers which make up the Potomac Group. The Patapsco Formation contains alternating aquifers and confining units.
- Three discontinuous layers of sand to silty sand (~0-10 ft thick: Sand Lenses 1-3) were identified in deeper boring locations extending into the Confining Unit of the Patapsco Formation. These lenses were found between 80 and 30 ft-msl, and are characteristic of the interspersed sand deposits often found in the Patapsco Formation.

Highest observed groundwater elevations in the Magothy Aquifer range from approximately elevation 95.7 ft-msl to 114.7 ft-msl under the footprint of the TRL expansion.

PROPOSED DEVELOPMENT AND CROSS SECTIONS

The proposed base grades and final cover grades are shown in Figures 1 and 2, respectively. The seven cross sections selected for the liner settlement analysis are also shown in Figures 1 and 2. Six of these cross sections (A-A', B-B', C-C', D-D', F-F', and G-G') run along the proposed leachate collection pipe corridors while E-E' runs perpendicular to the liner slope. Cross section E-E' was selected for evaluation because it was identified as a cell floor drainage path with the greatest potential for slope reversal due to differential settlement. The minimum required post-settlement slope of the leachate collection pipe corridor is 0.5 percent; the minimum required post-settlement slope of the cell floor is 2.0 percent. For this analysis, it is assumed that regrading will occur after rebound/settlement related to preparing the base of the landfill has occurred such that waste is placed directly on the base grades shown in Figure 1. The long-term strain of the geomembrane will be evaluated using the same cross sections used for the settlement analysis. The maximum allowable long-term strain of HDPE geomembranes is 4 to 5 percent (Berg and Bonaparte, 1993).

METHOD OF ANALYSIS

Settlement at TRL will be caused by the placement of construction and demolition (C&D) waste over the completed liner system. Total settlement of soil is usually attributed to three independent phenomena: (i) elastic settlement; (ii) primary consolidation; and (iii) secondary consolidation. Therefore, the total settlement (S_t) can be calculated as follows:

$$S_t = S_E + S_p + S_s \tag{1}$$

where

S_E = elastic settlement (immediate);

S_p = primary consolidation settlement (time and surcharge dependent); and

S_s = secondary consolidation settlement (time dependent).

Both cohesive soils (clays) and cohesionless soils (sands) are present at the site. For clays, immediate elastic settlements are considered negligible when compared to settlements that will occur due to primary and secondary consolidation processes. Sands are not subject to consolidation settlement. As such, only elastic settlement is considered for sand layers.

<u>Elastic Settlement</u>

According to the theory of elasticity, the subsurface material is expected to compress elastically immediately upon loading. The stress-dependency effect on compressibility may be taken into account using the drained secant constrained modulus (M_{ds}). The drained secant constrained modulus is estimated using the following empirical correlation for normally consolidated silts and sands from Kulhawy and Mayne (1990):

$$\frac{M_{ds}}{p_a} = m\left(\frac{\sigma_v'}{p_a}\right)^{0.5} \qquad (2)$$

where

σ_v' = vertical effective stress;

p_a = atmospheric pressure (2,116.2 psf); and

m = modulus number.

The modulus number m is estimated using the empirical correlation between porosity and modulus number shown Figure 3 (Kulhawy and Mayne, 1990).

Using the drained secant constrained modulus (M_{ds}), elastic settlement can be calculated as follows (Qian et al., 2001):

$$S_i = H_o\left(\frac{\Delta\sigma_v'}{M_{ds}}\right) \qquad (3)$$

where

S_i = elastic settlement (immediate);

H_o = initial layer thickness; and

$\Delta\sigma_v'$ = change in vertical effective stress.

Primary Consolidation Settlement

For cohesive soils (clays) below the groundwater table, primary consolidation is responsible for the majority of the total settlement. According to one-dimensional consolidation theory, the subsurface material is expected to exhibit increased pore water pressure upon loading, and compress over time while pore water pressures dissipate. Primary consolidation settlement (S_p) can be calculated as follows:

$$S_p = \begin{cases} H_o\frac{C_c}{1+e_o}\log\left(\frac{\sigma_{vo}'+\Delta\sigma_v'}{\sigma_{vo}'}\right), \text{if } \sigma_{vo}' = \sigma_p' \text{ and } \sigma_{vo}' + \Delta\sigma_v' \geq \sigma_p' \\ H_o\frac{1}{1+e_o}\left[C_r\log\left(\frac{\sigma_p'}{\sigma_{vo}'}\right) + C_c\log\left(\frac{\sigma_{vo}'+\Delta\sigma_v'}{\sigma_p'}\right)\right], \text{if } \sigma_{vo}' < \sigma_p' < \sigma_{vo}' + \Delta\sigma_v' \\ H_o\frac{C_r}{1+e_o}\log\left(\frac{\sigma_{vo}'+\Delta\sigma_v'}{\sigma_{vo}'}\right), \text{if } \sigma_{vo}' \leq \sigma_p' \text{ and } \sigma_{vo}' + \Delta\sigma_v' \leq \sigma_p' \end{cases} \qquad (4)$$

where

H_o = initial layer thickness;

C_c = compression index;

C_r = recompression index;

e_o = initial void ratio;

σ'_{vo} = initial vertical effective stress;

$\Delta\sigma'_v$ = change in vertical effective stress; and

σ'_p = preconsolidation stress.

Because cohesive soils at the site are expected to be overconsolidated, and the waste surcharge is not expected to cause effective stresses to exceed preconsolidation stresses, Equation 4 can be simplified as follows:

$$S_p = H_o \frac{C_r}{1+e_o} \log\left(\frac{\sigma'_{vo}+\Delta\sigma'_v}{\sigma'_{vo}}\right), \text{if } \sigma'_{vo} \leq \sigma'_p \text{ and } \sigma'_{vo} + \Delta\sigma'_v \leq \sigma'_p \quad (4)$$

Secondary Consolidation Settlement

Secondary consolidation settlement occurs due to particle rearrangement and creep. Secondary consolidation settlement (S_s) is calculated as a function of time for clay soils at the site as follows:

$$S_s = H \frac{C_\alpha}{1+e_o} \log\left(\frac{t_s}{t_p}\right) \quad (5)$$

where

H = thickness of compressible layer;

C_α = secondary compression index;

t_s = time of interest for secondary consolidation; and

t_p = time at end of primary consolidation.

The secondary compression index is defined as the reduction in void ratio during one logarithmic cycle of the ratio t_s/t_p. For the purposes of this calculation, the time which primary consolidation ends (t_p) is assumed to be one year and the time of interest for secondary consolidation (t_s) is assumed to be 30 years.

Differential Settlement and Tensile Strain

Differential settlement refers to the settlement of a point relative to the settlement of adjacent points, and is evaluated in order to determine the change in overall slope of the liner system due to settlement. Differential settlement (ΔS) is calculated as follows:

$$\Delta S = S_1 - S_2 \tag{6}$$

where

S_1 = total settlement at first point; and

S_2 = total settlement at second point.

The change in grade resulting from differential settlement is calculated as follows:

$$\Delta Grade\ (\%) = \left(\frac{\Delta S}{L}\right) \times 100\% \tag{7}$$

where

L = horizontal distance between points of concern.

The resulting tensile strain in a geomembrane (ε) is calculated using the following equation proposed by Giroud (1977):

$$\varepsilon\ (\%) = \frac{8}{3}\left(\frac{\Delta S}{L}\right)^2 \times 100\% \tag{8}$$

Depth of Influence

For settlement calculations, the depth of influence is considered to extend to a depth where the surcharge load at depth is less than 20 percent of the effective vertical stress at that depth. In essence:

$$I_f \times P \leq 0.2\sigma_v' \tag{9}$$

where

I_f = stress reduction influence factor (a value of 1.0 was used in this analysis);

P = surcharge; and

σ_v' = vertical effective stress.

This relationship is used to calculate the depth to which settlement is expected to occur. Materials below this depth are not expected to experience settlement induced by the weight of materials in the proposed TRL expansion. Maximum depths of influence at the site were found to extend to an elevation of approximately -410 ft-msl.

MATERIAL PROPERTIES

Material properties for the sands and clays that make up the Magothy Aquifer and Patapsco Formation were assigned based on data from field investigations and laboratory tests. For consistency across analyses, the moist unit weight, total unit weight, overconsolidation ratio (OCR), specific gravity, porosity, and plasticity index values that were reported in the Slope Stability Analysis (Appendix F) were used in this analysis as well. The values of compression, recompression, and secondary compression indices and modulus number were evaluated specifically for this settlement analysis using empirical relationships while the void ratio and water content were evaluated using phase relationships.

Waste:

Based on Geosyntec's experience, the moist and total unit weight of C&D waste was assumed to be 50 pcf and includes the unit weight of periodic and intermediate cover material. The saturated unit weight of waste is not considered as leachate recirculation is not practiced at TRL and the bottom of liner will always be above the groundwater table. Compression of waste is not considered for the liner settlement analysis. The unit weight is used to calculate post-development stresses on and settlements in underlying foundation materials.

Magothy Upper Aquifer Clay Lenses:

The values for moist unit weight, total unit weight, OCR, specific gravity, porosity, and plasticity index were taken from Appendix F and were based on data from field investigations and laboratory tests. The initial void ratio of the clay lenses in the Upper Aquifer was calculated using the following phase relationship in Equation 10:

$$e = \left(\frac{\gamma_{sat}}{\gamma_w} - G_s\right) \Big/ \left(1 - \frac{\gamma_{sat}}{\gamma_w}\right) \quad (10)$$

where

γ_{sat} = saturated unit weight of the material;

γ_w = unit weight of water; and

G_S = specific gravity of the material.

The water content of the clay lenses was calculated using the following phase relationship in Equation 11:

$$w_c = \frac{\gamma_{sat}(1+e)}{G_s \times \gamma_w} - 1 \tag{11}$$

where

γ_{sat} = saturated unit weight of the material.

The compression and recompression indices of the clay lenses were evaluated using the following empirical relationships from Kulhawy and Mayne (1990), which resulted in values that were consistent with a reported 0.12 compression index from a laboratory consolidation test (Geosyntec Consultants, 2019):

$$C_c = \frac{PI}{74} \tag{12}$$

$$C_r = \frac{C_c}{5} \tag{13}$$

where

C_c = compression index;

C_r = recompression index; and

PI = plasticity index.

The ratio of secondary compression index to compression index (C_α/C_c) is approximately constant for a given soil type, independent of the vertical effective stress and time elapsed following primary consolidation. The following typical values were proposed by Terzaghi et al. (1996):

Material	C_α/C_c
Shale and mudstone	0.03 ± 0.01
Inorganic clays and silts	0.04 ± 0.01
Organic clays and silts	0.05 ± 0.01
Peat and muskeg	0.06 ± 0.01

A ratio of 0.04 was selected for the clay lenses, consistent with typical values for inorganic clays and silts. Table 1 contains a summary of the material properties for the clay lenses.

Magothy Upper Aquifer Sands

The values for moist unit weight, total unit weight, specific gravity, and porosity were taken from the Appendix F and were based on data from field investigations and laboratory tests. The initial void ratio of the sands in the Upper Aquifer was calculated using the phase relationship in Equation

10 and the water content was calculated using the phase relationship in Equation 11. The modulus number was evaluated using the empirical correlation with porosity from Janbu (1963); a porosity value of 0.35 was used in the analysis. Table 1 contains a summary of the material properties for the sands in the Upper Aquifer.

Patapsco Formation Confining Unit Sand Lenses

The sand lenses in the Confining Unit were assumed to have the same material properties and parameters as the sand in the Upper Aquifer. Table 1 contains a summary of properties for the sand lenses.

Patapsco Formation Confining Unit Clays

The clays in the Confining Unit were assumed to have the same material properties and parameters as the clay lenses in the Upper Aquifer. Table 1 contains a summary of properties for the sand lenses.

Patapsco Formation Lower Aquifer Sands

The initial void ratio of the sands in the Lower Aquifer (LA) was calculated using the phase relationship in Equation 10 and the water content was calculated using the phase relationship in Equation 11. Using the empirical correlation with porosity from Janbu (1963), the modulus number was evaluated as 300. Table 1 contains a summary of the material properties for the Lower Aquifer sands.

RESULTS

The settlement results for cross sections A-A' through G-G' are presented in Tables 2 through 8, respectively. For each point along the cross sections, the tables summarize the ground surface elevation, horizontal distance, horizontal offset from previous point, waste thickness, elastic settlement, primary and secondary consolidation, total settlement, differential settlement, design grade, grade change, final grade, and geomembrane tensile strain.

Under loads from waste ranging in thickness from 48 to 137 ft, the expected liner settlement varies from 0.88 to 2.73 ft. While some variation in the settlement across the landfill is attributable to changes in the subsurface stratigraphy, the majority of the variation is related to the variation of waste loads across the landfill. In all cases, the post-settlement slopes of the leachate collection pipe corridors and the cell floor met the minimum slope requirements. The post-settlement slopes of the leachate collection pipe corridors range from 0.51 to 1.57 percent and the post-settlement slopes of the cell sides range from 2.16 to 2.78 percent.

The long-term strain of the geomembrane was estimated to range from 0 to 0.0093%, which is significantly less than the maximum allowable long-term strain ranging from 4 to 5 percent.

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TABLES

Table 1 - Material Properties for Liner Settlement Analysis

Tolson Rubble Landfill Expansion, Crofton, Maryland

Material Type	USCS Soil Type	Soil Type	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Compression Index, C_c	Recompression Index, C_r	C_α / C_c	Secondary Compression Index, C_α	Initial Void Ratio, e_o	OCR	Modulus Number, m	Gs	PI	Water Content, w_c (%)
Magothy Upper Aquifer Sand & Patapsco Formation Confining Unit Sand Lenses	SC-SM	COARSE	120	130	N/A	N/A	N/A	N/A	0.52	N/A	300	2.65	N/A	20
Magothy Upper Aquifer Clay Lenses & Patapsco Formation Confining Unit Clay	CL	FINE	125	132	0.12	0.02	0.04	0.005	0.52	2.00	N/A	2.70	9.0	19
Patapsco Formation Lower Aquifer Sand	SP-SM	COARSE	124	130	N/A	N/A	N/A	N/A	0.52	N/A	300	2.65	N/A	20
Fill	SW-SM	COARSE	120	130	N/A	N/A	N/A	N/A	0.52	N/A	300	2.65	N/A	20
Waste	N/A	N/A	50	50	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 2 - Summary of Settlement, Differential Settlement, Grade Change, and Geomembrane Strain Section A-A'
Tolson Rubble Landfill Expansion, Crofton, Maryland

Point	Ground Surface Elevation (ft-msl)	Horizontal Distance (ft)	Offset from Previous Point (ft)	Waste Thickness (ft)	Elastic Settlement (ft)	Primary Consolidation (ft)	Secondary Consolidation (ft)	Total Settlement (ft)	Differential Settlement (ft)	Design Grade (%)	Grade Change (%)	Final Grade (%)	Geomembrane Tensile Strain (%)
1	97.4	0	0	63	0.55	0.25	0.29	1.09	-	-	-	-	-
2	99.0	144	144	92	1.01	0.33	0.31	1.64	-0.55	1.10	-0.38	0.72	0.0039
3	100.6	288	144	123	1.68	0.39	0.31	2.38	-0.73	1.10	-0.51	0.59	0.0070
4	101.8	441	153	106	1.27	0.36	0.33	1.96	0.42	0.80	0.27	1.07	0.0020
5	103.1	594	153	90	0.99	0.30	0.32	1.61	0.35	0.80	0.23	1.03	0.0014
6	104.3	748	153	77	0.67	0.33	0.32	1.33	0.29	0.80	0.19	0.99	0.0009
7	105.2	867	119	82	0.74	0.40	0.33	1.47	-0.14	0.80	-0.12	0.68	0.0004
8	106.2	986	119	97	1.06	0.42	0.32	1.80	-0.33	0.80	-0.28	0.52	0.0020
9	107.1	1,105	119	113	1.59	0.28	0.25	2.12	-0.32	0.80	-0.27	0.53	0.0019
10	108.0	1,160	55	119	1.73	0.27	0.24	2.25	-0.13	1.50	-0.24	1.26	0.0015
11	109.8	1,281	121	115	1.65	0.27	0.24	2.16	0.09	1.50	0.07	1.57	0.0001
12	112.4	1,456	176	128	1.91	0.31	0.26	2.48	-0.32	1.50	-0.18	1.32	0.0009
13	113.6	1,660	203	129	1.85	0.39	0.32	2.56	-0.08	0.60	-0.04	0.56	0.0000
14	114.7	1,834	174	124	1.70	0.44	0.36	2.50	0.06	0.60	0.03	0.63	0.0000
15	116.1	2,067	233	127	1.73	0.45	0.37	2.55	-0.04	0.60	-0.02	0.58	0.0000
16	117.3	2,270	203	76	0.71	0.32	0.37	1.40	1.15	0.60	0.57	1.17	0.0085

Table 3 - Summary of Settlement, Differential Settlement, Grade Change, and Geomembrane Strain Section B-B'
Tolson Rubble Landfill Expansion, Crofton, Maryland

Point	Ground Surface Elevation (ft-msl)	Horizontal Distance (ft)	Offset from Previous Point (ft)	Waste Thickness (ft)	Elastic Settlement (ft)	Primary Consolidation (ft)	Secondary Consolidation (ft)	Total Settlement (ft)	Differential Settlement (ft)	Design Grade (%)	Grade Change (%)	Final Grade (%)	Geomembrane Tensile Strain (%)
1	101.8	0	0	61	0.42	0.34	0.33	1.09	-	-	-	-	-
2	100.9	161	161	75	0.66	0.36	0.32	1.34	0.25	0.60	0.15	0.75	0.0006
3	100.5	223	61	88	0.86	0.42	0.33	1.60	0.26	0.60	0.42	1.02	0.0048
4	99.6	376	154	88	0.89	0.39	0.32	1.61	0.01	0.60	0.01	0.61	0.0000
5	98.5	557	185	87	0.92	0.34	0.30	1.56	-0.05	0.60	-0.03	0.57	0.0000

Table 4 - Summary of Settlement, Differential Settlement, Grade Change, and Geomembrane Strain Section C-C'
Tolson Rubble Landfill Expansion, Crofton, Maryland

Point	Ground Surface Elevation (ft-msl)	Horizontal Distance (ft)	Offset from Previous Point (ft)	Waste Thickness (ft)	Elastic Settlement (ft)	Primary Consolidation (ft)	Secondary Consolidation (ft)	Total Settlement (ft)	Differential Settlement (ft)	Design Grade (%)	Grade Change (%)	Final Grade (%)	Geomembrane Tensile Strain (%)
1	112.3	0	0	48	0.34	0.21	0.33	0.88	-	-	-	-	-
2	111.8	74	74	64	0.53	0.27	0.34	1.15	0.27	0.60	0.37	0.97	0.0036
3	110.8	239	165	63	0.47	0.32	0.39	1.18	0.03	0.60	0.02	0.62	0.0000
4	109.7	432	192	57	0.33	0.38	0.42	1.13	-0.05	0.60	-0.02	0.58	0.0000
5	108.7	602	170	75	0.61	0.44	0.40	1.45	0.32	0.60	0.19	0.79	0.0010
6	107.6	780	179	116	1.45	0.52	0.35	2.32	0.87	0.60	0.49	1.09	0.0063

Table 5 - Summary of Settlement, Differential Settlement, Grade Change, and Geomembrane Strain Section D-D'
Tolson Rubble Landfill Expansion, Crofton, Maryland

Point	Ground Surface Elevation (ft-msl)	Horizontal Distance (ft)	Offset from Previous Point (ft)	Waste Thickness (ft)	Elastic Settlement (ft)	Primary Consolidation (ft)	Secondary Consolidation (ft)	Total Settlement (ft)	Differential Settlement (ft)	Design Grade (%)	Grade Change (%)	Final Grade (%)	Geomembrane Tensile Strain (%)
1	116.7	0	0	56	0.37	0.32	0.36	1.05	-	-	-	-	-
2	115.8	149	149	93	1.03	0.34	0.34	1.71	0.66	0.60	0.44	1.04	0.0053
3	115.0	289	139	128	1.78	0.42	0.33	2.53	0.82	0.60	0.59	1.19	0.0093
4	114.0	448	159	129	1.76	0.45	0.36	2.57	0.04	0.60	0.02	0.62	0.0000
5	113.1	597	149	127	1.76	0.43	0.34	2.52	-0.04	0.60	-0.03	0.57	0.0000

Table 6 - Summary of Settlement, Differential Settlement, Grade Change, and Geomembrane Strain Section E-E'
Tolson Rubble Landfill Expansion, Crofton, Maryland

Point	Ground Surface Elevation (ft-msl)	Horizontal Distance (ft)	Offset from Previous Point (ft)	Waste Thickness (ft)	Elastic Settlement (ft)	Primary Consolidation (ft)	Secondary Consolidation (ft)	Total Settlement (ft)	Differential Settlement (ft)	Design Grade (%)	Grade Change (%)	Final Grade (%)	Geomembrane Tensile Strain (%)
1	101.8	0	0	85	0.80	0.41	0.30	1.51	-	-	-	-	-
2	104.8	110	110	107	1.30	0.38	0.27	1.95	-0.43	2.70	-0.39	2.31	0.0041
3	107.9	225	115	134	1.94	0.38	0.25	2.57	-0.62	2.70	-0.54	2.16	0.0078
4	110.1	308	83	131	1.92	0.35	0.23	2.50	0.07	2.70	0.08	2.78	0.0002

Table 7 - Summary of Settlement, Differential Settlement, Grade Change, and Geomembrane Strain Section F-F'
Tolson Rubble Landfill Expansion, Crofton, Maryland

Point	Ground Surface Elevation (ft-msl)	Horizontal Distance (ft)	Offset from Previous Point (ft)	Waste Thickness (ft)	Elastic Settlement (ft)	Primary Consolidation (ft)	Secondary Consolidation (ft)	Total Settlement (ft)	Differential Settlement (ft)	Design Grade (%)	Grade Change (%)	Final Grade (%)	Geomembrane Tensile Strain (%)
1	106.5	0	0	122	1.67	0.46	0.29	2.43	-	-	-	-	-
2	107.2	81	81	137	1.98	0.47	0.28	2.73	-0.3	0.90	-0.37	0.53	0.0037
3	108.3	298	217	137	2.05	0.41	0.24	2.70	0.0	0.50	0.01	0.51	0.0000
4	109.1	448	149	134	2.14	0.27	0.19	2.61	0.09	0.50	0.06	0.56	0.0001
5	109.8	597	149	101	1.34	0.25	0.20	1.80	0.82	0.50	0.55	1.05	0.0080
6	110.6	746	149	67	0.63	0.20	0.21	1.04	0.75	0.50	0.51	1.01	0.0068

Table 8 - Summary of Settlement, Differential Settlement, Grade Change, and Geomembrane Strain Section G-G'
Tolson Rubble Landfill Expansion, Crofton, Maryland

Point	Ground Surface Elevation (ft-msl)	Horizontal Distance (ft)	Offset from Previous Point (ft)	Waste Thickness (ft)	Elastic Settlement (ft)	Primary Consolidation (ft)	Secondary Consolidation (ft)	Total Settlement (ft)	Differential Settlement (ft)	Design Grade (%)	Grade Change (%)	Final Grade (%)	Geomembrane Tensile Strain (%)
1	111.2	0	0	132	1.91	0.38	0.30	2.59	-	-	-	-	-
2	113.0	223	223	131	1.95	0.35	0.28	2.57	0.0	0.80	0.01	0.81	0.0000
3	114.2	383	160	129	1.94	0.31	0.25	2.50	0.1	0.80	0.04	0.84	0.0000
4	114.7	439	56	121	1.73	0.28	0.25	2.26	0.2	0.80	0.43	1.23	0.0049
5	115.2	510	70	127	1.87	0.30	0.26	2.42	-0.2	0.80	-0.23	0.57	0.0015
6	116.6	684	174	125	1.82	0.29	0.25	2.36	0.06	0.80	0.03	0.83	0.0000
7	117.4	777	93	113	1.55	0.28	0.27	2.10	0.26	0.80	0.28	1.08	0.0021
8	118.4	902	125	125	1.78	0.29	0.27	2.34	-0.24	0.80	-0.19	0.61	0.0010
9	119.5	1,035	133	123	1.76	0.30	0.29	2.35	-0.01	0.80	-0.01	0.79	0.0000
10	121.4	1,276	241	75	0.77	0.20	0.29	1.27	1.09	0.80	0.45	1.25	0.0054

FIGURES

TRL EXPANSION DESIGN

PROPOSED BASE GRADE
TOLSON RUBBLE LANDFILL, ODENTON, ANNE ARUNDEL COUNTY, MARYLAND

Geosyntec consultants

FIGURE 1

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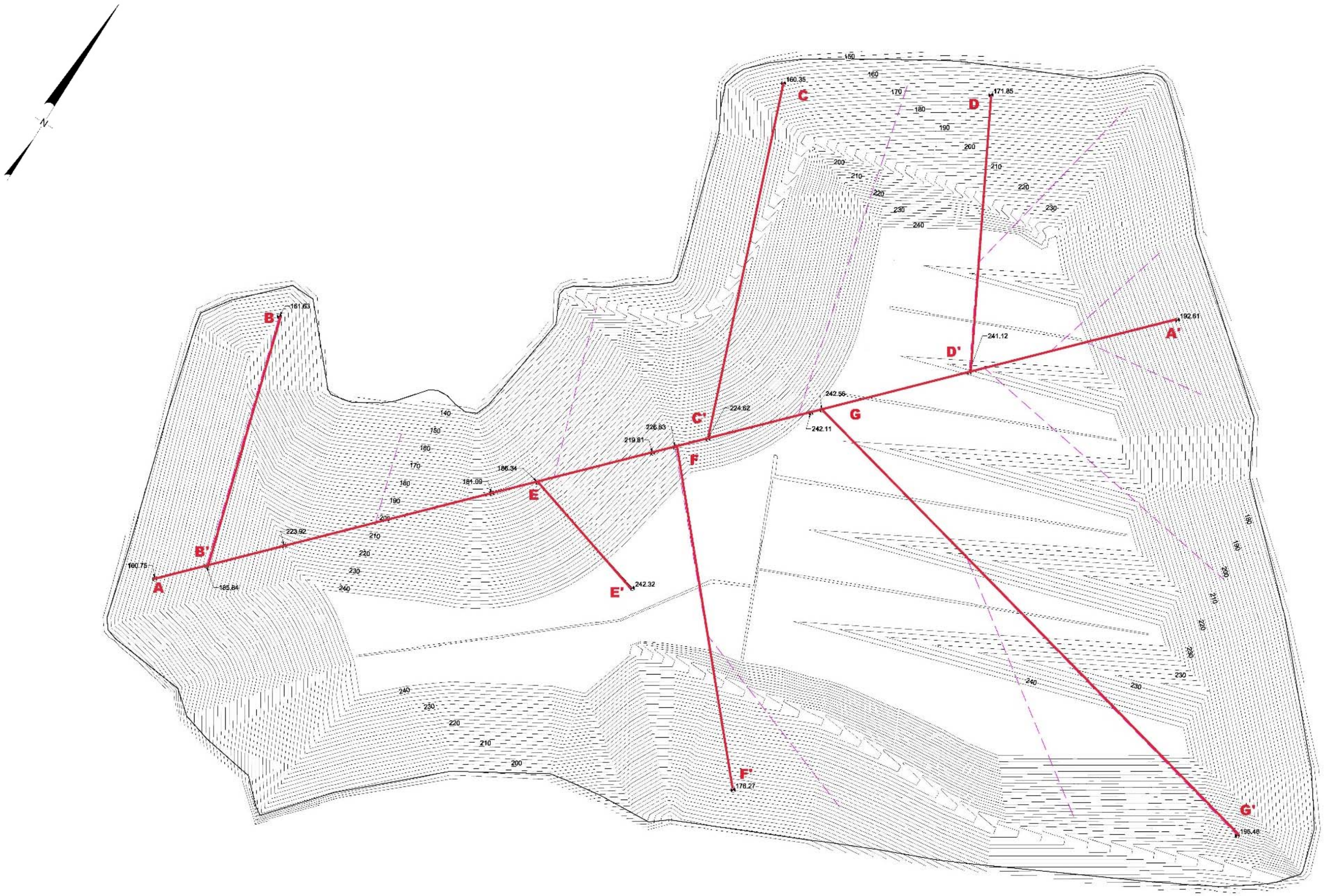

TRL EXPANSION DESIGN

PROPOSED FINAL COVER GRADE
TOLSON RUBBLE LANDFILL, ODENTON, ANNE ARUNDEL COUNTY, MARYLAND

Geosyntec consultants

FIGURE 2

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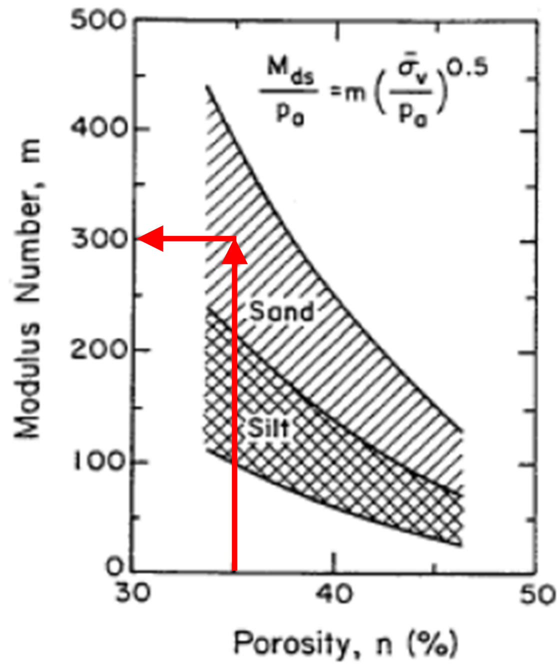

Source: Janbu (1963)

TRL EXPANSION DESIGN

MODULUS NUMBER VS POROSITY
TOLSON RUBBLE LANDFILL, ODENTON, ANNE ARUNDEL COUNTY, MARYLAND

Geosyntec consultants

FIGURE 3

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Appendix E.2: Liner Puncture Resistance

COMPUTATION COVER SHEET

Client: Tolson & Associates **Project:** TRL Vertical Expansion **Project #:** ME1606 **Task #:** 03

TITLE OF COMPUTATIONS LINER SYSTEM GEOMEMBRANE PUNCTURE RESISTANCE ANALYSIS

COMPUTATIONS BY: Signature Julia Roberts February 7, 2020
DATE

Printed Name Julia Roberts
and Title Professional

ASSUMPTIONS AND PROCEDURES CHECKED BY: (Peer Reviewer) Signature Sean T. O'Donnell February 13, 2020
DATE

Printed Name Sean O'Donnell
and Title Engineer

COMPUTATIONS CHECKED BY: Signature Sean T. O'Donnell February 13, 2020
DATE

Printed Name Sean O'Donnell
and Title Engineer

COMPUTATIONS BACKCHECKED BY: (Originator) Signature Julia Roberts February 14, 2020
DATE

Printed Name Julia Roberts
and Title Professional

APPROVED BY: (PM or Designate) Signature Jenny Ramirez March 6, 2020
DATE

Printed Name Jenny Ramirez
and Title Professional

APPROVAL NOTES:

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

GEOMEMBRANE PUNCTURE RESISTANCE ANALYSIS

PURPOSE

The purpose of this calculation is to evaluate the puncture resistance of the geomembrane component of the liner system for the proposed Tolson Rubble Landfill (TRL) expansion located in Crofton, Maryland. For the geomembrane to work effectively as a barrier layer, the integrity and function of the geomembrane should not be compromised by granular materials placed either above or below the geomembrane.

SITE INFORMATION

The plan views of liner and cover system for the proposed TRL expansion are shown in Figures 1 and 2, respectively. The maximum thickness of waste under the final configuration will be approximately 130 ft, corresponding to a maximum top of waste elevation of 240 ft-msl (maximum top of final cover elevation is 244 ft-msl). The proposed liner system design for the TRL expansion shown in Figure 3 consists of a series of engineered layers over a prepared subgrade composed of the following layers, from top to bottom:

- *Compacted Drainage/Protection layer:* 12-inch thick granular drainage layer;
- *Drainage layer:* Geocomposite drainage layer;
- *Hydraulic barrier layer:* 60-mil HDPE textured geomembrane;
- *Hydraulic barrier layer:* 24-inch thick compacted subbase; and
- *Compacted subgrade:* Natural soil prepared and compacted to specifications

The geomembrane of the liner systems is evaluated for puncture from both underlying and overlying soils. During construction of the liner system and operation of the landfill, it is assumed that the geomembrane will have a minimum soil cover of 1 ft when heavy equipment is driving over it.

METHOD OF ANALYSIS

This analysis will provide recommendations regarding construction equipment and prepared subgrade to be placed immediately beneath and above the geomembrane to provide an adequate factor of safety against puncture. The factor of safety against puncture for a given loading condition is defined as the ratio of the allowable pressure (P_{allow}) on the geomembrane to the applied pressure ($P_{applied}$), as follows:

$$FS = \frac{P_{allow}}{P_{applied}} \quad (1)$$

For this analysis, the factor of safety is calculated based on an estimate of the force acting on the geomembrane under an assumed loading condition. For the liner system, two loading conditions are considered: 1) static loading from the weight of heavy equipment operating directly on the drainage layer/protective cover of the liner system and 2) geostatic loading from the weight of waste and final cover soils when the landfill reaches final grades. The allowable force on the geomembrane surface is calculated using a modification of the design methodology proposed by Koerner [2012]. An excerpt from Koerner [2012] is included as Attachment 1 to this calculation package.

Allowable Pressure

The allowable pressure on the geomembrane is computed based on the methodology presented by Koerner [2012]. The governing equation is as follows:

$$P_{allow} = \left(50 + 0.00045 \cdot \frac{M}{H^2}\right) \cdot \left(\frac{1}{MF_S \cdot MF_{PD} \cdot MF_A}\right) \cdot \left(\frac{1}{RF_{CR} \cdot RF_{CBD}}\right) \quad (2)$$

where

P_{allow} = allowable pressure on geomembrane (kPa);
M = mass per unit area of a protective geotextile layer (g/m^2);
H = height of protrusion within adjoining soil mass (m);
MF_S = modification factor for protrusion shape;
MF_{PD} = modification factor for packing density;
MF_A = modification factor for arching in soils;
RF_{CR} = reduction factor for long-term creep; and
RF_{CBD} = reduction factor for chemical/biological degradation.

However, this method uses empirical correlations only and does not consider the membrane puncture resistance nor the testing conditions used to obtain that puncture resistance in the laboratory. A better representation is obtained by replacing the first term in Equation (2) with the ultimate puncture resistance (in pounds) of the geomembrane as measured according to ASTM D4833 (F_{lab}). This approach neglects the protection provided by a geotextile (or geocomposite) and the revised equation is as follows:

$$F_{allow} = F_{lab}\left(\frac{1}{MF_s \times MF_{PD} \times MF_A}\right)\left(\frac{1}{RF_{CR} \times RF_{CBD}}\right) \quad (3)$$

The second term in Equation (3) involves modification factors to account for shape, packing density, and arching of soils. The third term in Equation (3) represents the reduction factors to account for long-term creep and degradation of the geomembrane.

In Equation (3), F_{lab} is selected as the minimum required puncture resistance of a 60-mil HDPE textured geomembrane per GRI [2016], which is specified as 90 pounds (Attachment 2). Equation (3) calculates an allowable force on the geomembrane (F_{allow}) considering several modification and reduction factors proposed by Koerner [2012] (see Attachment 1).

Using the diameter of the test probe specified in ASTM D4833 for determining puncture resistance (8 mm diameter), the allowable pressure is calculated as follows:

$$P_{allow} = \frac{F_{allow}}{(\pi D^2/4)} \tag{4}$$

where

D = probe diameter (ASTM D4833, 2013).

<u>Applied Pressure</u>

The total vertical stress on the geomembrane is calculated as the sum of the overlying soil pressures and the pressure exerted by the construction equipment, as follows:

$$P_{applied} = \sum \gamma_m t_m + q_{eqp} \tag{5}$$

where,

$P_{applied}$ = applied pressure on geomembrane (kPa);
γ_m = unit weight of a given material above the geomembrane;
t_m = thickness of a given material above the geomembrane; and
q_{eqp} = equipment ground pressure (acting at the plane of the geomembrane).

Stresses induced by construction equipment at the geomembrane surface will be reduced with increasing thickness of soil/waste cover. In order to calculate the stresses acting directly on the geomembrane liner with overlying soil cover, the stresses from construction equipment are calculated using the 1:2 load spread method. The area over which the equipment weight is distributed at the geomembrane liner is increased at a rate of 1 horizontal to 2 vertical (1H:2V) from the edge of the loaded area at the ground surface, thus reducing the induced stress on the geomembrane. The stress-distributed area (A) under each tire at the geomembrane surface is calculated as follows:

$$A = B \times L = \left(B_g + t\right) \times \left(L_g + t\right) \tag{6}$$

where,

$B_g,\ L_g$ = width and length of equipment tire contact at ground surface;
t = thickness of overlying soil layers; and
L, B = width and length of area under loading at geomembrane plane.

INPUT DATA

Material Properties

The compacted subgrade shall be composed of natural soil prepared and compacted to specifications. Protrusions are not expected to be greater than 1 inch (25 mm). The compacted drainage/protection layer is composed of a granular material and also shall have a maximum particle size of 1 inch (25 mm). The unit weight of the drainage layer/protective cover is assumed to be 120 pounds per cubic foot (pcf). The waste is assumed to have a maximum thickness of 130 ft and a unit weight of 50 pcf. The final cover system is assumed to be 4-ft thick with a unit weight of 120 pcf.

Modification and Reduction Factors

The modification and reduction factors are used when calculating allowable pressure on the geomembrane to account for protrusion shape, packing density, soil arching, long-term geomembrane creep, and chemical/biological degradation of the geomembrane. For this analysis, a value of 1.0 was conservatively used for each of the modification factors. A reduction factor of 1.5 was used for long-term creep as suggested for geomembranes with density 825 gm/m^2 and a protrusion height of 25 mm (the design geomembrane has a density of 940 gm/m^2). A reduction factor of 1.5 was used for chemical/biological degradation as suggested for a moderate leachate condition, which is appropriate considering the type of waste (construction and demolition debris) that TRL will accept. The table below summarizes the modification and reduction factors used in the analysis.

Factor	Value	Description
Protrusion Shape, MF_S	1.0	Angular
Packing Density, MF_{PD}	1.0	Isolated
Soil Arching, MF_A	1.0	Hydrostatic
Long-Term Creep, RF_{CR}	1.5	Geomembrane density 825 gm/m^2, protrusion height 25 mm
Chemical/Biological Degradation, RF_{CBD}	1.5	Moderate Leachate

Heavy Equipment Loading

The maximum pressure acting on the geomembrane from a construction vehicle is estimated assuming a Caterpillar 730C2 Articulated Dump Vehicle (Attachment 3). The weight distribution of a fully-loaded dump vehicle is approximately equal across the six tires on the vehicle at 20,000 lbs per tire. Assuming the vehicle is equipped with 23.5R25 tires, the contact area between each tire and the ground surface is taken as 576 square inches (24 inch by 24 inch) (p. 34 of Attachment 4).

RESULTS AND CONCLUSION

The minimum factor of safety against puncture of the 60-mil HDPE geomembrane is 34.8 when heavy equipment is driving directly on the liner system and is 11.5 under a final condition with 130 ft of waste and 4-ft thick final cover. A summary of these results can be found in Table 1 and Figure 4. Based on the analysis presented herein, it is recommended that the prepared subgrade under the geomembrane and the compacted drainage/protection layer top of the geocomposite shall have a maximum particle size of 1 inch (25 mm). Preparation of the subgrade shall include proof-rolling and removal of isolated and oversized protrusions.

If field conditions are different from those assumed herein, the Engineer shall be notified and the calculations re-evaluated.

REFERENCES

ASTM D4833 / D4833M-07(2013)e1. 2013. *Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products*, ASTM International, West Conshohocken, PA.

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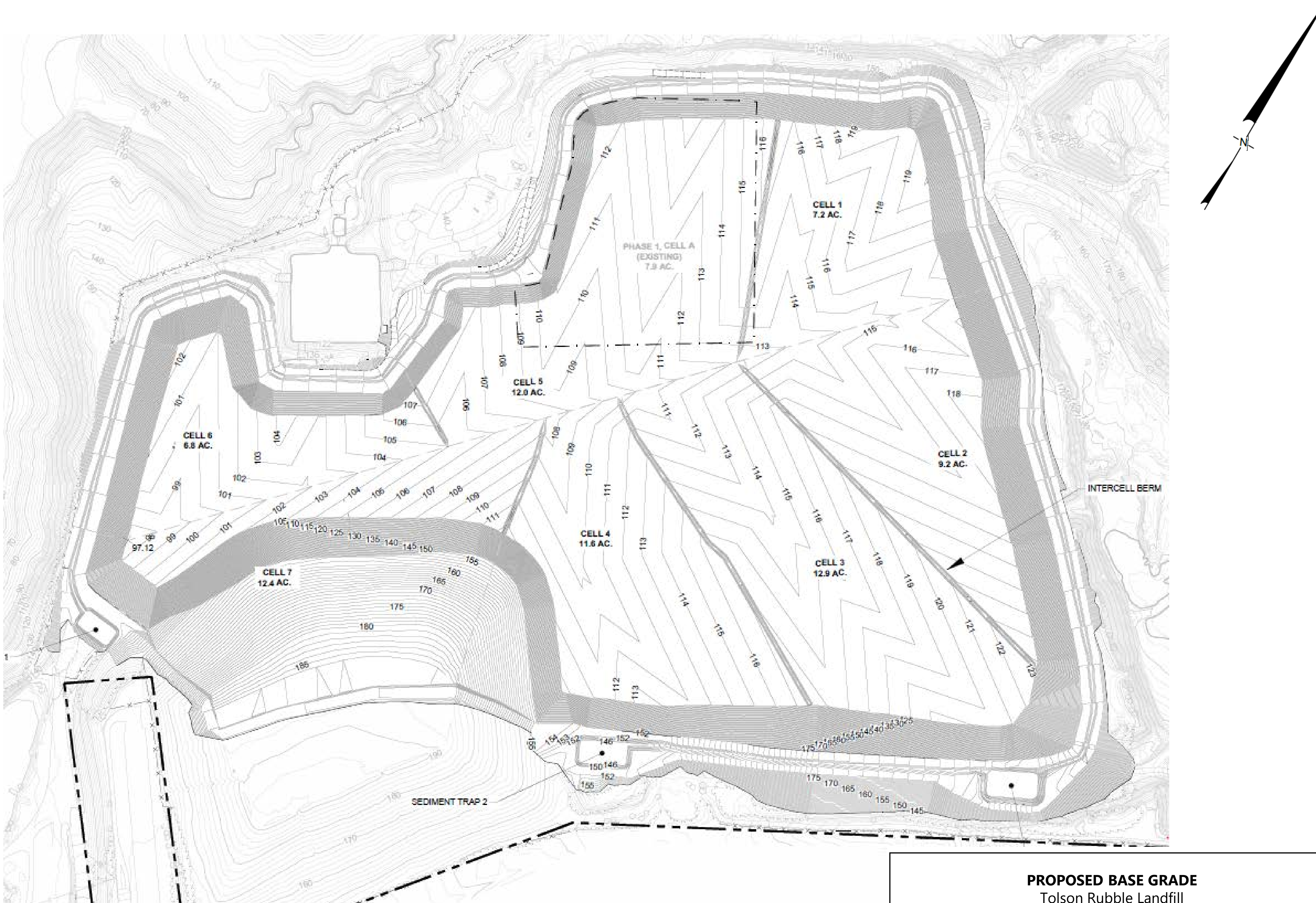
FIGURES

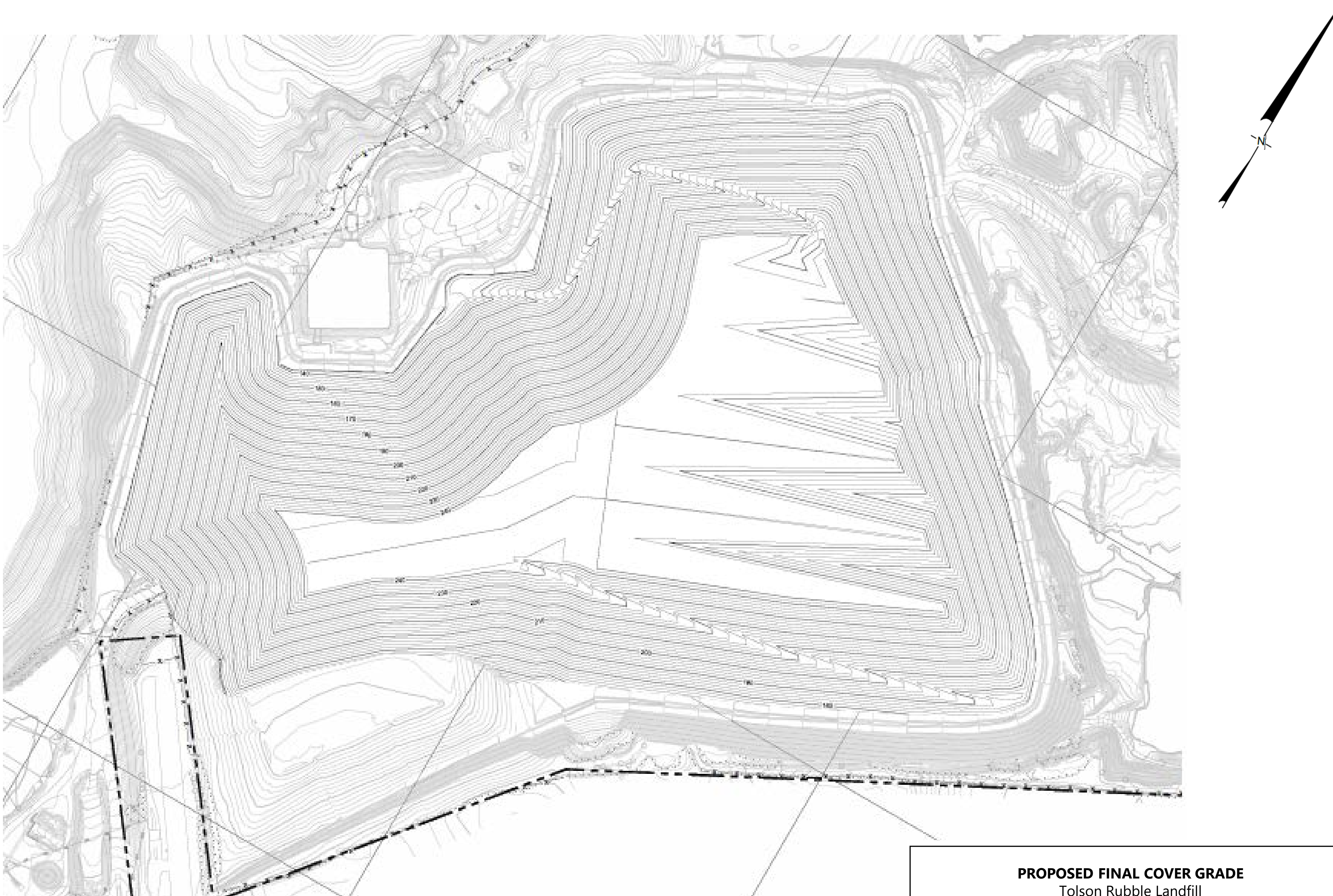


PROPOSED BASE GRADE
Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Geosyntec consultants

Columbia, Maryland | July 2020

Figure
1



PROPOSED FINAL COVER GRADE
Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Geosyntec consultants

Figure 2

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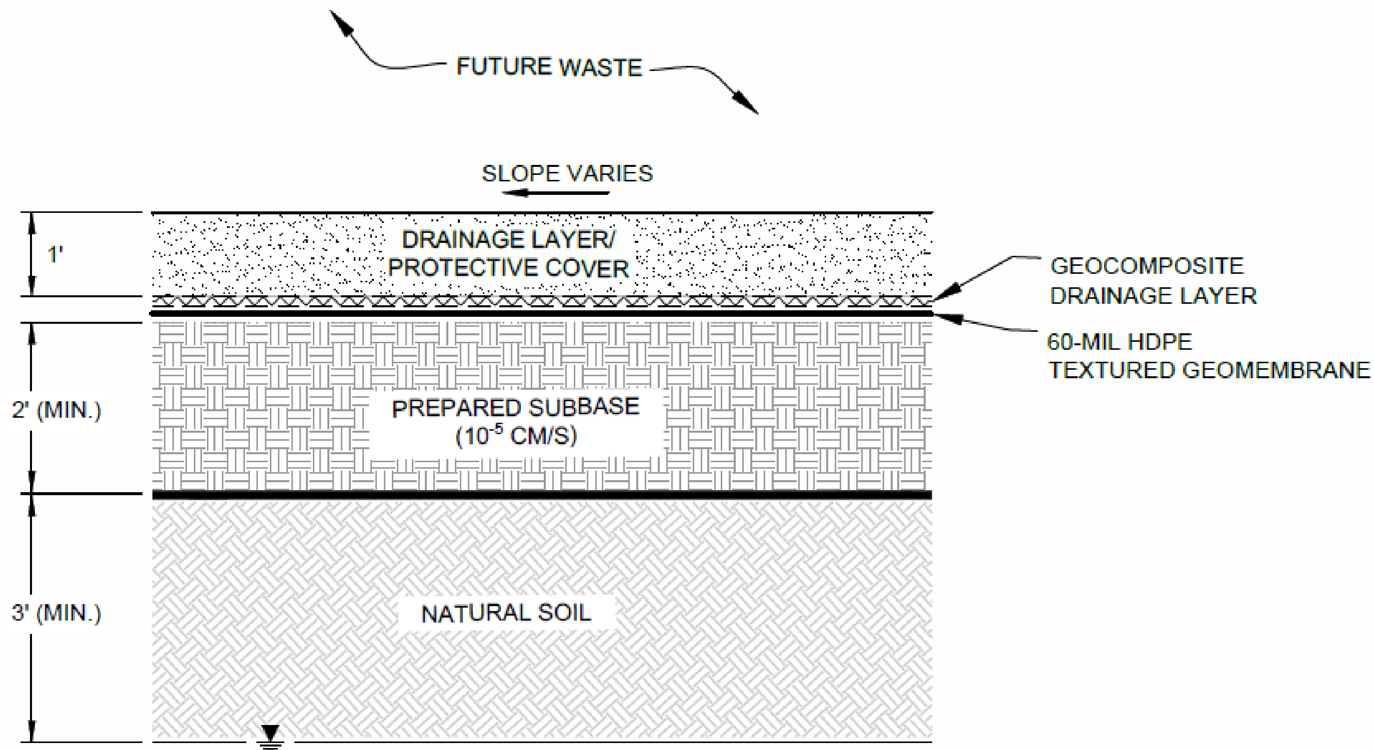


LINER DETAIL
Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

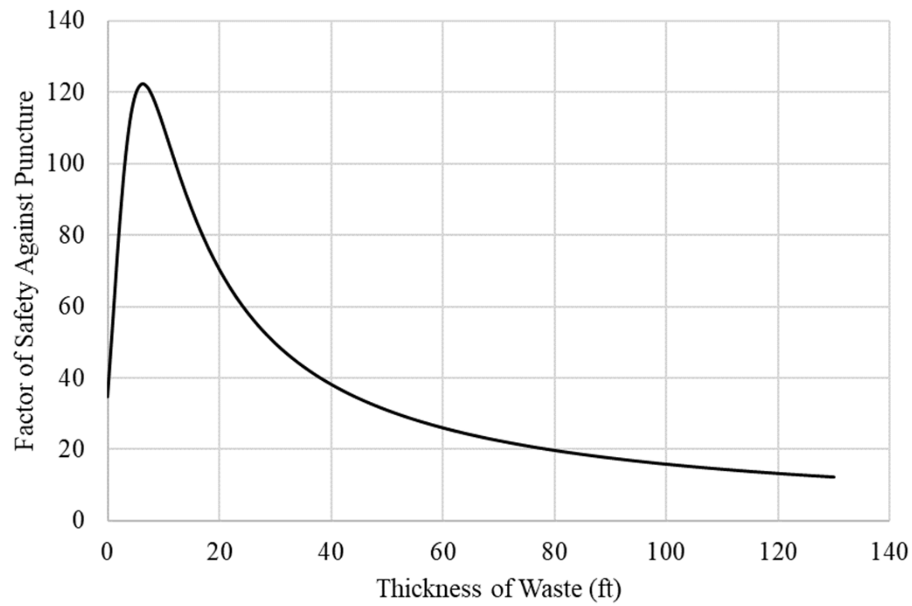
Geosyntec consultants

Columbia, Maryland

February 2020

Figure

3



FACTOR OF SAFETY AGAINST PUNCTURE
Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

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Figure 4

TABLES

Table 1. Liner Geomembrane Puncture Resistance

Tolson Rubble Landfill, Crofton, Maryland

Parameter		C730C2 on Liner System	Final Cover Condition	Units
Material Properties and Loading Conditions				
Test Probe Diameter (ASTM D4833)	H	8	8	mm
		0.3	0.3	in.
Puncture Resistance	F_{lab}	90	90	lb
Thickness of Liner Cover	t_{fc}	1.0	1.0	ft
Unit Weight of Liner Cover	γ_{fc}	120	120	lb/ft^3
Thickness of Waste	t_w	-	130	ft
Unit Weight of Waste	γ_w	-	50	lb/ft^3
Thickness of Final Cover	t_{fc}	-	4	ft
Unit Weight of Final Cover	γ_{fc}	-	120	lb/ft^3
Equipment Operating Weight (per tire)	W_{eqp}	20,000	-	lbs
Standard Tire Width	B_g	24	-	in.
Standard Tire Length	L_g	24	-	in.
Tire Contact Area (per tire)	A_g	576	-	in^2
Equipment Ground Pressure (per tire)	q_{eqp}	34.7	-	psi
Width (at Geomembrane plane, per tire)	B	3.0	-	ft
Length (at Geomembrane plane, per tire)	L	3.0	-	ft
Total Vertical Stress at Liner	$p_{applied}$	2,342	7,100	lb/ft^2
		16.3	49.3	psi
Estimated Allowable Pressure on Geomembrane				
Protrusion Shape	MF_S	1.0	1.0	-
Packing Density	MF_{PD}	1.0	1.0	-
Soil Arching	MF_A	1.0	1.0	-
Long-Term Creep	RF_{CR}	1.5	1.5	-
Chemical/Biological Degradation	RF_{CBD}	1.5	1.5	-
Geomembrane Allowable Force	F_{allow}	40	40	lb
Geomembrane Allowable Pressure	p_{allow}	81,487	81,487	lb/ft^2
Factor of Safety against Puncture				
Factor of Safety against Puncture	$FS_{puncture}$	34.8	11.5	-

ATTACHMENT 1

Excerpt from *Designing with Geosynthetics* [Koerner, 2012]

Modification Factors (all ≤ 1.0)					
MF_S		MF_{PD}		MF_A	
Angular	1.0	Isolated	1.0	Hydrostatic	1.0
Subrounded	0.5	Dense, 38 mm	0.83	Geostatic, shallow	0.75
Rounded	0.25	Dense, 25 mm	0.67	Geostatic, mod.	0.50
		Dense, 12 mm	0.50	Geostatic, deep	0.25

Reduction Factors (all ≥ 1.0)					
RF_{CBD}		RF_{CR}			
		Mass per unit area (gm/m^2)	Protrusion Height (mm)		
			38	25	12
Mild leachate	1.1	Geomembrane alone	N/R	N/R	N/R
Moderate leachate	1.3	270	N/R	N/R	N/R
Harsh leachate	1.5	550	N/R	N/R	1.5
		825	N/R	1.5	1.3
		≥ 1100	1.3	1.2	1.1

N/R = Not recommended

$$p_{allow} = \left(50 + 0.00045\frac{M}{H^2}\right)\left[\frac{1}{MF_S \times MF_{PD} \times MF_A}\right]\left[\frac{1}{RF_{CR} \times RF_{CBD}}\right] \tag{5.34}$$

where

p_{allow} = allowable pressure (kPa),
M = geotextile mass per unit area (g/m^2),
H = protrusion height (m),
MF_S = modification factor for protrusion shape,
MF_{PD} = modification factor for packing density,
MF_A = modification factor for arching in solids,
RF_{CR} = reduction factor for long-term creep (note that these creep reduction factors have been increased since the previous editions of this book, see Koerner et al. [83]), and
RF_{CBD} = reduction factor for long-term chemical/biological degradation.

ATTACHMENT 2

GSE® Geomembrane Product Data

PRODUCT DATA SHEET

GSE HD Textured Geomembrane

GSE HD Textured is a co-extruded textured high density polyethylene (HDPE) geomembrane available on one or both sides. It is manufactured from the highest quality resin specifically formulated for flexible geomembranes. This product is used in applications that require increased frictional resistance, excellent chemical resistance and endurance properties.

[*]

AT THE CORE:
An HDPE geomembrane used in applications that require increased frictional resistance, excellent chemical resistance and endurance properties.

Product Specifications

These product specifications meet GRI GM13

Tested Property	Test Method	Frequency	Minimum Average Value				
			30 mil	40 mil	60 mil	80 mil	100 mil
Thickness, mil Lowest individual reading	ASTM D 5994	every roll	30 27	40 36	60 54	80 72	100 90
Density, g/cm³	ASTM D 1505	200,000 lb	0.940	0.940	0.940	0.940	0.940
Tensile Properties (each direction Strength at Break, lb/in-width Strength at Yield, lb/in-width Elongation at Break, % Elongation at Yield, %	ASTM D 6693, Type IV Dumbell, 2 ipm G.L. 2.0 in G.L. 1.3 in	20,000 lb	 45 63 100 12	 60 84 100 12	 90 126 100 12	 120 168 100 12	 150 210 100 12
Tear Resistance, lb	ASTM D 1004	45,000 lb	21	28	42	56	70
Puncture Resistance, lb	ASTM D 4833	45,000 lb	45	60	90	120	150
Carbon Black Content, % (Range)	ASTM D 1603*/4218	20,000 lb	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	Note(1)	Note(1)	Note(1)	Note(1)	Note(1)
Asperity Height, mil	ASTM D 7466	second roll	16	18	18	18	18
Notched Constant Tensile Load(2), hr	ASTM D 5397, Appendix	200,000 lb	500	500	500	500	500
Oxidative Induction Time, mins	ASTM D 3895, 200°C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100	>100
TYPICAL ROLL DIMENSIONS							
Roll Length(3), ft	Double-Sided Textured Single-Sided Textured		830 1,010	700 780	520 540	400 410	330 330
Roll Width(3), ft			22.5	22.5	22.5	22.5	22.5
Roll Area, ft²	Double-Sided Textured Single-Sided Textured		18,675 22,725	15,750 17,550	11,700 12,150	9,000 9,225	7,425 7,425

NOTES:
- (1)Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- (2)NCTL for GSE HD Textured is conducted on representative smooth membrane samples.
- (3)Roll lengths and widths have a tolerance of ±1%.
- GSE HD Textured is available in rolls weighing approximately 4,000 lb.
- All GSE geomembranes have dimensional stability of ±2% when tested according to ASTM D 1204 and LTB of <-77°C when tested according to ASTM D 746.
- *Modified.

GSE is a leading manufacturer and marketer of geosynthetic lining products and services. We've built a reputation of reliability through our dedication to providing consistency of product, price and protection to our global customers.

Our commitment to innovation, our focus on quality and our industry expertise allow us the flexibility to collaborate with our clients to develop a custom, purpose-fit solution.

GSE ENVIRONMENTAL™

[DURABILITY RUNS DEEP] For more information on this product and others, please visit us at GSEworld.com, call 800.435.2008 or contact your local sales office.

ATTACHMENT 3

730C2 Three Axle Articulated Truck Specifications

GREAT PROTECTION + GREAT RATE = GREAT TIME TO BUY

LEARN MORE

ARTICULATED TRUCKS

730C2

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COMPARE MODELS

USED ARTICULATED TRUCKS

VIEW PRODUCT DOWNLOADS

730C2 Three Axle Articulated Truck

PHOTO 360 VIEW

SPECIFICATIONS EQUIPMENT RELATED PRODUCTS BENEFITS & FEATURES

OVERVIEW

The Cat 730C2, with a 17 m3 (23 yd3) 28 tonnes (31 tons) capacity, offers demonstrated reliability and durability, high performance and productivity, superior operator comfort and lower operating costs. Updating the successful 730C to include all axle enclosed wet brakes makes the 730C2 a more attractive proposition for our customers. Class leading levels of performance and operator comfort make for a productive machine all day long.

ENGINE

UNITS: US METRIC

Engine Model	Cat C13 ACERT
Bore	5.1 in
Stroke	6.2 in
Displacement	762.8 in³
Engine Model - U.S. EPA Tier 4 Final/EU Stage IV	Cat® C13 ACERT™
Gross Power - SAE J1995	375.0 HP
Net Power - ISO 14396	370.0 HP
Net Power - SAE J1349	367.0 HP
No Engine De-rating Below	12500.0 ft
Peak Engine Torque Gross (SAE J1995)	1579.0 ft·lbf
Peak Engine Torque Net (SAE J1349)	1564.0 ft·lbf
Peak Engine Torque Speed	1200.0 r/min
Emissions	The reference to Tier 4 Final/Stage IV includes U.S. EPA Tier 4 Final, EU Stage IV, Japan 2014 (Tier 4 Final), as well as Korea Tier 4 Final emission standards.
Note (1)	The power ratings apply at rated speed of 1,800 rpm when tested under the conditions for the specified standard.

Note (2)	The net power advertised is the power available at the flywheel when the engine is equipped with alternator, air cleaner, muffler and fan at minimum speed.
Note (3)	Net power when the fan is at maximum speed is 254 kW (341 hp) per the SAE reference conditions.
Note (4)	DEF used in Cat SCR systems must meet the requirements outlined in the International Organization for Standardization (ISO) standard 22241-1. ISO 22241-1 requirements are met by many brands of DEF, including those that carry the AdBlue or API certifications.

WEIGHTS

Rated Payload	31.0 t

BODY CAPACITIES

Heaped (SAE 2:1)	23.0 yd³
Struck	17.4 yd³
Tailgate Heaped SAE 2:1	24.6 yd³
Tailgate Struck	18.2 yd³

TRANSMISSION

Forward - 1	5.0 mile/h
Forward - 2	9.0 mile/h
Forward - 3	14.0 mile/h
Forward - 4	21.0 mile/h
Forward - 5	29.0 mile/h
Forward - 6	34.0 mile/h
Reverse - 1	6.0 mile/h

SOUND LEVELS

Interior Cab	76.0 dB(A)
Note (1)	The operator sound exposure Leq (equivalent sound pressure level) measured according to the work cycle procedures specified in ANSI/SAE J1166 OCT98 is 76 dB(A), for the cab offered by Caterpillar, when properly installed and maintained and tested with the doors and windows closed.
Note (2)	Hearing protection may be needed when operating with an open operator station and cab (when not properly maintained or doors/windows open) for extended periods or in noisy environments.

OPERATING WEIGHTS

Center Axle - Empty	9987.0 lb
Center Axle - Loaded	37236.0 lb
Center Axle - Rated Load	27249.0 lb
Front Axle - Empty	32882.0 lb
Front Axle - Loaded	40113.0 lb
Front Axle - Rated Load	7231.0 lb
Rear Axle - Empty	9436.0 lb
Rear Axle - Loaded	36685.0 lb
Rear Axle - Rated Load	27249.0 lb
Total - Empty	52305.0 lb
Total - Loaded	114034.0 lb
Total - Rated Load	61729.0 lb

SERVICE REFILL CAPACITIES

Fuel Tank	108.8 gal (US)
Cooling System	21.9 gal (US)
Hydraulic System	29.1 gal (US)
Engine Crankcase	10.0 gal (US)
Transmission	12.4 gal (US)
Final Drives/Differential	33.0 gal (US)
Output Transfer Gear Box	6.3 gal (US)
DEF Tank	5.2 gal (US)

BODY HOIST

Raise Time	12.0 s
Lower Time	8.0 s

STEERING

Lock to Lock	4.75 seconds @ 60 rpm

STANDARDS

Brakes	ISO 3450 – 2011
Cab - FOPS	ISO 3449 Level II – 2005
Cab - ROPS	ISO 3471 – 2008
Steering	ISO 5010 – 2007

BODY PLATE

Type	High strength Brinell HB450 wear resistant steel

TURNING CIRCLE

Note	Dimensions are for machines equipped with 23.5R25 tires.
Turning Dimensions - Aisle Width	210.0 in
Turning Dimensions - Clearance Radius	318.0 in
Turning Dimensions - Inside Radius	153.0 in
Turning Dimensions - SAE Turning Radius	294.0 in
Turning Dimensions - Steer Angle - Left/Right	45°

BODY PLATE THICKNESS

Front	0.28 in
Side	0.43 in
Base	0.51 in
Chute	0.51 in

ATTACHMENT 4

Bridgestone Off-The-Road Tires Specifications

BRIDGESTONE

DATA BOOK

OFF-THE-ROAD TIRES

GENERAL INFORMATION

RADIAL TIRE

BIAS TIRE

REMARKS & SPECIAL OPERATIONS

O-RING, FLAP, RIM, VALVE, CONVERSION TABLES

CONTENTS

INTRODUCTION

1. Industry Standard

Bridgestone Corporation has developed a wide range of tire patterns and specifications, so that the proper Off-the-Road tire can be matched to any vehicle, service, or operating conditions.
Bridgestone's Off-the-Road tires are designed and produced to meet the commonly accepted international standards, those set by the TRA (Tire and Rim Association) in the U.S.A., by the ETRTO (European Tire and Rim Technical Organization) in Europe and/or by the JATMA (Japan Automobile Tire Manufacturers' Association) in Japan*.
Load capacities, inflation pressures, dimensions such as overall tire diameter and width, as well as the relative rims and tube valves follow these standards.
If a tire is to be used for a purpose other than that for which it is originally intended, please consult Bridgestone Corporation for advice.

***Where differences exist between the TRA, ETRTO and JATMA standards,**
Bridgestone selects the most applicable.

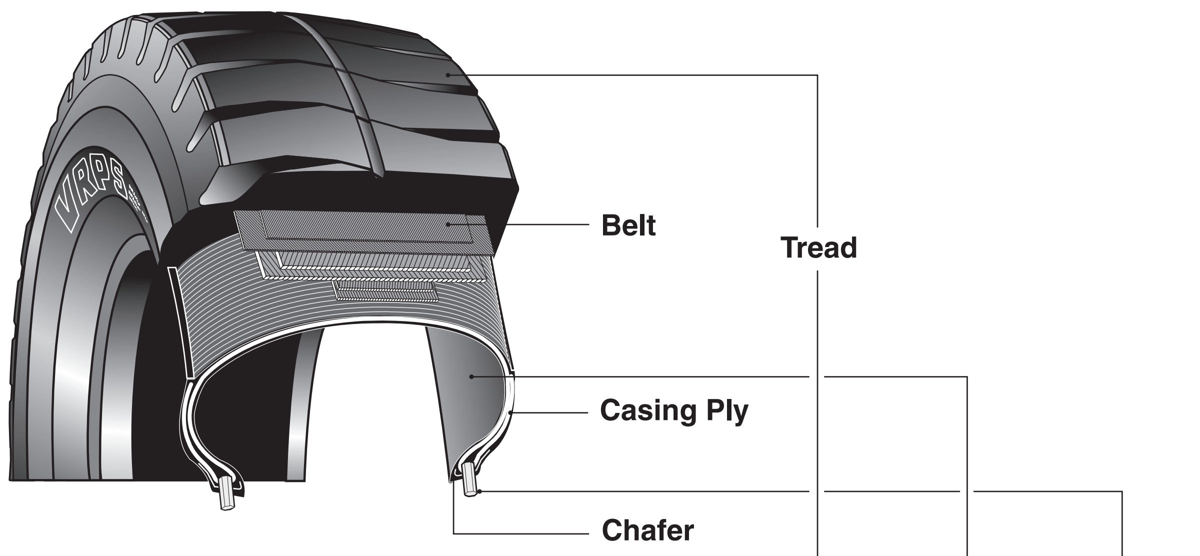
2. Application Vehicle Matching Chart

APPLICATION	VEHICLE
Earthmover Service	Dump Trucks, Motor Scrapers, Articulated Dump Trucks, Coal Haulers, Logging Trucks, Other Mining Trucks, etc.
Grader Service	Motor Graders
Loader & Dozer Service	Front-End Loaders, Back-hoe Loaders, Skid Steer Loaders, Dozers, Underground Trucks, Load-Haul-Dumps, etc.
Mobile Crane Service (High-Speed)	All-Terrain Cranes, High-Speed Vehicles, etc.
Industrial Service	Straddle Carriers, Aircraft Towing Tractors, Container Stackers, Counter-balanced Lift Trucks, Mobile Crushers, Log Stackers, etc.
Logging Service	Log-Skidders
Compactor Service	Compactor, Road Rollers
Sand Service	Sand Service Trucks
Underground Service	Underground Trucks, Load Haul Dumps, Drilling Jumbo

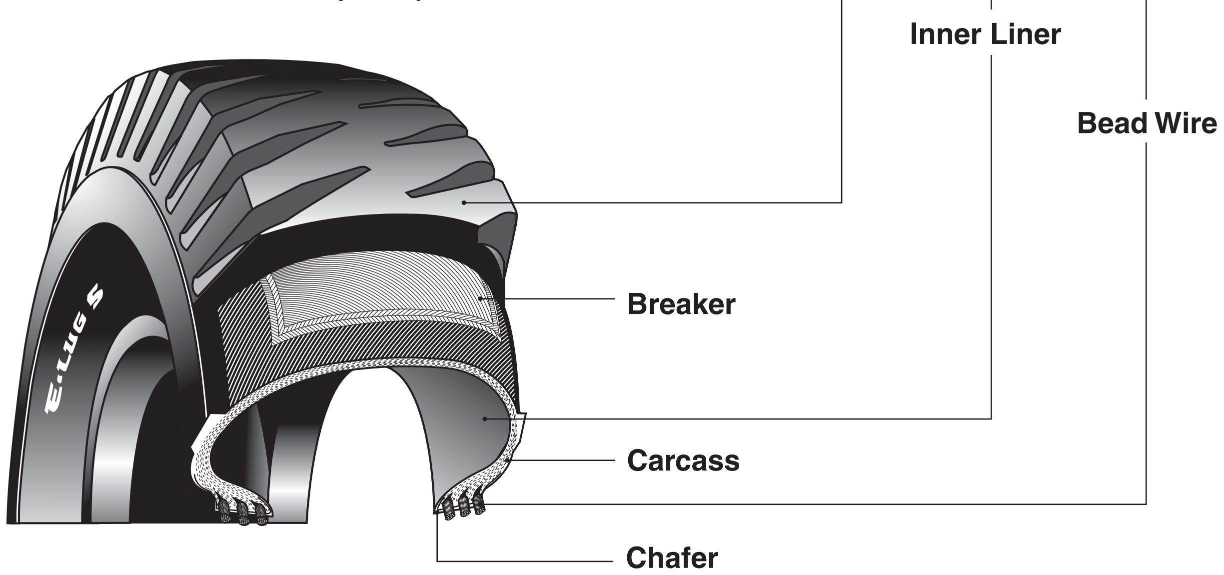
GENERAL INFORMATION

1. Structural Diagram

Off-The-Road Radial Tire (ORR)



Off-The-Road Bias Tire (ORS)



2. Definitions

2.1 Tire Size

The size of each tire is indicated by nominal width and rim diameter in inches and mm.
Radial structure is indicated by the letter "R". For some tire the aspect ratio is indicated by percentage.

Example
Radial Tire ; 40.00R57, 33.25R35, 445/95R25
Bias Tire ; 21.00-35, 45/65-45

2.2 Star Rating, Ply Rating and Load Index

The load capacity of a tire is indicated by the star rating (in case of radial tire) and the ply rating (in case of bias tire).
The load index is applied in countries where the ETRTO standards are used.

2.3 Overall Diameter (OD)

"Overall Diameter" is twice the section height of a new tire, plus the nominal rim diameter, including 24-hour inflation growth.

2.4 Overall Width (OW)

"Overall Width" is the width of a new tire, including 24-hour inflation growth, and including protective side ribs, bars or decorations.

2.5 Section Width (SW)

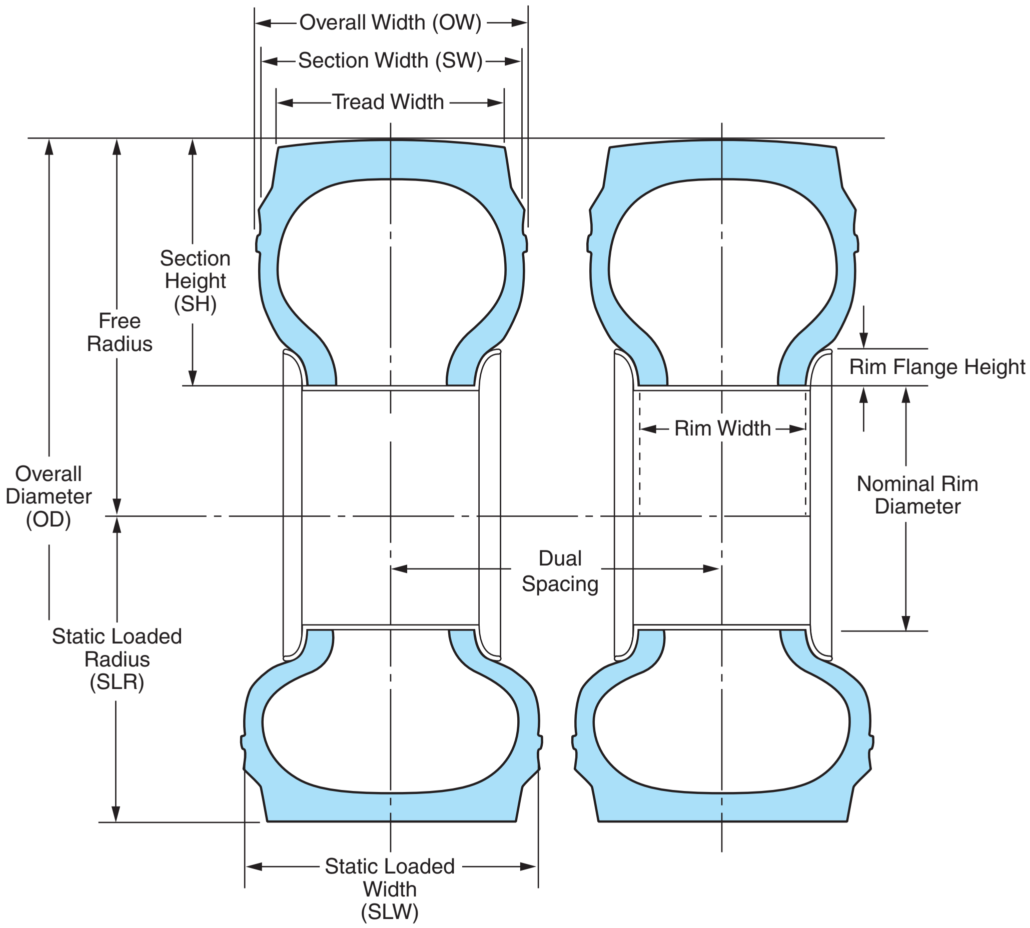
"Section Width" is the width of a new tire, including 24-hour inflation growth and including normal sidewalls, but not including protective side ribs, bars, or decorations.

2.6 Static Loaded Radius and Width (SLR, SLW)

"Static Loaded Radius" is the shortest distance from the axle center to the contact surface of a tire and "Static Loaded Width" is the overall width of a tire, mounted on the approved rim at the specified inflation pressure and placed still and vertically on a flat board, and loaded with the specified load.

2.7 Original Tread Depth (OTD)

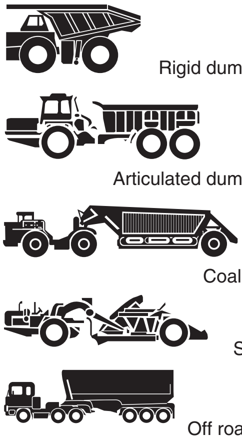
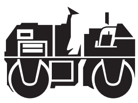
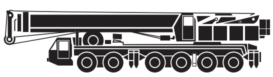
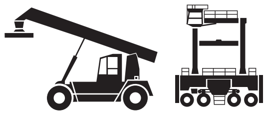
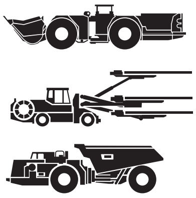
"Original Tread Depth" is the tread depth of a new tire measured at the point of tread-indicator where available or one-fourth the width of the tire crown section from the crown center, including 24-hour inflation growth.



3. Classification

3.1 Uses and Characteristics of Off-The-Road Tires

The characteristics that Off-The-Road tires must possess differ according to their function and the type of vehicles they are mounted on.

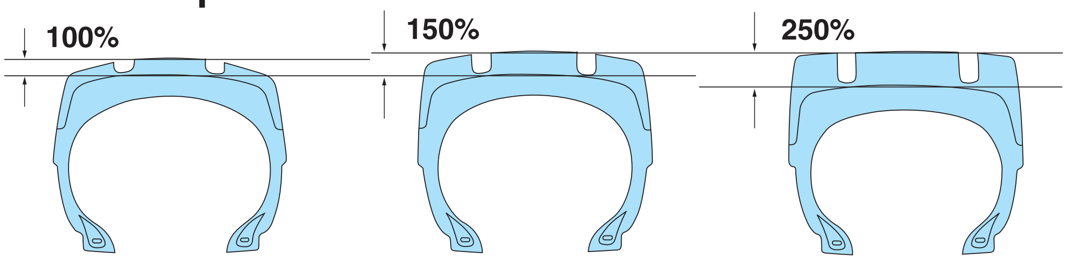
Type/Service	Function	Vehicles	Main tire characteristics required
Earthmover	Transporting	 Rigid dump trucks, Articulated dump trucks, Coal haulers, Scrapers, Off road trucks	Heat-resistance, Cut-resistance, Wear-resistance Shock burst-resistance
Grader	Grading, Leveling	 Graders	Traction, Maneuverability, (directional stability)
Loader and dozer	Loading and dozing	 Loaders, Bulldozers	Cut-resistance, Wear-resistance Stability
Compactor	Compacting	 Tire-rollers	Oil-resistance, Cut-resistance, Wear-resistance
Logging	Log-skidding	 Log-skidders	Traction, Flotation, Cut-resistance
Mobile crane (High-speed)	High-speed Travelling	 All-Terrain Cranes	Heat-resistance, Wear-resistance, Traction
Industrial	Handling & Towing	 Handling & Towing Equipments	Uneven wear, Wear-resistance, Stability
Underground	Underground	 LHDs, Drilling Jumbo, Underground Trucks	Cut-resistance, Wear-resistance

3.2 TRA Classification and Corresponding Bridgestone Off-The-Road Tires

Off-The-Road tires are classified by the TRA as follows, and the names of the tread patterns of the corresponding Bridgestone Off-The-Road tires are described below.

TRA Classification	Tread Type	Bridgestone Tread Pattern	
		Radial	Bias
E= Earthmover (Haulage Service)			
E-2	Traction	VUT VKT VSB VFT VHS VSW	
E-3	Rock	VLT VMT VTS VRL VRF	WL RL VL2
E-4	Rock Deep	L317 VLTS VSNT VMTS VMTP VZTS VZTP VELS VRLS VREP VRDP VRPS VREV VRQP	
E-7	Flotation	VSJ	
G=Grader			
G-1	Rib		RG
G-2	Traction	VUT VSW	GL FG
G-3	Rock	VJT	RL
G-4	Rock Deep	VMTS	
L=Loader & Dozer (Slow Speed Service)			
L-2	Traction Regular	VUT VSW	GL FG
L-3	Rock Regular	VLT VJT VTS	RL VL2
L-4	Rock Deep	VLTS VSNT VSNL	RLS
L-5	Rock Extra-Deep	VSDT VSDL VSDR	DL
L-5S	Smooth Extra-Deep	VSMS VSMS2	STMS
C=Compactor Service			
C-1	Smooth		RR
C-2	Grooved		AL2
LS=Logging Service			
LS-2	Intermediate	VSB	
Mobile Crane Service (High-Speed)			
Mobile Crane Service		VGT VHB VHS VSW	
Industrial Service			
Industrial Service		VHB VCH VCHD VCHR VCHS VELS VRLS VSDL VSMS	RL RLS ELS2 STMS YS2
Underground Service			
Underground Service		VSNL VSNT VSDL VSDR VSDT VSMS VSMS2	STMS DL

Design Tread-Depth

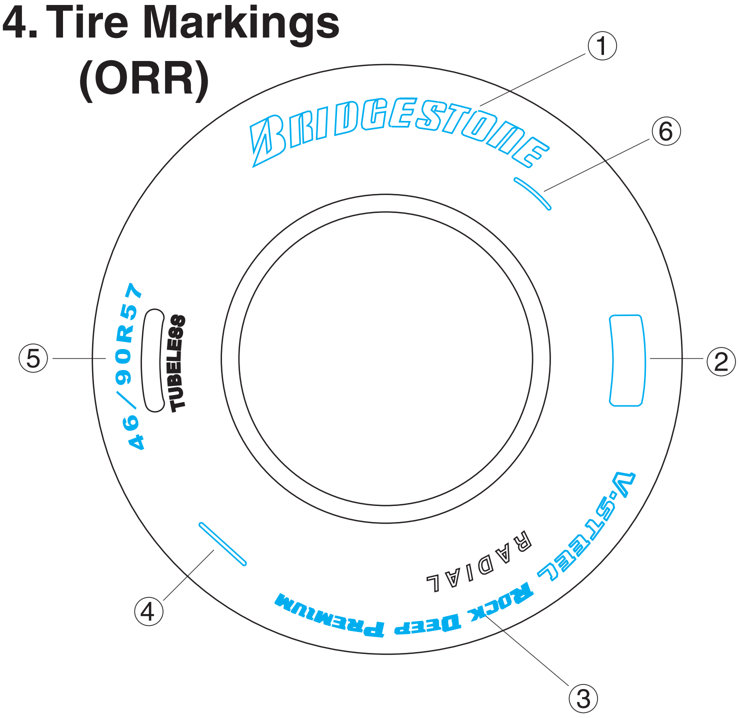


Regular Tread
E-2/E-3
L-2/L-3
G-2/G-3

Deep Tread
E-4
L-4
G-4

Extra Deep Tread
L-5/L-5S

4. Tire Markings (ORR)



① Brand Name

② Bridgestone's Specifications Code

③ Pattern Name

④ Serial Number

⑤ Tire Size, Star Rating, Tubeless or Tube Type

⑥ DOT Code
DOT code is necessary for USA public road.

4.1 Type of Tire Size Designation

Regular

27.00 R 49 ☆ ☆
- Star Rating
- Rim Diameter (inches)
- Radial Structure
- Section Width (inches)

Wide Base

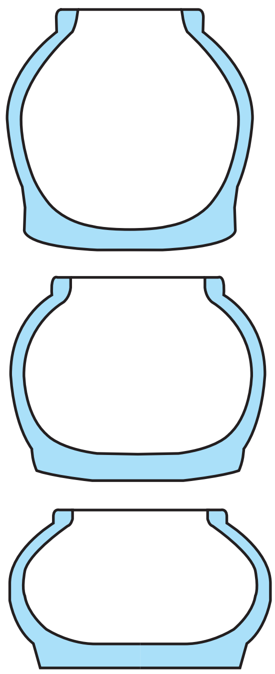
33.25 R 35 ☆ ☆
- Star Rating
- Rim Diameter (inches)
- Radial Structure
- Section Width (inches)

Super Wide Base

40 / 65 - 39 30PR
- Ply Rating
- Rim Diameter (inches)
- Aspect Ratio 65 Series
- Section Width (inches)

170 E 385 / 95 R 24
- Rim Diameter (inches)
- Radial Structure
- Aspect Ratio 95 Series
- Section Width (mm)
- Speed Symbol
- Load Index

***Tire Aspect Ratio**



$\frac{SH}{SW} = 0.95$*

$\frac{SH}{SW} = 0.80$*

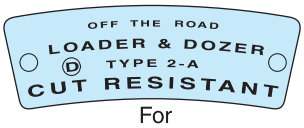
$\frac{SH}{SW} = 0.65$*

SH, SW : See Page 3

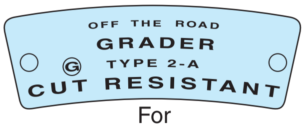
4.2 Type of Tire Structures Classified by Service and Designated by Bridgestone

Each Bridgestone tire has a Bridgestone code number on the tire sidewall according to its specifications.

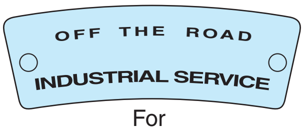
For
Earthmover service



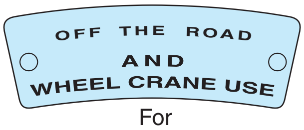
For
Loader and Dozer service



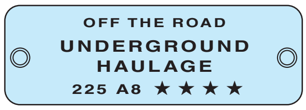
For
Grader service



For
Industrial service



For
Mobile Crane Service



For
Underground Truck Service

Tire Structures Classified by Type of Service and Bridgestone's Designations

Service	BS Code No.	Structure
Earthmover Service (E)	1A 2A 3A	Standard Cut-resistant Heat-resistant
Grader Service (G)	1A 2A	Standard Cut-resistant
Loader & Dozer Service (D)	2A 2V* 2Z*	Cut-resistant Special cut-resistant (Type"V") Special cut-resistant (Type"Z")
Logging Service (S)	2V	**Standard

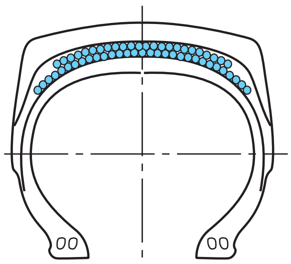
NOTES: *Bias Tire Only
**2V tires are standard for log skidder service since the possibility of the cutting is high in log skidder operations.

D 2 A

- Structure:
  - A: Standard
  - V: Cut-resistant type "V" (Steel Breaker)
  - Z: Cut-resistant type "Z" (Side Steel Breaker)
- Characteristics:
  - 1: Standard
  - 2: Cut-resistant
  - 3: Heat-resistant
- Type of Service:
  - E: Earthmover
  - G: Grader
  - D: Loader & Dozer
  - S: Logging

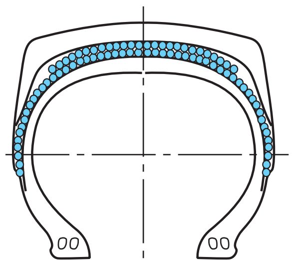
Steel Breaker Tire

Type V



Steel breaker construction

Type Z



Side steel breaker construction

Steel Breaker Bias Tire

Steel Breaker Off-the-Road tires feature breaker material which is changed from nylon to steel in order to resist cutting and cut bursting. Bridgestone Steel Breaker Off-the-Road tires are widely used on loaders at mining and quarry sites, loaders and underground trucks in underground mines, and also on log loaders.

Side Steel Breaker Bias Tire

In this tire the steel breaker extends to the sidewall of the tire to protect it against damage. The construction is similar to that described above.

4.3 Load Index

The LOAD INDEX is an international numerical code for the maximum load a tire can carry at the speed indicated by its speed symbol under service conditions specified by Bridgestone.

LI	kg	LI	kg	LI	kg	LI	kg	LI	kg	LI	kg
0	45	50	190	100	800	150	3 350	200	14 000	250	60 000
1	46.2	51	195	101	825	151	3 450	201	14 500	251	61 500
2	47.5	52	200	102	850	152	3 550	202	15 000	252	63 000
3	48.7	53	206	103	875	153	3 650	203	15 500	253	65 000
4	50	54	212	104	900	154	3 750	204	16 000	254	67 000
5	51.5	55	218	105	925	155	3 875	205	16 500	255	69 000
6	53	56	224	106	950	156	4 000	206	17 000	256	71 000
7	54.5	57	230	107	975	157	4 125	207	17 500	257	73 000
8	56	58	236	108	1 000	158	4 250	208	18 000	258	75 000
9	58	59	243	109	1 030	159	4 375	209	18 500	259	77 500
10	60	60	250	110	1 060	160	4 500	210	19 000	260	80 000
11	61.5	61	257	111	1 090	161	4 625	211	19 500	261	82 500
12	63	62	265	112	1 120	162	4 750	212	20 000	262	85 000
13	65	63	272	113	1 150	163	4 875	213	20 600	263	87 500
14	67	64	280	114	1 180	164	5 000	214	21 200	264	90 000
15	69	65	290	115	1 215	165	5 150	215	21 800	265	92 500
16	71	66	300	116	1 250	166	5 300	216	22 400	266	95 000
17	73	67	307	117	1 285	167	5 450	217	23 000	267	97 500
18	75	68	315	118	1 320	168	5 600	218	23 600	268	100 000
19	77.5	69	325	119	1 360	169	5 800	219	24 300	269	103 000
20	80	70	335	120	1 400	170	6 000	220	25 000	270	106 000
21	82.5	71	345	121	1 450	171	6 150	221	25 750	271	109 000
22	85	72	355	122	1 500	172	6 300	222	26 500	272	112 000
23	87.5	73	365	123	1 550	173	6 500	223	27 250	273	115 000
24	90	74	375	124	1 600	174	6 700	224	28 000	274	118 000
25	92.5	75	387	125	1 650	175	6 900	225	29 000	275	121 000
26	95	76	400	126	1 700	176	7 100	226	30 000	276	125 000
27	97	77	412	127	1 750	177	7 300	227	30 750	277	128 000
28	100	78	425	128	1 800	178	7 500	228	31 500	278	132 500
29	103	79	437	129	1 850	179	7 750	229	32 500	279	136 000
30	106	80	450	130	1 900	180	8 000	230	33 500		
31	109	81	462	131	1 950	181	8 250	231	34 500		
32	112	82	475	132	2 000	182	8 500	232	35 500		
33	115	83	487	133	2 060	183	8 750	233	36 500		
34	118	84	500	134	2 120	184	9 000	234	37 500		
35	121	85	515	135	2 180	185	9 250	235	38 750		
36	125	86	530	136	2 240	186	9 500	236	40 000		
37	128	87	545	137	2 300	187	9 750	237	41 250		
38	132	88	560	138	2 360	188	10 000	238	42 500		
39	136	89	580	139	2 430	189	10 300	239	43 750		
40	140	90	600	140	2 500	190	10 600	240	45 000		
41	145	91	615	141	2 575	191	10 900	241	46 250		
42	150	92	630	142	2 650	192	11 200	242	47 500		
43	155	93	650	143	2 725	193	11 500	243	48 750		
44	160	94	670	144	2 800	194	11 800	244	50 000		
45	165	95	690	145	2 900	195	12 150	245	51 500		
46	170	96	710	146	3 000	196	12 500	246	53 000		
47	175	97	730	147	3 075	197	12 850	247	54 500		
48	180	98	750	148	3 150	198	13 200	248	56 000		
49	185	99	775	149	3 250	199	13 600	249	58 000		

4.4 Speed Symbol

The SPEED SYMBOL indicates the speed at which the tire can carry a load corresponding to its load index under service conditions specified by Bridgestone.

Speed Symbol	Speed (km/h)
A1	5
A2	10
A3	15
A4	20
A5	25
A6	30
A7	35
A8	40

Speed Symbol	Speed (km/h)
B	50
C	60
D	65
E	70
F	80
G	90

4.5 Conversion Table: Star Rating to Ply Rating

Service	Tire Size	Star Rating	Corresponding Ply Rating
Earthmover	12.00R24	★3	up to 24
	14.00R24	★3	up to 32
	14.00R25	★3	up to 32
	16.00R25	★2	up to 36
	18.00R25	★1	up to 24
		★2	up to 36
	18.00R33	★2	up to 40
	21.00R35	★2	up to 44
	40.00R57	★2	up to 74
	17.5R25	★1	up to 16
	20.5R25	★1	up to 24
		★2	up to 28
	23.5R25	★1	up to 24
		★2	up to 32
	26.5R25	★2	up to 32
	29.5R25	★2	up to 34
	29.5R29	★2	up to 40
	33.25R29	★2	up to 44
	33.25R35	★2	up to 44
	37.25R35	★2	up to 48
	37.5R39	★2	up to 52
	40.5/75R39	★2	up to 54

Service	Tire Size	Star Rating	Corresponding Ply Rating
Grader	14.00R24	★1	up to 16
	16.00R24	★1	up to 16
	17.5R25	★1	up to 16
Loader	15.5R25	★1	up to 16
	17.5R25	★1	up to 16
	20.5R25	★1	up to 24
		★2	up to 28
	23.5R25	★1	up to 24
		★2	up to 32
	26.5R25	★1	up to 24
		★2	up to 36
	29.5R25	★1	up to 28
		★2	up to 34
	29.5R29	★1	up to 34
	35/65R33	★1	up to 36
	45/65R45	★1	up to 50
	50/65R51	★2	up to 54

Note: Due to the practice of altering inflation pressure to improve flotation on sand, Bridgestone does not apply a star rating to tire size 21.00R25 VSJ.

4.6 Size Conversion Table

Metric	Inch
385/95R24, 25	14.00R24, 25
445/95R24, 25	16.00R24, 25
445/80R25	17.5R25
505/95R25	18.00R25
525/80R25	20.5R25
750/65R25	30/65R25

4.7 Dual Specification Codes

Some Bridgestone Off-The-Road Tires have dual specification codes which can be used for both services.

Combination	Construction	Size Designation
Loader & Dozer Service + Earthmover Service	Radial	26.5R25 MS* VLT T DE2 ★1 D2A ★2 E2A
	Bias	26.5 – 25 20 VL2 T DE2 D2A E2A
Loader & Dozer Service + Grader Service	Bias	17.5 – 25 12 FG T DG2 D2A G2A
Earthmover Service + Grader Service	Radial	17.5R25 ★1 VKT T EG2 E2A G2A
Underground Trucks + Loader & Dozer Service	Radial	35/65R33 MT* VSNT T DUH UGH D2A

*** Multiple Star Rating**

Bridgestone Radial Tires marked with “LOADER & DOZER ★(one star)” and “EARTHMOVER ★★(two star)” have specified load capacity on each servicing condition.

Strength of tire casing is designed to constrain inflation pressure used.

<26.5R25 as an example>

	Type of Service	Star Rating	Inflation Pressure	Load (Load Index)	Speed (Speed Symbol)
MS	Loader	★(one star)	5.00 bar	15,000 kgs (202)	10 km/hour (A2)
	Earthmover	★★(two stars)	5.25 bar	11,500 kgs (193)	50 km/hour (B)

<35/65R33 as an example>

MT	Underground Trucks	★★★★(four stars)	8.00 bar	29,000 kgs (225)	40 km/hour (A8)
	Loader	★★(two stars)	6.50 bar	28,000 kgs (224)	10 km/hour (A2)

Description on Tire Sidewall

5. Ton-Kilometer-Per-Hour (TKPH)

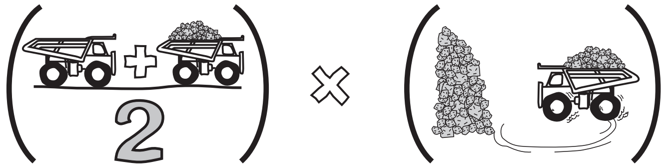
5.1 Operating TKPH

Earth-moving, mining and logging tires have become increasingly important with the development of large construction vehicles. The primary task of these heavy-duty tires is to haul heavy loads faster, over longer distances. This heavy hauling inevitably causes heat built-up in the tires. As tires have limited resistance to heat, deterioration of the tire may occur at an early stage of operation if used beyond the rated TKPH.

Accordingly, it is necessary when selecting tires, to determine the amount of work which will keep the tire within a safe range to avoid over-heating when the vehicle is operated under given conditions. The amount of work done under the given conditions and within a safe range is shown as "Operating Ton-Kilometer-Per-Hour (Operating TKPH)" which can be determined by the following formula:

Formula for Calculation of Operating TKPH

Operating TKPH =



Mean Tire-Load (MTL) × **Average Work Shift Speed (AWSS)**

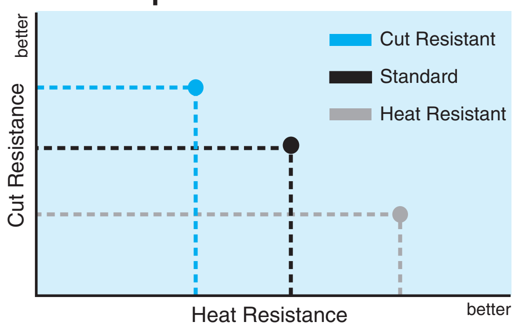
$$\text{MTL [metric tons]} = \frac{\text{Tire Load (Empty)} + \text{Tire Load (Loaded)}}{2}$$

$$\text{AWSS [km/hour]} = \frac{\text{Round Trip Distance[km]} \times \text{Number of Cycles per Shift}}{\text{Total Hours of Operation per Shift}}$$

5.2 Tire TKPH

Tire TKPH varies depending on the tire's design (size, tread pattern and the type of compound). A High TKPH tire generates less heat than that of lower TKPH tire. However, the lower TKPH tire will have greater cut and wear resistance than the higher TKPH one.

Compound Characteristics



The TKPH method is applicable in the following situations.

(1) One way distance: within 16 km (10 miles)

a. When haul length exceeds 16 km one way, consult a Bridgestone Representative.

b. If the round-trip distance is less than 5km (3miles), Tire TKPH figures can be increased by 12%.

(2) Ambient temperature: 38˚C (100˚F)

For ambient temperatures other than 38˚C (100˚F), the Tire TKPH rating should be revised based on the following formula.

a. Radial Tire

Revised TKPH rating = [1 + α × (38˚C–Max. Ambient Temperature ˚C)]* × Tire TKPH

Below	27.00 (33.5)	inches in Section Width: α =0.010
Above	30.00 (37.25)	inches in Section Width: α =0.009

b. Bias Tire

Revised TKPH rating = [1 + α × (38˚C–Max. Ambient Temperature ˚C)]* × Tire TKPH

Below	27.00 (33.5)	inches in Section Width: α =0.006
Above	30.00 (37.25)	inches in Section Width: α =0.005

*Revising coefficient: The value is shown in the following table.

Revising Coefficient

Ambient Temperature		Bias Tire Tire Section		Radial Tire Tire Section	
˚C	˚F	27.00 and below	30.00 and over	27.00 and below	30.00 and over
14	57	1.144	1.120	1.240	1.216
15	59	1.138	1.115	1.230	1.207
16	61	1.132	1.110	1.220	1.198
18	64	1.120	1.100	1.200	1.180
20	68	1.108	1.090	1.180	1.162
22	72	1.096	1.080	1.160	1.144
24	75	1.084	1.070	1.140	1.126
26	79	1.072	1.060	1.120	1.108
28	82	1.060	1.050	1.100	1.090
30	86	1.048	1.040	1.080	1.072
32	90	1.036	1.030	1.060	1.054
34	93	1.024	1.020	1.040	1.036
36	97	1.012	1.010	1.020	1.018
38	100	1.000	1.000	1.000	1.000
40	104	0.988	0.990	0.980	0.982
42	108	0.976	0.980	0.960	0.964
44	111	0.964	0.970	0.940	0.946
46	115	0.952	0.960	0.920	0.928
48	118	0.940	0.950	0.900	0.910
50	122	0.928	0.940	0.880	0.892

For all ambient temperatures below 14˚C (57˚F), the same TKPH value as calculated at 14˚C (57˚F) should be used.

(3) Maximum speed

a. Radial Tire

For 65km/h(40mph) maximum speed, the loads must be reduces 12% with no change in inflation pressure.

b. Bias Tire

When the maximum speed exceeds 50 km/h (30 mph) under loaded conditions, the following formula is used:

$$\text{Revised TKPH Rating} = \frac{50\text{ km/h}}{\text{Max. speed}} \times \text{Tire TKPH}$$

Example:

The TKPH Rating for 21.00-35, 36PR RLS E1A is 226; if the tire is to run at 60 km/h when loaded.

$$\frac{50}{60} \times 226 = 188$$

(4) To obtain the TKPH(TMPH) for type 2A-LS, multiply type 2A rating by 0.8.

(5) The respective types of vehicles are subject to the following speed limitations.

Maximum Speed

Type of Vehicle	Maximum Speed
Dump & Scraper	**50 km/h (30 mph)**
Grader	**40 km/h (25 mph)**
Loader & Dozer	**10 km/h (5 mph)**

5.3 Proper TKPH

The average operating TKPH, calculated after several samples, should not exceed the tire TKPH rating. Exceeding the tire TKPH may result in serious tire damage or failure.

RADIAL TIRE

1. Tread Designs

■Earthmover Service

E2

V-STEEL
ULTRA TRACTION
(VUT)

V-STEEL
K-TRACTION
(VKT)

V-STEEL
S-BLOCK
(VSB)

E2

V-STEEL
F-TRACTION
(VFT)

V-STEEL
H-SERVICE
(VHS)

V-STEEL
SNOW WEDGE
(VSW)

E3

V-STEEL
L-TRACTION
(VLT)

Wide Base Regular
V-STEEL M-TRACTION
(VMT)

V-STEEL
TRACTION-STABILITY
(VTS)

E3

Wide Base Regular
V-STEEL R-LUG
(VRL)

V-STEEL
ROCK FAST
(VRF)

E4

L317

V-STEEL
L-TRACTION S
(VLTS)

V-STEEL
N-TRACTION
(VSNT)

V-STEEL
M-TRACTION S
(VMTS)

V-STEEL
M-TRACTION
PREMIUM (VMTP)

E4

V-STEEL
Z-TRACTION S
(VZTS)

V-STEEL
Z-TRACTION
PREMIUM (VZTP)

18.00R25~
21.00R35

40.00R57

V-STEEL E-LUG S (VELS)

E4

14.00R24~
16.00R25

21.00R33~
37.00R57

V-STEEL R-LUG S (VRLS)

V-STEEL
ROCK E-PREMIUM
(VREP)

V-STEEL
ROCK DEEP
PREMIUM (VRDP)

E4

V-STEEL
ROCK PREMIUM
SERVICE (VRPS)

V-STEEL
ROCK EXTRA
V-OPERATION (VREV)

V-STEEL
ROCK QUARRY
PREMIUM (VRQP)

■Sand Service

E7

V-STEEL
JAMAL
(VSJ)

■Grader Service

G2

V-STEEL
U-TRACTION
(VUT)

V-STEEL
SNOW WEDGE
(VSW)

G3

V-STEEL
J-TRACTION
(VJT)

G4

V-STEEL
M-TRACTION S
(VMTS)

Loader & Dozer Service

L2

L3

V-STEEL
U-TRACTION
(VUT)

V-STEEL
SNOW WEDGE
(VSW)

V-STEEL
L-TRACTION
(VLT)

V-STEEL
J-TRACTION
(VJT)

V-STEEL TRACTION-
STABILITY
(VTS)

L4

L5

V-STEEL
L-TRACTION S
(VLTS)

V-STEEL
N-TRACTION
(VSNT)

V-STEEL
N-LUG
(VSNL)

V-STEEL
SUPER-DEEP
TRACTION (VSDT)

L5

L5S

V-STEEL
D-LUG
(VSDL)

V-STEEL
SUPER DEEP
ROCK (VSDR)

V-STEEL SMOOTH
TREAD-MS
(VSMS)

V-STEEL SMOOTH
TREAD-MS 2
(VSMS2)

Mobile Crane Service (High-Speed)

V-STEEL
G-TRACTION
(VGT)

V-STEEL
H-BLOCK
(VHB)

V-STEEL
HIGHWAY SERVICE
(VHS)

V-STEEL
SNOW WEDGE
(VSW)

Industrial Service

V-STEEL
H-BLOCK
(VHB)

V-STEEL
CONTAINER
HANDLER
(VCH)

V-STEEL
CONTAINER
HANDLER DEEP
(VCHD)

V-STEEL
CONTAINER
HANDLER RIB
(VCHR)

V-STEEL CONTAINER
HANDLER STABILITY
AND SAFETY
(VCHS)

V-STEEL
E-LUG S
(VELS)

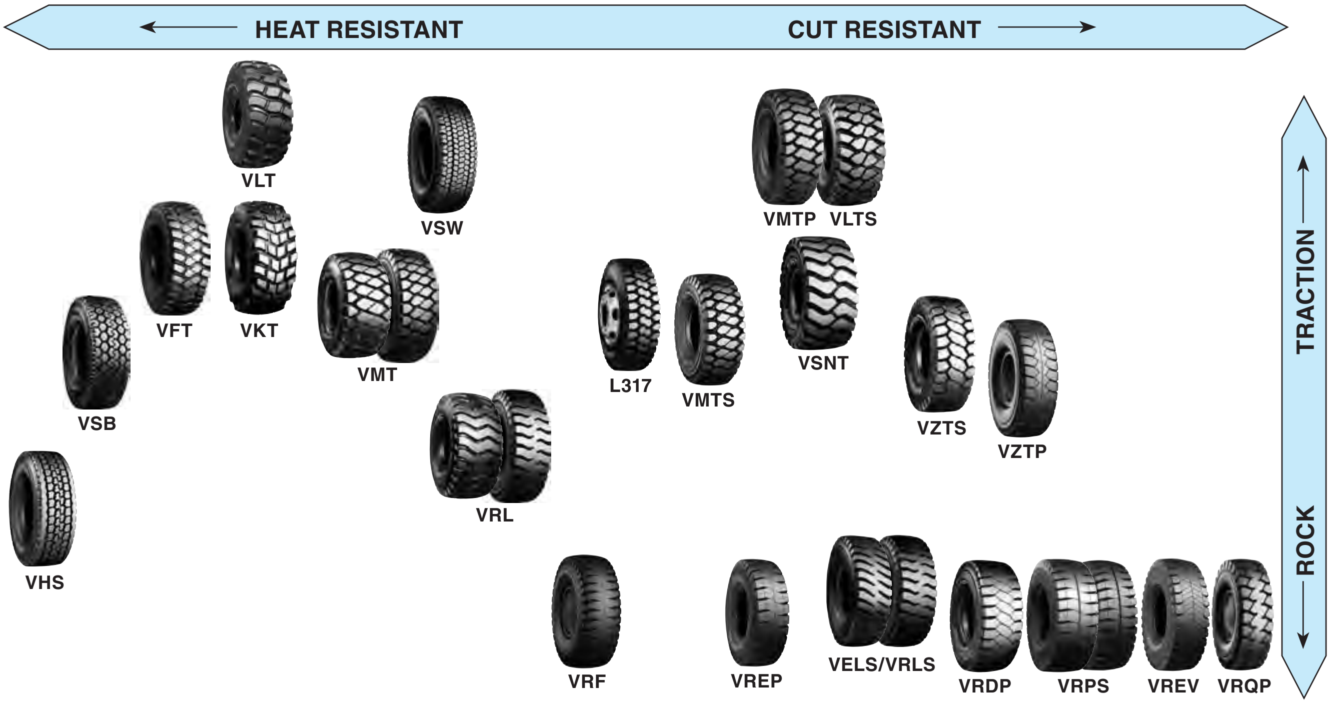
V-STEEL
R-LUG S
(VRLS)

V-STEEL
D-LUG
(VSDL)

V-STEEL
SMOOTH
TREAD-MS
(VSMS)

2. Application

■Earthmover Service



VUT(E2)

Size	Type	Star Rating
335/80 R 20	T/L	
365/80 R 20	T/L	
405/70 R 20	T/L	

VKT(E2)

Size	Type	Star Rating
29.5 R 29	T/L	★2
37.5 R 39	T/L	★2

VSB(E2)

Size	Type	Star Rating
14.00 R 24	T/T	★3
14.00 R 25	T/L	★3

VFT(E2)

Size	Type	Star Rating
27.00 R 49	T/L	★2

VHS(E2)

Size	Type	Star Rating
36.00 R 51	T/L	★2

＊**VSW**(E2)

Size	Type	Star Rating
20.5 R 25	T/L	MS
23.5 R 25	T/L	MS

VLT(E3)

Size	Type	Star Rating
20.5 R 25	T/L	MS
23.5 R 25	T/L	MS
750/65(30/65) R 25	T/L	MS
26.5 R 25	T/L	MS
29.5 R 25	T/L	MS ★2
33.25 R 29	T/L	★2
37.25 R 35	T/L	★2
40.5/75 R 39	T/L	★2

VTS(E3)

Size	Type	Star Rating
875/65 R 29	T/L	MS

VMT(E3)

Size	Type	Star Rating
30.00 R 51	T/L	★2
33.00 R 51	T/L	★2
40.00 R 57	T/L	★2

VRL(E3)

Size	Type	Star Rating
29.5 R 35	T/L	★2
33.25 R 35	T/L	★2

VRF(E3)

Size	Type	Star Rating
53/80 R 63	T/L	★2
59/80 R 63	T/L	★2

L317(E4)

Size	Type	Star Rating
11.00 R 20	T/T	★3
12.00 R 20	T/T	★3
11 R 22.5	T/L	14
12 R 22.5	T/L	★3
12.00 R 24	T/T	★3

VLTS(E4)

Size	Type	Star Rating
20.5 R 25	T/L	MS
23.5 R 25	T/L	MS
750/65(30/65) R 25	T/L	★2
26.5 R 25	T/L	★2
29.5 R 25	T/L	★2
875/65 R 29	T/L	MS

VSNT(E4)

Size	Type	Star Rating
26.5 R 25	T/L	MS
29.5 R 25	T/L	MS
29.5 R 29	T/L	MS
35/65 R 33	T/L	MT

VMTS(E4)

Size	Type	Star Rating
14.00 R 25	T/L	★3
16.00 R 25	T/L	★2
18.00 R 25	T/L	★2
27.00 R 49	T/L	★2

T/T: Tube Type T/L: Tubeless Type
MS: Multiple Star Rating (★1/★2)
MT: Multiple Star Rating (★2/★4)

＊**VSW** is especially designed for snow surface operations.

Size	Type	Star Rating

VMTP(E4)

Size	Type	Star Rating
12.00 R 24	T/T	★3
18.00 R 33	T/L	★2
21.00 R 33	T/L	★2
21.00 R 35	T/L	★2
24.00 R 35	T/L	★2
27.00 R 49	T/L	★2
33.00 R 51	T/L	★2

VZTS(E4)

Size	Type	Star Rating
37.00 R 57	T/L	★2
40.00 R 57	T/L	★2

VZTP(E4)

Size	Type	Star Rating
46/90 R 57	T/L	★2

VELS(E4)

Size	Type	Star Rating
18.00 R 25	T/L	★2
18.00 R 33	T/L	★2
21.00 R 35	T/L	★2
40.00 R 57	T/L	★2

VRLS(E4)

Size	Type	Star Rating
14.00 R 24	T/T	★3
14.00 R 25	T/L	★3
16.00 R 25	T/L	★2
21.00 R 33	T/L	★2
	T/T	★2
24.00 R 35	T/L	★2
27.00 R 49	T/L	★2
30.00 R 51	T/L	★2
33.00 R 51	T/L	★2
36.00 R 51	T/L	★2
37.00 R 57	T/L	★2

VREP(E4)

Size	Type	Star Rating
27.00 R 49	T/L	★2

VRDP(E4)

Size	Type	Star Rating
27.00 R 49	T/L	★2
33.00 R 51	T/L	★2
42/90 R 57	T/L	★2
40.00 R 57	T/L	★2
46/90 R 57	T/L	★2

VRPS(E4)

Size	Type	Star Rating
33.00 R 51	T/L	★2
42/90 R 57	T/L	★2
40.00 R 57	T/L	★2
46/90 R 57	T/L	★2
50/90 R 57	T/L	★2
53/80 R 63	T/L	★2
59/80 R 63	T/L	★2

VREV(E4)

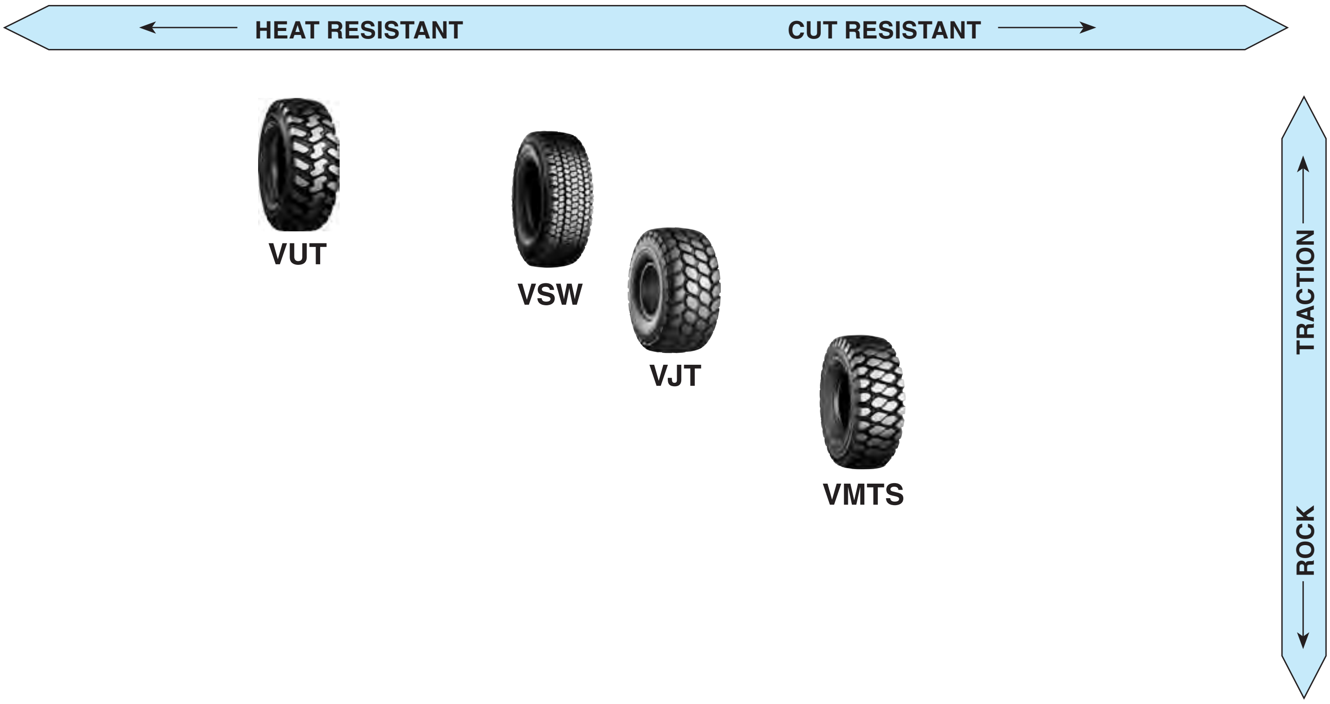
Size	Type	Star Rating
NEW 27.00 R 49	T/L	★2
46/90 R 57	T/L	★2

VRQP(E4)

Size	Type	Star Rating
18.00 R 33	T/L	★2
24.00 R 35	T/L	★2

T/T: Tube Type
T/L: Tubeless Type

Grader Service

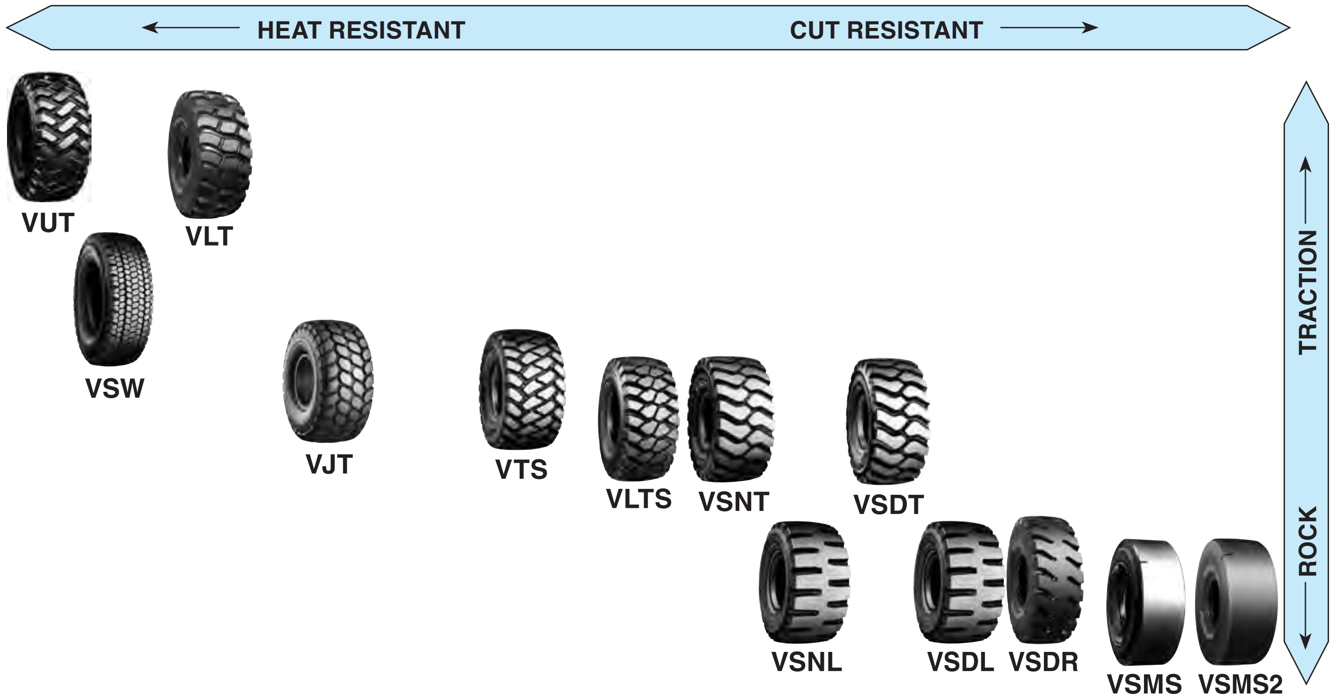


Size	Type	Star Rating
VUT(G2)		
13.00 R 24 TG	T/L	★1
14.00 R 24 TG	T/L	★1
15.5 R 25	T/L	★1★2
17.5 R 25	T/L	★1
20.5 R 25	T/L	★1
23.5 R 25	T/L	★1
*****VSW**(G2)		
14.00 R 24 TG	T/L	★1★3
16.00 R 24 TG	T/L	★1
17.5 R 25	T/L	★1
VJT(G3)		
20.5 R 25	T/L	★1
23.5 R 25	T/L	★1
VMTS(G4)		
14.00 R 24 TG	T/L	★1

*****VSW** is especially designed for snow surface operations.

T/L: Tubeless Type
TG: For Semi-Drop Center Rim

■Loader & Dozer Service



VUT(L2)

Size	Type	Star Rating
335/80 R 20	T/L	
365/80 R 20	T/L	
405/70 R 20	T/L	
15.5 R 25	T/L	★1★2
17.5 R 25	T/L	★1
20.5 R 25	T/L	★1
23.5 R 25	T/L	★1

*__VSW__(L2)

Size	Type	Star Rating
14.00 R 24 TG	T/L	★1
17.5 R 25	T/L	★1
20.5 R 25	T/L	MS
23.5 R 25	T/L	MS
600/65 R 25	T/L	★1

VLT(L3)

Size	Type	Star Rating
20.5 R 25	T/L	MS
23.5 R 25	T/L	MS
750/65(30/65) R 25	T/L	MS
26.5 R 25	T/L	MS
29.5 R 25	T/L	MS

VJT(L3)

Size	Type	Star Rating
17.5 R 25	T/L	★1★2
20.5 R 25	T/L	★1
23.5 R 25	T/L	★1★2
26.5 R 25	T/L	★1★2
29.5 R 25	T/L	★1★2

T/T: Tube Type
T/L: Tubeless Type
MS: Multiple Star Rating (★1/★2)
MT: Multiple Star Rating (★2/★4)
TG: For Semi-Drop Center Rim

VTS(L3)

Size	Type	Star Rating
550/65 R 25	T/L	★1
650/65 R 25	T/L	★1
775/65 R 29	T/L	★1
875/65 R 29	T/L	MS

VLTS(L4)

Size	Type	Star Rating
20.5 R 25	T/L	MS
23.5 R 25	T/L	MS
875/65 R 29	T/L	MS

VSNT(L4)

Size	Type	Star Rating
26.5 R 25	T/L	MS ★2
29.5 R 25	T/L	MS ★2
29.5 R 29	T/L	MS ★2
35/65 R 33	T/L	MT MS★2

VSNL(L4)

Size	Type	Star Rating
14.00 R 20	T/T	★2
35/65 R 33	T/L	★2
45/65 R 45	T/L	★2

VSDT(L5)

Size	Type	Star Rating
23.5 R 25	T/L	★1★2
26.5 R 25	T/L	★1★2
29.5 R 25	T/L	★1★2
29.5 R 29	T/L	★1★2
35/65 R 33	T/L	★1★2

VSDL(L5)

Size	Type	Star Rating
8.25 R 15	T/T	★2
10.00 R 15	T/T	★2
14.5 R 15	T/L	★2
12.00 R 20	T/T	★2

VSDL(L5) (continued)

Size	Type	Star Rating
15.5 R 25	T/L	★1
17.5 R 25	T/L	★1★2
20.5 R 25	T/L	★1★2
23.5 R 25	T/L	★1★2
26.5 R 25	T/L	★1★2
29.5 R 25	T/L	★1★2
29.5 R 29	T/L	★1★2
35/65 R 33	T/L	★1★2
45/65 R 39	T/L	★1
45/65 R 45	T/L	★1★2
50/65 R 51	T/L	★2
55.5/80 R 57	T/L	
60/80 R 57	T/L	

VSDR(L5)

Size	Type	Star Rating
20.5 R 25	T/L	★1★2

VSMS(L5S)

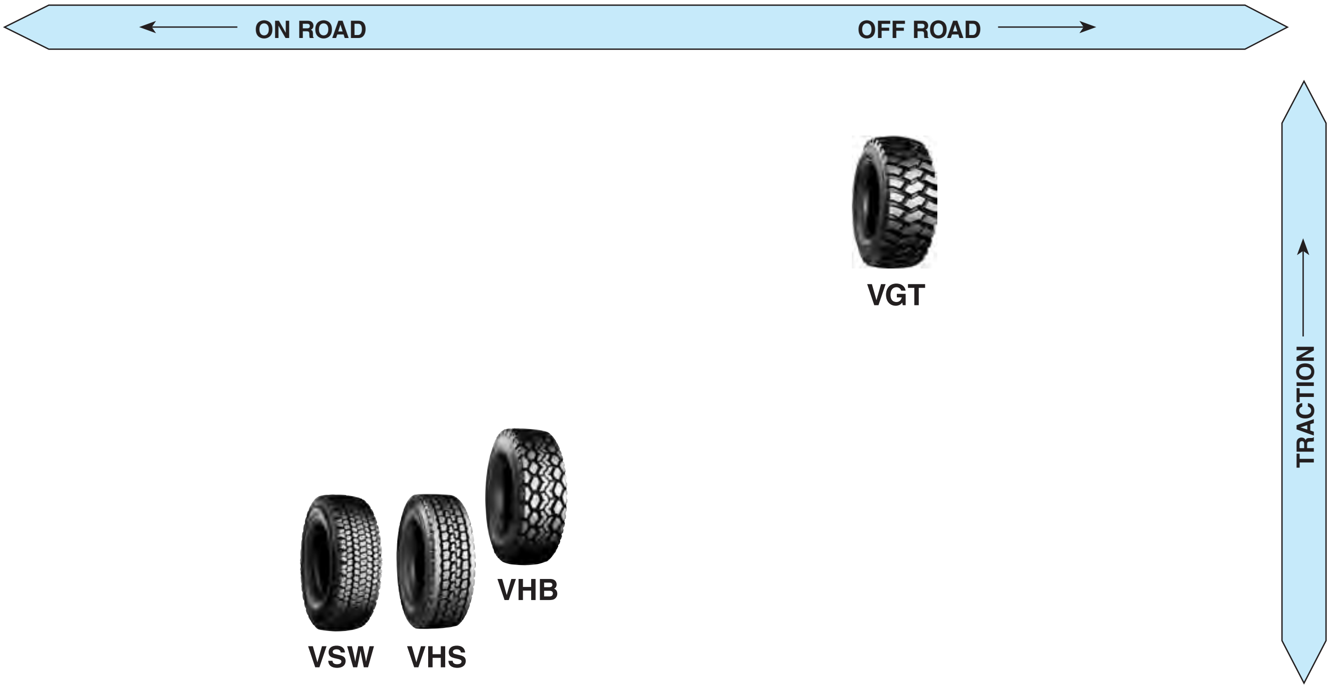
Size	Type	Star Rating
9.00 R 20	T/T	★2
12.00 R 20	T/T	★2
12.00 R 24	T/T	★2
14.00 R 24	T/T	★2
17.5 R 25	T/L	★1★2
18.00 R 25	T/L	★1★2
26.5 R 25	T/L	★1★2
29.5 R 29	T/L	★2

VSMS2(L5S) NEW

Size	Type	Star Rating
17.5 R 25	T/L	★2
26.5 R 25	T/L	★2
29.5 R 29	T/L	★2

*__VSW__ is especially designed for snow surface operations.

Mobile Crane Service (High-Speed)



Size	Type
VGT	
170E 445/80 R 25	T/L
VHB	
170E 385/95 R 24	T/T
177E 445/95 R 25	T/L
186E 505/95 R 25	T/L

Size	Type
VHS	
170E 385/95 R 24	T/T
170E 385/95 R 25	T/L
170F 385/95 R 25	T/L
177E 445/95 R 25	T/L
174F 445/95 R 25	T/L
186E 505/95 R 25	T/L
179E 525/80 R 25	T/L
176F 525/80 R 25	T/L

Size	Type
***VSW**	
170E 385/95 R 25	T/L
177E 445/95 R 25	T/L

***VSW** is especially designed for snow surface operations.

T/T: Tube Type
T/L: Tubeless Type

■Industrial Service

VHB

14.00 R 24	T/T	★3
16.00 R 25	T/L	★2
18.00 R 25	T/L	★3

VCH

12.00 R 20	T/T	★3
12.00 R 24	T/T	★2
14.00 R 24	T/T	★3

VCHD

16.00 R 25	T/L	

VCHS

12.00 R 20	T/T	★3
12.00 R 24	T/T	
14.00 R 24	T/T	★3
14.00 R 24 TG	T/L	★3
18.00 R 25	T/L	★3
18.00 R 33	T/L	★3

VELS

18.00 R 33	T/L	★3

VRLS

16.00 R 25	T/L	★2

VSDL

23.5 R 25	T/L	★2
35/65 R 33	T/L	★2

VSMS

18.00 R 25	T/L	★2

VCHR

16.00 R 25	T/L	

■Sand Service

VSJ(E7)

16.00 R 20	T/L	28
	T/T	28
21.00 R 25	T/L	

T/T: Tube Type
T/L: Tubeless Type
TG: For Semi-Drop Center Rim

3. Technical Data

Tire Size	Pattern	LI/SS	Star Rating	TRA Code or Application	Spec	TKPH	TMPH	Approximate Inflated Dimensions OD	OW	SLR	SLW	OTD	Minimum Dual Spacing	Recommended Rim/Flange Height
								mm *inch*	mm *inch*	mm *inch*	mm *inch*	mm	mm *inch*	inch
15"														
8.25R15	VSDL		★2	L5	D2A	-	-	**880** *34.6*	**248** *9.8*	**405** *15.9*	**285** *11.2*	**48.0**	- -	6.50T
10.00R15	VSDL		★2	L5	D2A	-	-	**905** *35.6*	**287** *11.3*	**416** *16.4*	**330** *13.0*	**48.0**	- -	7.50V
14.5R15 Tubeless	VSDL		★2	L5	D2A	-	-	**899** *35.4*	**359** *14.1*	**413** *16.3*	**412** *16.2*	**48.0**	- -	11.00/1.5
20"														
9.00R20	VSMS		★2	L5S	D2A	-	-	**1054** *41.5*	**260** *10.2*	**474** *18.7*	**303** *11.9*	**51.0**	-	7.00T
11.00R20	L317		★3	E4	-	**188**	*129*	**1107** *43.6*	**290** *11.4*	**512** *20.2*	**325** *12.8*	**25.0**	**335** *13.2*	8.00V
12.00R20	L317		★3	E4	-	**208**	*142*	**1146** *45.1*	**308** *12.1*	**523** *20.6*	**346** *13.6*	**25.0**	**384** *15.1*	8.50V
	VSDL		★2	L5	D2A	-	-	**1168** *46.0*	**320** *12.6*	**538** *21.2*	**359** *14.1*	**57.0**	- -	
	VSMS		★2	L5S	D2A	-	-	**1173** *46.2*	**312** *12.3*	**540** *21.3*	**351** *13.8*	**57.0**	- -	
	VCH		★3	Industrial Service	IDU	-	-	See characteristics page 48						
	VCHS	176A5	★3	Industrial Service	IDU	-	-							
14.00R20	VSNL		★2	L4	D2A	-	-	**1196** *47.1*	**360** *14.2*	**550** *21.7*	**414** *16.3*	**34.0**	- -	10.00WI
16.00R20 Tubeless **16.00R20**	VSJ		28	E7	-	-	-	See characteristics page 52						
335/80R20 Tubeless	VUT	136B 147A2		E2 L2	DE2	-	-	**1036** *40.8*	**319** *12.6*	**463** *18.2*	**357** *14.1*	**19.0**	- -	11x20
365/80R20 Tubeless	VUT	141B 153A2		E2 L2	DE2	-	-	**1087** *42.8*	**347** *13.7*	**483** *19.0*	**389** *15.3*	**21.0**	- -	11x20
405/70R20 Tubeless	VUT	143B 155A2		E2 L2	DE2	-	-	**1092** *43.0*	**398** *15.7*	**485** *19.1*	**446** *17.6*	**20.0**	- -	13x20

For the TKPH(TMPH) Ratings, please refer to page 11.

Pattern	Application Max.Speed km/h mph	Tire Load Limits at Various Cold Inflation Pressures																			Size
15"																					
		kPa psi	**400** 58	**425** 62	**450** 65	**475** 69	**500** 73	**525** 76	**550** 80	**575** 83	**600** 87	**625** 91	**650** 94	**675** 98	**700** 102	**725** 105	**750** 109	**775** 112	**800** 115	**825** 120	
VSDL	Loader	★																		★2	**8.25R15**
	10	**kg**						**2200**	**2275**	**2350**	**2425**	**2500**	**2575**	**2650**	**2725**	**2800**	**2875**	**2950**	**3025**	**3100**	
	5	*lbs*						*4860*	*5020*	*5200*	*5360*	*5540*	*5700*	*5860*	*6000*	*6200*	*6350*	*6500*	*6650*	*6800*	
VSDL		★																		★2	**10.00R15**
		kg						**2875**	**2975**	**3075**	**3175**	**3275**	**3375**	**3475**	**3575**	**3650**	**3750**	**3850**	**3950**	**4025**	
		lbs						*6350*	*6550*	*6800*	*7000*	*7200*	*7450*	*7650*	*7850*	*8050*	*8250*	*8500*	*8700*	*8900*	
VSDL		★											★2								**14.5R15**
		kg	**2425**	**2550**	**2650**	**2775**	**2875**	**2975**	**3100**	**3200**	**3300**	**3400**	**3500**								
		lbs	*5360*	*5620*	*5860*	*6100*	*6350*	*6600*	*6800*	*7050*	*7250*	*7500*	*7700*								
20"																					
VSMS	Loader	★																		★2	**9.00R20**
	10	**kg**						**3075**	**3250**	**3350**	**3450**	**3550**	**3650**	**3750**	**3875**	**4000**	**4000**	**4125**	**4250**	**4375**	
	5	*lbs*						*6800*	*7150*	*7400*	*7600*	*7850*	*8050*	*8250*	*8550*	*8800*	*8800*	*9100*	*9350*	*9650*	
L317	E/M	★																★3			**11.00R20**
	50	**kg**			**2500**	**2600**	**2710**	**2810**	**2910**	**3010**	**3100**	**3200**	**3300**	**3390**	**3480**	**3570**	**3670**	**3760**			
	30	*lbs*			*5510*	*5730*	*5970*	*6200*	*6420*	*6640*	*6830*	*7050*	*7280*	*7470*	*7670*	*7880*	*8080*	*8290*			
L317		★																★3			**12.00R20**
		kg			**2770**	**2880**	**2990**	**3110**	**3220**	**3330**	**3430**	**3540**	**3650**	**3750**	**3850**	**3950**	**4060**	**4160**			
		lbs			*6110*	*6350*	*6590*	*6860*	*7100*	*7340*	*7560*	*7800*	*8050*	*8270*	*8490*	*8720*	*8940*	*9170*			
VSDL VSMS	Loader	★																		★2	
	10	**kg**						**4375**	**4500**	**4625**	**4875**	**5000**	**5150**	**5300**	**5450**	**5600**	**5800**	**5800**	**6000**	**6150**	
	5	*lbs*						*9650*	*9900*	*10200*	*10700*	*11000*	*11400*	*11700*	*12000*	*12300*	*12800*	*12800*	*13200*	*13600*	
VCH VCHS	IDU	See characteristics page 49																			
VSNL	Loader	★																		★2	**14.00R20**
	10	**kg**						**5200**	**5400**	**5550**	**5750**	**5900**	**6100**	**6250**	**6450**	**6600**	**6800**	**6950**	**7100**	**7300**	
	5	*lbs*						*11400*	*11900*	*12300*	*12600*	*13000*	*13400*	*13800*	*14200*	*14600*	*15000*	*15300*	*15700*	*16100*	
VSJ	Sand	See characteristics page 53																			**16.00R20**
		kPa psi	**275** 40	**300** 44	**325** 47	**350** 51	**375** 54														
VUT	E/M	★																			**335/80R20**
	50	**kg**	**1800**	**1900**	**2000**	**2120**	**2240**														
	30	*lbs*	*4000*	*4200*	*4400*	*4700*	*5000*														
VUT	Loader	★																			
	10	**kg**	**2430**	**2575**	**2725**	**2900**	**3075**														
	5	*lbs*	*5350*	*5700*	*6000*	*6400*	*6800*														
VUT	E/M	★																			**365/80R20**
	50	**kg**	**2060**	**2180**	**2300**	**2430**	**2575**														
	30	*lbs*	*4500*	*4800*	*5100*	*5400*	*5700*														
VUT	Loader	★																			
	10	**kg**	**2900**	**3075**	**3250**	**3450**	**3650**														
	5	*lbs*	*6400*	*6800*	*7150*	*7600*	*8000*														
VUT	E/M	★																			**405/70R20**
	50	**kg**	**2180**	**2300**	**2430**	**2575**	**2725**														
	30	*lbs*	*4800*	*5100*	*5400*	*5700*	*6000*														
VUT	Loader	★																			
	10	**kg**	**3075**	**3250**	**3450**	**3650**	**3875**														
	5	*lbs*	*6800*	*7250*	*7600*	*8100*	*8550*														

1) Figures under the star rating denote the maximum load and inflation pressures.
2) For Loader & Dozer Service, Tire Load Limits will depend on a type of the operation. Please refer to page 82.

Tire Size	Pattern	LI/SS	Star Rating	TRA Code or Application	Spec	**TKPH**	*TMPH*	Approximate Inflated Dimensions				OTD	Minimum Dual Spacing	Recommended Rim/Flange Height
								OD	OW	SLR	SLW			
								mm *inch*	**mm** *inch*	**mm** *inch*	**mm** *inch*	**mm**	**mm** *inch*	inch
22.5"														
11R22.5 Tubeless	L317		14	E4	-	**TBA**	*TBA*	**1078** *42.4*	**270** *10.6*	**TBA** *TBA*	**TBA** *TBA*	**25.0**	**TBA** *TBA*	8.25
12R22.5 Tubeless	L317		★3	E4	-	**188**	*129*	**1109** *43.7*	**292** *11.5*	**517** *20.4*	**327** *12.9*	**25.0**	**343** *13.5*	9.00
24"														
12.00R24	L317		★3	E4	-	**177**	*121*	**1254** *49.4*	**319** *12.6*	**577** *22.7*	**355** *14.0*	**31.5**	**391** *15.4*	8.50V
	VMTP		★3	E4	E2A	**136**	*93*	**1254** *49.4*	**319** *12.6*	**577** *22.7*	**355** *14.0*	**31.5**	**391** *15.4*	
	VSMS		★2	L5S	D2A	-	-	**1275** *50.2*	**312** *12.3*	**573** *22.6*	**364** *14.3*	**57.0**	- -	
	VCH		★2	Industrial Service	IDU	-	-	See characteristics page 48						
	VCHS	178A5		Industrial Service	IDU	-	-							
13.00R24 TG Tubeless	VUT		★1	G2	G2A	-	-	**1290** *50.8*	**357** *14.1*	**585** *23.0*	**380** *15.0*	**25.0**	- -	8.00TG
14.00R24	VSB		★3	E2	E2A	**179**	*123*	**1365** *53.7*	**390** *15.4*	**628** *24.7*	**433** *17.0*	**21.0**	**450** *17.7*	10.00W
				Logging	-	-	-	See characteristics page 50						
	VHB		★3	Industrial Service	-	-	-	See characteristics page 48						
	VRLS		★3	E4	E2A	**85**	*58*	**1403** *55.2*	**390** *15.4*	**644** *25.4*	**432** *17.0*	**39.0**	**450** *17.7*	10.00W
	VSMS		★2	L5S	D2A	-	-	**1394** *54.8*	**390** *15.4*	**634** *25.0*	**437** *17.2*	**72.0**	- -	
	VCH		★3	Industrial Service	IDU	-	-	See characteristics page 48						
	VCHS	196A5	★3	Industrial Service	IDU	-	-							

For the TKPH(TMPH) Ratings, please refer to page 11.

Pattern	Application Max.Speed km/h mph		Tire Load Limits at Various Cold Inflation Pressures																Size
22.5"																			
L317	11R22.5 14PR TBA																		12R22.5
		kPa	**450**	**475**	**500**	**525**	**550**	**575**	**600**	**625**	**650**	**675**	**700**	**725**	**750**	**775**	**800**	**815**	
		psi	65	69	73	76	80	83	87	91	94	98	102	105	109	112	115	118	
L317	E/M	★																★3	
	50	**kg**	**2410**	**2510**	**2610**	**2700**	**2800**	**2890**	**2990**	**3080**	**3170**	**3260**	**3350**	**3440**	**3530**	**3620**	**3690**	**3760**	
	30	*lbs*	*5310*	*5530*	*5750*	*5950*	*6170*	*6370*	*6590*	*6790*	*6990*	*7190*	*7390*	*7580*	*7780*	*7980*	*8140*	*8290*	
24"																			
		kPa	**450**	**475**	**500**	**525**	**550**	**575**	**600**	**625**	**650**	**675**	**700**	**725**	**750**	**775**	**800**	**825**	12.00R24
		psi	65	69	73	76	80	83	87	91	94	98	102	105	109	112	115	120	
L317 VMTP	E/M	★											★3						
	50	**kg**	**3050**	**3180**	**3300**	**3430**	**3550**	**3670**	**3790**	**3900**	**4020**	**4140**	**4250**						
	30	*lbs*	*6720*	*7010*	*7280*	*7560*	*7830*	*8090*	*8360*	*8600*	*8860*	*9130*	*9370*						
VSMS	Loader	★																★2	
	10	**kg**				**4875**	**5150**	**5300**	**5450**	**5600**	**5800**	**6000**	**6150**	**6300**	**6500**	**6500**	**6700**	**6900**	
	5	*lbs*				*11000*	*11400*	*11700*	*12000*	*12300*	*12800*	*13200*	*13600*	*13900*	*14300*	*14300*	*14700*	*15200*	
VCH VCHS	IDU		See characteristics page 49																
		kPa	**200**	**225**	**250**	**275**	**300**	**325**	**350**	**375**									13.00R24 TG
		psi	29	33	36	40	44	47	51	54									
VUT	Grader	★								★1									
	40	**kg**	**1850**	**2000**	**2180**	**2360**	**2500**	**2650**	**2800**	**3000**									
	25	*lbs*	*4080*	*4400*	*4800*	*5200*	*5520*	*5840*	*6150*	*6600*									
		kPa	**450**	**475**	**500**	**525**	**550**	**575**	**600**	**625**	**650**	**675**	**700**	**725**	**750**	**775**	**800**		14.00R24
		psi	65	69	73	76	80	83	87	91	94	98	102	105	109	112	115		
VSB VRLS	E/M	★															★3		
	50	**kg**	**4000**	**4125**	**4375**	**4500**	**4625**	**4750**	**5000**	**5150**	**5300**	**5450**	**5600**	**5710**	**5830**	**5940**	**6050**		
	30	*lbs*	*8800*	*9100*	*9650*	*9900*	*10200*	*10500*	*11000*	*11400*	*11700*	*12000*	*12300*	*12500*	*12800*	*13100*	*13400*		
VSB	Logging		See characteristics page 51																
VSMS	Loader	★															★2		
	10	**kg**	**5950**	**6200**	**6450**	**6700**	**6950**	**7200**	**7450**	**7700**	**7950**	**8200**	**8450**	**8700**	**8950**	**9200**	**9500**		
	5	*lbs*	*13120*	*13700*	*14220*	*14800*	*15300*	*15900*	*16400*	*16980*	*17500*	*18080*	*19600*	*19180*	*19690*	*20680*	*20900*		
VHB VCH VCHS	IDU		See characteristics page 49																

1) Figures under the star rating denote the maximum load and inflation pressures.
2) For Loader & Dozer Service, Tire Load Limits will depend on a type of the operation. Please refer to page 82.

Tire Size	Pattern	LI/SS	Star Rating	TRA Code or Application	Spec	**TKPH**	*TMPH*	Approximate Inflated Dimensions OD	OW	SLR	SLW	OTD	Minimum Dual Spacing	Recommended Rim/Flange Height
								mm *inch*	mm *inch*	mm *inch*	mm *inch*	mm	mm *inch*	inch
14.00R24 TG Tubeless	VUT		★1	G2	G2A	-	-	**1350** *53.1*	**373** *14.7*	**608** *23.9*	**420** *16.5*	**25.5**	- -	8.00TG
	VSW		★3	G2	-	-	-	**1351** *53.2*	**390** *15.4*	**594** *23.4*	**446** *17.6*	**23.5**	- -	10.00VA
		153A8 175A2	★1	L2	DG2				**370** *14.6*		**426** *16.8*			8.00TG
	VMTS		★1	G4	G2A			**1400** *55.1*	**373** *14.7*	**TBA** *TBA*	**TBA** *TBA*	**38.0**	- -	
	VCHS	196A5	★3	Industrial Service	IDU	-	-	See characteristics page 48						
385/95R24	VHS	170E		Mobile Crane Service	-	-	-	See characteristics page 50						
	VHB	170E		Mobile Crane Service	-	-	-							
16.00R24 TG Tubeless	VSW		★1	G2	-	-	-	**1485** *58.5*	**417** *16.4*	**680** *26.8*	**467** *18.4*	**22.5**	- -	10.00VA
25"														
14.00R25 Tubeless	VSB		★3	E2	E2A	**179**	*123*	**1365** *53.7*	**390** *15.4*	**628** *24.7*	**433** *17.0*	**21.0**	**450** *17.7*	10.00/1.5
				Logging	-	-	-	See characteristics page 50						
	VMTS		★3	E4	E2A - E3A	**91** - **136**	*62* - *93*	**1406** *55.4*	**391** *15.4*	**650** *25.6*	**435** *17.1*	**38.0**	**450** *17.7*	10.00/1.5
	VRLS		★3	E4	E2A	**85**	*58*	**1403** *55.2*	**391** *15.4*	**650** *25.6*	**435** *17.1*	**39.0**	**450** *17.7*	
385/95R25 Tubeless	VHS	170E 170F		Mobile Crane Service	-	-	-	See characteristics page 50						
	VSW	170E		Mobile Crane Service	-	-	-							
15.5R25 Tubeless	VUT		★2 ★1	G2, L2	DG2	-	-	**1269** *50.0*	**383** *15.1*	**559** *22.0*	**436** *17.2*	**27.0**	- -	12.00/1.3
	VSDL		★1	L5	D2A	-	-	**1329** *52.3*	**393** *15.5*	**606** *23.9*	**443** *17.4*	**64.0**	- -	

For the TKPH(TMPH) Ratings, please refer to page 11.

Will be discontinued.

Pattern	Application Max.Speed km/h mph		Tire Load Limits at Various Cold Inflation Pressures															Size
		kPa	200	225	250	275	300	325	350	375						525	550	14.00R24 TG
		psi	29	33	36	40	44	47	51	54						76	80	
VUT VSW VMTS	Grader **40** 25	★								★1	★3 VSW=Consult a Bridgestone Representative.							
		kg	**2240**	**2430**	**2650**	**2800**	**3000**	**3250**	**3350**	**3650**								
		lbs	*4940*	*5360*	*5840*	*6150*	*6600*	*7150*	*7400*	*8050*								
VSW	Loader **10** 5	★															★1	
		kg														**6700**	**6900**	
		lbs														*14800*	*15200*	
VCHS	IDU		See characteristics page 49															
VHS VHB	High-Speed		See characteristics page 51															385/95R24
VSW	Grader **40** 25	★								★1								16.00R24 TG
		kg	**2900**	**3150**	**3350**	**3650**	**3875**	**4125**	**4375**	**4625**								
		lbs	*6400*	*6950*	*7400*	*8050*	*8550*	*9100*	*9650*	*10200*								
25"																		
		kPa	450	475	500	525	550	575	600	625	650	675	700	725	750	775	800	14.00R25
		psi	65	69	73	76	80	83	87	91	94	98	102	105	109	112	115	
VSB VMTS VRLS	E/M **50** 30	★															★3	
		kg	**4000**	**4125**	**4375**	**4500**	**4625**	**4750**	**5000**	**5150**	**5300**	**5450**	**5600**	**5710**	**5830**	**5940**	**6050**	
		lbs	*8800*	*9100*	*9650*	*9900*	*10200*	*10500*	*11000*	*11400*	*11700*	*12000*	*12300*	*12500*	*12800*	*13100*	*13400*	
VSB	Logging		See characteristics page 51															
VHS VSW	High-Speed		See characteristics page 51															385/95R25
		kPa	400	425	450	475	500	525	550	575	600	625	650					15.5R25
		psi	58	62	65	69	73	76	80	83	87	91	94					
VUT VSDL	Loader **10** 5	★					★1						★2					
		kg	**5000**	**5150**	**5450**	**5600**	**5800**	**6150**	**6300**	**6500**	**6700**	**6900**	**7100**					
		lbs	*11000*	*11400*	*12000*	*12300*	*12800*	*13600*	*13900*	*14300*	*14800*	*15200*	*15700*					
		kPa	125	150	175	200	225	250	275	300								
		psi	18	22	25	29	33	36	40	44								
VUT	Grader **40** 25	★								★1								
		kg	**1550**	**1750**	**2000**	**2180**	**2360**	**2575**	**2800**	**3000**								
		lbs	*3420*	*3860*	*4400*	*4800*	*5200*	*5680*	*6150*	*6600*								

For slope and ditching service, inflation pressures should be increased by 100kPa (15psi) with no increase in load rating.
For extreme conditions, consult a Bridgestone Representative for additional recommended operating requirements.

1) Figures under the star rating denote the maximum load and inflation pressures.
2) For Loader & Dozer Service, Tire Load Limits will depend on a type of the operation. Please refer to page 82.

Tire Size	Pattern	LI/SS	Star Rating	TRA Code or Application	Spec	TKPH	TMPH	Approximate Inflated Dimensions OD	OW	SLR	SLW	OTD	Minimum Dual Spacing	Recommended Rim/Flange Height
								mm inch	mm inch	mm inch	mm inch	mm	mm inch	inch
16.00R25 Tubeless	VMTS		★2	E4	E2A	**123**	*84*	**1535** *60.4*	**450** *17.7*	**696** *27.4*	**507** *20.0*	**45.0**	**513** *20.2*	11.25/2.0
	VRLS		★2	E4	E2A E1A	**112** **146**	*77* *100*	**1531** *60.3*	**448** *17.6*	**697** *27.4*	**510** *20.1*	**45.0**	**513** *20.2*	
	VHB		★2	Industrial Service	IDU	-	-	See characteristics page 48						
	VCHD			Industrial Service	IDU	-	-							
	VCHR	200A5		Industrial Service	IDU	-	-							
	VRLS		★2	Industrial Service	IDU	-	-							
445/95R25 Tubeless	VHB	177E		Mobile Crane Service	-	-	-	See characteristics page 50						
	VHS	177E 174F		Mobile Crane Service	-	-	-							
	VSW	177E		Mobile Crane Service	-	-	-							
17.5R25 Tubeless	VUT		★1	G2, L2	DG2	-	-	**1340** *52.8*	**444** *17.5*	**586** *23.1*	**500** *19.7*	**28.0**	- -	14.00/1.5
	VSW	153A8 176A2	★1	G2 L2	DG2	-	-	**1340** *52.8*	**440** *17.3*	**597** *23.5*	**480** *18.9*	**27.0**	- -	
	VJT	176A2 182A2	★1 ★2	L3	D2A	-	-	**1352** *53.2*	**443** *17.4*	**604** *23.8*	**510** *20.1*	**30.0**	- -	
	VSDL		★2 ★1	L5	D2A	-	-	**1400** *55.1*	**440** *17.3*	**639** *25.2*	**495** *19.5*	**68.0**	- -	
	VSMS		★2 ★1	L5S	D2A	-	-	**1374** *54.1*	**440** *17.3*	**631** *24.8*	**487** *19.2*	**68.5**	- -	
	New VSMS2		★2	L5S	D2A	-	-	**TBA** *TBA*	**TBA** *TBA*	**TBA** *TBA*	**TBA** *TBA*	**68.5**	- -	
445/80R25 Tubeless	VGT	170E		Mobile Crane Service	-	-	-	See characteristics page 50						

For the TKPH(TMPH) Ratings, please refer to page 11.

Will be discontinued.

Pattern	Application Max.Speed **km/h** mph	Tire Load Limits at Various Cold Inflation Pressures												Size
		kPa psi	**450** 65	**475** 69	**500** 73	**525** 76	**550** 80	**575** 83	**600** 87	**625** 91	**650** 94	**675** 98	**700** 102	**16.00R25**
VMTS VRLS	E/M **50** 30	★											★2	**16.00R25**
		kg	**5150**	**5450**	**5600**	**5800**	**6000**	**6300**	**6500**	**6700**	**6900**	**7100**	**7300**	**16.00R25**
		lbs	*11400*	*12000*	*12300*	*12800*	*13200*	*13900*	*14300*	*14800*	*15200*	*15700*	*16100*	**16.00R25**
VHB VCHD VCHR VRLS	IDU	See characteristics page 49												**16.00R25**
VHB VHS VSW	High- Speed	See characteristics page 51												**445/95R25**
		kPa psi	**400** 58	**425** 62	**450** 65	**475** 69	**500** 73	**525** 76	**550** 80	**575** 83	**600** 87	**625** 91	**650** 94	**17.5R25**
VUT VSW VJT VSDL VSMS VSMS2	Loader **10** 5	★					★1						★2	**17.5R25**
		kg	**6000**	**6150**	**6500**	**6700**	**7100**	**7300**	**7500**	**7750**	**8000**	**8250**	**8500**	**17.5R25**
		lbs	*13200*	*13600*	*14300*	*14800*	*15700*	*16100*	*16500*	*17100*	*17600*	*18200*	*18700*	**17.5R25**
		kPa psi	**125** 18	**150** 22	**175** 25	**200** 29	**225** 33	**250** 36	**275** 40	**300** 44				**17.5R25**
VUT VSW	Grader **40** 25	★								★1				**17.5R25**
		kg	**1850**	**2120**	**2360**	**2650**	**2900**	**3075**	**3350**	**3650**				**17.5R25**
		lbs	*4080*	*4680*	*5200*	*5840*	*6400*	*6800*	*7400*	*8050*				**17.5R25**
VGT	High- Speed	See characteristics page 51												**445/80R25**

For slope and ditching service, inflation pressures should be increased by 100kPa (15psi) with no increase in load rating.
For extreme conditions, consult a Bridgestone Representative for additional recommended operating requirements.

1) Figures under the star rating denote the maximum load and inflation pressures.
2) For Loader & Dozer Service, Tire Load Limits will depend on a type of the operation. Please refer to page 82.

Tire Size	Pattern	LI/SS	Star Rating	TRA Code or Application	Spec	TKPH	TMPH	Approximate Inflated Dimensions OD mm / inch	OW mm / inch	SLR mm / inch	SLW mm / inch	OTD mm	Minimum Dual Spacing mm / inch	Recommended Rim/Flange Height inch
18.00R25 Tubeless	VMTS		★2	E4	E2A	**169**	*116*	**1654** *65.1*	**505** *19.9*	**754** *29.7*	**571** *22.5*	**51.0**	**587** *23.1*	13.00/2.5
	VELS		★2	E4	E2A E1A	**144** **179**	*99* *123*	**1642** *64.6*	**515** *20.3*	**744** *29.3*	**580** *22.8*	**50.0**	**587** *23.1*	
	VSMS		★2 ★1	L5S	D2A	-	-	**1675** *65.9*	**512** *20.2*	**733** *28.9*	**592** *23.3*	**84.5**	- -	
			★2	Industrial Service	-	-	-	See characteristics page 48						
	VHB		★3	Industrial Service	IDU	-	-							
	VCHS	214A5	★3	Industrial Service	IDU	-	-							
505/95R25 Tubeless	VHB	186E		Mobile Crane Service	-	-	-	See characteristics page 50						
	VHS	186E		Mobile Crane Service	-	-	-							
20.5R25 Tubeless	VSW		MS	E2, L2	DE2	-	-	**1470** *57.9*	**530** *20.9*	**640** *25.2*	**603** *23.7*	**29.0**	- -	17.00AL/1.7(★1only) 17.00/2.0
	VUT		★1	G2, L2	DG2	-	-	**1473** *58.0*	**533** *21.0*	**643** *25.3*	**608** *23.9*	**30.5**	- -	
	VLT	177B 186A2	MS	E3 L3	DE2	**149** -	*102* -	**1498** *59.0*	**530** *20.9*	**676** *26.6*	**586** *23.1*	**40.0**	- -	
	VJT	186A2	★1	L3 G3	D2A DG2	-	-	**1480** *58.3*	**530** *20.9*	**652** *25.7*	**609** *24.0*	**33.0**	- -	
	VLTS	177B 186A2	MS	E4 L4	DE2	**126** -	*86* -	**1478** *58.2*	**530** *20.9*	**667** *26.3*	**581** *22.9*	**49.0**	- -	
	VSDL		★2 ★1	L5	D2A	-	-	**1552** *61.1*	**531** *20.9*	**702** *27.6*	**600** *23.6*	**78.0**	- -	
	VSDR		★2 ★1	L5	D2A	-	-	**1552** *61.1*	**531** *20.9*	**702** *27.6*	**600** *23.6*	**78.0**	-	
525/80R25 Tubeless	VHS	179E 176F		Mobile Crane Service	-	-	-	See characteristics page 50						
21.00R25 Tubeless	VSJ			E7	-	-	-	See characteristics page 52						

For the TKPH(TMPH) Ratings, please refer to page 11.
Will be discontinued.

Pattern	Application Max.Speed km/h mph		Tire Load Limits at Various Cold Inflation Pressures																Size
		kPa	450	475	500	525	550	575	600	625	650	675	700	725	750	775	800	825	18.00R25
		psi	65	69	73	76	80	83	87	91	94	98	102	105	109	112	115	120	18.00R25
VMTS VELS	E/M **50** 30	★											★2						18.00R25
		kg	**6700**	**7100**	**7300**	**7500**	**7750**	**8000**	**8250**	**8500**	**8750**	**9000**	**9250**						18.00R25
		lbs	*14800*	*15700*	*16100*	*16500*	*17100*	*17600*	*18200*	*18700*	*19300*	*19800*	*20400*						18.00R25
VSMS	Loader **10** 5	★					★1											★2	18.00R25
		kg				**11200**	**11800**	**12150**	**12500**	**12850**	**13200**	**13600**	**14000**	**14500**	**15000**	**15000**	**15500**	**16000**	18.00R25
		lbs				*24700*	*26000*	*26800*	*27600*	*28300*	*29100*	*30000*	*30900*	*32000*	*33100*	*33100*	*34200*	*35300*	18.00R25
VSMS VHB VCHS	IDU	See characteristics page 49																	18.00R25
VHB VHS	High-Speed	See characteristics page 51																	505/95R25
		kPa	275	300	325	350	375	400	425	450	475	500	525						20.5R25
		psi	40	44	47	51	54	58	62	65	69	73	76						20.5R25
VSW VLT VLTS	E/M **50** 30	★					★1						★2						20.5R25
		kg	**4375**	**4750**	**5000**	**5300**	**5600**	**5800**	**6150**	**6500**	**6700**	**6900**	**7300**						20.5R25
		lbs	*9650*	*10500*	*11000*	*11700*	*12300*	*12800*	*13600*	*14300*	*14800*	*15200*	*16100*						20.5R25
		kPa	125	150	175	200	225	250	275	300									20.5R25
		psi	18	22	25	29	33	36	40	44									20.5R25
VUT VJT	Grader **40** 25	★								★1									20.5R25
		kg	**2430**	**2800**	**3150**	**3450**	**3875**	**4125**	**4375**	**4625**									20.5R25
		lbs	*5360*	*6150*	*6950*	*7600*	*8550*	*9100*	*9650*	*10200*									20.5R25
		For slope and ditching service, inflation pressures should be increased by 100kPa (15psi) with no increase in load rating. For extreme conditions, consult a Bridgestone Representative for additional recommended operating requirements.																	20.5R25
		kPa	400	425	450	475	500	525	550	575	600	625	650						20.5R25
		psi	58	62	65	69	73	76	80	83	87	91	94						20.5R25
VUT VSW VLT VJT VLTS VSDL VSDR	Loader **10** 5	★					★1						★2						20.5R25
		kg	**8000**	**8250**	**8750**	**9000**	**9500**	**9750**	**10000**	**10300**	**10900**	**11200**	**11500**						20.5R25
		lbs	*17600*	*18200*	*19300*	*19800*	*20900*	*21500*	*22000*	*22700*	*24000*	*24700*	*25400*						20.5R25
VHS	High-Speed	See characteristics page 51																	525/80R25
VSJ	Sand	See characteristics page 53																	21.00R25

1) Figures under the star rating denote the maximum load and inflation pressures.
2) For Loader & Dozer Service, Tire Load Limits will depend on a type of the operation. Please refer to page 82.

Tire Size	Pattern	LI/SS	Star Rating	TRA Code or Application	Spec	**TKPH**	*TMPH*	Approximate Inflated Dimensions				OTD	Minimum Dual Spacing	Recommended Rim/Flange Height
								OD	OW	SLR	SLW			
								mm *inch*	**mm** *inch*	**mm** *inch*	**mm** *inch*	**mm**	**mm** *inch*	inch
23.5R25 Tubeless	VSW		MS	E2, L2	DE2	-	-	**1596** *62.8*	**620** *24.4*	**692** *27.2*	**689** *27.1*	**31.5**	- -	19.50/2.5
	VUT		★1	G2, L2	DG2	-	-	**1599** *63.0*	**620** *24.4*	**702** *27.6*	**688** *27.1*	**33.5**	- -	
	VLT	185B 195A2	MS	E3 L3	E2A DE2	**190** **153** -	*130* *105* -	**1623** *63.9*	**616** *24.3*	**734** *28.9*	**680** *26.8*	**42.5**	- -	
	VJT	195A2 201A2	★1 ★2 ★1	L3 G3	D2A G2A	-	-	**1600** *63.0*	**617** *24.3*	**696** *27.4*	**695** *27.4*	**35.0**	- -	
	VLTS	185B 195A2	MS	E4 L4	DE2	**161** -	*110* -	**1616** *63.6*	**612** *24.1*	**729** *28.7*	**675** *26.6*	**54.0**	- -	
	VSDT	201A2 195A2	★2 ★1	L5	D2A	-	-	**1660** *65.4*	**621** *24.4*	**745** *29.3*	**680** *26.8*	**79.0**	- -	
	VSDL		★2 ★1	L5	D2A	-	-	**1672** *65.8*	**613** *24.1*	**755** *29.7*	**677** *26.7*	**87.0**	- -	
			★2	Industrial Service	IDU	-	-	See characteristics page 48						
550/65R25 Tubeless	VTS		★1	L3	D2A	-	-	**1350** *53.1*	**547** *21.5*	**594** *23.4*	**605** *23.8*	**32.5**	- -	(14.00/1.5) 17.00/2.0
600/65R25 Tubeless	VSW	187A2	★1	L2	D2A	-	-	**1424** *56.0*	**600** *23.6*	**627** *24.7*	**668** *26.3*	**31.5**	- -	(17.00/1.7, 17.00/2.0) 19.50/2.5
650/65R25 Tubeless	VTS		★1	L3	D2A	-	-	**1502** *59.1*	**642** *25.3*	**660** *26.0*	**710** *28.0*	**37.0**	- -	19.50/2.5
750/65R25 **(30/65R25)** Tubeless	VLT	190B 202A2	MS	E3 L3	DE2	**225** -	*154* -	**1625** *64.0*	**765** *30.1*	**718** *28.3*	**831** *32.7*	**43.0**	- -	(22.00/3.0) 24.00/3.0
	VLTS	190B	★2	E4	E2A	**195**	*134*	**1623** *63.9*	**765** *30.1*	**713** *28.1*	**832** *32.8*	**55.0**	- -	
26.5R25 Tubeless	VLT	193B 202A2	MS	E3 L3	DE2	**190** -	*130* -	**1747** *68.8*	**684** *26.9*	**787** *31.0*	**736** *29.0*	**45.0**	- -	22.00/3.0

For the TKPH(TMPH) Ratings, please refer to page 11.

Pattern	Application Max.Speed km/h mph		Tire Load Limits at Various Cold Inflation Pressures																Size
		kPa	275	300	325	350	375	400	425	450	475	500	525						23.5R25
		psi	40	44	47	51	54	58	62	65	69	73	76						23.5R25
VSW	E/M	★					★1						★2						23.5R25
VLT	**50**	**kg**	**5600**	**6000**	**6500**	**6700**	**7100**	**7500**	**7750**	**8250**	**8500**	**9000**	**9250**						23.5R25
VLTS	30	*lbs*	*12300*	*13200*	*14300*	*14800*	*15700*	*16500*	*17100*	*18200*	*18700*	*19800*	*20400*						23.5R25
		kPa	125	150	175	200	225	250	275	300									23.5R25
		psi	18	22	25	29	33	36	40	44									23.5R25
VUT	Grader	★								★1									23.5R25
VJT	**40**	**kg**	**3150**	**3550**	**4000**	**4500**	**4875**	**5300**	**5600**	**6000**									23.5R25
	25	*lbs*	*6950*	*7850*	*8800*	*9900*	*10700*	*11700*	*12300*	*13200*									23.5R25
			For slope and ditching service, inflation pressures should be increased by 100kPa (15psi) with no increase in load rating. For extreme conditions, consult a Bridgestone Representative for additional recommended operating requirements.																23.5R25
		kPa	275	300	325	350	375	400	425	450	475	500	525	550	575	600	625	650	23.5R25
		psi	40	44	47	51	54	58	62	65	69	73	76	80	83	87	91	94	23.5R25
VUT	Loader	★										★1						★2	23.5R25
VSW	**10**	**kg**						**10300**	**10600**	**11200**	**11500**	**12150**	**12500**	**12850**	**13200**	**13600**	**14000**	**14500**	23.5R25
VLT	5	*lbs*						*22700*	*23400*	*24700*	*25400*	*26800*	*27600*	*28300*	*29100*	*30000*	*30900*	*32000*	23.5R25
VJT VLTS VSDT VSDL																			23.5R25
VSDL	IDU		See characteristics page 49																23.5R25
VTS	Loader	★									★1								550/65R25
	10	**kg**						**7500**	**7750**	**8250**	**8500**								550/65R25
	5	*lbs*						*16500*	*17100*	*18200*	*18700*								550/65R25
VSW		★									★1								600/65R25
		kg						**8750**	**9000**	**9500**	**9750**								600/65R25
		lbs						*19300*	*19800*	*20900*	*21500*								600/65R25
VTS		★									★1								650/65R25
		kg						**10000**	**10600**	**10900**	**11500**								650/65R25
		lbs						*22000*	*23400*	*24000*	*25400*								650/65R25
VLT	E/M	★									★2								750/65R25 (30/65R25)
VLTS	**50**	**kg**	**6900**	**7300**	**7750**	**8250**	**8750**	**9250**	**9750**	**10300**	**10600**								750/65R25 (30/65R25)
	30	*lbs*	*15200*	*16100*	*17100*	*18200*	*19300*	*20400*	*21500*	*22700*	*23400*								750/65R25 (30/65R25)
VLT	Loader	★									★1								750/65R25 (30/65R25)
	10	**kg**						**13200**	**13600**	**14500**	**15000**								750/65R25 (30/65R25)
	5	*lbs*						*29100*	*30000*	*32000*	*33100*								750/65R25 (30/65R25)
VLT	E/M	★					★1						★2						26.5R25
	50	**kg**	**7100**	**7500**	**8000**	**8500**	**9000**	**9500**	**9750**	**10300**	**10600**	**11200**	**11500**						26.5R25
	30	*lbs*	*15700*	*16500*	*17600*	*18700*	*19800*	*20900*	*21500*	*22700*	*23400*	*24700*	*25400*						26.5R25
VLT	Loader	★										★1						★2	26.5R25
	10	**kg**						**12850**	**13200**	**14000**	**14500**	**15000**	**15500**	**16000**	**16500**	**17000**	**18000**	**18500**	26.5R25
	5	*lbs*						*28300*	*29100*	*30900*	*32000*	*33100*	*34200*	*35300*	*36400*	*37500*	*39700*	*40800*	26.5R25

1) Figures under the star rating denote the maximum load and inflation pressures.
2) For Loader & Dozer Service, Tire Load Limits will depend on a type of the operation. Please refer to page 82.

Tire Size	Pattern	LI/SS	Star Rating	TRA Code or Application	Spec	TKPH	*TMPH*	Approximate Inflated Dimensions OD mm *inch*	OW mm *inch*	SLR mm *inch*	SLW mm *inch*	OTD mm	Minimum Dual Spacing mm *inch*	Recommended Rim/Flange Height inch
26.5R25 Tubeless	VJT	202A2 209A2	★1 ★2	L3	D2A	-	-	**1737** *68.4*	**682** *26.9*	**754** *29.7*	**795** *31.3*	**38.0**	- -	22.00/3.0
	VLTS	193B	★2	E4	E2A	**186**	*127*	**1736** *68.3*	**678** *26.7*	**784** *30.9*	**743** *29.3*	**59.0**	- -	
	VSNT		MS ★2	E4 L4	DE2 D2A	**165** -	*113* -	**1779** *70.0*	**685** *27.0*	**780** *30.7*	**774** *30.5*	**57.5**	- -	
	VSDT	209A2 202A2	★2 ★1	L5	D2A	-	-	**1775** *69.9*	**697** *27.4*	**790** *31.1*	**778** *30.6*	**88.0**	- -	
	VSDL		★2 ★1	L5	D2A	-	-	**1790** *70.5*	**684** *26.9*	**797** *31.4*	**761** *30.0*	**95.5**	- -	
	VSMS		★2 ★1	L5S	D2A	-	-	**1775** *69.9*	**684** *26.9*	**800** *31.5*	**760** *29.9*	**95.0**	- -	
	VSMS2		★2	L5S	D2A	-	-	**1775** *69.9*	**704** *27.7*	**800** *31.5*	**760** *29.9*	**95.0**	- -	
29.5R25 Tubeless	VLT	200B 208A2	★2 MS	E3 L3	E3A DE2	**304** **200** -	*208* *137* -	**1877** *73.9*	**762** *30.0*	**840** *33.1*	**830** *32.7*	**48.0**	- -	25.00/3.5
	VJT	216A2 208A2	★2 ★1	L3	D2A	-	-	**1865** *73.4*	**762** *30.0*	**810** *31.9*	**878** *34.6*	**42.0**	- -	
	VLTS	200B	★2	E4	E2A	**225**	*154*	**1865** *73.4*	**762** *30.0*	**835** *32.9*	**844** *33.2*	**65.0**	- -	
	VSNT		MS ★2	E4 L4	DE2 D2A	**220** -	*151* -	**1905** *75.0*	**768** *30.2*	**849** *33.4*	**835** *32.9*	**60.0**	- -	
	VSDT	216A2 208A2	★2 ★1	L5	D2A	-	-	**1903** *74.9*	**779** *30.7*	**845** *33.3*	**869** *34.2*	**96.0**	- -	
	VSDL		★2 ★1	L5	D2A	-	-	**1925** *75.8*	**766** *30.2*	**855** *33.7*	**846** *33.3*	**104.0**	- -	
29"														
775/65R29 Tubeless	VTS		★1	L3	D2A	-	-	**1740** *68.5*	**775** *30.5*	**762** *30.0*	**843** *33.2*	**43.0**	- -	(24.00/3.5) 25.00/3.5
875/65R29 Tubeless	VTS	203B 214A2	MS	E3 L3	DE2	**237** -	*162* -	**1865** *73.4*	**850** *33.5*	**792** *31.2*	**963** *37.9*	**47.5**	- -	27.00/3.5 (28.00/3.5)
	VLTS	203B 214A2	MS	E4 L4	DE2	**225** -	*154* -	**1868** *74.0*	**858** *33.8*	**827** *32.6*	**938** *36.9*	**60.0**	- -	
29.5R29 Tubeless	VKT		★2	E2	E2A E1A	**330** **401**	*226* *275*	**1958** *77.1*	**765** *30.1*	**870** *34.3*	**841** *33.1*	**44.0**	- -	25.00/3.5
	VSNT		MS ★2	E4 L4	DE2 D2A	**232** -	*159* -	**2000** *78.7*	**774** *30.5*	**905** *35.6*	**849** *34.6*	**60.0**	- -	

For the TKPH(TMPH) Ratings, please refer to page 11.

Will be discontinued.

Pattern	Application Max.Speed km/h mph	kPa / psi	275 / 40	300 / 44	325 / 47	350 / 51	375 / 54	400 / 58	425 / 62	450 / 65	475 / 69	500 / 73	525 / 76	550 / 80	575 / 83	600 / 87	625 / 91	650 / 94	Size
									Tire Load Limits at Various Cold Inflation Pressures										
VLTS	E/M	★					★1						★2						26.5R25
VSNT	**50**	kg	**7100**	**7500**	**8000**	**8500**	**9000**	**9500**	**9750**	**10300**	**10600**	**11200**	**11500**						26.5R25
	30	*lbs*	*15700*	*16500*	*17600*	*18700*	*19800*	*20900*	*21500*	*22700*	*23400*	*24700*	*25400*						26.5R25
VJT	Loader	★										★1						★2	26.5R25
VSNT	**10**	kg						**12850**	**13200**	**14000**	**14500**	**15000**	**15500**	**16000**	**16500**	**17000**	**18000**	**18500**	26.5R25
VSDT	5	*lbs*						*28300*	*29100*	*30900*	*32000*	*33100*	*34200*	*35300*	*36400*	*37500*	*39700*	*40800*	26.5R25
VSDL																			26.5R25
VSMS																			26.5R25
VSMS2																			26.5R25
VLT	E/M	★					★1						★2						29.5R25
VLTS	**50**	kg	**8500**	**9250**	**9750**	**10300**	**10900**	**11500**	**11800**	**12500**	**12850**	**13600**	**14000**						29.5R25
VSNT	30	*lbs*	*18700*	*20400*	*21500*	*22700*	*24000*	*25400*	*26000*	*27600*	*28300*	*30000*	*30900*						29.5R25
VLT	Loader	★										★1						★2	29.5R25
VJT	**10**	kg						**15500**	**16000**	**17000**	**17500**	**18000**	**19000**	**19500**	**20000**	**20600**	**21200**	**22400**	29.5R25
VSNT	5	*lbs*						*34200*	*35300*	*37500*	*38600*	*39700*	*41900*	*43000*	*44100*	*45400*	*46700*	*49400*	29.5R25
VSDT																			29.5R25
VSDL																			29.5R25
29"																			
VTS	Loader	★									★1								775/65R29
	10	kg						**15000**	**15500**	**16500**	**17000**								775/65R29
	5	*lbs*						*33100*	*34200*	*36400*	*37500*								775/65R29
VTS	E/M	★									★2								875/65R29
VLTS	**50**	kg	**10000**	**10900**	**11500**	**12150**	**12850**	**13600**	**14000**	**14500**	**15500**								875/65R29
	30	*lbs*	*22000*	*24000*	*25400*	*26800*	*28300*	*30000*	*30900*	*32000*	*34200*								875/65R29
VTS	Loader	★									★1								875/65R29
VLTS	**10**	kg						**18500**	**19500**	**20600**	**21200**								875/65R29
	5	*lbs*						*40800*	*43000*	*45400*	*46700*								875/65R29
VKT	E/M	★											★2						29.5R29
VSNT	**50**	kg	**9250**	**9750**	**10300**	**10900**	**11500**	**12150**	**12500**	**13200**	**13600**	**14500**	**15000**						29.5R29
	30	*lbs*	*20400*	*21500*	*22700*	*24000*	*25400*	*26800*	*27600*	*29100*	*30000*	*32000*	*33100*						29.5R29
VSNT	Loader	★										★1						★2	29.5R29
	10	kg						**16500**	**17000**	**18000**	**18500**	**19500**	**20000**	**20600**	**21200**	**22400**	**23000**	**23600**	29.5R29
	5	*lbs*						*36400*	*37500*	*39700*	*40800*	*43000*	*44100*	*45400*	*46700*	*49400*	*50700*	*52000*	29.5R29

1) Figures under the star rating denote the maximum load and inflation pressures.
2) For Loader & Dozer Service, Tire Load Limits will depend on a type of the operation. Please refer to page 82.

Tire Size	Pattern	LI/SS	Star Rating	TRA Code or Application	Spec	**TKPH**	*TMPH*	Approximate Inflated Dimensions OD	OW	SLR	SLW	OTD	Minimum Dual Spacing	Recommended Rim/Flange Height
								mm *inch*	**mm** *inch*	**mm** *inch*	**mm** *inch*	**mm**	**mm** *inch*	inch
29.5R29 Tubeless	VSDT	218A2 211A2	★2 ★1	L5	D2A	-	-	**1989** *78.3*	**779** *30.7*	**883** *34.8*	**872** *34.3*	**96.0**	- -	25.00/3.5
	VSDL		★2 ★1	L5	D2A	-	-	**2008** *79.1*	**776** *30.6*	**900** *35.4*	**856** *33.7*	**104.5**	- -	
	VSMS		★2	L5S	D2A	-	-	**2008** *79.1*	**773** *30.4*	**912** *35.9*	**829** *32.6*	**104.5**	- -	
	VSMS2		★2	L5S	D2A	-	-	**2008** *79.1*	**792** *31.2*	**912** *35.9*	**829** *32.6*	**104.5**	- -	
33.25R29 Tubeless	VLT		★2	E3	E2A	**349**	*239*	**2081** *81.9*	**853** *33.6*	**925** *36.4*	**950** *37.4*	**54.0**	- -	27.00/3.5
33"														
18.00R33 Tubeless	VMTP		★2	E4	E2A E1A	**185** **229**	*127* *157*	**1870** *73.6*	**515** *20.3*	**846** *33.3*	**575** *22.6*	**55.0**	**587** *23.1*	13.00/2.5
	VELS		★2	E4	E2A E1A	**170** **211**	*116* *145*	**1856** *73.1*	**512** *20.2*	**856** *33.7*	**575** *22.6*	**49.0**	**587** *23.1*	
			★3	Industrial Service	-	-	-	See characteristics page 48						
	VRQP		★2	E4	E2ALS E2A	**122** **152**	*84* *104*	**1890** *74.4*	**515** *20.3*	**876** *34.5*	**575** *22.6*	**64.5**	**587** *23.1*	13.00/2.5
	VCHS	219A5	★3	Industrial Service	IDU	-	-	See characteristics page 48						
21.00R33 Tubeless	VMTP		★2	E4	E2A E1A	**237** **293**	*162* *201*	**1998** *78.7*	**578** *22.8*	**909** *35.8*	**650** *25.6*	**61.0**	**701** *27.6*	15.00/3.0
	VRLS		★2	E4	E2A	**227**	*155*	**1978** *77.9*	**578** *22.8*	**899** *35.4*	**650** *25.6*	**54.0**	**701** *27.6*	
21.00R33														
35/65R33 Tubeless	VSNT	225A8	MT	E4 L4	DUH	**250** -	*171* -	**2075** *81.7*	**904** *35.6*	**936** *36.9*	**976** *38.4*	**62.5**	- -	28.00/3.5
			MS	E4 L4	DE2	**250** -	*171* -							
			★2		D2A									
	VSNL		★2	L4	D2A	-	-	**2075** *81.7*	**880** *34.6*	**936** *36.9*	**981** *38.6*	**62.5**	- -	
	VSDT	224A2 217A2	★2 ★1	L5	D2A	-	-	**2075** *81.7*	**890** *35.0*	**914** *36.0*	**990** *39.0*	**96.0**	- -	
	VSDL		★2 ★1	L5	D2A	-	-	**2075** *81.7*	**880** *34.6*	**917** *36.1*	**951** *37.4*	**95.0**	- -	
			★2	Industrial Service	IDU	-	-	See characteristics page 48						

For the TKPH(TMPH) Ratings, please refer to page 11.

Will be discontinued.

Pattern	Application Max.Speed km/h mph	Tire Load Limits at Various Cold Inflation Pressures																Size
		kPa	275	300	325	350	375	400	425	450	475	500	525	550	575	600	625	650	29.5R29
		psi	40	44	47	51	54	58	62	65	69	73	76	80	83	87	91	94	
VSDT	Loader	★										★1						★2	
VSDL	**10**	**kg**						**16500**	**17000**	**18000**	**18500**	**19500**	**20000**	**20600**	**21200**	**22400**	**23000**	**23600**	
VSMS	5	*lbs*						*36400*	*37500*	*39700*	*40800*	*43000*	*44100*	*45400*	*46700*	*49400*	*50700*	*52000*	
VSMS2																			
VLT	E/M	★											★2						33.25R29
	50	**kg**	**11200**	**12150**	**12850**	**13600**	**14000**	**15000**	**15500**	**16500**	**17000**	**17500**	**18500**						
	30	*lbs*	*24700*	*26800*	*28300*	*30000*	*30900*	*33100*	*34200*	*36400*	*37500*	*38600*	*40800*						
33"																			
		kPa	450	475	500	525	550	575	600	625	650	675	700						18.00R33
		psi	65	69	73	76	80	83	87	91	94	98	102						
VMTP	E/M	★											★2						
VELS	**50**	**kg**	**7750**	**8000**	**8500**	**8750**	**9000**	**9250**	**9750**	**10000**	**10300**	**10600**	**10900**						
VRQP	30	*lbs*	*17100*	*17600*	*18700*	*19300*	*19800*	*20400*	*21500*	*22000*	*22700*	*23400*	*24000*						
VCHS VELS	IDU	See characteristics page 49																	
VMTP	E/M	★											★2						21.00R33
VRLS	**50**	**kg**	**10000**	**10300**	**10900**	**11200**	**11500**	**11800**	**12500**	**12850**	**13200**	**13600**	**14000**						
	30	*lbs*	*22000*	*22700*	*24000*	*24700*	*25400*	*26000*	*27600*	*28300*	*29100*	*30000*	*30900*						
VSNT	UG E/M	See characteristics page 84																	35/65R33
		kPa	275	300	325	350	375	400	425	450	475	500	525	550	575	600	625	650	
		psi	40	44	47	51	54	58	62	65	69	73	76	80	83	87	91	94	
VSNT	E/M	★											★2						
	50	**kg**	**10600**	**11500**	**12150**	**12850**	**13600**	**14000**	**15000**	**15500**	**16000**	**17000**	**17500**						
	30	*lbs*	*23400*	*25400*	*26800*	*28300*	*30000*	*30900*	*33100*	*34200*	*35300*	*37500*	*38600*						
VSNT	Loader	★										★1						★2	
VSNL	LHD	**kg**						**19500**	**20600**	**21200**	**22400**	**23000**	**23600**	**25000**	**25750**	**26500**	**27250**	**28000**	
VSDT	**10**	*lbs*						*43000*	*45400*	*46700*	*49400*	*50700*	*52000*	*55100*	*56800*	*58400*	*60000*	*61500*	
VSDL	5																		
VSDL	IDU	See characteristics page 49																	

1) Figures under the star rating denote the maximum load and inflation pressures.
2) For Loader & Dozer Service, Tire Load Limits will depend on a type of the operation. Please refer to page 82.

Tire Size	Pattern	LI/SS	Star Rating	TRA Code or Application	Spec	**TKPH**	*TMPH*	Approximate Inflated Dimensions				OTD	Minimum Dual Spacing	Recommended Rim/Flange Height
								OD	OW	SLR	SLW			
								mm *inch*	**mm** *inch*	**mm** *inch*	**mm** *inch*	**mm**	**mm** *inch*	inch
35"														
21.00R35 Tubeless	VMTP		★2	E4	E2A E1A E3A	**237** **293** **342**	*162* *201* *234*	**2048** *80.6*	**577** *22.7*	**922** *36.3*	**655** *25.8*	**61.0**	**701** *27.6*	15.00/3.0
	VELS		★2	E4	E2A E1A	**227** **281**	*155* *192*	**2044** *80.5*	**577** *22.7*	**935** *36.8*	**650** *25.6*	**59.0**	**701** *27.6*	
24.00R35 Tubeless	VMTP		★2	E4	E2A E1A E3A	**314** **388** **453**	*215* *266* *310*	**2184** *86.0*	**660** *26.0*	**975** *38.4*	**734** *28.9*	**68.0**	**795** *31.3*	17.00/3.5
	VRLS		★2	E4	E2A E1A E3A	**314** **388** **453**	*215* *266* *310*	**2175** *85.6*	**660** *26.0*	**980** *38.6*	**734** *28.9*	**59.0**	**795** *31.3*	
	VRQP		★2	E4	E2ALS E2A	**207** **259**	*142* *177*	**2194** *86.4*	**660** *26.0*	**995** *39.2*	**745** *29.3*	**71.5**	**795** *31.3*	
29.5R35 Tubeless	VRL		★2	E3	- E1A	- **380**	- *260*	**2120** *83.5*	**768** *30.2*	**932** *36.7*	**844** *33.2*	**39.5**	- -	25.00/3.5
33.25R35 Tubeless	VRL		★2	E3	- E1A	- **472**	- *323*	**2228** *87.7*	**846** *33.3*	**990** *39.0*	**970** *38.2*	**49.0**	- -	27.00/3.5
37.25R35 Tubeless	VLT		★2	E3	E2A E1A	**417** **569**	*286* *390*	**2388** *94.0*	**954** *37.6*	**1054** *41.5*	**1063** *41.9*	**59.5**	- -	31.00/4.0
39"														
37.5R39 Tubeless	VKT		★2	E2	- E1A	- **696**	- *477*	**2524** *99.4*	**982** *38.7*	**1120** *44.1*	**1080** *42.5*	**51.0**	- -	32.00/4.5
40.5/75R39 Tubeless	VLT		★2	E3	E2A E1A	**500** **682**	*342* *467*	**2609** *102.6*	**1002** *39.4*	**1157** *45.6*	**1127** *44.4*	**58.5**	- -	32.00/4.5
45/65R39 Tubeless	VSDL		★1	L5	D2A	-	-	**2580** *101.6*	**1074** *42.3*	**1116** *43.9*	**1205** *47.4*	**116.0**	- -	32.00/4.5 36.00/4.5

For the TKPH(TMPH) Ratings, please refer to page 11.

Pattern	Application Max.Speed km/h mph		Tire Load Limits at Various Cold Inflation Pressures											Size
35"														
		kPa	**450**	**475**	**500**	**525**	**550**	**575**	**600**	**625**	**650**	**675**	**700**	
		psi	65	69	73	76	80	83	87	91	94	98	102	
VMTP VELS	E/M **50** 30	★											★2	**21.00R35**
		kg	**10300**	**10600**	**11200**	**11500**	**11800**	**12150**	**12850**	**13200**	**13600**	**14000**	**14500**	
		lbs	*22700*	*23400*	*24700*	*25400*	*26000*	*26800*	*28300*	*29100*	*30000*	*30900*	*32000*	
VMTP VRLS VRQP		★											★2	**24.00R35**
		kg	**13200**	**13600**	**14000**	**14500**	**15500**	**16000**	**16500**	**17000**	**17500**	**18000**	**18500**	
		lbs	*29100*	*30000*	*30900*	*32000*	*34200*	*35300*	*36400*	*37500*	*38600*	*39700*	*40800*	
		kPa	**275**	**300**	**325**	**350**	**375**	**400**	**425**	**450**	**475**	**500**	**525**	
		psi	40	44	47	51	54	58	62	65	69	73	76	
VRL	E/M **50** 30	★											★2	**29.5R35**
		kg	**10000**	**10600**	**11200**	**11800**	**12500**	**13200**	**13600**	**14500**	**15000**	**15500**	**16000**	
		lbs	*22000*	*23400*	*24700*	*26000*	*27600*	*29100*	*30000*	*32000*	*33100*	*34200*	*35300*	
VRL		★											★2	**33.25R35**
		kg	**12150**	**12850**	**14000**	**14500**	**15500**	**16000**	**17000**	**17500**	**18500**	**19000**	**20000**	
		lbs	*26800*	*28300*	*30900*	*32000*	*34200*	*35300*	*37500*	*38600*	*40800*	*41900*	*44100*	
VLT		★											★2	**37.25R35**
		kg	**14500**	**15500**	**16500**	**17500**	**18500**	**19500**	**20600**	**21200**	**22400**	**23000**	**23600**	
		lbs	*32000*	*34200*	*36400*	*38600*	*40800*	*43000*	*45400*	*46700*	*49400*	*50700*	*52000*	
39"														
VKT	E/M **50** 30	★											★2	**37.5R39**
		kg	**16000**	**17000**	**18000**	**19000**	**20000**	**21200**	**21800**	**23000**	**23600**	**25000**	**25750**	
		lbs	*35300*	*37500*	*39700*	*41900*	*44100*	*46700*	*48100*	*50700*	*52000*	*55100*	*56800*	
VLT		★											★2	**40.5/75R39**
		kg	**18000**	**19000**	**20600**	**21800**	**22400**	**23600**	**25000**	**25750**	**27250**	**28000**	**29000**	
		lbs	*39700*	*41900*	*45400*	*48100*	*49400*	*52000*	*55100*	*56800*	*60000*	*61500*	*64000*	
VSDL	Loader **10** 5	★										★1		**45/65R39**
		kg						**33500**	**34500**	**36500**	**37500**	**40000**		
		lbs						*74000*	*76000*	*80500*	*82500*	*88000*		

1) Figures under the star rating denote the maximum load and inflation pressures.
2) For Loader & Dozer Service, Tire Load Limits will depend on a type of the operation. Please refer to page 82.

Tire Size	Pattern	LI/SS	Star Rating	TRA Code or Application	Spec	TKPH	*TMPH*	Approximate Inflated Dimensions OD mm *inch*	OW mm *inch*	SLR mm *inch*	SLW mm *inch*	OTD mm	Minimum Dual Spacing mm *inch*	Recommended Rim/Flange Height inch
45"														
45/65R45 Tubeless	VSNL		★2	L4	D2A	-	-	**2730** *107.5*	**1123** *44.2*	**1190** *46.8*	**1275** *50.2*	**75.0**	- -	36.00/4.5
	VSDL		★2 ★1	L5	D2A	-	-	**2730** *107.5*	**1123** *44.2*	**1188** *46.8*	**1274** *50.2*	**111.5**	- -	
49"														
27.00R49 Tubeless	VFT		★2	E2	E2A - E3A	**557** - **804**	*382* - *551*	**2646** *104.2*	**750** *29.5*	**1207** *47.5*	**835** *32.9*	**44.0**	**892** *35.1*	19.50/4.0
	VMTS		★2	E4	E2A E1A E3A	**486** **600** **702**	*333* *411* *481*	**2690** *105.9*	**750** *29.5*	**1230** *48.4*	**835** *32.9*	**64.0**	**892** *35.1*	
	VMTP		★2	E4	E2A E1A E3A	**440** **544** **636**	*301* *373* *436*	**2700** *106.3*	**750** *29.5*	**1239** *48.8*	**835** *32.9*	**73.0**	**892** *35.1*	
	VRLS		★2	E4	E2A E1A E3A	**415** **513** **600**	*284* *351* *411*	**2687** *105.8*	**750** *29.5*	**1228** *48.3*	**835** *32.9*	**66.5**	**892** *35.1*	
	VREP		★2	E4	E2A E1A E3A	**457** **564** **660**	*313* *386* *452*	**2690** *105.9*	**750** *29.5*	**1231** *48.4*	**835** *32.9*	**66.5**	**892** *35.1*	
	VRDP		★2	E4	E2A E1A E3A	**415** **513** **600**	*284* *351* *411*	**2711** *106.7*	**750** *29.5*	**1240** *48.8*	**835** *32.9*	**76.0**	**892** *35.1*	
New	VREV		★2	E4	E2A E1A E3A	**415** **513** **600**	*284* *351* *411*	**TBA** *TBA*	**TBA** *TBA*	**TBA** *TBA*	**TBA** *TBA*	**83.0**	**892** *35.1*	
51"														
30.00R51 Tubeless	VMT		★2	E3	- - E3A	- - **1065**	- - *729*	**2850** *112.2*	**854** *33.6*	**1294** *50.9*	**950** *37.4*	**45.0**	**993** *39.1*	22.00/4.5
	VRLS		★2	E4	E2A E1A E3A	**496** **603** **717**	*340* *413* *491*	**2904** *114.3*	**854** *33.6*	**1311** *51.6*	**963** *37.9*	**74.5**	**993** *39.1*	
33.00R51 Tubeless	VMT		★2	E3	- E1A E3A	- **1018** **1209**	- *697* *828*	**2988** *117.6*	**932** *36.7*	**1338** *52.7*	**1052** *41.4*	**48.0**	**1074** *42.3*	24.00/5.0
	VMTP		★2	E4	E2A E1A E3A	**591** **700** **832**	*405* *479* *570*	**3063** *120.6*	**932** *36.7*	**1376** *54.2*	**1052** *41.4*	**89.5**	**1074** *42.3*	
	VRLS		★2	E4	E2A E1A E3A	**558** **679** **807**	*382* *465* *553*	**3035** *119.5*	**932** *36.7*	**1371** *54.0*	**1051** *41.4*	**78.5**	**1074** *42.3*	
	VRDP		★2	E4	E2A E1A E3A	**558** **679** **807**	*382* *465* *553*	**3061** *120.5*	**932** *36.7*	**1376** *54.2*	**1051** *41.4*	**87.0**	**1074** *42.3*	
	VRPS		★2	E4	E2A E1A E3A	**558** **679** **807**	*382* *465* *553*	**3061** *120.5*	**932** *36.7*	**1376** *54.2*	**1051** *41.4*	**87.0**	**1074** *42.3*	
36.00R51 Tubeless	VHS		★2	E2	- - E3A	- - **1485**	- - *1017*	**3108** *122.4*	**1015** *40.0*	**1390** *54.7*	**1163** *45.4*	**44.0**	**1184** *46.6*	26.00/5.0
	VRLS		★2	E4	E2A E1A E3A	**642** **781** **927**	*440* *535* *635*	**3204** *126.1*	**1015** *40.0*	**1431** *56.3*	**1153** *45.4*	**86.5**	**1184** *46.6*	
50/65R51 Tubeless	VSDL		★2	L5	D2A	-	-	**3070** *120.9*	**1278** *50.3*	**1347** *53.0*	**1361** *53.6*	**128.0**	- -	40.00/4.5

For the TKPH(TMPH) Ratings, please refer to page 11.
Will be discontinued.

Pattern	Application Max.Speed km/h mph	Tire Load Limits at Various Cold Inflation Pressures														Size
45"																
		kPa	**400**	**425**	**450**	**475**	**500**	**525**	**550**	**575**	**600**	**625**	**650**	**675**	**700**	45/65R45
		psi	58	62	65	69	73	76	80	83	87	91	94	98	102	
VSNL	Loader	★					★1						★2			
VSDL	**10**	**kg**	**35500**	**37500**	**38750**	**40000**	**42500**	**43750**	**45000**	**46250**	**47500**	**50000**	**51500**			
	5	*lbs*	*78500*	*82500*	*85500*	*88000*	*93500*	*96500*	*99000*	*102000*	*104500*	*110000*	*113500*			
49"																
VFT	E/M	★													★2	27.00R49
VMTS	**50**	**kg**			**19500**	**20000**	**20600**	**21800**	**22400**	**23000**	**23600**	**25000**	**25750**	**26500**	**27250**	
VMTP	30	*lbs*			*43000*	*44100*	*45400*	*48100*	*49400*	*50700*	*52000*	*55100*	*56800*	*58400*	*60000*	
VRLS																
VREP																
VRDP																
VREV																
51"																
VMT	E/M	★													★2	30.00R51
VRLS	**50**	**kg**			**23600**	**25000**	**25750**	**26500**	**28000**	**29000**	**30000**	**30750**	**31500**	**32500**	**33500**	
	30	*lbs*			*52000*	*55100*	*56800*	*58400*	*61500*	*64000*	*66000*	*68000*	*69500*	*71500*	*74000*	
VMT		★													★2	33.00R51
VMTP		**kg**			**27250**	**29000**	**30000**	**30750**	**32500**	**33500**	**34500**	**35500**	**36500**	**37500**	**38750**	
VRLS		*lbs*			*60000*	*64000*	*66000*	*68000*	*71500*	*74000*	*76000*	*78500*	*80500*	*82500*	*85500*	
VRDP																
VRPS																
VHS		★													★2	36.00R51
VRLS		**kg**			**33500**	**35500**	**36500**	**37500**	**38750**	**40000**	**41250**	**42500**	**43750**	**45000**	**46250**	
		lbs			*74000*	*78500*	*80500*	*82500*	*85500*	*88000*	*91000*	*93500*	*96500*	*99000*	*102000*	
VSDL	Loader	★											★2			50/65R51
	10	**kg**	**45000**	**47500**	**50000**	**51500**	**54500**	**56000**	**58000**	**60000**	**61500**	**63000**	**65000**			
	5	*lbs*	*99000*	*104500*	*110000*	*113500*	*120000*	*123000*	*127500*	*131500*	*135500*	*139000*	*143500*			

1) Figures under the star rating denote the maximum load and inflation pressures.
2) For Loader & Dozer Service, Tire Load Limits will depend on a type of the operation. Please refer to page 82.

Tire Size	Pattern	LI/SS	Star Rating	TRA Code or Application	Spec	**TKPH**	*TMPH*	Approximate Inflated Dimensions OD	OW	SLR	SLW	OTD	Minimum Dual Spacing	Recommended Rim/Flange Height
								mm *inch*	**mm** *inch*	**mm** *inch*	**mm** *inch*	**mm**	**mm** *inch*	inch
57"														
37.00R57	VZTS		★2	E4	E2A	**694**	*475*	**3422**	**1044**	**1541**	**1190**	**87.5**	**1217**	27.00/6.0
Tubeless					E1A	**845**	*579*	*134.7*	*41.1*	*60.7*	*46.9*		*47.9*	
					E3A	**1003**	*687*							
	VRLS		★2	E4	E2A	**694**	*475*	**3410**	**1044**	**1535**	**1190**	**87.5**	**1217**	
					E1A	**845**	*579*	*134.3*	*41.1*	*60.4*	*46.9*		*47.9*	
					E3A	**1003**	*687*							
42/90R57	VRDP		★2	E4	E2A	**715**	*490*	**3456**	**1060**	**1539**	**1210**	**97.0**	**1323**	27.00/6.0
Tubeless					E1A	**870**	*596*	*136.1*	*41.7*	*60.6*	*47.7*		*52.1*	29.00/6.0
					E3A	**1033**	*708*							
	VRPS		★2	E4	E2A	**715**	*490*	**3456**	**1060**	**1539**	**1210**	**97.0**	**1323**	
					E1A	**870**	*596*	*136.1*	*41.7*	*60.6*	*47.7*		*52.1*	
					E3A	**1033**	*708*							
40.00R57	VMT		★2	E3	E2A	**1204**	*825*	**3512**	**1108**	**1560**	**1264**	**64.0**	**1311**	29.00/6.0
Tubeless					E1A	**1463**	*1002*	*138.3*	*43.6*	*61.4*	*49.8*		*51.6*	
					E3A	**1739**	*1191*							
	VZTS		★2	E4	E2A	**773**	*529*	**3585**	**1140**	**1606**	**1289**	**91.5**	**1311**	
					E1A	**940**	*644*	*141.1*	*44.9*	*63.2*	*50.7*		*51.6*	
					E3A	**1117**	*765*							
	VELS		★2	E4	E2A	**773**	*529*	**3562**	**1127**	**1582**	**1291**	**91.5**	**1311**	
					E1A	**940**	*644*	*140.2*	*44.4*	*62.3*	*50.8*		*51.6*	
					E3A	**1117**	*765*							
	VRDP		★2	E4	E2A	**773**	*529*	**3575**	**1108**	**1591**	**1264**	**97.0**	**1311**	
					E1A	**940**	*644*	*140.7*	*43.6*	*62.6*	*49.8*		*51.6*	
					E3A	**1117**	*765*							
	VRPS		★2	E4	E2A	**773**	*529*	**3575**	**1108**	**1591**	**1264**	**97.0**	**1311**	
					E1A	**940**	*644*	*140.7*	*43.6*	*62.6*	*49.8*		*51.6*	
					E3A	**1117**	*765*							
46/90R57	VZTP		★2	E4	E2A	**766**	*525*	**3585**	**1145**	**1591**	**1299**	**97.0**	**1412**	29.00/6.0
Tubeless					E1A	**927**	*635*	*141.1*	*45.1*	*62.6*	*51.1*		*55.6*	(32.00/6.0)
					E3A	**1103**	*755*							
	VRDP		★2	E4	E2A	**796**	*545*	**3572**	**1145**	**1586**	**1299**	**97.0**	**1412**	
					E1A	**968**	*663*	*140.6*	*45.1*	*62.4*	*51.1*		*55.6*	
					E3A	**1150**	*788*							
	VRPS		★2	E4	E2A	**796**	*545*	**3572**	**1145**	**1586**	**1299**	**97.0**	**1412**	
					E1A	**968**	*663*	*140.6*	*45.1*	*62.4*	*51.1*		*55.6*	
					E3A	**1150**	*788*							
	VREV		★2	E4	E2A	**876**	*600*	**3572**	**1145**	**1586**	**1299**	**97.0**	**1412**	
					E1A	**968**	*663*	*140.6*	*45.1*	*62.4*	*51.1*		*55.6*	
						(1065)*	*(729)**							
					E3A	**1150**	*788*							
						(1265)*	*(866)**							
55.5/80R57	VSDL			L5	D2A	-	-	**3740**	**1395**	**1634**	**1616**	**125.5**	-	44.00/6.0
Tubeless								*147.2*	*54.9*	*64.3*	*63.6*		-	
50/90R57	VRPS		★2	E4	E2A	**884**	*605*	**3840**	**1283**	**1702**	**1471**	**107.0**	**1562**	32.00/6.0
Tubeless					E1A	**1092**	*748*	*151.2*	*50.5*	*67.0*	*57.9*		*61.5*	34.00/6.0
					E3A	**1278**	*875*							32.00/6.5
														34.00/6.5
60/80R57	VSDL			L5	D2A	-	-	**3952**	**1491**	**1738**	**1755**	**118.0**	-	47.00/6.0
Tubeless								*155.6*	*58.7*	*68.4*	*69.1*		-	

For the TKPH(TMPH) Ratings, please refer to page 11.
*If you operate with this TKPH(TMPH), consult your Bridgestone Representative.
Will be discontinued.

Pattern	Application Max.Speed km/h mph															Size
57"																
		kPa psi	**400** 58	**425** 62	**450** 65	**475** 69	**500** 73	**525** 76	**550** 80	**575** 83	**600** 87	**625** 91	**650** 94	**675** 98	**700** 102	
VZTS	E/M	★													★2	**37.00R57**
VRLS	**50**	**kg**			**37500**	**38750**	**40000**	**41250**	**43750**	**45000**	**46250**	**47500**	**48750**	**50000**	**51500**	
	30	*lbs*			*82500*	*85500*	*88000*	*91000*	*96500*	*99000*	*102000*	*104500*	*107500*	*110000*	*113500*	
VRDP		★													★2	**42/90R57**
VRPS		**kg**			**38750**	**40000**	**41250**	**42500**	**45000**	**46250**	**47500**	**48750**	**50000**	**51500**	**53000**	
		lbs			*85500*	*88000*	*91000*	*96500*	*99000*	*102000*	*104500*	*107500*	*110000*	*113500*	*117000*	
VMT		★													★2	**40.00R57**
VZTS		**kg**			**42500**	**45000**	**46250**	**48750**	**50000**	**51500**	**53000**	**54500**	**56000**	**58000**	**60000**	
VELS		*lbs*			*93500*	*99000*	*102000*	*107500*	*110000*	*113500*	*117000*	*120000*	*123500*	*128000*	*132500*	
VRDP																
VRPS																
VZTP		★													★2	**46/90R57**
VRDP		**kg**			**45000**	**47500**	**48750**	**51500**	**53000**	**54500**	**56000**	**58000**	**60000**	**61500**	**63000**	
VRPS		*lbs*			*99000*	*104500*	*107500*	*113500*	*117000*	*120000*	*123500*	*128000*	*132500*	*135500*	*139000*	
VREV																
VSDL	Loader	★														**55.5/80R57**
	10	**kg**					**82500**	**85000**	**90000**	**92500**	**95000**	**97500**	**100000**	**103000**	**106000**	
	5	*lbs*					*182000*	*187500*	*198000*	*203500*	*209000*	*214500*	*220500*	*227000*	*233500*	
VRPS	E/M	★													★2	**50/90R57**
	50	**kg**			**56000**	**58000**	**60000**	**63000**	**65000**	**67000**	**69000**	**71000**	**73000**	**75000**	**77500**	
	30	*lbs*			*123500*	*128000*	*132500*	*139000*	*143500*	*147500*	*152000*	*156500*	*161000*	*165500*	*171000*	
VSDL	Loader	★														**60/80R57**
	10	**kg**	**82000**	**85750**	**89500**	**93250**	**97000**	**100500**	**104000**	**107750**	**111000**	**114750**	**118000**			
	5	*lbs*	*180500*	*189250*	*197500*	*205500*	*213500*	*221500*	*229500*	*237250*	*245000*	*252500*	*260000*			

Tire Load Limits at Various Cold Inflation Pressures

* About some exceptions, consult a bridgestone representative.

1) Figures under the star rating denote the maximum load and inflation pressures.
2) For Loader & Dozer Service, Tire Load Limits will depend on a type of the operation. Please refer to page 82.

Tire Size	Pattern	LI/SS	Star Rating	TRA Code or Application	Spec	**TKPH**	*TMPH*	Approximate Inflated Dimensions				OTD	Minimum Dual Spacing	Recommended Rim/Flange Height
								OD	OW	SLR	SLW			
								mm *inch*	**mm** *inch*	**mm** *inch*	**mm** *inch*	**mm**	**mm** *inch*	inch
63"														
53/80R63	VRF		★2	E3	-	-	-	**3741**	**1311**	**1615**	**1524**	**64.0**	**1626**	36.00/5.0
Tubeless					E1A	**1330**	*911*	*147.3*	*51.6*	*63.6*	*60.0*		*64.0*	38.00/5.0
					E3A	**1626**	*1115*							
	VRPS		★2	E4	E2A	**974**	*667*	**3828**	**1304**	**1657**	**1511**	**110.0**	**1626**	
					E1A	**1150**	*788*	*150.7*	*51.3*	*65.2*	*59.5*		*64.0*	
					E3A	**1408**	*964*							
59/80R63	VRF		★2	E3	E1A	**1784**	*1222*	**4022**	**1459**	**1710**	**1712**	**71.0**	**1780**	44.00/5.0
Tubeless					E3A	**2050**	*1404*	*158.3*	*57.4*	*67.3*	*67.4*		*70.0*	
					E1A	**1686**	*1155*							41.00/5.0
					E3A	**1937**	*1327*							
	VRPS		★2	E4	E2A	**1228**	*841*	**4017**	**1467**	**1710**	**1712**	**116.0**	**1780**	44.00/5.0
					E1A	**1515**	*1038*	*158.1*	*57.8*	*67.3*	*67.4*		*70.0*	
					E3A	**1773**	*1214*							
					E2A	**1160**	*795*							41.00/5.0
					E1A	**1431**	*980*							
					E3A	**1675**	*1147*							

For the TKPH(TMPH) Ratings, please refer to page 11.

Pattern	Application Max.Speed km/h mph	Tire Load Limits at Various Cold Inflation Pressures									Size
63"											
		kPa psi	**450** 65	**475** 69	**500** 73	**525** 76	**550** 80	**575** 83	**600** 87		
VRF VRPS	E/M **50** 30	★							★2		**53/80R63**
		kg	**67000**	**69000**	**71000**	**75000**	**77500**	**80000**	**82500**		
		lbs	*147500*	*152000*	*156500*	*165500*	*171000*	*176500*	*182000*		
VRF VRPS		★							★2		**59/80R63**
		kg	**80000**	**82500**	**87500**	**90000**	**92500**	**95000**	**100000**	* 44.00/5.0 Rim	
		lbs	*176500*	*182000*	*193000*	*198500*	*204000*	*209500*	*220500*		
		★							★2		
		kg	**77000**	**79000**	**84000**	**86000**	**89000**	**91000**	**96000**	* 41.00/5.0 Rim	
		lbs	*169300*	*174600*	*185200*	*190500*	*195800*	*201050*	*211650*		

1) Figures under the star rating denote the maximum load and inflation pressures.
2) For Loader & Dozer Service, Tire Load Limits will depend on a type of the operation. Please refer to page 82.

Tire Size	Pattern	LI/SS	Star Rating	TRA Code or Application	Approximate Inflated Dimensions OD mm / *inch*	OW mm / *inch*	SLR mm / *inch*	SLW mm / *inch*	OTD mm	Recommended Rim/Flange Height inch
Industrial Service										
20"										
12.00R20	VCH		★3	Industrial Service	**1140** *44.9*	**315** *12.4*	**512** *20.2*	**360** *14.2*	**29.5**	8.50V
	VCHS	176A5	★3	Industrial Service	**1139** *44.8*	**297** *11.7*	**507** *20.0*	**355** *14.0*	**41.5**	
24"										
12.00R24	VCH		★2	Industrial Service	**1254** *49.4*	**323** *12.7*	**558** *22.0*	**376** *14.8*	**29.5**	8.50V
	VCHS	178A5		Industrial Service	**1263** *49.7*	**310** *12.2*	**580** *22.8*	**351** *13.8*	**42.0**	
14.00R24	VHB		★3	Industrial Service	**1357** *53.4*	**383** *15.1*	**630** *24.8*	**410** *16.1*	**23.5**	10.00W
	VCH		★3	Industrial Service	**1393** *54.8*	**390** *15.4*	**610** *24.0*	**460** *18.1*	**32.0**	
	VCHS	196A5	★3	Industrial Service	**1412** *55.6*	**383** *15.1*	**626** *24.6*	**445** *17.5*	**63.0**	
14.00R24 TG Tubeless	VCHS	196A5	★3	Industrial Service	**1412** *55.6*	**383** *15.1*	**626** *24.6*	**445** *17.5*	**63.0**	10.00VA
25"										
16.00R25 Tubeless	VHB		★2	Industrial Service	**1484** *58.4*	**440** *17.3*	**690** *27.2*	**475** *18.7*	**22.5**	11.25/2.0
	VCHD	200A5		Industrial Service	**1500** *59.1*	**435** *17.1*	**655** *25.8*	**503** *19.8*	**54.0**	
	VCHR	200A5		Industrial Service	**1504** *59.2*	**435** *17.1*	**674** *26.5*	**500** *19.7*	**50.0**	
	VRLS		★2	Industrial Service	**1531** *60.3*	**448** *17.6*	**713** *28.1*	**488** *17.6*	**45.0**	
18.00R25 Tubeless	VHB		★3	Industrial Service	**1610** *63.4*	**515** *20.3*	**733** *28.9*	**565** *22.2*	**26.0**	13.00/2.5
	VCHS	214A5	★3	Industrial Service	**1650** *65.0*	**504** *19.8*	**707** *27.8*	**596** *23.5*	**64.0**	
	VSMS		★2	Industrial Service	**1681** *66.2*	**512** *20.2*	**730** *28.7*	**592** *23.3*	**84.5**	
23.5R25 Tubeless	VSDL		★2	Industrial Service	**1672** *65.8*	**613** *24.1*	**755** *29.7*	**687** *27.0*	**87.0**	19.50/2.5
33"										
18.00R33 Tubeless	VCHS	219A5	★3	Industrial Service	**1856** *73.1*	**494** *19.4*	**803** *31.6*	**585** *23.0*	**70.0**	13.00/2.5
	VELS		★3	Industrial Service	**1860** *73.2*	**512** *20.2*	**800** *31.5*	**604** *23.8*	**49.0**	
35/65R33 Tubeless	VSDL		★2	Industrial Service	**2075** *81.7*	**880** *34.6*	**900** *35.4*	**986** *38.8*	**95.0**	28.00/3.5

Off-the-Road Tires Used for Industrial Vehicle Applications

1) Industrial Vehicles comprise vehicles such as counter-balanced lift trucks, container handlers, straddle carriers, aircraft tow tractors, mobile crushers, log stackers etc., used on hard improved surfaces, smooth floors and runways.
2) Use Specifications of **Industrial Service only.**
3) Consult a Rim Manufacturer when inflation pressure exceeds 800kPa (116psi).

Pattern	Application	Star Rating		Inflation Pressure	Tire Load Limits at Various Speeds											Size
Industrial Service																
20"																
				kPa	**km/h**	**0**	**Creep**	**5**	**10**	**15**	**20**	**25**	**30**	**35**		
				psi	mph	Static	Creep	3	5	9	12	15	19	22		
VCH	Industrial	★3	Load	**1000**	**kg**	**9230**	**9230**	**9230**	**9230**	**9230**	**9230**	**9230**	**8875**	**8875**		**12.00R20**
VCHS			Wheel	145	*lbs*	*20350*	*20350*	*20350*	*20350*	*20350*	*20350*	*20350*	*19570*	*19570*		
			Steering	**1000**	**kg**	**7100**	**7100**	**7100**	**7100**	**7100**	**7100**	**7100**	**6570**	**6570**		
			Wheel	145	*lbs*	*15620*	*15620*	*15620*	*15620*	*15620*	*15620*	*15620*	*14480*	*14480*		
24"																
VCH	Industrial	★2	Load	**960**	**kg**	**12420**	**11040**	**10005**	**9315**	**8970**	**8765**	**8625**				**12.00R24**
			Wheel	139	*lbs*	*27385*	*24345*	*22060*	*20540*	*19780*	*19320*	*19020*				
			Steering	**960**	**kg**	**9935**	**8830**	**8005**	**7450**	**7175**	**7010**	**6900**				
			Wheel	139	*lbs*	*21910*	*19475*	*17650*	*16430*	*15825*	*15455*	*15215*				
VCHS	Industrial		Load	**1000**	**kg**	**9750**	**9750**	**9750**	**9750**	**9750**	**9750**	**9750**	**9375**	**9375**	*Compliant with the ETRTO standard of industrial tires	
			Wheel	145	*lbs*	*21500*	*21500*	*21500*	*21500*	*21500*	*21500*	*21500*	*20670*	*20670*		
			Steering	**1000**	**kg**	**7500**	**7500**	**7500**	**7500**	**7500**	**7500**	**7500**	**6935**	**6935**		
			Wheel	145	*lbs*	*16500*	*16500*	*16500*	*16500*	*16500*	*16500*	*16500*	*15200*	*15200*		
VHB	Industrial	★3	Load	**1000**	**kg**	**18000**	**16000**	**14500**	**13500**	**13000**	**12700**	**12500**	**12400**			**14.00R24**
VCH			Wheel	145	*lbs*	*39690*	*35280*	*31970*	*29765*	*28665*	*28005*	*27560*	*27340*			
VCHS			Steering	**1000**	**kg**	**14400**	**12800**	**11600**	**10800**	**10400**	**10160**	**10000**	**9920**			
			Wheel	145	*lbs*	*31750*	*28225*	*25580*	*23815*	*22930*	*22400*	*22050*	*21875*			
VCHS	Industrial	★3	Load	**1000**	**kg**	**18000**	**16000**	**14500**	**13500**	**13000**	**12700**	**12500**	**12400**			**14.00R24 TG**
			Wheel	145	*lbs*	*39690*	*35280*	*31970*	*29765*	*28665*	*28005*	*27560*	*27340*			
			Steering	**1000**	**kg**	**14400**	**12800**	**11600**	**10800**	**10400**	**10160**	**10000**	**9920**			
			Wheel	145	*lbs*	*31750*	*28225*	*25580*	*23815*	*22930*	*22400*	*22050*	*21875*			
25"																
VHB	Industrial	★2	Load	**960**	**kg**	**21870**	**19440**	**17615**	**16400**	**15795**	**15430**	**15185**	**15065**			**16.00R25**
VRLS			Wheel	139	*lbs*	*48225*	*42865*	*38845*	*36165*	*34825*	*34025*	*33490*	*33220*			
			Steering	**960**	**kg**	**17495**	**15550**	**14095**	**13120**	**12635**	**12345**	**12150**	**12050**			
			Wheel	139	*lbs*	*38580*	*34290*	*31075*	*28935*	*27860*	*27220*	*26790*	*26575*			
VCHD	Industrial			**1000**	**kg**	**18200**	**18200**	**18200**	**18200**	**14000**	**14000**	**14000**			*Compliant with the ETRTO standard of industrial tires (For straddle carrier use only)	
VCHR				145	*lbs*	*40140*	*40140*	*40140*	*40140*	*30900*	*30900*	*30900*				
VHB	Industrial	★3	Load	**1000**	**kg**	**30600**	**27200**	**24650**	**22950**	**22100**	**21590**	**21250**	**21080**			**18.00R25**
VCHS			Wheel	145	*lbs*	*67475*	*59975*	*54355*	*50605*	*48730*	*47605*	*46855*	*46480*			
			Steering	**1000**	**kg**	**24480**	**21760**	**19720**	**18360**	**17680**	**17270**	**17000**	**16865**			
			Wheel	145	*lbs*	*53980*	*47980*	*43480*	*40485*	*38985*	*38085*	*37485*	*37185*			
VSMS	Industrial	★2	Load	**960**	**kg**	**28800**	**25600**	**23200**	**21600**	**20800**	**20320**	**20000**	**19840**			
			Wheel	139	*lbs*	*63505*	*56450*	*51155*	*47630*	*45865*	*44805*	*44100*	*43745*			
			Steering	**960**	**kg**	**23040**	**20480**	**18560**	**17280**	**16640**	**16255**	**16000**	**15870**			
			Wheel	139	*lbs*	*50805*	*45160*	*40925*	*38100*	*36690*	*35845*	*35280*	*34995*			
VSDL	Industrial	★2	Load	**690**	**kg**	**26100**	**23200**	**21025**	**19575**	**18850**	**18415**	**18125**	**17980**			**23.5R25**
			Wheel	100	*lbs*	*57550*	*51155*	*46360*	*43160*	*41565*	*40605*	*39965*	*39645*			
			Steering	**690**	**kg**	**20880**	**18560**	**16820**	**15660**	**15080**	**14730**	**14500**	**14385**			
			Wheel	100	*lbs*	*46040*	*40925*	*37090*	*34530*	*33250*	*32485*	*31970*	*31715*			
33"																
VCHS	Industrial	★3	Load	**1000**	**kg**	**35100**	**31200**	**28275**	**26325**	**25350**	**24765**	**24375**	**24180**			**18.00R33**
VELS			Wheel	145	*lbs*	*77395*	*68795*	*62345*	*58045*	*55895*	*54605*	*53745*	*53315*			
			Steering	**1000**	**kg**	**28080**	**24960**	**22620**	**21060**	**20280**	**19810**	**19500**	**19345**			
			Wheel	145	*lbs*	*61915*	*55035*	*49875*	*46435*	*44715*	*43685*	*42995*	*42655*			
VSDL	Industrial	★2	Load	**780**	**kg**	**50400**	**44800**	**40600**	**37800**	**36400**	**35560**	**35000**				**35/65R33**
			Wheel	113	*lbs*	*111130*	*98785*	*89525*	*83350*	*80260*	*78410*	*77175*				
			Steering	**780**	**kg**	**40320**	**35840**	**32480**	**30240**	**29120**	**28450**	**28000**				
			Wheel	113	*lbs*	*88905*	*79025*	*71620*	*66680*	*64210*	*62725*	*61740*				

4) For Speeds exceeding 30km/h (18mph), consult a Bridgestone Representative.
5) For tire sizes and star ratings other than listed above, consult a Bridgestone Representative.
6) For Minimum Dual Spacing information, please consult a Bridgestone Representative.

Tire Size	Pattern	LI/SS	TRA Code or Application	Approximate Inflated Dimensions OD mm / inch	OW mm / inch	SLR mm / inch	SLW mm / inch	OTD mm	Minimum Dual Spacing mm / inch	Recommended Rim/Flange Height inch
Mobile Crane Service (High-Speed)										
24"										
385/95R24	VHS	170E	Mobile Crane Service	**1356** *53.4*	**384** *15.1*	**626** *24.6*	**422** *16.6*	**23.0**	**450** *17.7*	10.00W
	VHB	170E	Mobile Crane Service	**1357** *53.4*	**383** *15.1*	**630** *24.8*	**410** *16.1*	**23.5**	**450** *17.7*	
25"										
385/95R25 Tubeless	VHS	170E / 170F	Mobile Crane Service	**1356** *53.4*	**384** *15.1*	**626** *24.6*	**422** *16.6*	**23.0**	**450** *17.7*	10.00/1.5
	VSW	170E	Mobile Crane Service	**1355** *53.3*	**394** *15.5*	**631** *24.8*	**427** *16.8*	**23.5**	**450** *17.7*	
445/95R25 Tubeless	VHB	177E	Mobile Crane Service	**1484** *58.4*	**440** *17.3*	**690** *27.2*	**475** *18.7*	**22.5**	**513** *20.2*	11.25/2.0
	VHS	177E / 174F	Mobile Crane Service	**1484** *58.4*	**435** *17.1*	**684** *26.9*	**480** *18.9*	**25.5**	**513** *20.2*	
	VSW	177E	Mobile Crane Service	**1484** *58.4*	**435** *17.1*	**695** *27.4*	**476** *18.7*	**23.0**	**513** *20.2*	
445/80R25 Tubeless	VGT	170E	Mobile Crane Service	**1339** *52.7*	**440** *17.3*	**610** *24.0*	**485** *19.1*	**24.0**	- -	14.00/1.5
505/95R25 Tubeless	VHB	186E	Mobile Crane Service	**1590** *62.6*	**510** *20.1*	**778** *30.6*	**565** *22.2*	**26.0**	**587** *23.1*	13.00/2.5
	VHS	186E	Mobile Crane Service	**1590** *62.6*	**505** *19.9*	**727** *28.6*	**565** *22.2*	**25.5**	**587** *23.1*	
525/80R25 Tubeless	VHS	179E / 176F	Mobile Crane Service	**1480** *58.3*	**537** *21.1*	**677** *26.7*	**578** *22.8*	**31.0**	- -	17.00/2.0

Tire Size	Pattern	LI/SS	TRA Code or Application	Approximate Inflated Dimensions OD mm / inch	OW mm / inch	SLR mm / inch	SLW mm / inch	OTD mm	Minimum Dual Spacing mm / inch	Recommended Rim/Flange Height inch
Logging Service										
24"										
14.00R24*	VSB		Truck, Trailers	**1365** *53.7*	**387** *15.2*	**628** *24.7*	**433** *17.0*	**21.0**	**450** *17.7*	10.00W
25"										
14.00R25* Tubeless	VSB		Truck, Trailers	**1365** *53.7*	**387** *15.2*	**628** *24.7*	**433** *17.0*	**21.0**	**450** *17.7*	10.00

* USA use only
Will be discontinued.

Pattern	Application	Inflation Pressure		Tire Load Limits at Various Speeds															Size
Mobile Crane Service (High-Speed) 24"				*Consult a Rim Manufacturer when inflation pressure exceeds 800kPa (116psi).															
		kPa psi	**km/h** mph	**0** Static	**Creep** Creep	**5** 3	**10** 5	**15** 9	**20** 12	**30** 19	**40** 25	**50** 31	**60** 37	**70** 43	**80** 50	**90** 56	**100** 62	
VHS VHB (170E)	High-Speed	**900**	**kg**	**17700**	**14400**	**12700**	**11000**	**9850**	**8900**	**7800**	**7450**	**7100**	**6700**	**6000**	**4925**	**4200**	**3600**	**385/95R24**
		131	*lbs*	*39000*	*31700*	*28100*	*24300*	*21700*	*19600*	*17200*	*16400*	*15600*	*14800*	*13200*	*10800*	*9250*	*7950*	
25"																			
VHS VSW (170E)	High-Speed	**900**	**kg**	**17700**	**14400**	**12700**	**11000**	**9850**	**8900**	**7800**	**7450**	**7100**	**6700**	**6000**	**4925**	**4200**	**3600**	**385/95R25**
		131	*lbs*	*39000*	*31700*	*28100*	*24300*	*21700*	*19600*	*17200*	*16400*	*15600*	*14800*	*13200*	*10800*	*9250*	*7950*	
VHS (170F)	High-Speed	**900**	**kg**	**17700**	**14400**	**12700**	**11000**	**9900**	**9000**	**7500**	**6900**	**6700**	**6600**	**6300**	**6000**	**5640**	**5100**	**385/95R25**
		131	*lbs*	*39000*	*31700*	*28000*	*24200*	*21800*	*19800*	*16500*	*15200*	*14800*	*14500*	*13900*	*13200*	*12400*	*11200*	
VHB VHS VSW (177E)	High-Speed	**900**	**kg**	**21500**	**17500**	**15500**	**13400**	**12000**	**10800**	**9500**	**9050**	**8600**	**8100**	**7300**	**6000**	**5100**	**4375**	**445/95R25**
		131	*lbs*	*47500*	*38500*	*34200*	*29600*	*26400*	*23800*	*20900*	*20000*	*19000*	*18000*	*16100*	*13200*	*11300*	*9650*	
VHS (174F)	High-Speed	**900**	**kg**	**21500**	**17600**	**15500**	**13500**	**11100**	**10000**	**8400**	**7700**	**7500**	**7400**	**7050**	**6700**	**6300**	**5700**	**445/95R25**
		131	*lbs*	*47400*	*38800*	*34100*	*29700*	*24400*	*22200*	*18500*	*17000*	*16500*	*16200*	*15500*	*14800*	*13900*	*12600*	
VGT	High-Speed	**700**	**kg**	**17700**	**14400**	**12700**	**11000**	**9850**	**8900**	**7800**	**7450**	**7100**	**6700**	**6000**	**4925**	**4200**	**3600**	**445/80R25**
		102	*lbs*	*39000*	*31700*	*28100*	*24300*	*21700*	*19600*	*17200*	*16400*	*15600*	*14800*	*13200*	*10800*	*9250*	*7950*	
VHB VHS	High-Speed	**900**	**kg**	**28000**	**22700**	**20200**	**17500**	**15600**	**14100**	**12300**	**11800**	**11200**	**10600**	**9500**	**7800**	**6650**	**5700**	**505/95R25**
		131	*lbs*	*61800*	*50200*	*44500*	*38500*	*34300*	*31000*	*27200*	*26000*	*24700*	*23400*	*20900*	*17200*	*14700*	*12600*	
VHS (179E)	High-Speed	**700**	**kg**	**22900**	**18600**	**16500**	**14300**	**12700**	**11500**	**10100**	**9600**	**9150**	**8700**	**7750**	**6350**	**5400**	**4650**	**525/80R25**
		102	*lbs*	*50400*	*40900*	*36300*	*31400*	*28000*	*25300*	*22200*	*21200*	*20200*	*19100*	*17100*	*14000*	*12000*	*10200*	
VHS (176F)	High-Speed	**700**	**kg**	**21500**	**17600**	**15500**	**13500**	**11700**	**10600**	**8900**	**8200**	**7950**	**7800**	**7450**	**7100**	**6700**	**6050**	**525/80R25**
		102	*lbs*	*47200*	*38700*	*34100*	*29600*	*25800*	*23500*	*19600*	*18000*	*17500*	*17200*	*16400*	*15600*	*14700*	*13300*	

Pattern	Application Max.Speed **km/h** mph			Tire Load Limits at Various Cold Inflation Pressures											Size
Logging Service 24"															
		kPa psi		**450** 65	**480** 70	**520** 75	**550** 80	**590** 85	**620** 90	**660** 95	**690** 100	**720** 105	**760** 110	**790** 115	
VSB*	Truck, Trailers	Load Range									J			L	**14.00R24**
	90 55	**kg**	Dual	**3610**	**3780**	**3950**	**4110**	**4270**	**4420**	**4580**	**4750**	**4880**	**5010**	**5150**	
		lbs		*7960*	*8340*	*8710*	*9070*	*9410*	*9750*	*10090*	*10500*	*10800*	*11100*	*11400*	
		kg	Single	**3700**	**3910**	**4110**	**4310**	**4500**	**4690**	**4870**	**5150**	**5300**	**5450**	**5600**	
		lbs		*8150*	*8620*	*9070*	*9500*	*9930*	*10340*	*10730*	*11400*	*11700*	*12000*	*12300*	
25"															
VSB*	Truck, Trailers	**kg**	Dual	**3610**	**3780**	**3950**	**4110**	**4270**	**4420**	**4580**	**4750**	**4880**	**5010**	**5150**	**14.00R25**
		lbs		*7960*	*8340*	*8710*	*9070*	*9410*	*9750*	*10090*	*10500*	*10800*	*11100*	*11400*	
	90 55	**kg**	Single	**3700**	**3910**	**4110**	**4310**	**4500**	**4690**	**4870**	**5150**	**5300**	**5450**	**5600**	
		lbs		*8150*	*8620*	*9070*	*9500*	*9930*	*10340*	*10730*	*11400*	*11700*	*12000*	*12300*	

* USA use only

Tire Size	Pattern	LI/SS	Star Rating	TRA Code or Application	Approximate Inflated Dimensions OD mm *inch*	OW mm *inch*	SLR mm *inch*	SLW mm *inch*	OTD mm	Minimum Dual Spacing mm *inch*	Recommended Rim/Flange Height inch
Sand Service											
20"											
16.00R20 Tubeless ✻1	VSJ		28	E7	**1315** *51.8*	**414** *16.3*	**590** *23.2*	**475** *18.7*	**18.5**	**520** *20.5*	10.00V
16.00R20											10.00W
25"											
21.00R25 Tubeless	VSJ			E7	**1728** *68.0*	**589** *23.2*	**784** *30.9*	**649** *25.6*	**22.5**	**685** *27.0*	15.00/3.0

✻1 When you mount 16.00R20 VSJ tubeless tire on flat base rim (10.00V), installation of “sealing ring” is recommended.
For further information, please consult a Bridgestone representative.

Pattern	Application	Ply Rating	Max. Speed	Tire Cold Inflation Pressures at Various Load Limits													Size
Sand Service			*It is Recommended that 90% of the below indicated loads per tire is to be applied when used on a dual axle.														
20"																	
				kg	**4250**	**4500**	**4750**	**5000**	**5250**	**5500**	**6000**	**7000**	**8000**	**8500**	**9000**	**9500**	**16.00R20**
				lbs	9370	9920	10470	11020	11570	12130	13230	15430	17640	18740	19840	20940	
VSJ	Sand	28PR	**65km/h**	**kPa**	**490**	**540**	**580**	**630**	**680**	**720**							
			40mph	*psi*	*71*	*78*	*84*	*91*	*98*	*105*							
			50km/h	**kPa**	**390**	**420**	**450**	**490**									
			30mph	*psi*	*57*	*61*	*65*	*71*									
			16km/h	**kPa**	**280**	**300**	**320**	**350**									
			10mph	*psi*	*41*	*44*	*47*	*51*									
25"																	
VSJ	Sand	-	**65km/h**	**kPa**							**330**	**410**	**490**	**540**	**590**	**630**	**21.00R25**
			40mph	*psi*							*48*	*60*	*71*	*78*	*85*	*92*	
			50km/h	**kPa**							**260**	**320**	**390**	**420**			
			30mph	*psi*							*38*	*47*	*57*	*61*			
			16km/h	**kPa**							**200**	**230**	**280**	**300**			
			10mph	*psi*							*28*	*34*	*41*	*44*			

BIAS TIRE

1. Tread Designs

■Earthmover Service

E3

W-LUG
(WL)

R-LUG
(RL)

V-LUG2
(VL2)

■Grader Service

G1

RIB GRADER
(RG)

G2

G-LUG
(GL)

FAST GRIP
(FG)

G3

R-LUG
(RL)

■Loader & Dozer Service

L2

G-LUG
(GL)

FAST GRIP
(FG)

L3

R-LUG
(RL)

V-LUG2
(VL2)

L4

R-LUG S
(RLS)

L5

D-LUG
(DL)

L5S

SMOOTH TREAD-MS
(STMS)

■Compactor Service

C1

ROAD ROLLER
(RR)

C2

ALLIGATOR2
(AL2)

■Industrial Service

R-LUG
(RL)

R-LUG S
(RLS)

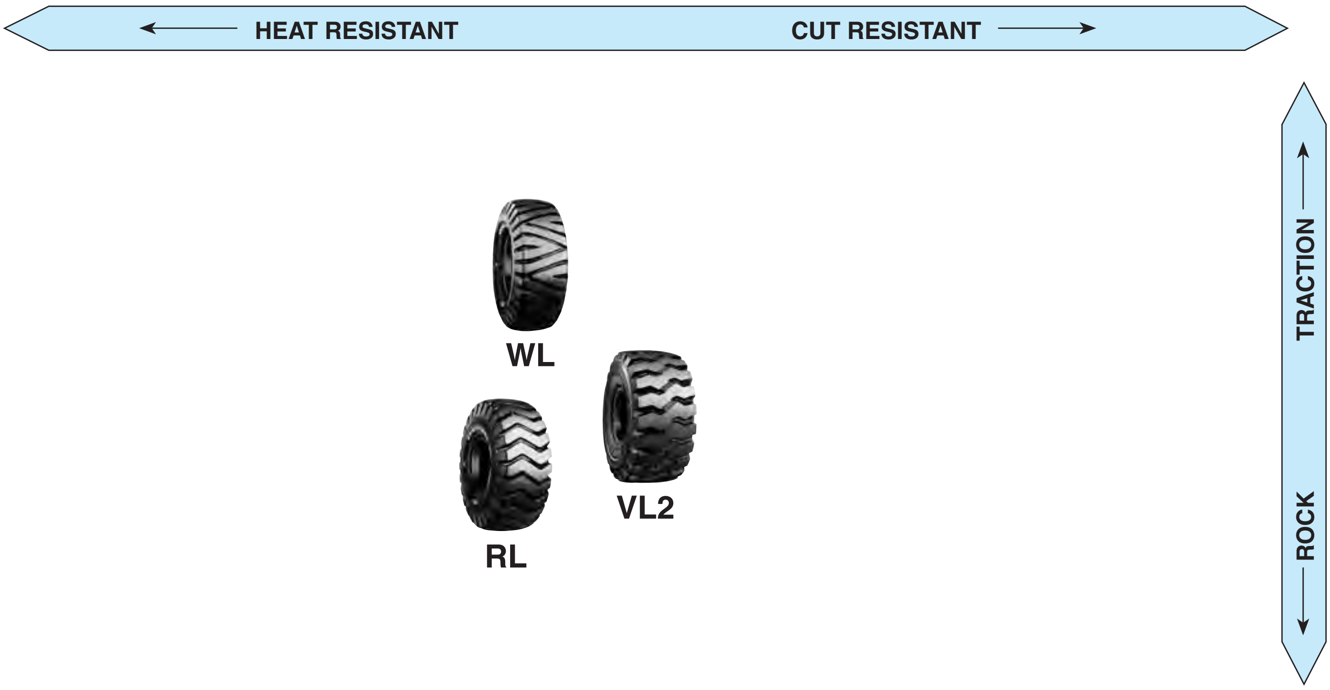
E-LUG S2
(ELS2)

SMOOTH TREAD-MS
(STMS)

YARD SERVICE-2
(YS2)

2. Application

■Earthmover Service



Size	Type	Ply Rating
WL(E3)		
9.00-20	T/T	14
RL(E3)		
10.00-20	T/T	14
11.00-20	T/T	14
12.00-20	T/T	18
12.00-24	T/T	20
14.00-24	T/T	24 28
16.00-25	T/L	28
18.00-25	T/L	32
37.25-35	T/L	36
VL2(E3)		
20.5-25	T/L	16 20
23.5-25	T/L	16 20 24
	T/T	16 20 24
26.5-25	T/L	20 24 26
29.5-25	T/L	22 28

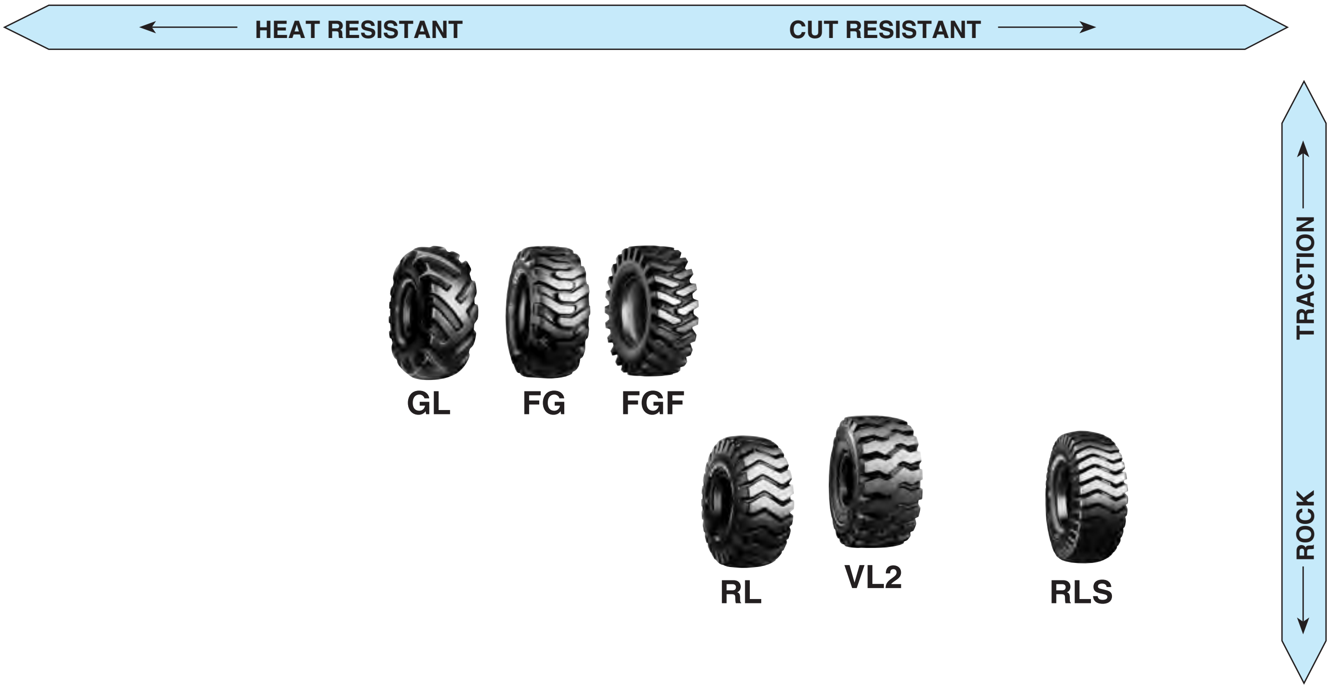
T/T: Tube Type
T/L: Tubeless Type

Grader Service

Size	Type	Ply Rating
RG(G1)		
9.00-20	T/T	10
GL(G2)		
9.00-20	T/T	14
FG(G2)		
13.00-24 TG	T/L	12
	T/T	10
14.00-24 TG	T/L	12 14
	T/T	12 16
16.00-24 TG	T/T	16
17.5-25	T/L	12
20.5-25	T/L	12
RL(G3)		
16.00-24 TG	T/T	16

T/T: Tube Type
T/L: Tubeless Type
TG: For Semi-Drop Center Rim

■Loader & Dozer Service



Size	Type	Ply Rating
GL(L2)		
9.00-20	T/T	14
FG(L2)		
27x8.50-15	T/T	4
33x12.5-15	T/T	8
12.5/70-16	T/L	6 8
10-16.5	T/L	6 8
12-16.5	T/L	8 10
	T/T	8
15.5/60-18	T/L	8
15.5/70-18	T/L	8
10.00-20	T/T	14
11.00-20	T/T	10 16
42x17-20	T/T	10
17.5/65-20	T/L	10
13.00-24 TG	T/L	12
14.00-24 TG	T/L	12
	T/T	12
16.9-24	T/T	10
18.4-24	T/T	10
17.5-25	T/L	12
20.5-25	T/L	12

Size	Type	Ply Rating
FGF(L2)		
10.00-20	T/T	16
RL(L3)		
12.00-24	T/T	20
14.00-24 TG	T/L	12
16.00-24 TG	T/T	16

T/T: Tube Type
T/L: Tubeless Type
TG: For Semi-Drop Center Rim

← HEAT RESISTANT   CUT RESISTANT →

TRACTION ↑ / ROCK ↓

DL

STMS

VL2(L3)

Size	Type	Ply Rating
15.5-25	T/L	12
17.5-25	T/L	16
	T/T	16
20.5-25	T/L	16 20
	T/T	16 20
23.5-25	T/L	16 20 24
	T/T	16 20 24
26.5-25	T/L	16 20 24 26
	T/T	24
29.5-25	T/L	22 28

RLS(L4)

Size	Type	Ply Rating
14.00-24	T/T	20
26.5-25	T/L	26
29.5-25	T/L	28

DL(L5)

Size	Type	Ply Rating
17.5-25	T/L	16
20.5-25	T/L	16
23.5-25	T/L	20
26.5-25	T/L	20 26
29.5-25	T/L	28
35/65-33	T/L	42
40/65-39	T/L	56
45/65-45	T/L	58
50/65-51	T/L	62
65/65-57	T/L	62

STMS(L5S)

Size	Type	Ply Rating
12.00-24	T/T	16 20
14.00-24	T/T	20
17.5-25	T/L	20
18.00-25	T/L	24 28 32
26.5-25	T/L	32 36
29.5-29	T/L	34

T/T: Tube Type
T/L: Tubeless Type

■Compactor Service

RR

AL2

Size	Type	Ply Rating
RR(C1)		
7.50-15	T/T	12
9.5/65-15	T/T	6
7.50-16	T/L	6
	T/T	6
10.5/80-16	T/L	6
9.00-20	T/T	10
14/70-20	T/T	12
AL2(C2)		
23.1-26	T/L	8
	T/T	8

T/T: Tube Type
T/L: Tubeless Type

Industrial Service

RL

Size	Type	Ply Rating
RL		
12.00-20	T/T	20
14.00-24	T/T	24 28
14.00-24 TG	T/L	24
16.00-25	T/L	28 32
18.00-25	T/L	40
21.00-25	T/L	40
21.00-35	T/L	40

RLS

RLS

16.00-25	T/L	28 32

ELS2

ELS2

18.00-25	T/L	40
18.00-33	T/L	36
21.00-35	T/L	40

STMS

STMS

12.00-24	T/T	20
18.00-25	T/L	40

YS2

YS2

16.00-25	T/L	32

T/T: Tube Type
T/L: Tubeless Type
TG: For Semi-Drop Center Rim

3. Technical Data

Tire Size	Pattern	Ply Rating	TRA Code or Application	Spec	**TKPH**	*TMPH*	Approximate Inflated Dimensions				OTD	Minimum Dual Spacing	Recommended Rim/Flange Height
							OD	OW	SLR	SLW			
							mm *inch*	**mm** *inch*	**mm** *inch*	**mm** *inch*	**mm**	**mm** *inch*	inch
15"													
7.50-15	RR	12	C1	-	-	-	**775** *30.5*	**209** *8.2*	**360** *14.2*	**225** *8.9*	-	**250** *9.8*	6.00GS
27x8.50-15	FG	4	L2	-	-	-	**686** *27.0*	**208** *8.2*	**317** *12.5*	**218** *8.6*	**16.5**	- -	7JA
9.5/65-15	RR	6	C1	-	-	-	**671** *26.4*	**238** *9.4*	**312** *12.3*	**242** *9.5*	-	- -	7JA
33x12.5-15	FG	8	L2	-	-	-	**851** *33.5*	**318** *12.5*	**TBA** *TBA*	**TBA** *TBA*	**22.5**	- -	10.00F
16"													
7.50-16 Tubeless	RR	6	C1	-	-	-	**814** *32.0*	**225** *8.9*	**379** *14.9*	**243** *9.6*	-	**250** *9.8*	6.00GS 6LB
7.50-16							**776** *30.6*	**214** *8.4*	**361** *14.2*	**224** *8.8*			
10.5/80-16 Tubeless	RR	6	C1	-	-	-	**812** *32.0*	**272** *10.7*	**376** *14.8*	**282** *11.1*	-	- -	8LB
12.5/70-16 Tubeless	FG	6 8	L2	-	-	-	**860** *33.9*	**319** *12.6*	**389** *15.3*	**336** *13.2*	**21.0**	- -	10LB
16.5"													
10-16.5 Tubeless	FG	6 8	L2	-	-	-	**771** *30.4*	**268** *10.6*	**353** *13.9*	**278** *10.9*	**19.5**	- -	8.25
12-16.5 Tubeless	FG	8 10	L2	-	-	-	**831** *32.7*	**315** *12.4*	**376** *14.8*	**325** *12.8*	**20.0**	- -	9.75
12-16.5		8											
18"													
15.5/60-18 Tubeless	FG	8	L2	-	-	-	**932** *36.7*	**391** *15.4*	**416** *16.4*	**404** *15.9*	**21.5**	- -	W10
15.5/70-18 Tubeless	FG	8	L2	-	-	-	**1035** *40.7*	**405** *15.9*	**459** *18.1*	**424** *16.7*	**20.5**	- -	W13

Pattern	Application Max.Speed **km/h** mph		Tire Load Limits at Various Cold Inflation Pressures																	Size
15"																				
		kPa	**350**	**375**	**400**	**425**	**450**	**475**	**500**	**525**	**550**	**575**	**600**	**625**	**650**	**675**	**700**	**725**	**750**	**7.50-15**
		psi	51	54	58	62	65	69	73	76	80	84	87	91	94	98	102	105	109	
RR	Compactor	PR																	12	
	10	**kg**	**1700**	**1750**	**1850**	**1900**	**1950**	**2060**	**2120**	**2180**	**2240**	**2300**	**2300**	**2360**	**2430**	**2500**	**2575**	**2575**	**2650**	
	5	*lbs*	*3740*	*3860*	*4080*	*4180*	*4300*	*4540*	*4680*	*4800*	*4940*	*5080*	*5080*	*5200*	*5360*	*5520*	*5680*	*5680*	*5840*	
		kPa	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**325**										**27x8.50-15**
		psi	26	29	32	35	38	41	44	47										
FG	Loader	PR					4													
	10	**kg**	**695**	**740**	**780**	**820**	**860**													
	5	*lbs*	*1530*	*1630*	*1720*	*1805*	*1895*													
RR	Compactor	PR								6										**9.5/65-15**
	10	**kg**				**1100**	**1155**	**1205**	**1255**	**1315**										
	5	*lbs*				*2430*	*2550*	*2560*	*2770*	*2900*										
		kPa	**120**	**140**	**160**	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**325**	**350**	**375**	**400**	**425**	**450**		**33x12.5-15**
		psi	17	20	23	26	29	32	35	38	41	44	47	51	54	58	62	65		
FG	Loader	PR											8							
	10	**kg**				**1510**	**1605**	**1695**	**1785**	**1870**	**1950**	**2035**	**2130**							
	5	*lbs*				*3330*	*3540*	*3735*	*3935*	*4125*	*4300*	*4485*	*4695*							
16"																				
RR	Compactor	PR														6				**7.50-16**
	10	**kg**							**1405**	**1470**	**1535**	**1600**	**1675**	**1750**	**1820**	**1890**				
	5	*lbs*							*3100*	*3240*	*3380*	*3530*	*3690*	*3860*	*4010*	*4170*				
RR		PR										6								**10.5/80-16**
		kg							**1645**	**1725**	**1800**	**1875**								
		lbs							*3630*	*3800*	*3970*	*4130*								
FG	Loader	PR					6			8										**12.5/70-16**
	10	**kg**	**1050**	**1145**	**1240**	**1330**	**1410**	**1495**	**1570**	**1645**										
	5	*lbs*	*2315*	*2525*	*2735*	*2930*	*3110*	*3295*	*3460*	*3625*										
16.5"																				
FG	Loader	PR											6			8				**10-16.5**
	10	**kg**				**1140**	**1215**	**1285**	**1350**	**1415**	**1475**	**1540**	**1610**	**1685**	**1750**	**1820**				
	5	*lbs*				*2515*	*2680*	*2830*	*2975*	*3120*	*3250*	*3395*	*3550*	*3715*	*3860*	*4010*				
FG		PR												8				10		**12-16.5**
		kg				**1470**	**1565**	**1655**	**1740**	**1820**	**1905**	**1980**	**2075**	**2170**				**2540**		
		lbs				*3240*	*3450*	*3650*	*3835*	*4010*	*4200*	*4365*	*4575*	*4785*				*5600*		
18"																				
FG	Loader	PR						8												**15.5/60-18**
	10	**kg**	**1525**	**1670**	**1805**	**1935**	**2060**	**2195**												
	5	*lbs*	*3360*	*3680*	*3980*	*4265*	*4540*	*4840*												
FG		PR						8												**15.5/70-18**
		kg	**1725**	**1885**	**2040**	**2185**	**2325**	**2455**												
		lbs	*3800*	*4155*	*4495*	*4815*	*5125*	*5410*												

1) Figures under the star rating denote the maximum load and inflation pressures.
2) For Loader & Dozer Service, Tire Load Limits will depend on a type of the operation. Please refer to page 82.

Tire Size	Pattern	Ply Rating	TRA Code or Application	Spec	TKPH	TMPH	Approximate Inflated Dimensions OD mm / inch	OW mm / inch	SLR mm / inch	SLW mm / inch	OTD mm	Minimum Dual Spacing mm / inch	Recommended Rim/Flange Height inch
20"													
9.00-20	RG	10	G1	-	-	-	**1023** *40.3*	**267** *10.5*	**473** *18.6*	**291** *11.5*	**15.0**	- -	7.00T
	RR	10	C1	-	-	-	**1005** *39.6*	**265** *10.4*	**458** *18.0*	**297** *11.7*	-	**310** *12.2*	
	GL	14	G2, L2	-	-	-	**1023** *40.3*	**255** *10.0*	**478** *18.8*	**276** *10.9*	**21.0**	- -	
	WL	14	E3	SCR	-	-	**1027** *40.4*	**257** *10.1*	**466** *18.3*	**280** *11.0*	**19.5**	**310** *12.2*	
10.00-20	FG	14	L2	-	-	-	**1064** *41.9*	**281** *11.1*	**479** *18.9*	**307** *12.1*	**24.0**	- -	7.50V
	FGF	16	L2	-	-	-	**1057** *41.6*	**276** *10.9*	**478** *18.8*	**302** *11.9*	**18.0**	**334** *13.1*	
	RL	14	E3	CRT	**42**	*29*	**1067** *42.0*	**285** *11.2*	**489** *19.3*	**304** *12.0*	**22.5**	- -	
11.00-20	FG	10 / 16	L2	-	-	-	**1100** *43.3*	**299** *11.8*	**510** *20.0*	**323** *12.7*	**24.5**	**352** *13.9*	8.00V
	RL	14	E3	CRT	**49**	*34*	**1091** *43.0*	**296** *11.7*	**514** *20.2*	**311** *12.2*	**24.0**	**344** *13.5*	
12.00-20	RL	18	E3	SCR	**52**	*36*	**1138** *44.8*	**316** *12.4*	**513** *20.2*	**331** *13.0*	**25.5**	**382** *15.0*	8.50V
		20	Industrial Service	IDU	-	-	See characteristics page 76						
14/70-20	RR	12	C1	-	-	-	**975** *38.4*	**382** *15.0*	**448** *17.6*	**392** *15.4*	-	- -	11.00TG

For the TKPH(TMPH) Ratings, please refer to page 11.

Pattern	Application Max.Speed **km/h** mph		Tire Load Limits at Various Cold Inflation Pressures																	Size
20"																				
		kPa	**140**	**160**	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**325**	**350**	**375**	**400**	**425**	**450**	**475**	**500**	**9.00-20**
		psi	20	23	26	29	32	35	38	41	44	47	51	54	58	62	65	69	73	
RG	Grader	PR											10						14	
GL	**40**	**kg**	**955**	**1035**	**1110**	**1180**	**1245**	**1310**	**1375**	**1435**	**1495**	**1565**	**1635**	**1705**	**1780**	**1850**	**1910**	**1965**	**2025**	
	25	*lbs*	*2110*	*2280*	*2450*	*2600*	*2740*	*2890*	*3040*	*3160*	*3300*	*3460*	*3600*	*3760*	*3920*	*4060*	*4210*	*4340*	*4480*	
		kPa	**350**	**375**	**400**	**425**	**450**	**475**	**500**	**525**	**550**	**575**	**600**	**625**	**650**	**675**	**700**			
		psi	51	54	58	62	65	69	73	76	80	83	87	91	94	98	102			
RR	Compactor	PR								10										
	10	**kg**	**2900**	**3000**	**3150**	**3250**	**3350**	**3450**	**3550**	**3650**										
	5	*lbs*	*6400*	*6600*	*6950*	*7150*	*7400*	*7600*	*7850*	*8050*										
GL	Loader	PR															14			
	10	**kg**						**3150**	**3250**	**3350**	**3450**	**3450**	**3550**	**3630**	**3710**	**3790**	**3875**			
	5	*lbs*						*6950*	*7150*	*7400*	*7600*	*7600*	*7850*	*8000*	*8190*	*8360*	*8550*			
		kPa	**200**	**220**	**240**	**260**	**280**	**300**	**325**	**350**	**375**	**400**	**425**	**450**	**475**	**500**	**525**	**550**		
		psi	29	32	35	38	41	44	47	51	54	58	62	65	69	73	76	80		
WL	E/M	PR																14		
	50	**kg**	**1280**	**1350**	**1420**	**1490**	**1555**	**1620**	**1695**	**1770**	**1845**	**1915**	**1985**	**2055**	**2120**	**2185**	**2245**	**2310**		
	30	*lbs*	*2820*	*2980*	*3130*	*3280*	*3430*	*3570*	*3740*	*3900*	*4070*	*4220*	*4380*	*4530*	*4670*	*4820*	*4950*	*5090*		
		kPa	**475**	**500**	**525**	**550**	**575**	**600**	**625**	**650**	**675**	**700**	**725**	**750**						**10.00-20**
		psi	69	73	76	80	83	87	91	94	98	102	105	109						
FG	Loader	PR								14				16						
FGF	**10**	**kg**	**3550**	**3650**	**3750**	**3875**	**4000**	**4125**	**4125**	**4250**	**4345**	**4440**	**4530**	**4620**						
	5	*lbs*	*7850*	*8050*	*8250*	*8550*	*8800*	*9100*	*9100*	*9350*	*9580*	*9790*	*9990*	*10180*						
		kPa	**200**	**220**	**240**	**260**	**280**	**300**	**325**	**350**	**375**	**400**	**425**	**450**	**475**	**500**				
		psi	29	32	35	38	41	44	47	51	54	58	62	65	69	73				
RL	E/M	PR														14				
	50	**kg**	**1445**	**1530**	**1610**	**1685**	**1760**	**1830**	**1920**	**2005**	**2085**	**2170**	**2245**	**2320**	**2395**	**2470**				
	30	*lbs*	*3190*	*3370*	*3550*	*3710*	*3880*	*4030*	*4230*	*4420*	*4600*	*4780*	*4950*	*5110*	*5280*	*5450*				
		kPa	**450**	**475**	**500**	**525**	**550**	**575**	**600**	**625**	**650**	**675**	**700**							**11.00-20**
		psi	65	69	73	76	80	83	87	91	94	98	102							
FG	Loader	PR	10										16							
	10	**kg**	**3750**	**3875**	**4000**	**4125**	**4250**	**4250**	**4375**	**4500**	**4675**	**4780**	**4880**							
	5	*lbs*	*8300*	*8550*	*8800*	*9100*	*9350*	*9350*	*9650*	*9900*	*10300*	*10540*	*10740*							
		kPa	**200**	**220**	**240**	**260**	**280**	**300**	**325**	**350**	**375**	**400**	**425**	**450**	**475**					
		psi	29	32	35	38	41	44	47	51	54	58	62	65	69					
RL	E/M	PR													14					
	50	**kg**	**1570**	**1660**	**1750**	**1830**	**1910**	**1990**	**2085**	**2180**	**2270**	**2355**	**2440**	**2525**	**2605**					
	30	*lbs*	*3460*	*3660*	*3860*	*4030*	*4210*	*4390*	*4600*	*4810*	*5000*	*5190*	*5380*	*5570*	*5740*					
		kPa	**275**	**300**	**325**	**350**	**375**	**400**	**425**	**450**	**475**	**500**								**12.00-20**
		psi	40	44	47	51	54	58	62	65	69	73								
RL	E/M	PR										18								
	50	**kg**	**2180**	**2300**	**2430**	**2500**	**2650**	**2725**	**2800**	**2900**	**3000**	**3075**								
	30	*lbs*	*4800*	*5080*	*5360*	*5520*	*5840*	*6000*	*6150*	*6400*	*6600*	*6800*								
RL	IDU	See characteristics page 77																		
		kPa	**240**	**260**	**280**	**300**	**325**	**350**	**375**	**400**	**425**	**450**								**14/70-20**
		psi	35	38	41	44	47	51	54	58	62	65								
RR	Compactor	PR										12								
	10	**kg**	**2775**	**2905**	**3035**	**3160**	**3310**	**3460**	**3600**	**3740**	**3875**	**4005**								
	5	*lbs*	*6100*	*6400*	*6700*	*6950*	*7300*	*7650*	*7950*	*8250*	*8550*	*8850*								

1) Figures under the star rating denote the maximum load and inflation pressures.
2) For Loader & Dozer Service, Tire Load Limits will depend on a type of the operation. Please refer to page 82.

Tire Size	Pattern	Ply Rating	TRA Code or Application	Spec	**TKPH**	*TMPH*	Approximate Inflated Dimensions OD	OW	SLR	SLW	OTD	Minimum Dual Spacing	Recommended Rim/Flange Height
							mm *inch*	**mm** *inch*	**mm** *inch*	**mm** *inch*	**mm**	**mm** *inch*	inch
42x17-20	FG	10	L2	-	-	-	**1077**	**431**	**480**	**452**	**25.5**	-	14.00TG
							42.4	*17.0*	*18.9*	*17.8*		-	
17.5/65-20	FG	10	L2	-	-	-	**1107**	**450**	**494**	**477**	**25.0**	-	W14L
Tubeless							*43.6*	*17.7*	*19.4*	*18.8*		-	
24"													
12.00-24	RL	20	E3	DE2	**66**	*45*	**1238**	**326**	**576**	**341**	**24.5**	-	8.5
			L3		-	-	*48.7*	*12.8*	*22.7*	*13.4*		-	8.50V
	STMS	16	L5S	D2A	-	-	**1275**	**321**	**606**	**339**	**55.0**	-	8.5
		20					*50.2*	*12.6*	*23.9*	*13.3*		-	8.50V
			Industrial Service	IDU	-	-	See characteristics page 76						
13.00-24 TG	FG	12	G2	G2A	-	-	**1286**	**340**	**588**	**374**	**28.0**	-	8.00TG
Tubeless			G2, L2	DG2			*50.6*	*13.4*	*23.1*	*14.7*			(10.00VA)
13.00-24 TG		10	G2	G2A	-	-							
14.00-24	RL	28	E3	E2A	**109**	*75*	**1366**	**387**	**627**	**400**	**28.0**	**450**	10.00W
		24					*53.8*	*15.2*	*24.7*	*15.7*		*17.7*	
		28	Industrial Service	IDU	-	-	See characteristics page 76						
	RLS	20	L4	D2A	-	-	**1407**	**390**	**646**	**440**	**48.0**	**450**	10.00W
							55.4	*15.4*	*25.4*	*17.3*		*17.7*	
	STMS	20	L5S	D2A	-	-	**1373**	**367**	**646**	**391**	**78.0**	-	
							54.1	*14.4*	*25.4*	*15.4*		-	

For the TKPH(TMPH) Ratings, please refer to page 11.

Pattern	Application Max.Speed **km/h** mph		Tire Load Limits at Various Cold Inflation Pressures																Size
		kPa	**120**	**140**	**160**	**180**	**200**	**220**	**240**	**260**	**280**	**300**							42x17-20
		psi	17	20	23	26	29	32	35	38	41	44							42x17-20
FG	Loader	PR										10							42x17-20
	10	**kg**				**2740**	**2915**	**3080**	**3240**	**3395**	**3545**	**3690**							42x17-20
	5	*lbs*				*6040*	*6425*	*6790*	*7140*	*7485*	*7815*	*8135*							42x17-20
FG		PR							10										17.5/65-20
		kg	**2130**	**2330**	**2520**	**2700**	**2875**	**3040**	**3195**										17.5/65-20
		lbs	*4695*	*5135*	*5555*	*5950*	*6340*	*6700*	*7045*										17.5/65-20
24"																			
		kPa	**475**	**500**	**525**	**550**													12.00-24
		psi	69	73	76	80													12.00-24
RL	E/M	PR				20													12.00-24
	50	**kg**	**3350**	**3450**	**3550**	**3650**													12.00-24
	30	*lbs*	*7400*	*7600*	*7850*	*8050*													12.00-24
		kPa	**475**	**500**	**525**	**550**	**575**	**600**	**625**	**650**	**675**	**700**	**725**	**750**	**775**	**800**	**825**		12.00-24
		psi	69	73	76	80	83	87	91	94	98	102	105	109	112	115	120		12.00-24
RL	Loader	PR									16						20		12.00-24
STMS	**10**	**kg**	**5000**	**5150**	**5300**	**5450**	**5600**	**5600**	**5800**	**6000**	**6150**	**6270**	**6410**	**6540**	**6660**	**6780**	**6900**		12.00-24
	5	*lbs*	*11000*	*11400*	*11700*	*12000*	*12300*	*12300*	*12800*	*13200*	*13600*	*13790*	*14100*	*14390*	*14700*	*14900*	*15200*		12.00-24
STMS	IDU		See characteristics page 77																12.00-24
		kPa	**125**	**150**	**175**	**200**	**225**	**250**	**275**	**300**	**325**	**350**	**375**	**400**	**425**	**450**			13.00-24 TG
		psi	18	22	25	29	33	36	40	44	47	51	54	58	62	65			13.00-24 TG
FG	Grader	PR					10			12									13.00-24 TG
	40	**kg**	**1700**	**1900**	**2060**	**2240**	**2360**	**2500**	**2650**	**2725**									13.00-24 TG
	25	*lbs*	*3740*	*4180*	*4540*	*4940*	*5200*	*5520*	*5840*	*6000*									13.00-24 TG
FG	Loader	PR														12			13.00-24 TG
	10	**kg**									**4500**	**4750**	**5000**	**5150**	**5300**	**5600**			13.00-24 TG
	5	*lbs*									*9900*	*10500*	*11000*	*11400*	*11700*	*12300*			13.00-24 TG
		kPa	**275**	**300**	**325**	**350**	**375**	**400**	**425**	**450**	**475**	**500**	**525**	**550**	**575**	**600**	**625**	**650**	14.00-24
		psi	40	44	47	51	54	58	62	65	69	73	76	80	83	87	91	94	14.00-24
RL	E/M	PR													24			28	14.00-24
	50	**kg**	**3350**	**3550**	**3750**	**3875**	**4000**	**4250**	**4375**	**4500**	**4625**	**4750**	**4875**	**5000**	**5150**	**5300**	**5450**	**5600**	14.00-24
	30	*lbs*	*7400*	*7850*	*8250*	*8550*	*8800*	*9350*	*9650*	*9900*	*10200*	*10500*	*10700*	*11000*	*11400*	*11700*	*12000*	*12300*	14.00-24
		kPa	**575**	**600**	**625**	**650**	**675**	**700**											14.00-24
		psi	83	87	91	94	98	102											14.00-24
RLS	Loader	PR						20											14.00-24
STMS	**10**	**kg**	**7500**	**7750**	**8000**	**8250**	**8250**	**8500**											14.00-24
	5	*lbs*	*16500*	*17100*	*17600*	*18200*	*18200*	*18700*											14.00-24
RL	IDU		See characteristics page 77																14.00-24

1) Figures under the star rating denote the maximum load and inflation pressures.
2) For Loader & Dozer Service, Tire Load Limits will depend on a type of the operation. Please refer to page 82.

Tire Size	Pattern	Ply Rating	TRA Code or Application	Spec	**TKPH**	*TMPH*	Approximate Inflated Dimensions OD	OW	SLR	SLW	OTD	Minimum Dual Spacing	Recommended Rim/Flange Height
							mm *inch*	**mm** *inch*	**mm** *inch*	**mm** *inch*	**mm**	**mm** *inch*	inch
14.00-24 TG Tubeless	FG	14	G2	G2A	-	-	**1336** *52.6*	**365** *14.4*	**597** *23.5*	**406** *16.0*	**31.0**	- -	8.00TG (10.00VA)
		12	G2, L2	DG2	-	-	**1336** *52.6*	**365** *14.4*	**610** *24.0*	**392** *15.4*			8.00TG 10.00VA
	RL	12	L3	D2A	-	-	**1366** *53.8*	**387** *15.2*	**614** *24.2*	**410** *16.1*	**28.0**	**450**	10.00VA (8.00TG)
		24	Industrial Service	IDU	-	-	See characteristics page 76						
14.00-24 TG	FG	12	G2	G2A	-	-	**1336** *52.6*	**365** *14.4*	**610** *24.0*	**392** *15.4*	**31.0**	- -	8.00TG (10.00VA)
		16						**390** *15.4*		**417** *16.4*			10.00VA (8.00TG)
		12	L2	D2A			**1330** *52.3*	**390** *15.4*	**610** *24.0*	**417** *16.4*			10.00VA
16.00-24 TG	FG	16	G2	G2A	-	-	**1453** *57.2*	**438** *17.2*	**638** *25.1*	**500** *19.7*	**32.5**	- -	10.00VA
	RL	16	G3, L3	DG2	-	-	**1478** *58.2*	**419** *16.5*	**671** *26.4*	**446** *17.6*	**33.5**	**513** *20.2*	
16.9-24	FG	10	L2	-	-	-	**1320** *52.0*	**447** *17.6*	**591** *23.3*	**462** *18.2*	**30.5**	- -	W15L
18.4-24	FG	10	L2	-	-	-	**1385** *54.5*	**483** *19.0*	**612** *24.1*	**516** *20.3*	**32.5**	- -	W16L
25"													
15.5-25 Tubeless	VL2	12	L3	D2A	-	-	**1284** *50.6*	**410** *15.6*	**568** *22.4*	**448** *17.6*	**27.0**	- -	12.00/1.3
16.00-25 Tubeless	RL	28	E3	E2A	**139**	*95*	**1478** *58.2*	**432** *17.0*	**671** *26.4*	**459** *18.1*	**33.5**	**513** *20.2*	11.25/2.0
		28 32	Industrial Service	IDU	-	-	See characteristics page 76						
	RLS	28 32	Industrial Service	IDU	-	-							
	YS2	32	Industrial Service	IDU	-	-							

For the TKPH(TMPH) Ratings, please refer to page 11.

Pattern	Application Max.Speed km/h mph	Tire Load Limits at Various Cold Inflation Pressures																Size
		kPa	125	150	175	200	225	250	275	300	325	350	375	400	425			14.00-24 TG
		psi	18	22	25	29	33	36	40	44	47	51	54	58	62			14.00-24 TG
FG	Grader	PR						12		14		16						14.00-24 TG
	40	**kg**	**2060**	**2300**	**2500**	**2650**	**2800**	**3075**	**3250**	**3450**	**3550**	**3650**						14.00-24 TG
	25	*lbs*	*4540*	*5080*	*5520*	*5840*	*6150*	*6800*	*7150*	*7600*	*7850*	*8050*						14.00-24 TG
FG	Loader	PR													12			14.00-24 TG
RL	**10**	**kg**													**6300**			14.00-24 TG
	5	*lbs*													*13900*			14.00-24 TG
RL	IDU	See characteristics page 77																14.00-24 TG
FG	Grader	PR								16								16.00-24 TG
RL	**40**	**kg**	**2650**	**3000**	**3250**	**3450**	**3650**	**4000**	**4250**	**4500**								16.00-24 TG
	25	*lbs*	*5840*	*6600*	*7150*	*7600*	*8050*	*8800*	*9350*	*9900*								16.00-24 TG
RL	Loader	PR													16			16.00-24 TG
	10	**kg**									**7100**	**7300**	**7750**	**8000**	**8250**			16.00-24 TG
	5	*lbs*									*15700*	*16100*	*17100*	*17600*	*18200*			16.00-24 TG
		kPa	120	140	160	180	200	220	240									16.9-24
		psi	17	20	23	26	29	32	35									16.9-24
FG	Loader	PR							10									16.9-24
	10	**kg**	**2300**	**2520**	**2725**	**2920**	**3105**	**3280**	**3455**									16.9-24
	5	*lbs*	*5070*	*5555*	*6005*	*6435*	*6845*	*7230*	*7615*									16.9-24
FG		PR						10										18.4-24
		kg	**2765**	**3025**	**3270**	**3505**	**3725**	**3940**										18.4-24
		lbs	*6095*	*6670*	*7210*	*7725*	*8210*	*8685*										18.4-24
25"																		
		kPa	225	250	275	300	325	350	375	400	425	450	475	500	525	550	575	15.5-25
		psi	33	36	40	44	47	51	54	58	62	65	69	73	76	80	83	15.5-25
VL2	Loader	PR								12								15.5-25
	10	**kg**	**4000**	**4250**	**4500**	**4750**	**4875**	**5150**	**5300**	**5600**								15.5-25
	5	*lbs*	*8800*	*9350*	*9900*	*10500*	*10700*	*11400*	*11700*	*12300*								15.5-25
RL	E/M	PR															28	16.00-25
	50	**kg**			**4375**	**4625**	**4875**	**5000**	**5300**	**5450**	**5600**	**5800**	**6000**	**6300**	**6500**	**6500**	**6700**	16.00-25
	30	*lbs*			*9650*	*10200*	*10700*	*11000*	*11700*	*12000*	*12300*	*12800*	*13200*	*13900*	*14300*	*14300*	*14800*	16.00-25
RLS YS2	IDU	See characteristics page 77																16.00-25

1) Figures under the star rating denote the maximum load and inflation pressures.
2) For Loader & Dozer Service, Tire Load Limits will depend on a type of the operation. Please refer to page 82.

Tire Size	Pattern	Ply Rating	TRA Code or Application	Spec	**TKPH**	*TMPH*	Approximate Inflated Dimensions OD	OW	SLR	SLW	OTD	Minimum Dual Spacing	Recommended Rim/Flange Height
							mm *inch*	**mm** *inch*	**mm** *inch*	**mm** *inch*	**mm**	**mm** *inch*	inch
17.5-25 Tubeless	FG	12	G2, L2	DG2	-	-	**1345** *53.0*	**450** *17.7*	**588** *23.1*	**480** *18.9*	**27.5**	- -	14.00/1.5
	VL2	16	L3	D2A	-	-	**1348** *53.1*	**444** *17.5*	**597** *23.5*	**470** *18.5*	**30.5**	- -	
	DL	16	L5	D2A	-	-	**1410** *55.5*	**445** *17.5*	**656** *25.8*	**470** *18.5*	**69.5**	- -	
	STMS	20	L5S	D2A D2Z	-	-	**1385** *54.5*	**450** *17.7*	**645** *25.4*	**462** *18.2*	**69.0**	- -	
17.5-25	VL2	16	L3	D2A	-	-	**1348** *53.1*	**444** *17.5*	**597** *23.5*	**470** *18.5*	**30.5**	- -	
18.00-25 Tubeless	RL	32	E3	E2A	**173**	*118*	**1607** *63.3*	**508** *20.0*	**727** *28.6*	**572** *22.5*	**37.5**	**587** *23.1*	13.00/2.5
		40	Industrial Service	IDU	-	-	See characteristics page 76						
	ELS2	40	Industrial Service	IDU	-	-							
	STMS	24 28 32	L5S	D2A	-	-	**1675** *65.9*	**520** *20.5*	**762** *30.0*	**550** *21.7*	**84.0**	- -	13.00/2.5
		40	Industrial Service	IDU	-	-	See characteristics page 76						
20.5-25 Tubeless	FG	12	G2, L2	DG2	-	-	**1493** *58.8*	**534** *21.0*	**652** *25.7*	**551** *21.7*	**29.5**	- -	17.00/1.7 (12,16PR) 17.00/2.0
	VL2	16 20	E3 L3	DE2	**80** -	*55* -	**1494** *58.8*	**542** *21.3*	**641** *25.2*	**587** *23.1*	**33.0**	- -	
	DL	16	L5	D2A	-	-	**1558** *61.3*	**548** *21.6*	**714** *28.1*	**570** *22.4*	**79.5**	- -	
20.5-25	VL2	16 20	L3	D2A	-	-	**1494** *58.8*	**542** *21.3*	**641** *25.2*	**587** *23.1*	**33.0**	- -	
21.00-25 Tubeless	RL	40	Industrial Service	IDU	-	-	See characteristics page 76						

For the TKPH(TMPH) Ratings, please refer to page 11.

Pattern	Application Max.Speed km/h mph	Tire Load Limits at Various Cold Inflation Pressures																	Size
		kPa	125	150	175	200													17.5-25
		psi	18	22	25	29													
FG	Grader 40 25	PR				12													
		kg	**2120**	**2360**	**2575**	**2900**													
		lbs	*4680*	*5200*	*5680*	*6400*													
			For slope and ditching service, inflation pressures should be increased by 100kPa (15psi) with no increase in load rating. For extreme conditions, consult a Bridgestone Representative for additional recommended operating requirements.																
		kPa	225	250	275	300	325	350	375	400	425	450	475	500	525	550	575		
		psi	33	36	40	44	47	51	54	58	62	65	69	73	76	80	83		
FG VL2 DL STMS	Loader 10 5	PR						12					16				20		
		kg	**4750**	**5000**	**5300**	**5600**	**5800**	**6150**	**6300**	**6700**	**6900**	**7100**	**7300**	**7500**	**7750**	**8000**	**8250**		
		lbs	*10500*	*11000*	*11700*	*12300*	*12800*	*13600*	*13900*	*14800*	*15200*	*15700*	*16100*	*16500*	*17100*	*17600*	*18200*		
RL	E/M 50 30	PR															32		18.00-25
		kg			**5600**	**6000**	**6300**	**6500**	**6900**	**7100**	**7300**	**7500**	**7750**	**8000**	**8250**	**8500**	**8750**		
		lbs			*12300*	*13200*	*13900*	*14300*	*15200*	*15700*	*16100*	*16500*	*17100*	*17600*	*18200*	*18700*	*19300*		
		kPa	375	400	425	450	475	500	525	550	575	600	625	650	675	700	725	750	
		psi	54	58	62	65	69	73	76	80	83	87	91	94	98	102	105	109	
STMS	Loader 10 5	PR								24				28				32	
		kg	**10000**	**10450**	**10900**	**11500**	**11500**	**11800**	**12150**	**12500**	**12850**	**13200**	**13600**	**13600**	**14000**	**14500**	**14500**	**15000**	
		lbs	*22000*	*23000*	*24000*	*25400*	*25400*	*26000*	*26800*	*27600*	*28300*	*29100*	*30000*	*30000*	*30900*	*32000*	*32000*	*33100*	
RL ELS2 STMS	IDU	See characteristics page 77																	
		kPa	125	150	175	200	225	250	275	300	325	350	375	400	425	450			20.5-25
		psi	18	22	25	29	33	36	40	44	47	51	54	58	62	65			
VL2	E/M 50 30	PR							16		20								
		kg			**4125**	**4500**	**4875**	**5150**	**5450**	**5800**	**6000**								
		lbs			*9100*	*9900*	*10700*	*11400*	*12000*	*12800*	*13200*								
FG	Grader 40 25	PR			12														
		kg	**2800**	**3150**	**3550**														
		lbs	*6150*	*6950*	*7850*														
			For slope and ditching service, inflation pressures should be increased by 100kPa (15psi) with no increase in load rating. For extreme conditions, consult a Bridgestone Representative for additional recommended operating requirements.																
FG VL2 DL	Loader 10 5	PR						12				16				20			
		kg					**6300**	**6700**	**7100**	**7500**	**7750**	**8250**	**8500**	**8750**	**9250**	**9500**			
		lbs					*13900*	*14800*	*15700*	*16500*	*17100*	*18200*	*18700*	*19300*	*20400*	*20900*			
RL	IDU	See characteristics page 77																	21.00-25

1) Figures under the star rating denote the maximum load and inflation pressures.
2) For Loader & Dozer Service, Tire Load Limits will depend on a type of the operation. Please refer to page 82.

Tire Size	Pattern	Ply Rating	TRA Code or Application	Spec	**TKPH**	*TMPH*	Approximate Inflated Dimensions				OTD	Minimum Dual Spacing	Recommended Rim/Flange Height
							OD	OW	SLR	SLW			
							mm *inch*	**mm** *inch*	**mm** *inch*	**mm** *inch*	**mm**	**mm** *inch*	inch
23.5-25	VL2	16	E3	DE2	**107**	*73*	**1607**	**618**	**682**	**688**	**43.0**	-	19.50/2.5
Tubeless		20	L3		-	-	*63.3*	*24.3*	*26.9*	*27.1*		-	
		24											
		20		D2A									
	DL	20	L5	D2A	-	-	**1673**	**616**	**779**	**646**	**88.0**	-	
							65.9	*24.3*	*30.7*	*25.4*		-	
23.5-25	VL2	16	E3, L3	DE2	-	-	**1607**	**618**	**682**	**688**	**43.0**	-	
		20					*63.3*	*24.3*	*26.9*	*27.1*		-	
		24											
26.5-25	VL2	20	E3	DE2	**132**	*90*	**1738**	**683**	**745**	**734**	**44.0**	-	22.00/3.0
Tubeless		24	L3		-	-	*68.4*	*26.9*	*29.3*	*28.9*		-	
		26											
		16		D2A									
		24											
	RLS	26	L4	D2A	-	-	**1785**	**700**	**800**	**736**	**67.0**	-	
							70.3	*27.6*	*31.5*	*29.0*		-	
	DL	20	L5	D2A	-	-	**1798**	**694**	**820**	**726**	**97.0**	-	
		26					*70.8*	*27.3*	*32.3*	*28.6*		-	
	STMS	32	L5S	D2A	-	-	**1798**	**680**	**827**	**719**	**95.0**	-	
		36					*70.8*	*26.8*	*32.6*	*28.3*		-	
26.5-25	VL2	24	L3	D2A	-	-	**1738**	**683**	**745**	**734**	**44.0**	-	
							68.4	*26.9*	*29.3*	*28.9*		-	
29.5-25	VL2	22	E3	DE2	**150**	*103*	**1850**	**770**	**792**	**833**	**49.0**	-	25.00/3.5
Tubeless		28	L3		-	-	*72.8*	*30.3*	*31.2*	*32.8*		-	
	RLS	28	L4	D2A	-	-	**1912**	**784**	**813**	**805**	**74.0**	-	
							75.3	*30.9*	*32.0*	*31.7*		-	
	DL	28	L5	D2A	-	-	**1900**	**768**	**873**	**805**	**105.5**	-	
							74.8	*30.2*	*34.4*	*31.7*		-	
26"													
23.1-26	AL2	8	C2	-	-	-	**1490**	**595**	**654**	**618**	**19.0**	-	DW20A
Tubeless							*58.7*	*23.4*	*25.7*	*24.3*		-	DW20B
23.1-26	AL2	8	C2	-	-	-	**1490**	**595**	**654**	**618**	**19.0**	-	
							58.7	*23.4*	*25.7*	*24.3*		-	
29"													
29.5-29	STMS	34	L5S	D2A	-	-	**2009**	**749**	**931**	**792**	**103.0**	-	25.00/3.5
Tubeless				D2Z			*79.1*	*29.5*	*36.7*	*31.2*		-	
33"													
18.00-33	ELS2	36	Industrial Service	IDU	-	-	See characteristics page 76						
Tubeless													
35/65-33	DL	42	L5	D2V	-	-	**2075**	**896**	**979**	**945**	**97.0**	-	28.00/3.5
Tubeless							*81.7*	*35.3*	*38.5*	*37.2*	*97.0*	-	

For the TKPH(TMPH) Ratings, please refer to page 11.

Pattern	Application Max.Speed km/h mph		Tire Load Limits at Various Cold Inflation Pressures																		Size
		kPa	**175**	**200**	**225**	**250**	**275**	**300**	**325**	**350**	**375**	**400**	**425**	**450**	**475**	**500**	**525**	**550**		**630**	
		psi	25	29	33	36	40	44	47	51	54	58	62	65	69	73	76	80		92	
VL2	Loader	PR						16			20				24						**23.5-25**
DL	**10**	**kg**			**8000**	**8500**	**9000**	**9500**	**10000**	**10600**	**10900**	**11200**	**11800**	**12150**	**12500**						
	5	*lbs*			*17600*	*18700*	*19800*	*20900*	*22000*	*23400*	*24000*	*24700*	*26000*	*26800*	*26700*						
VL2	E/M	PR			16			20		24											
	50	**kg**	**5300**	**5800**	**6150**	**6500**	**6900**	**7300**	**7750**	**8000**											
	30	*lbs*	*11700*	*12800*	*13600*	*14300*	*15200*	*16100*	*17100*	*17600*											
VL2		PR				20		24	26												**26.5-25**
		kg	**6700**	**7300**	**7750**	**8250**	**8750**	**9250**	**9500**												
		lbs	*14800*	*16100*	*17100*	*18200*	*19300*	*20400*	*20900*												
VL2	Loader	PR					16			20		24		26				32		36	
RLS	**10**	**kg**					**11500**	**12150**	**12500**	**13200**	**13600**	**14000**	**14500**	**15000**	**15500**	**16000**	**16500**	**17000**		**18600**	
DL	5	*lbs*					*25400*	*26800*	*27600*	*29100*	*30000*	*30900*	*32000*	*33100*	*34200*	*35300*	*36480*	*37500*		*41000*	
STMS																					
VL2	E/M	PR				22			28												**29.5-25**
	50	**kg**	**8000**	**8750**	**9250**	**10000**	**10600**	**10900**	**11500**												
	30	*lbs*	*17600*	*19300*	*20400*	*22000*	*23400*	*24000*	*25400*												
VL2	Loader	PR							22				28								
RLS	**10**	**kg**			**12150**	**12850**	**13600**	**14500**	**15000**	**16000**	**16500**	**17000**	**17500**								
DL	5	*lbs*			*26800*	*28300*	*30000*	*32000*	*33100*	*35300*	*36480*	*37500*	*38600*								

26"

Pattern	Application			Size
		kPa	**110**	
		psi	16	
AL2	Compactor	PR	8	**23.1-26**
	10	**kg**	**2850**	
	5	*lbs*	*6285*	

29"

Pattern	Application															Size
		kPa	**225**	**250**	**275**	**300**	**325**	**350**	**375**	**400**	**425**	**450**	**475**	**500**	**525**	
		psi	33	36	40	44	47	51	54	58	62	65	69	73	76	
STMS	Loader	PR													34	**29.5-29**
	10	**kg**	**12850**	**14000**	**14500**	**15500**	**16000**	**17000**	**17500**	**18000**	**19000**	**19500**	**20000**	**20600**	**21200**	
	5	*lbs*	*28300*	*30900*	*32000*	*34200*	*35300*	*37500*	*38600*	*39700*	*41900*	*43000*	*44100*	*45400*	*46700*	

33"

Pattern	Application													Size
ELS2	IDU	See characteristics page 77												**18.00-33**
		kPa	**375**	**400**	**425**	**450**	**475**	**500**	**525**	**550**	**575**	**600**	**625**	
		psi	54	58	62	65	69	73	76	80	83	87	91	
DL	Loader	PR											42	**35/65-33**
	10	**kg**	**19500**	**20000**	**21200**	**21800**	**22400**	**23000**	**23600**	**24300**	**25000**	**25750**	**26500**	
	5	*lbs*	*43000*	*44100*	*46700*	*48100*	*49400*	*50700*	*52000*	*53600*	*55100*	*56800*	*58400*	

1) Figures under the star rating denote the maximum load and inflation pressures.
2) For Loader & Dozer Service, Tire Load Limits will depend on a type of the operation. Please refer to page 82.

Tire Size	Pattern	Ply Rating	TRA Code or Application	Spec	TKPH	TMPH	Approximate Inflated Dimensions				OTD	Minimum Dual Spacing	Recommended Rim/Flange Height
							OD	OW	SLR	SLW			
							mm *inch*	**mm** *inch*	**mm** *inch*	**mm** *inch*	**mm**	**mm** *inch*	inch
35"													
21.00-35 Tubeless	RL	40	Industrial Service	IDU	-	-	See characteristics page 78						
	ELS2	40	Industrial Service	IDU	-	-							
37.25-35 Tubeless	RL	36	E3	E1A	**358**	*245*	**2330** *91.7*	**955** *37.6*	**1060** *41.7*	**1000** *39.4*	**51.5**	- -	31.00/4.0
39"													
40/65-39 Tubeless	DL	56	L5	D2V	-	-	**2420** *95.3*	**1020** *40.2*	**1112** *43.8*	**1070** *42.1*	**106.5**	- -	32.00/4.0
45"													
45/65-45 Tubeless	DL	58	L5	D2V	-	-	**2730** *107.5*	**1146** *45.1*	**1261** *49.6*	**1185** *46.6*	**116.0**	- -	36.00/4.5
51"													
50/65-51 Tubeless	DL	62	L5	D2A D2V	-	-	**3070** *120.9*	**1260** *49.6*	**1412** *55.6*	**1300** *51.2*	**127.5**	- -	40.00/4.5
57"													
65/65-57 Tubeless	DL	62	L5	D2V	-	-	**3735** *147.0*	**1640** *64.6*	**1672** *65.8*	**1706** *67.2*	**142.5**	- -	52.00/6.0

For the TKPH(TMPH) Ratings, please refer to page 11.

Pattern	Application Max.Speed **km/h** mph		Tire Load Limits at Various Cold Inflation Pressures																		Size
35"																					
RL ELS2	IDU		See characteristics page 79																		**21.00-35**
		kPa	**175**	**200**	**225**	**250**	**275**	**300**	**325**												**37.25-35**
		psi	25	29	33	36	40	44	47												
RL	E/M	PR	36																		
	50	**kg**	**13600**	**14500**	**15500**	**16500**	**17500**	**18500**	**19500**												
	30	*lbs*	*30000*	*32000*	*34200*	*36400*	*38600*	*40800*	*43000*												
39"																					
		kPa	**275**	**300**	**325**	**350**	**375**	**400**	**425**	**450**	**475**	**500**	**525**	**550**	**575**	**600**	**625**	**650**	**675**	**700**	**40/65-39**
		psi	40	44	47	51	54	58	62	65	69	73	76	80	83	87	91	94	98	102	
DL	Loader	PR	56																		
	10	**kg**	**22400**	**23600**	**25000**	**25750**	**27250**	**28000**	**29000**	**30000**	**30750**	**31500**	**32500**	**34500**	**34500**	**36500**	**37500**	**38750**	**40000**	**41250**	
	5	*lbs*	*49400*	*52000*	*55100*	*56800*	*60000*	*61500*	*64000*	*66000*	*68000*	*69500*	*71500*	*76100*	*76000*	*80500*	*82700*	*85400*	*88200*	*90900*	
45"																					
DL	Loader	PR	58																		**45/65-45**
	10	**kg**	**30000**	**31500**	**32500**	**34500**	**35500**	**37500**	**38750**	**40000**	**41250**	**42500**	**43750**	**45000**	**46250**	**47250**	**48250**	**49250**	**50000**		
	5	*lbs*	*66000*	*69500*	*71500*	*76000*	*78500*	*82500*	*85500*	*88000*	*91000*	*93500*	*96500*	*99000*	*102000*	*104200*	*106400*	*108600*	*110000*		
51"																					
DL	Loader	PR	62																		**50/65-51**
	10	**kg**	**37500**	**40000**	**42500**	**43750**	**46250**	**47500**	**48750**	**51500**	**53000**	**54500**	**56000**	**58000**	**58000**	**60000**	**61500**	**63000**			
	5	*lbs*	*82500*	*88000*	*93500*	*96500*	*102000*	*104500*	*107500*	*113500*	*117000*	*120000*	*123500*	*128000*	*128000*	*132500*	*135500*	*139000*			
57"																					
DL	Loader	PR	62																		**65/65-57**
	10	**kg**	**67000**	**71000**	**73000**	**77500**	**80000**	**82500**	**87500**	**90000**	**92500**	**95000**									
	5	*lbs*	*147500*	*156500*	*161000*	*171000*	*176500*	*182000*	*193000*	*198500*	*204000*	*209500*									

1) Figures under the star rating denote the maximum load and inflation pressures.
2) For Loader & Dozer Service, Tire Load Limits will depend on a type of the operation. Please refer to page 82.

Tire Size	Pattern	Ply Rating	TRA Code or Application	Approximate Inflated Dimensions OD mm / inch	OW mm / inch	SLR mm / inch	SLW mm / inch	OTD mm	Minimum Dual Spacing mm / inch	Recommended Rim/Flange Height inch
Industrial Service										
20"										
12.00-20	RL	20	Industrial Service	**1138** *44.8*	**316** *12.4*	**507** *20.0*	**348** *13.7*	**24.0**	**378** *14.9*	8.50V
24"										
12.00-24	STMS	20	Industrial Service	**1275** *50.2*	**321** *12.6*	**606** *23.9*	**339** *13.3*	**55.0**	**391** *15.4*	8.50V
14.00-24	RL	24 28	Industrial Service	**1366** *53.8*	**387** *15.2*	**627** *24.7*	**400** *15.7*	**28.0**	**450** *17.7*	10.00W
14.00-24 TG Tubeless	RL	24	Industrial Service	**1360** *53.5*	**395** *15.6*	**614** *24.2*	**410** *16.1*	**28.0**	**450** *17.7*	10.00VA
25"										
16.00-25 Tubeless	RL	28 32	Industrial Service	**1495** *58.9*	**445** *17.5*	**671** *26.4*	**459** *18.1*	**33.5**	**513** *20.2*	11.25/2.0
	RLS	28 32	Industrial Service	**1548** *60.9*	**438** *17.2*	**722** *28.4*	**460** *18.1*	**57.0**	**513** *20.2*	
	YS2	32	Industrial Service	**1465** *57.7*	**430** *16.9*	**658** *25.9*	**472** *18.6*	**49.2**	**513** *20.2*	
18.00-25 Tubeless	RL	40	Industrial Service	**1608** *63.3*	**508** *20.0*	**727** *28.6*	**572** *22.5*	**36.0**	**587** *23.1*	13.00/2.5
	ELS2	40	Industrial Service	**1685** *66.3*	**515** *20.3*	**796** *31.3*	**530** *20.9*	**66.5**	**587** *23.1*	
	STMS	40	Industrial Service	**1675** *65.9*	**520** *20.5*	**762** *30.0*	**550** *21.7*	**84.0**	**587** *23.1*	
21.00-25 Tubeless	RL	40	Industrial Service	**1750** *68.9*	**570** *22.4*	**775** *30.5*	**620** *24.4*	**41.0**	**668** *26.3*	15.00/3.0
33"										
18.00-33 Tubeless	ELS2	36	Industrial Service	**1878** *73.9*	**515** *20.3*	**887** *34.9*	**533** *21.0*	**66.5**	**587** *23.1*	13.00/2.5

Pattern	Appli.	Ply Rating		Inflation Pressure						Tire Load Limits at Various Speeds				Size
Industrial Service 20"														
				kPa psi	**km/h** mph	**0** Static	**Creep** Creep	**5** 3	**10** 5	**15** 9	**20** 12	**25** 15	**30** 19	
RL	IDU	20	Load	**1000**	**kg**	**11880**	**10560**	**9570**	**8910**	**8580**	**8380**	**8250**	**8185**	**12.00-20**
			Wheel	145	*lbs*	*26200*	*23290*	*21100*	*19650*	*18920*	*18480*	*18190*	*18050*	
			Steering	**1000**	**kg**	**9505**	**8450**	**7655**	**7130**	**6865**	**6705**	**6600**	**6550**	
			Wheel	145	*lbs*	*20960*	*18630*	*16880*	*15720*	*15135*	*14785*	*14550*	*14440*	
24"														
STMS	IDU	20	Load	**1000**	**kg**	**12420**	**11040**	**10005**	**9315**	**8970**	**8765**	**8625**	**8555**	**12.00-24**
			Wheel	145	*lbs*	*27385*	*24345*	*22060*	*20540*	*19780*	*19320*	*19020*	*18865*	
			Steering	**1000**	**kg**	**9935**	**8830**	**8005**	**7450**	**7175**	**7010**	**6900**	**6845**	
			Wheel	145	*lbs*	*21910*	*19475*	*17650*	*16430*	*15825*	*15455*	*15215*	*15090*	
RL	IDU	24	Load	**1000**	**kg**	**17100**	**15200**	**13775**	**12825**	**12350**	**12065**	**11875**	**11780**	**14.00-24**
			Wheel	145	*lbs*	*37705*	*33515*	*30375*	*28280*	*27230*	*26605*	*26185*	*25975*	
			Steering	**1000**	**kg**	**13680**	**12160**	**11020**	**10260**	**9880**	**9650**	**9500**	**9425**	
			Wheel	145	*lbs*	*30165*	*26810*	*24300*	*22625*	*21785*	*21280*	*20945*	*20780*	
		28	Load	**1000**	**kg**	**18000**	**16000**	**14500**	**13500**	**13000**	**12700**	**12500**	**12400**	
			Wheel	145	*lbs*	*39690*	*35280*	*31970*	*29765*	*28665*	*28005*	*27560*	*27340*	
			Steering	**1000**	**kg**	**14400**	**12800**	**11600**	**10800**	**10400**	**10160**	**10000**	**9920**	
			Wheel	145	*lbs*	*31750*	*28225*	*25580*	*23815*	*22930*	*22400*	*22050*	*21875*	
25"														
RL RLS YS2	IDU	28	Load	**900**	**kg**	**20700**	**18400**	**16675**	**15525**	**14950**	**14605**	**14375**	**14260**	**16.00-25**
			Wheel	131	*lbs*	*45645*	*40570*	*36770*	*34230*	*32965*	*32205*	*31695*	*31445*	
			Steering	**900**	**kg**	**16560**	**14720**	**13340**	**12420**	**11960**	**11685**	**11500**	**11410**	
			Wheel	131	*lbs*	*36515*	*32455*	*29415*	*27385*	*26370*	*25765*	*25355*	*25155*	
		32	Load	**1000**	**kg**	**22500**	**20000**	**18125**	**16875**	**16250**	**15875**	**15625**	**15500**	
			Wheel	145	*lbs*	*49610*	*44100*	*39965*	*37210*	*35830*	*35005*	*34455*	*34175*	
			Steering	**1000**	**kg**	**18000**	**16000**	**14500**	**13500**	**13000**	**12700**	**12500**	**12400**	
			Wheel	145	*lbs*	*39690*	*35280*	*31970*	*29765*	*28665*	*28005*	*27560*	*27340*	
RL ELS2 STMS	IDU	40	Load	**1000**	**kg**	**30600**	**27200**	**24650**	**22950**	**22100**	**21590**	**21250**	**21080**	**18.00-25**
			Wheel	145	*lbs*	*67475*	*59975*	*54355*	*50605*	*48730*	*47605*	*46855*	*46480*	
			Steering	**1000**	**kg**	**24480**	**21760**	**19720**	**18360**	**17680**	**17270**	**17000**	**16865**	
			Wheel	145	*lbs*	*53980*	*47980*	*43480*	*40485*	*38985*	*38085*	*37485*	*37185*	
RL	IDU	40	Load	**1000**	**kg**	**36385**	**32345**	**29310**	**27290**	**26280**	**25670**	**25270**	**25065**	**21.00-25**
			Wheel	145	*lbs*	*80230*	*71320*	*64630*	*60170*	*57950*	*56610*	*55720*	*55270*	
			Steering	**1000**	**kg**	**29110**	**25875**	**23450**	**21830**	**21025**	**20535**	**20215**	**20050**	
			Wheel	145	*lbs*	*64185*	*57055*	*51705*	*48135*	*46360*	*45290*	*44575*	*44215*	
33"														
ELS2	IDU	36	Load	**1000**	**kg**	**33300**	**29600**	**26825**	**24975**	**24050**	**23495**	**23125**	**22940**	**18.00-33**
			Wheel	145	*lbs*	*73425*	*65270*	*59150*	*55070*	*53030*	*51805*	*50990*	*50580*	
			Steering	**1000**	**kg**	**26640**	**23680**	**21460**	**19980**	**19240**	**18795**	**18500**	**18350**	
			Wheel	145	*lbs*	*58740*	*52215*	*47320*	*44055*	*42425*	*41445*	*40790*	*40465*	

Tire Size	Pattern	Ply Rating	TRA Code or Application	Approximate Inflated Dimensions OD mm *inch*	OW mm *inch*	SLR mm *inch*	SLW mm *inch*	OTD mm	Minimum Dual Spacing mm *inch*	Recommended Rim/Flange Height inch
35"										
21.00-35 Tubeless	RL	40	Industrial Service	**2008** *79.1*	**570** *22.4*	**937** *36.9*	**648** *25.5*	**41.0**	**701** *27.6*	15.00/3.0
	ELS2	40	Industrial Service	**2040** *80.3*	**592** *23.3*	**955** *37.6*	**617** *24.3*	**67.0**	**701** *27.6*	

Pattern	Appli.	Ply Rating		Inflation Pressure	Tire Load Limits at Various Speeds									Size
35"														
				kPa psi	**km/h** mph	**0** Static	**Creep** Creep	**5** 3	**10** 5	**15** 9	**20** 12	**25** 15	**30** 19	**21.00-35**
RL ELS2	IDU	40	Load Wheel	**1000** 145	**kg** *lbs*	**43740** *96445*	**38880** *85730*	**35235** *77695*	**32805** *72335*	**31590** *69655*	**30860** *68050*	**30375** *66975*	**30130** *66440*	
			Steering Wheel	**1000** 145	**kg** *lbs*	**34990** *77155*	**31105** *68585*	**28190** *62155*	**26245** *57870*	**25270** *55725*	**24690** *54440*	**24300** *53580*	**24105** *53150*	

Off-the-Road Tires Used for Industrial Vehicle Applications

1) Industrial Vehicles comprise vehicles such as counter-balanced lift trucks, container handlers, straddle carriers, aircraft tow tractors, mobile crushers, log stackers etc., used on hard improved surfaces, smooth floors and runways.
2) Use Specifications of **Industrial Service only.**
3) Consult a Rim Manufacturer when inflation pressure exceeds 800kPa (116psi).
4) For Speeds exceeding 30km/h (18mph), consult a Bridgestone Representative.
5) For tire sizes and star ratings other than listed above, consult a Bridgestone Representative.
6) For RTG (Rubber Tired Gantry Crane) operation, consult a Bridgestone Representative.

REMARKS & SPECIAL OPERATIONS

1. Remarks

Both rules of 1.1 and 1.2 can't be applied at the same time.

1.1 Excess Load

Due to the specialized nature of Off-The-Road vehicle usage, loads in excess of those in the appropriate above-listed load tables are often encountered.
These excess loads result from items such as actual vehicle weight exceeding the design weight, varying density of materials, field modifications to the equipment, load transfer, etc.
Only under these conditions, the actual tire load in service may exceed the above load ratings for the tire(*) by an amount not greater than shown in the following table:

For Radial Tires

	E2, E3, E4*	L**
Maximum Excess Load	7%	7%
Maximum Excess Pressure	14%	14%
Maximum Pressure	**800kPa**	**825kPa**
	116psi	*120psi*

(except for underground vehicles)

When excess loads are encountered, cold inflation pressures must be increased to compensate for higher loads. For each 1% increase in load, the inflation pressure must be increased by 2%.

*except following sizes on the list

11.00R20	335/80R20	405/70R20	12.00R24
12.00R20	365/80R20	12R22.5	

About 63" tires, consult a Bridgestone representative.

**except 55.5/80R57 and 60/80R57

The maximum excess loads will result in reduced tire performance.

For Bias Tires

	E2, E3, E4*	L**	
			L5/L5S***
Maximum Excess Load	15%	15%	0%
Maximum Excess Pressure	30%	30%	+100kPa
Maximum Pressure	**825kPa** *120psi*	**825kPa** *120psi*	

(except for underground vehicles)

When excess loads are encountered, cold inflation pressures must be increased to compensate for higher loads. For each 1% increase in load, the inflation pressure must be increased by 2%.

*except following sizes on the list

9.00-20	10.00-20	11.00-20

**except following sizes on the list

27x8.50-15	10-16.5	15.5/70-18	16.9-24
33x12.5-15	12-16.5	42x17-20	18.4-24
12.5/70-16	15.5/60-18	17.5/65-20	

***For L5/L5S tires following sizes on the list, on front tires for front end loaders, it is permissible to increase inflation pressure up to 100kPa (15psi) above, with no increase in load.
(Maximum inflation pressure should not exceed 825 kPa (120psi).)

17.5-25	26.5-25	35/65-33	50/65-51
20.5-25	29.5-25	40/65-39	65/65-57
23.5-25	29.5-29	45/65-45	

The maximum excess loads will result in reduced tire performance.

1.2 The Variation in Load Carrying Capacity with Operating Speed

For Radial Tires

Maximum Speed (km/h)	G	L*
Static		+60%
Creep		+30%
5		+14%
10		0
15	-	-13%
20		-
25		-20%
30		
35		-26%
40	0	-30%
45	-	
50	-9%	
55	-	
60	-18%	
65	-27%	
70		
75		
80		
80<		

(except for underground vehicles)

Reference speed for calculating load variance

* About the size of 55.5/80R57 and 60/80R57, consult a Bridgestone representative.

This table doesn't secure to prevent the risk derived from heat buildup.

For Bias Tires

Maximum Speed (km/h)	G	L*
Static		+60%
Creep		+30%
5		+14%
10		0
15	-	-13%
20		-
25		-20%
30		
35		-26%
40	0	-30%
45	-	
50	-9%	
55	-	
60	-18%	
65	-27%	
70		
75		
80		
80<		

(except for underground vehicles)

Reference speed for calculating load variance

*except following sizes on the list

27x8.50-15	10-16.5	15.5/70-18	16.9-24
33x12.5-15	12-16.5	42x17-20	18.4-24
12.5/70-16	15.5/60-18	17.5/65-20	

This table doesn't secure to prevent the risk derived from heat buildup.

2. Special Operations

Please check your operation to make sure of the Tire Load Limit.

Type/Service	Type of Operations	Reference No.
Earthmover	Standard	-
	Underground Truck Service	2.1.3
	When the vehicle is driven over the highway for delivery, or moved by an operator to a new job site - Drive-Away	2.2.1
Loader & Dozer	Distance of picking up and relocating material Less than 76m (one way) - Standard	-
	Distance of picking up and relocating material More than 76m (one way) - Load-and-Carry Operations	2.1.1
	Underground Load Haul Dump Service	2.1.2
	Underground Truck Service	2.1.3
	When the vehicle is driven over the highway for delivery, or moved by an operator to a new job site - Drive-Away	2.2.2

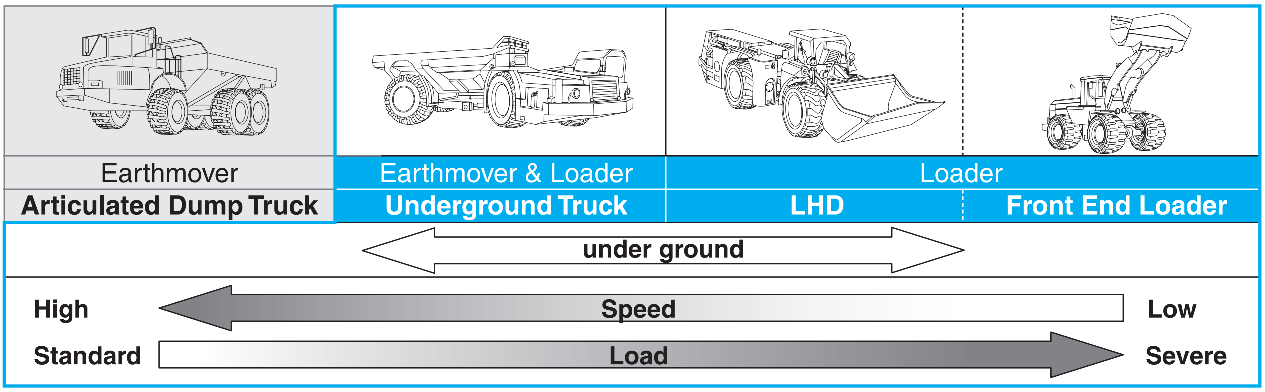
2.1 For Load-and-Carry Operations

Service conditions of a loader is defined as “picking up material and relocating a short distance away, a maximum of 76m (250 feet), one way, with a maximum speed of 10km/h (5 mph)”. However, a loader can pick up a load and transport such load to another location and return unloaded for a longer distance. This type of service is called as **Load-and-Carry** operations. Transportation usually occurs at low speeds, up to 25km/h (15 mph), and distances are limited.

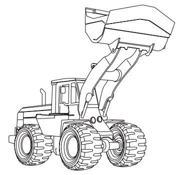
The tires when used in Load-and-Carry operations may encounter heat problems especially on the front axle tires. To avoid such problems, Bridgestone recommends the following operating conditions.

For tires over 33" inch rim diameter tires, careful study is required to maximize tire life while considering Ton-Kilometer-Per-Hour limits. Please consult a Bridgestone representative for more information.

If you need to use the tire beyond this recommendation, please consult a Bridgestone representative.



2.1.1 For Front End Loader Service



For Radial Tires

Tread Class	Inflation Pressure – Rim Diameter – 29" and below – Conventional size (95 series) ★1	29" and below – Conventional size (95 series) ★2	29" and below – Wide base size (80, 65 series) ★1	29" and below – Wide base size (80, 65 series) ★2	33" and above – Wide base size (65 series) ★1	33" and above – Wide base size (65 series) ★2	Load Capacity* 10km/h (5mph)	Maximum Cycle Distance (m)	Allowable Average Work-shift Speed (km/h)
L2, L3	550kpa (80psi)	825kpa (120psi)	500kpa (73psi)	650kpa (94psi)	600kpa (87psi)	750kpa (109psi)	100% of STD. load	1800	16
L4									14
L5								1500 (VSDT)	10
								1200 (VSDL, VSDR)	6
L5S								1200	5

*STD.load: Maximum permissible load at standard inflation pressure for respective tire size and star rating.
Please refer to the load - inflation pressure table for loader and dozer service "10km/h (5mph) service" .

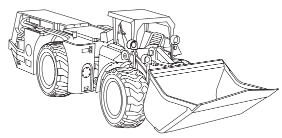
For Bias Tires

Tread Class	Inflation Pressure for Front Tires	Load Capacity* 10km/h (5mph) – Rim Diameter – 29" and below	33" and above	Maximum Cycle Distance (m)	Allowable Average Work-shift Speed (km/h)
L2, L3	Standard inflation pressure + 100kpa (15psi)	90% of STD. load	**	1200	10
L4				500	3
L5			85% of STD. load	300	
L5S					

* STD.load: Maximum permissible load at standard inflation pressure for respective tire size and star rating.
Please refer to the load - inflation pressure table for loader and dozer service "10km/h (5mph) service".
** Not permissible
The inflation pressure should not exceed 825kPa (120psi).

2.1.2 For Load Haul Dump Service

Since a load haul dump (LHD) unit has a similar structure and operational characteristics as load and carry service on a front end loader, the following operating parameters are recommended.



For Radial Tires

Tread Class	Inflation Pressure – Conventional size (95 series) ★2 D2A	Inflation Pressure – Wide base size (80, 65 series) ★2 D2A	Load Capacity* 10km/h (5mph) ★2 D2A	Maximum Cycle Distance (m) ★2 D2A	Allowable Average Work-shift Speed (km/h) ★2 D2A
L2, L3	**				
L4	825kpa (120psi)	650kpa (94psi)	100% of STD. load	1800	14
L5				1500 (VSDT)	10
				1200 (VSDL, VSDR)	6
L5S				1200	5

*See note in Table 2.1.1. **Not permissible

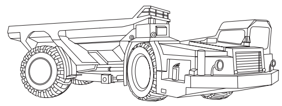
For Bias Tires

Tread Class	Inflation Pressure for Front Tires	Load Capacity* 10km/h (5mph) – Rim Diameter – 29" and below	33" and above	Maximum Cycle Distance (m)	Allowable Average Work-shift Speed (km/h)
L2, L3	**				
L4	Standard inflation pressure + 100kpa (15psi)	90% of STD. load	**	500	3
L5			85% of STD. load	300	
L5S					

*See note in Table 2.1.1. **Not permissible
The inflation pressure must meet 1.1 for maximum excess load.

2.1.3 For Underground Truck Service

Underground truck service is defined as small and low vehicle height dump truck used in underground mines. However, the application is considered to be similar to load and carry operation which has relatively slower speed and shorter distance with more load than normal dump truck use.
Consequently, the severity to the tire is estimated using the load and carry concept.
Bridgestone defines the recommendation in this section.



For Radial Tires

	Tread Class & Pattern			Inflation Pressure	Load Capacity*	Speed	
						Maximum Speed (km/h)	Allowable Average Work-shift Speed (km/h)
35/65R33	L4	VSNT	MT DUH	700 kpa	**	25	10
				800 kpa		40	10
Wide base size (80, 65 series) 15" – 33"	L4	VSNT	★2 D2A	650 kpa	100% of STD. load	25	14
	L5	VSDT					10
		VSDL					6
	L5S	VSMS					5
Conventional size (95 series) 15" – 33"	E4	VELS	★2 E2A	700 kpa	115% of STD. load	30	14
		VMTP					
		VRLS					

*See note in 2.1.1.
**Underground Truck Load and Inflation Table

	kPa						
km/h	500	550	600	650	700	750	800
25	23000	25000	26500	28000	30000		
40	20000	21800	23000	24300	25750	27250	29000

For over Maximum Speed, consult a Bridgestone Representative.

For Bias Tires

Not recommendable.

2.2 Drive-Away Tires on Vehicles

2.2.1 Off-the-Road Tires for Earthmover

(1) Recommendations for Off-the-Road Tires

Because of the special extra-heavy construction of Off-the-Road tires, special precautions must be observed to protect these expensive tires when the vehicle is driven over the highway for delivery, or moved by an operator to a new job site.

If the precautions are not observed, excessive tire heat is built up and the tires most likely will fail prematurely. These precautions are as follows and apply to tires on all vehicles in transit—driven or towed. Consult a Bridgestone Representative for specific information before starting out on a drive-away trip.

(2) Load and Pressure

[1] Vehicles must be empty during transportation.
[2] Inflation pressure is to be checked before starting, each break and adjusted to the pressure recommended for over-the-highway transit by Bridgestone.
[3] Inflation pressures are not to be reduced by “bleeding” tires during transportation.
[4] Periodical inflation pressure checks during transportation (i.e. every 2 hours) is recommended. Although operational pressure build-up in tires is normal during transportation, when it increases 20% or more than the cold pressure reading, it indicates over heating, and the vehicle should be stopped and a Bridgestone Representative should be consulted.

(3)Speed

[1] Regular tread tires (E-3):

(Note: For deep tread tires (E-4), always consult a Bridgestone Representative.)

a. Maximum highway speed:

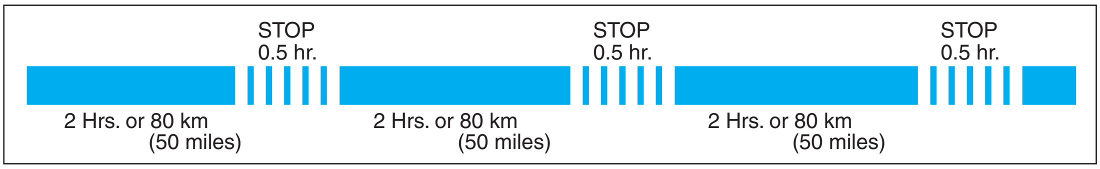
Maximum Speed (Drive-Away)

		Maximum Speed	
Radial / Bias	Regular	50 km/h	30 mph
	Wide Base	32 km/h	20 mph

b. Stop for a 30-minute cooling period after each 80 km (50 miles) of driving or before 2 hours of continual operation, whichever comes first. (shown in the following figure)

c. One-hour minimum midday lunch stop should be observed during full day operations. (shown in the following figure)

Drive-Away



[2] Vehicles in transit should be accompanied by responsible personnel in a pilot car to enforce these precautions and maintain a check on equipment. This is good insurance for a valuable investment.

2.2.2 Off-the-Road Tires for Loader & Dozer

During or after the operation, please wait for the following hours prior to start Drive-Away.

Size & Pattern	Load per tire [ton]		Maximum Travel Distance (One way)				
			5 km or 3.1 Mil	10 km or 6.2 Mil	20 km or 12.4 Mil	50 km or 31 Mil	60 km or 37 Mil
35/65R33 VSDL	16.6	Rest time prior to traveling (Hour)	2	4	5	7	9
		Maximum speed on traveling	10 km/h or 6.2 MPH				
45/65R45 VSDL	30.3	Rest time prior to traveling (Hour)	2	3	5	10	11
		Maximum speed on traveling	10 km/h or 6.2 MPH				
50/65R51 VSDL	40.3	Rest time prior to traveling (Hour)	3	5	9	20	23
		Maximum speed on traveling	20 km/h or 12.4 MPH			10 km/h or 6.2 MPH	
555/80R57 VSDL	64.8	Rest time prior to traveling (Hour)	1.5	3.5	7	10	14
		Maximum speed on traveling	20 km/h or 12.4 MPH			10 km/h or 6.2 MPH	
60/80R57 VSDL	69.5	Rest time prior to traveling (Hour)	1	2	4	9	11
		Maximum speed on traveling	10 km/h or 6.2 MPH				
65/65-57 DL	64.8	Rest time prior to traveling (Hour)	3	6.5	10	*	
		Maximum speed on traveling	20 km/h or 12.4 MPH		10 km/h or 6.2 MPH		

*Please consult a Bridgestone representative.

Remarks;
1. Time for cooling temperature of the tire (Parked up the loader) should be applied prior to start to travel on the road.
2. Ambient temperature of 38˚C or 100˚F is assumed.
3. Maximum load on tire should be less than the Load per tire in the above table.
4. Air pressure for "Drive-Away" should be the same as our recommended figures, and need to confirm whether it would not be higher figures that we experienced prior to travel.
5. We recommend that it would be best way for Giant loaders to use tow hauler for long way traveling. The drive away distance should be shorter than 60km (37 miles) within 20 km/h as the maximum speed to minimize the risk of tire heat damage.
6. If you have a plan of Drive-Away, please consult a Bridgestone representative.

OTHER SPECIFICATION

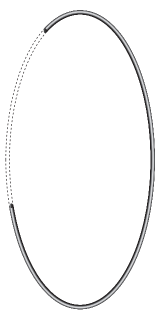
1. O-Ring Specifications

Code No.	Applicable Size		Diameter		Inner Circumference	
	Radial	Bias	mm	inch	mm	inch
P-24A	13.00R24 TG 14.00R24 TG 16.00R24 TG	13.00-24 TG 14.00-24 TG -	6.6	0.26	1768	69.61
P-25AX	14.00R25* 15.5R25 17.5R25 20.5R25 29.5R25 385/95R25 445/80R25 445/95R25	- 15.5-25 17.5-25 20.5-25 - - - -	6.8	0.27	1779	70.04
P-25B	14.00R25** 16.00R25 17.5R25 18.00R25 20.5R25 21.00R25 23.5R25 26.5R25 29.5R25 30/65R25(750/65R25) 385/95R25 445/80R25 445/95R25 505/95R25 525/80R25 550/65R25 600/65R25 650/65R25 750/65R25	- 16.00-25 17.5-25 18.00-25 20.5-25 21.00-25 23.5-25 26.5-25 29.5-25 - - - - - - - - - -	9.8	0.39	1779	70.04
P-29B	29.5R29 33.25R29 775/65R29 875/65R29	29.5-29 - - -	9.8	0.39	2127	83.74
P-33B	18.00R33 21.00R33 35/65R33	18.00-33 - 35/65-33	9.8	0.39	2382	93.78
P-35B	21.00R35 24.00R35 29.5R35 33.25R35 37.25R35	21.00-35 - - - 37.25-35	9.8	0.39	2572	101.26
P-39B	37.5R39 - 40.5/75R39 45/65R39	- 40/65-39 - -	9.8	0.39	2900	114.17
P-45B	45/65R45	45/65-45	9.8	0.39	3326	130.94
P-49B	27.00R49	-	9.8	0.39	3611	142.17
P-51C	30.00R51 33.00R51 36.00R51 50/65R51	- - - 50/65-51	12.7	0.5	3694	145.43
P-57C	37.00R57 40.00R57 42/90R57 46/90R57 50/90R57 55.5/80R57 60/80R57 -	- - - - - - - 65/65-57	12.7	0.5	4129	162.56
P-63C	53/80R63 59/80R63	- -	12.7	0.5	4580	180.31

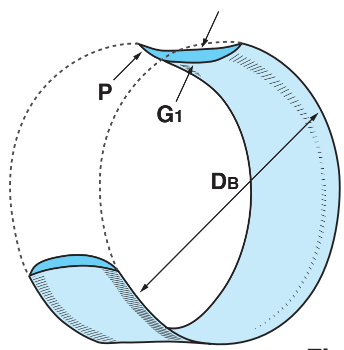
* For Rim Size 10.00-25
** For Rim Size 11.25-25

2. Flap Specifications

Flap	πD_B		G_1		P	
	mm	inch	mm	inch	mm	inch
550/600-15	1175	46.3	4.0	0.16	129	5.1
650/700/750-15	1177	46.3	4.5	0.18	169	6.7
12/65B-15	1196	47.1	7.0	0.28	270	10.6
750/825AR15	1201	47.3	6.0	0.24	184	7.2
750/825-R16	1255	49.4	5.0	0.20	174	6.9
200D1000-R15	1201	47.3	6.5	0.26	205	8.1
700A825-R20	1255	49.4	5.0	0.20	180	7.1
900A111-R20	1201	47.3	6.0	0.24	205	8.1
1100B13/80-R20	1594	62.8	6.5	0.26	218	8.6
1400/14/80R20	1594	62.8	8.5	0.33	240	9.4
1300A1600-20	1618	63.7	8.0	0.31	246	9.7
42x17-20	1576	62.1	9.0	0.35	390	15.4
14/70-20	1587	62.5	9.0	0.35	331	13.0
1300-24	1916	75.4	9.0	0.35	229	9.0
1200A1400-24,25	1942	76.5	9.0	0.35	232	9.1
1100B1300-R24	1922	75.7	7.5	0.30	220	8.7
1300/1400-24,25	1942	76.5	9.0	0.35	232	9.1
1400/1600R24,25	1942	76.5	9.0	0.35	260	10.2
1600-24,25	1916	75.4	9.0	0.35	293	11.5
155A1800-24,25	1926	75.8	6.0	0.24	340	13.4
235-25	1934	76.1	9.0	0.35	560	22.1
265-25	2010	79.1	12.0	0.47	570	22.4
2100R33	2553	100.5	9.0	0.35	413	16.3

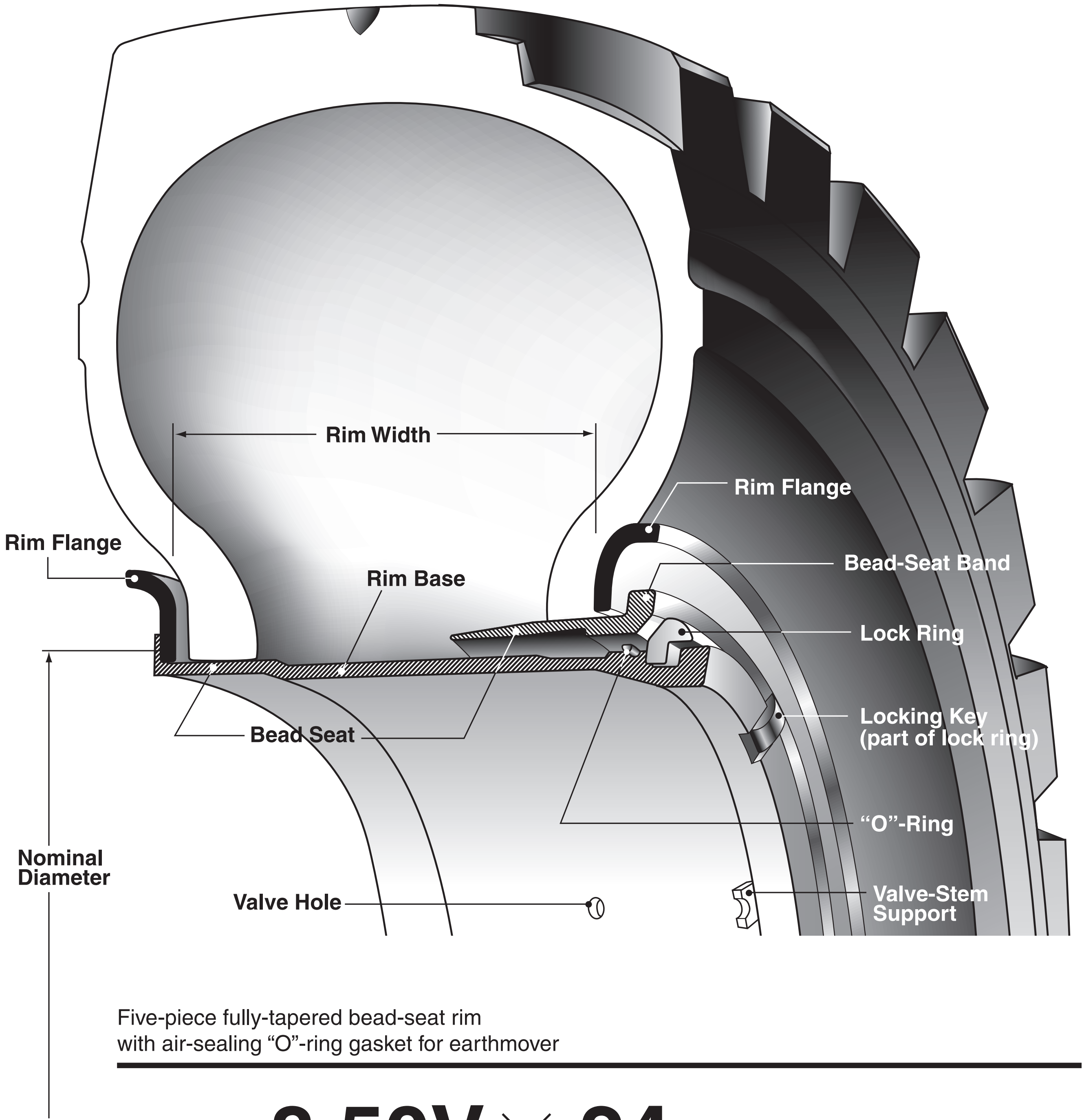


O-Ring



Flap

3. Rim and Valve



Five-piece fully-tapered bead-seat rim
with air-sealing "O"-ring gasket for earthmover

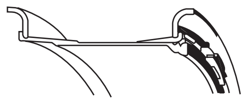
8.50V × 24

- 24 — Nominal Diameter of Rim (inches)
- V — Flange Type
- 8.50 — Rim Width (inches)

3.1 Rim Designation

Full Tapered Bead Seat Rims (5 pieces)

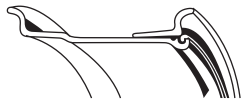
Ⓐ



Recommended Rim/ Flange Height	Tire Size	
	Radial	Bias
11.00/1.5	14.5R15	-
11.25/2.0	16.00R25	16.00-25
	445/95R25	-
13.00/2.5	18.00R25	18.00-25
	505/95R25	-
	18.00R33	18.00-33
15.00/3.0	21.00R25	21.00-25
	21.00R33	-
	21.00R35	21.00-35
17.00/2.0	550/65R25	-
	600/65R25	-
17.00/3.5	24.00R35	24.00-35
19.50/2.5	23.5R25	23.5-25
	600/65R25	-
	650/65R25	-
19.50/4.0	27.00R49	-
22.00/3.0	750/65R25(30/65R25)	-
	26.5R25	26.5-25
22.00/4.5	30.00R51	-
24.00/3.0	750/65R25(30/65R25)	-
24.00/3.5	775/65R29	-
24.00/5.0	33.00R51	-
25.00/3.5	29.5R25	29.5-25
	775/65R29	-
	29.5R29	29.5-29
	29.5R35	-
26.00/5.0	36.00R51	-
27.00/3.5	875/65R29	-
	33.25R29	-
	33.25R35	-
27.00/6.0	37.00R57	-
	42/90R57	-
28.00/3.5	875/65R29	-
	35/65R33	35/65-33
29.00/6.0	40.00R57	-
	42/90R57	-
	46/90R57	-
31.00/4.0	37.25R35	37.25-35
32.00/4.0	-	40/65-39
32.00/4.5	37.5R39	-
	40.5/75R39	-
	45/65R39	-
32.00/6.0	46/90R57	-
	50/90R57	-
32.00/6.5	50/90R57	-
34.00/6.0	50/90R57	-
34.00/6.5	50/90R57	-
36.00/4.5	45/65R39	-
	45/65R45	45/65-45
36.00/5.0	53/80R63	-
38.00/5.0	53/80R63	-
40.00/4.5	50/65R51	50/65-51
41.00/5.0	59/80R63	-
44.00/5.0	59/80R63	-
44.00/6.0	55.5/80R57	-
47.00/6.0	60/80R57	-
52.00/6.0	-	65/65-57

Full Tapered Bead Seat Rims (3 pieces)

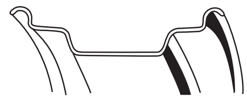
Ⓑ



Recommended Rim/ Flange Height	Tire Size	
	Radial	Bias
10.00/1.5	14.00R25	14.00-25
	385/95R25	-
12.00/1.3	15.5R25	15.5-25
14.00/1.5	17.5R25	17.5-25
	445/80R25	-
	550/65R25	-
17.00AL/1.7(★1only)	20.5R25	-
17.00/1.7	-	20.5-25
	600/65R25	-
17.00/2.0	20.5R25	20.5-25
	525/80R25	-
	550/65R25	-

Drop Center Rims (DC, W, DW)

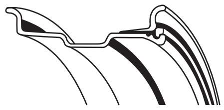
Ⓒ



Recommended Rim/ Flange Height	Tire Size	
	Radial	Bias
7JA	-	27x8.50-15
	-	9.5/65-15
11LB	-	14.0/65-15
6LB	-	7.50-16
8LB	-	10.5/80-16
10LB	-	12.5/70-16
8.25	-	10-16.5
	11R22.5	-
9.75	-	12-16.5
W10	-	15.5/60-18
W13	-	15.5/70-18
W14L	-	17.5/65-20
W15L	-	16.9-24
W16L	-	18.4-24
DW20A	-	23.1-26
DW20B	-	23.1-26

Semi Drop Center Rims (SDC)

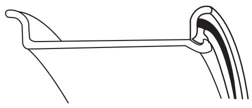
D



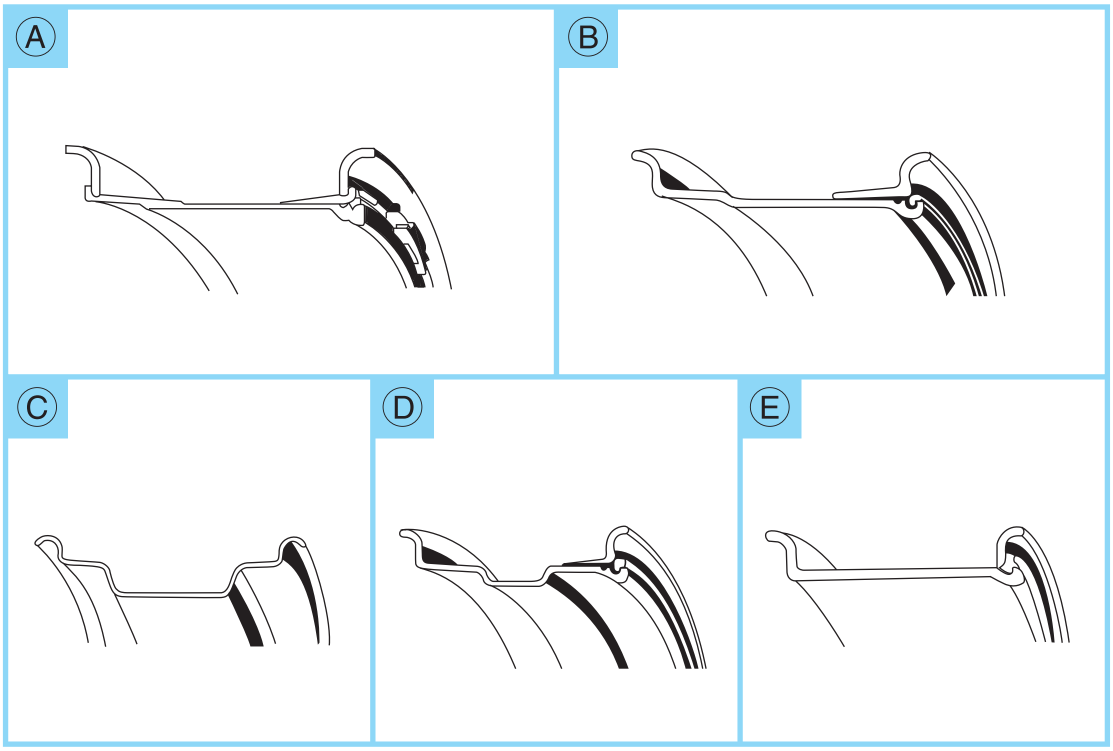
Recommended Rim/ Flange Height	Tire Size	
	Radial	Bias
6.00GS	-	7.50-15
	-	7.50-16
8.00TG	13.00R24 TG	13.00-24 TG
	14.00R24 TG	14.00-24 TG
10.00F	-	33x12.5-15
10.00VA	-	13.00-24 TG
	14.00R24 TG	14.00-24 TG
	16.00R24 TG	16.00-24 TG
11x20	335/80R20	-
	365/80R20	-
11.00TG	-	14/70-20
13x20	405/70R20	-
14.00TG	-	42x17-20

Flat Base Rims

E

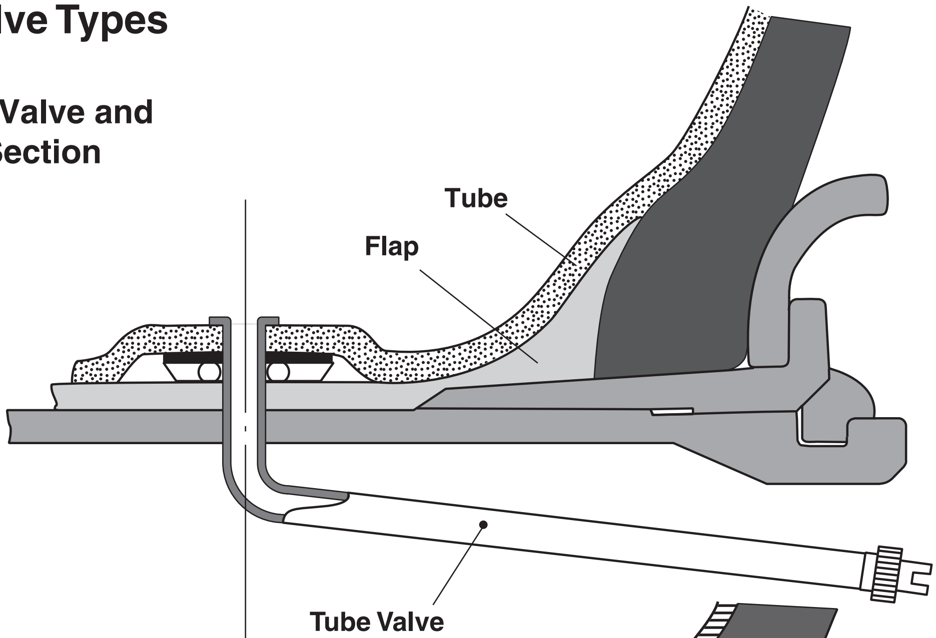


Recommended Rim/ Flange Height	Tire Size	
	Radial	Bias
6.50T	8.25R15	-
7.00T	9.00R20	9.00-20
7.50V	10.00R15	-
	-	10.00-20
8.00V	11.00R20	11.00-20
8.5	-	12.00-24
8.50V	12.00R20	12.00-20
	12.00R24	12.00-24
9.00	12R22.5	-
10.00V	16.00R20	-
10.00WI	14.00R20	-
10.00W	16.00R20	-
	14.00R24	14.00-24

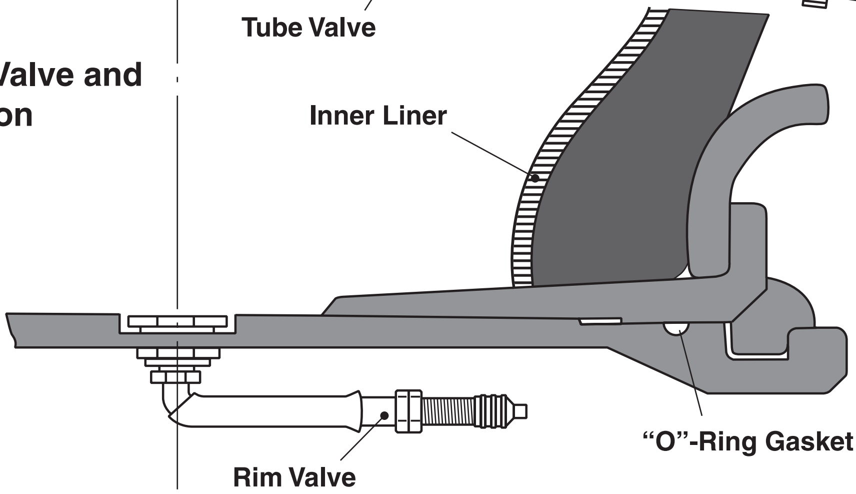


3.2 Valve Types

Tube Valve and Rim Section

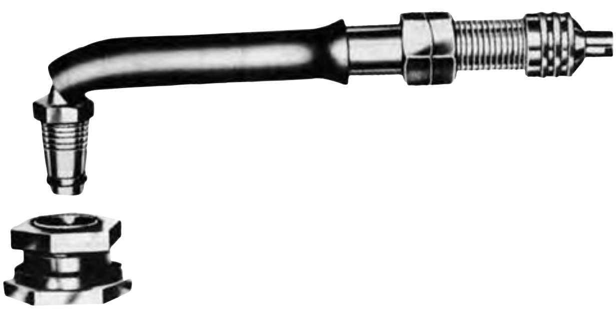


Tubeless Valve and Rim Section



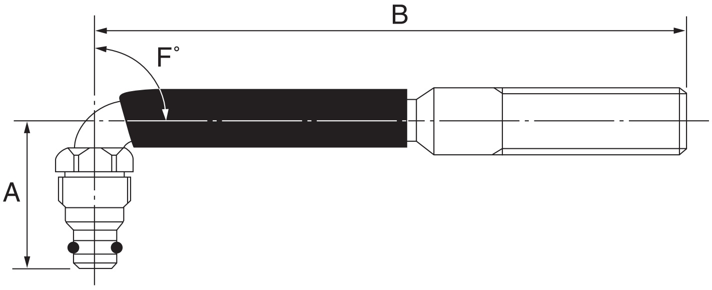
Tube Valve

Tubeless Valve



Interchangeable Swivel Valves For Tubeless Or Tube Type Tires

TRJ4000-4 1/2



Large Bore Valves

Valve No.	Dimensions (mm)		
	A	B	F°
TRJ650	27.5	79.5	80°
TRJ4000-4 1/2	31	114.0	90°
TRJ4000-8	31	203.0	90°
TRJ4000-7 1/2	31	190.5	90°

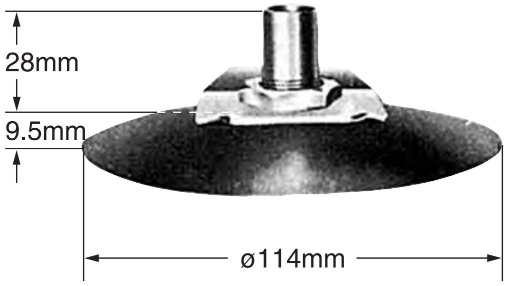
This type of VALVE consists of a combination of the rubber base SP-4000 or SP-2.

Tubeless Type Spud

SP2

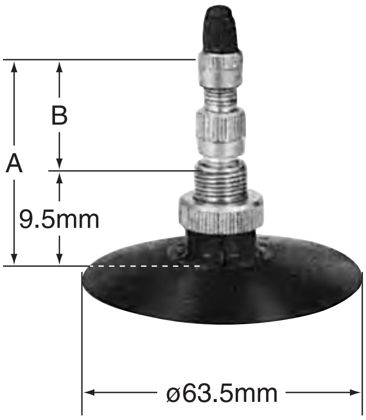
Tube Type Spud

SP4000



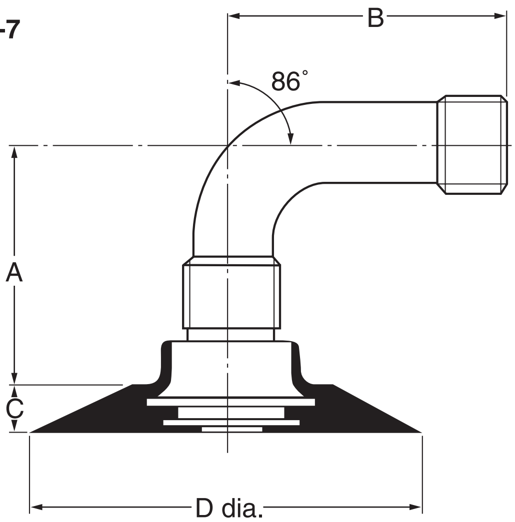
Tube Type Rubber Base Valves

TR218



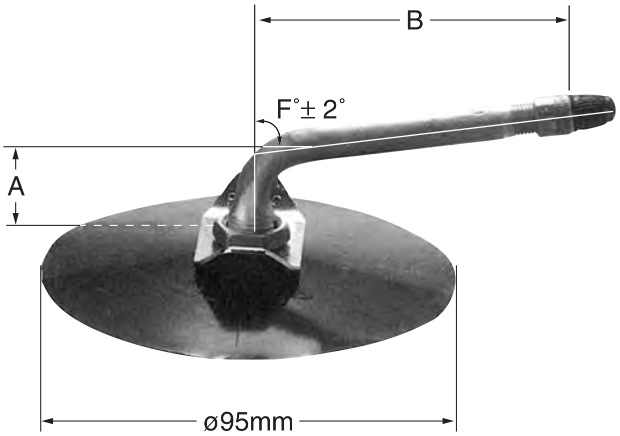
Valve No.	Dimensions (mm)	
	A	B
TR218A	20.6	11.1
TR220A	30.2	20.7

PV-7



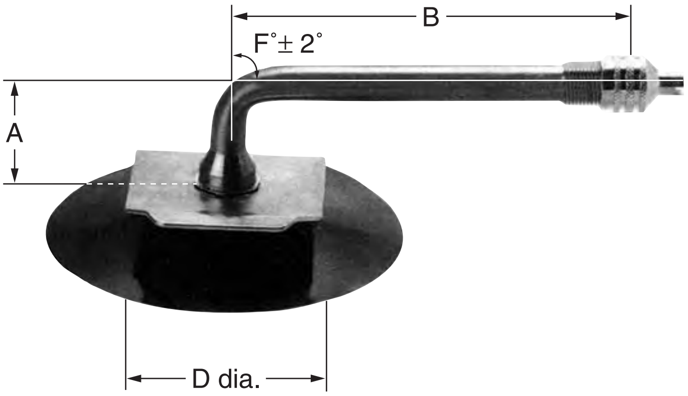
Valve No.	Dimensions (mm)			
	A	B	C	D dia.
PV-7	73	100	7	90

JS75



Valve No.	Dimensions (mm)		
	A	B	F°
JS75	24	70	82°
TR76A	24	86	86°
TR77A	24	105	86°
TR77E	35	94	86°
TR78A	24	127	86°
TR175A	24	115	86°
TR177A	24	95	86°
JS177B	28	91	86°
JS179	36	133	86°
JS179A	29	137	86°
TR179A	24	141	86°
PV38	24	136	80°
PV89	42.8	123	86°
V3-02-3	35.8	44.5	85°
V3-02-15	23.3	145.5	86°

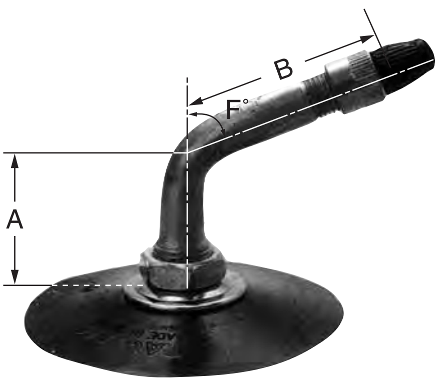
JSJ1175



Large Bore Valves

Valve No.	Dimensions (mm)			
	A	B	D dia.	F°
JSJ1078S	30	121	32	84°
JSJ1175	35	105	32	88°
JSJ1175B	35	105	32	80°
JSJ1175C	35	102	32	60°

JS2



Valve No.	Dimensions (mm)		
	A	B	F°
JS2	26	33	70°

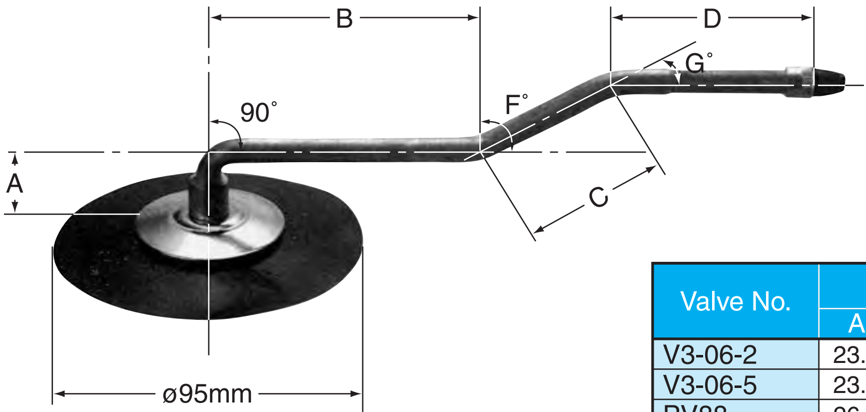
Tube Type Rubber Covered Valves

TR13

Valve No.	Dimensions (mm)
	E
TR13	11.5
TR15	16.5

Tube Type Screw-on Valves

PV88



Valve No.	Dimensions (mm)					
	A	B	C	D	F°	G°
V3-06-2	23.3	44.5	20.8	37.5	55°	55°
V3-06-5	23.3	62.5	25.9	49.0	41°	41°
PV88	26.3	80.5	47.0	54.5	30°	30°
PV118	35.4	130.0	84.0	–	10°	–

TR150CW

Valves, TR150 and TR150CW, are also called Hand Bendable Valves, that is, their stems are made of very flexible material permitting manual bending in all directions and to any angle.

OTHER INFORMATION

1. Unit Conversion Tables

INFLATION PRESSURE

kg/cm²	psi	kPa	bar
0.1	1	10	0.1
0.2	3	20	0.2
0.3	4	30	0.3
0.4	6	40	0.4
0.5	7	50	0.5
0.6	9	60	0.6
0.7	10	70	0.7
0.8	11	80	0.8
0.9	13	90	0.9
1.0	14	100	1.0
1.1	16	110	1.1
1.2	17	120	1.2
1.3	18	130	1.3
1.4	20	140	1.4
1.5	21	150	1.5
1.6	23	160	1.6
1.7	24	170	1.7
1.8	26	180	1.8
1.9	27	190	1.9
2.0	28	200	2.0
2.1	30	210	2.1
2.2	31	220	2.2
2.3	33	230	2.3
2.4	34	240	2.4
2.5	36	250	2.5

kg/cm²	psi	kPa	bar
2.6	37	250	2.5
2.7	38	260	2.6
2.8	40	270	2.7
2.9	41	280	2.8
3.0	43	290	2.9
3.1	44	300	3.0
3.2	45	310	3.1
3.3	47	320	3.2
3.4	48	330	3.3
3.5	50	340	3.4
3.6	51	350	3.5
3.7	53	360	3.6
3.8	54	370	3.7
3.9	55	380	3.8
4.0	57	390	3.9
4.1	58	400	4.0
4.2	60	410	4.1
4.3	61	420	4.2
4.4	62	430	4.3
4.5	64	440	4.4
4.6	65	450	4.5
4.7	67	460	4.6
4.8	68	470	4.7
4.9	70	480	4.8
5.0	71	490	4.9

kg/cm²	psi	kPa	bar
5.1	72	490	4.9
5.2	74	500	5.0
5.3	75	510	5.1
5.4	77	520	5.2
5.5	78	530	5.3
5.6	80	540	5.4
5.7	81	550	5.5
5.8	82	560	5.6
5.9	84	570	5.7
6.0	85	580	5.8
6.1	87	590	5.9
6.2	88	600	6.0
6.3	89	610	6.1
6.4	91	620	6.2
6.5	92	630	6.3
6.6	94	640	6.4
6.7	95	650	6.5
6.8	97	660	6.6
6.9	98	670	6.7
7.0	99	680	6.8
7.1	101	690	6.9
7.2	102	700	7.0
7.3	104	710	7.1
7.4	105	720	7.2
7.5	107	730	7.3

kg/cm²	psi	kPa	bar
7.6	108	740	7.4
7.7	109	750	7.5
7.8	111	760	7.6
7.9	112	770	7.7
8.0	114	780	7.8
8.1	115	790	7.9
8.2	116	800	8.0
8.3	118	810	8.1
8.4	119	820	8.2
8.5	121	830	8.3
8.6	122	840	8.4
8.7	124	850	8.5
8.8	125	860	8.6
8.9	126	870	8.7
9.0	128	880	8.8
9.1	129	890	8.9
9.2	131	900	9.0
9.3	132	910	9.1
9.4	133	920	9.2
9.5	135	930	9.3
9.6	136	940	9.4
9.7	138	950	9.5
9.8	139	960	9.6
9.9	141	970	9.7
10.0	142	980	9.8

WEIGHT

FROM POUND TO KILOGRAM

lb	kg	lb	kg	lb	kg	lb	kg
1	0.5	260	117.9	1200	544.3	5000	2268.0
10	4.5	280	120.0	1300	589.7	5200	2358.7
20	9.1	300	136.1	1400	635.0	5400	2449.4
30	13.6	320	145.2	1500	680.4	5600	2540.2
40	18.1	340	154.2	1600	725.8	5800	2630.9
50	22.7	360	163.3	1700	771.1	6000	2721.6
60	27.2	380	172.4	1800	816.5	7000	3175.2
70	31.8	400	181.4	1900	861.8	8000	3628.8
80	36.3	420	190.5	2000	907.2	9000	4082.4
90	40.8	440	199.6	2200	997.9	10000	4536.0
100	45.4	460	208.7	2400	1088.6	11000	4989.6
110	49.9	480	217.7	2600	1179.4	12000	5443.2
120	54.4	500	226.8	2800	1270.1	13000	5896.8
130	59.0	520	235.9	3000	1360.8	14000	6350.4
140	63.5	540	244.9	3200	1451.5	15000	6804.0
150	68.0	560	254.0	3400	1542.2	16000	7257.6
160	72.6	580	263.1	3600	1633.0	17000	7711.2
170	77.1	600	272.2	3800	1723.7	18000	8164.8
180	81.6	700	317.5	4000	1814.4	19000	8618.4
190	86.2	800	362.9	4200	1905.1	20000	9072.0
200	90.7	900	408.2	4400	1995.8		
220	99.8	1000	453.6	4600	2086.6		
240	108.9	1100	499.0	4800	2177.3		

FROM KILOGRAM TO POUND

kg	lb	kg	lb	kg	lb	kg	lb
1	2.2	130	286.6	600	1322.8	2500	5511.5
5	11.0	140	308.6	650	1433.0	2600	5732.0
10	22.0	150	330.7	700	1543.2	2700	5952.4
15	33.1	160	352.7	750	1653.5	2800	6173.0
20	44.1	170	374.8	800	1763.7	2900	6393.3
25	55.1	180	396.8	850	1873.9	3000	6613.8
30	66.1	190	418.9	900	1984.1	3500	7716.1
35	77.2	200	440.9	950	2094.4	4000	8818.4
40	88.2	210	463.0	1000	2204.6	4500	9920.7
45	99.2	220	485.0	1100	2425.1	5000	11023.0
50	110.2	230	507.1	1200	2645.5	5500	12125.3
55	121.3	240	529.1	1300	2866.0	6000	13227.6
60	132.3	250	551.2	1400	3086.4	6500	14329.9
65	143.3	260	573.2	1500	3306.9	7000	15432.2
70	154.3	270	595.2	1600	3527.4	7500	16534.5
75	165.3	280	617.3	1700	3747.8	8000	17636.8
80	176.4	290	639.3	1800	3968.3	8500	18739.1
85	187.4	300	661.4	1900	4188.7	9000	19841.4
90	198.4	350	771.6	2000	4409.2	9500	20943.7
95	209.4	400	881.8	2100	4629.7	10000	22046.0
100	220.5	450	992.1	2200	4850.1		
110	242.5	500	1102.3	2300	5070.6		
120	264.6	550	1212.5	2400	5291.0		

TEMPERATURE

°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F
-19	-2.2	11	51.8	41	105.8	71	159.8	101	213.8	131	267.8
-18	-0.4	12	53.6	42	107.6	72	161.6	102	215.6	132	269.6
-17	1.4	13	55.4	43	109.4	73	163.4	103	217.4	133	271.4
-16	3.2	14	57.2	44	111.2	74	165.2	104	219.2	134	273.2
-15	5.0	15	59.0	45	113.0	75	167.0	105	221.0	135	275.0
-14	6.8	16	60.8	46	114.8	76	168.8	106	222.8	136	276.8
-13	8.6	17	62.6	47	116.6	77	170.6	107	224.6	137	278.6
-12	10.4	18	64.4	48	118.4	78	172.4	108	226.4	138	280.4
-11	12.2	19	66.2	49	120.2	79	174.2	109	228.2	139	282.2
-10	14.0	20	68.0	50	122.0	80	176.0	110	230.0	140	284.0
-9	15.8	21	69.8	51	123.8	81	177.8	111	231.8	141	285.8
-8	17.6	22	71.6	52	125.6	82	179.6	112	233.6	142	287.6
-7	19.4	23	73.4	53	127.4	83	181.4	113	235.4	143	289.4
-6	21.2	24	75.2	54	129.2	84	183.2	114	237.2	144	291.2
-5	23.0	25	77.0	55	131.0	85	185.0	115	239.0	145	293.0
-4	24.8	26	78.8	56	132.8	86	186.8	116	240.8	146	294.8
-3	26.6	27	80.6	57	134.6	87	188.6	117	242.6	147	296.6
-2	28.4	28	82.4	58	136.4	88	190.4	118	244.4	148	298.4
-1	30.2	29	84.2	59	138.2	89	192.2	119	246.2	149	300.2
0	32.0	30	86.0	60	140.0	90	194.0	120	248.0	150	302.0
1	33.8	31	87.8	61	141.8	91	195.8	121	249.8	160	320.0
2	35.6	32	89.6	62	143.6	92	197.6	122	251.6	170	338.0
3	37.4	33	91.4	63	145.4	93	199.4	123	253.4	180	356.0
4	39.2	34	93.2	64	147.2	94	201.2	124	255.2	190	374.0
5	41.0	35	95.0	65	149.0	95	203.0	125	257.0	200	392.0
6	42.8	36	96.8	66	150.8	96	204.8	126	258.8		
7	44.6	37	98.6	67	152.6	97	206.6	127	260.6		
8	46.4	38	100.4	68	154.4	98	208.4	128	262.4		
9	48.2	39	102.2	69	156.2	99	210.2	129	264.2		
10	50.0	40	104.0	70	158.0	100	212.0	130	266.0		

TREAD DEPTH CONVERSION TABLE

FROM INCH TO MILIMETER

inch/32	mm	inch/32	mm	inch/32	mm	inch/32	mm
1	0.8	21	16.7	41	32.5	105	83.3
2	1.6	22	17.5	42	33.3	110	87.3
3	2.4	23	18.3	43	34.1	115	91.3
4	3.2	24	19.1	44	34.9	120	95.3
5	4.0	25	19.8	45	35.7	125	99.2
6	4.8	26	20.6	46	36.5	130	103.2
7	5.6	27	21.4	47	37.3	135	107.2
8	6.4	28	22.2	48	38.1	140	111.1
9	7.1	29	23.0	49	38.9	145	115.1
10	8.0	30	23.8	50	39.7	150	119.1
11	8.7	31	24.6	55	43.7	155	123.0
12	9.5	32	25.4	60	47.6	160	127.0
13	10.3	33	26.2	65	51.6	165	131.0
14	11.1	34	27.0	70	55.6	170	134.9
15	11.9	35	27.8	75	59.5	175	138.9
16	12.7	36	28.6	80	63.5	180	142.9
17	13.5	37	29.4	85	67.5	185	146.9
18	14.3	38	30.2	90	71.4	190	150.8
19	15.1	39	31.0	95	75.4	195	154.8
20	15.9	40	31.8	100	79.4	200	158.8

FROM MILIMETER TO INCH

mm	inch/32	mm	inch/32	mm	inch/32	mm	inch/32
1	1.3	19	23.9	37	46.6	75	95.5
2	2.5	20	25.2	38	47.9	80	100.8
3	3.8	21	26.5	39	49.1	85	107.1
4	5.0	22	27.7	40	50.4	90	113.4
5	6.3	23	29.0	41	51.7	95	119.7
6	7.6	24	30.2	42	52.1	100	126.0
7	8.8	25	31.5	43	54.2	105	132.3
8	10.1	26	32.8	44	55.4	110	138.6
9	11.3	27	34.0	45	56.7	115	144.9
10	12.6	28	35.3	46	58.0	120	151.2
11	13.9	29	36.5	47	59.2	125	157.5
12	15.1	30	37.8	48	60.5	130	163.8
13	16.4	31	39.1	49	61.7	135	170.1
14	17.6	32	40.3	50	63.0	140	176.4
15	18.9	33	41.6	55	69.3	145	182.7
16	20.2	34	42.8	60	75.6	150	189.0
17	21.4	35	44.1	65	81.9		
18	22.7	36	45.4	70	88.2		

PRESSURE

	kg/cm²	kPa	bar	psi
kg/cm²	1	98.07	0.9807	14.22
kPa	0.0102	1	0.01	0.1450
bar	1.020	100	1	14.503
psi	0.0703	6.895	0.06895	1

LENGTH

	m.meter	c.meter	meter	k.meter	inch	foot	yard	mile
m.meter	1	0.10000	0.00100	-	0.03937	0.00328	0.00109	-
c.meter	10.0000	1	0.01000	0.00001	0.39371	0.03281	0.01094	-
meter	1000.00	100.00	1	0.00100	39.3707	3.28089	1.09363	0.00062
k.meter	-	100000	1000.00	1	39370.7	3280.89	1093.63	0.62138
inch	25.3995	2.53995	0.02540	0.00003	1	0.08333	0.02778	0.00002
foot	304.794	30.4794	0.30479	0.00030	12.0000	1	0.33333	0.00019
yard	914.383	91.4383	0.91438	0.00091	36.0000	3.00000	1	0.00057
mile	-	160931	1609.31	1.60931	63360.0	5280.00	1760.00	1

AREA

	meter²	are	hectare	k.meter²	foot²	yard²	acre	mile²
meter²	1	0.010000	0.000100	0.000001	10.7639	1.19600	0.000247	0.000000
are	100.000	1	0.010000	0.000100	1076.39	119.600	0.024710	0.000039
hectare	10000.0	100.000	1	0.010000	107639.0	11960.0	2.47105	0.003861
k.meter²	-	10000.0	100.000	1	-	-	247.105	0.386098
foot²	0.092903	0.000929	0.000009	0.000000	1	0.111111	0.000023	0.000000
yard²	0.836130	0.008361	0.000084	0.000000	9.00000	1	0.000207	0.00000
acre	4046.87	40.4687	0.404687	0.004047	43560.2	4840.00	1	0.001562
mile²	-	25900.2	259.002	2.59002	-	-	640.000	1

WEIGHT

	gram	k.gram	ton	s.ton	l.ton	ounce	pound
gram	1	0.00100	-	-	-	0.03527	0.00220
k.gram	1000.00	1	0.00100	0.00110	0.00098	35.2739	2.20462
ton	-	1000.00	1	1.10230	0.98421	35273.9	2204.62
s.ton	907185	907.185	0.90719	1	0.89286	32000.0	2000.00
l.ton	-	1016.04	1.01604	1.12000	1	35840.0	2240.00
ounce	28.3495	0.02835	0.00003	0.00003	0.00003	1	0.06250
pound	453.592	0.45359	0.00045	0.00050	0.00045	16.0000	1

CAPACITY

	cub.meter	liter	cub.inch	cub.foot	cub.yard	U.S.gallon	U.K.gallon
cub.meter	1	1000.00	61027.1	35.3147	1.30802	264.186	220.216
liter	0.00100	1	61.0271	0.03532	0.00131	0.26419	0.22022
cub.inch	0.00002	0.01639	1	0.00058	0.00002	0.00433	0.00361
cub.foot	0.02832	28.3167	1728.00	1	0.03704	7.48051	6.23549
cub.yard	0.76455	764.554	46656.0	27.0000	1	201.974	168.358
U.S.gallon	0.00379	3.78543	231.000	0.13368	0.00495	1	0.83270
U.K.gallon	0.00455	4.54596	277.413	0.16037	0.00594	1.20091	1

FORCE

1 kgf = 9.81 N

POWER (horse power)

1 hp = 550 ft • lbf/s = 745.7 W

1 PS = 75 m • kgf/s = 735.5 W

2. Specific Weight (Approximately)

Material	Pounds/cu.yd	Metric Tons/m³	Material	Pounds/cu.yd	Metric Tons/m³
Anthracite	2000	1.2	Iron ore: Magnetite	4700	2.8
Basalt	3400	2.0	Limestone	2500	1.5
Bauxite	2400	1.4	Pyrites	4400	2.6
Clay: dry	2500	1.5	Over-Burden		
wet	2900	1.7	75%rock-25%earth	3400	2.0
Coal	1200	0.7	50%rock-50%earth	2900	1.7
Copper ore	2700	1.6	25%rock-75%earth	2700	1.6
Crushed gypsum	2700	1.6	Sand: dry	2400	1.4
Earth: dry	2500	1.5	wet	3000	1.8
wet	2700	1.6	Sandstone	2500	1.5
Granite	2900	1.7	Snow: dry	170	0.1
Gravel: dry	2900	1.7	wet	840	0.5
wet	3400	2.0	Uranium	2700	1.6

Note: Weight of materials varies with moisture content, grain size, degree of compaction, etc. Test must be made to know exact weight.

MEMO

DATA BOOK

Printed in Japan with vegetable oil ink on recycled paper
16ORA01E(May'16)

Appendix E.3: Liner Veneer Stability Analysis

Geosyntec consultants

COMPUTATION COVER SHEET

Client: Tolson & Associates **Project:** TRL Vertical Expansion **Project/Proposal #:** ME1606 **Task:** 03

TITLE OF COMPUTATIONS: Veneer Stability Analysis

COMPUTATIONS BY:
Signature
February 7, 2020
DATE
Printed Name and Title: Sean O'Donnell, Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY: (Peer Reviewer)
Signature
February 10, 2020
DATE
Printed Name and Title: Julia Roberts, Professional

COMPUTATIONS CHECKED BY:
Signature
February 10, 2020
DATE
Printed Name and Title: Julia Roberts, Professional

COMPUTATIONS BACKCHECKED BY: (Originator)
Signature
February 20, 2020
DATE
Printed Name and Title: Sean O'Donnell, Engineer

APPROVED BY: (PM or Designate)
Signature
August 3, 2020
DATE
Printed Name and Title: David Espinoza, Senior Principal

APPROVAL NOTES:

REVISIONS: (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

VENEER STABILITY ANALYSIS
VERTICAL EXPANSION TOLSON RUBBLE LANDFILL

PURPOSE

The purpose of this calculation is to determine the Factor of Safety (FS) against interface shear failure for the components of the proposed liner system for the vertical expansion of Tolson Rubble Landfill (TRL). The TRL Expansion will be completed by excavating and regrading the existing site south of Cell A in the current landfill and installing a geosynthetic liner system.

BACKGROUND

The proposed liner system design for the TRL expansion consists of a series of engineered layers over a prepared subgrade composed of the following layers, from top to bottom:

- *Compacted Drainage/Protection layer:* 12-inch thick drainage material layer ($k > 1\times10^{-3}$ cm/s);
- *Drainage layer:* 250-mil Geocomposite drainage layer;
- *Hydraulic barrier layer:* 60-mil HDPE textured geomembrane;
- *Hydraulic barrier layer:* 24-inch thick compacted subbase ($k \leq 1\times10^{-5}$ cm/s); and
- *Compacted subgrade:* Native soil prepared and compacted to specifications

The liner design is shown in Figure 1. A plan view with the proposed base grades for the TRL expansion is shown in Figure 2. The proposed liner contains 7 cells with bottom grades of approximately 2.5 percent. The base is surrounded by side slopes with a maximum vertical height of 68 feet. These slopes have a 2 horizontal to 1 vertical (2H:1V) side slope grade (50 percent slope).

METHOD OF ANALYSIS

Veneer stability analysis of the liner system was evaluated using the sliding wedge failure analysis method outlined in Giroud et al. [1995] for geosynthetic-soil layered systems along critical interfaces of a finite slope length. The minimum interface friction angle (internal frication angle along slip surface) required to achieve a target factor of safety (*FS*) was calculated using the equation laid out therein:

$$FS = \lambda * \frac{\tan\delta}{\tan\beta} + \frac{\gamma_{t,t}(t - t_w{}^*) + \gamma_{b,t}(t_w{}^*)}{\gamma_{t,s}(t - t_w) + \gamma_{sat,s}(t_w)} * \frac{t}{h} * \frac{\sin\Phi}{2\sin\beta\cos\beta\cos(\beta+\Phi)} + \frac{\frac{\alpha}{\sin\beta}}{\gamma_{t,s}(t - t_w) + \gamma_{sat,s}(t_w)} + \frac{\frac{ct}{h}}{\gamma_{t,s}(t - t_w) + \gamma_{sat,s}(t_w)}\frac{\cos\Phi}{\cos\beta\cos(\beta+\Phi)} + \frac{\frac{T}{h}}{\gamma_{t,s}(t - t_w) + \gamma_{sat,s}(t_w)}$$

where:

FS	=	factor of safety;
λ	=	$\frac{\gamma_{t,s}(t-t_w)+\gamma_{b,t}(t_w)}{\gamma_{t,s}(t-t_w)+\gamma_{sat,s}(t_w)}$ for failure surface above the geomembrane;
λ	=	1 for failure surface below the geomembrane;
$\gamma_{t,t}$	=	total unit weight of soil at toe of slope (pounds per cubic food [pcf]);
$\gamma_{b,t}$	=	buoyant unit weight of soil at toe of slope (pcf);
$\gamma_{t,s}$	=	total unit weight of soil on slope (pcf);
$\gamma_{b,t}$	=	buoyant unit weight of soil on slope (pcf);
$\gamma_{sat,s}$	=	saturated unit weight of soil on slope (pcf);
δ	=	interface friction angle along slip surface (degrees);
β	=	slope angle (degrees);
α	=	interface adhesion (pounds per square foot [psf]);
t	=	thickness of soil layer (feet [ft]);
t_w	=	thickness of water flow along slope (ft);
$t_w{}^*$	=	thickness of water flow in toe of slope
h	=	height of slope (ft);
Φ	=	internal friction angle of soil above critical surface (degrees);
c	=	cohesion of soil above critical surface (psf); and
T	=	tension in geosynthetics (pounds per foot [lb/ft]).

In this analysis, the following conservative assumptions are made:

- Tension in the geosynthetic, $T = 0$ psf; and
- Cohesion of the soil above the critical surface, $c = 0$ psf.

STABILITY CRITERION

According to the United States Environmental Protection Agency (U.S. EPA) technical manual *Solid Waste Disposal Facility Criteria* [U.S. EPA, 1993], when there is no imminent danger to human life or threat of major environmental impact, the minimum recommended slope stability factor of safety is 1.25. A veneer stability failure of the liner system is unlikely to pose an imminent threat to human life or the environment and a failure could be repaired relatively easily. Therefore, the stability of the liner systems will be considered acceptable if the factor of safety is greater than or equal to 1.25.

WATER FLOW ALONG SLOPE

The Hydrologic Evaluation of Landfill Performance (HELP) model Version 3.07 [USEPA, 1997] was used to estimate the depth of water above the geomembrane in this calculation. The case analyzed was a 50 percent slope with a drainage distance of 152 feet based on a maximum 68-foot high slope. Because the model assumes an exposed liner slope, the simulation was conducted for a 5-year period rather than for the duration of the life of the facility. A hydraulic conductivity of 7.87 centimeters per second (cm/s) was used for the geocomposite layers, which is consistent with the value used in the calculations of leachate generation, Appendix H.1 of this report. The output of the HELP model is presented in Attachment 1. Based on the output of this model, the peak daily values for hydraulic head above the geomembrane on the slope are summarized below:

Average head along slope (in.)	Maximum head along slope (in.)
0.354	0.194

To produce a conservative factor of safety, the thickness of water flowing along the slope (t_w) was taken to be the smaller of the two outputted values (i.e. the maximum head along the slope) and the thickness of the water at the toe of the slope (t_w^*) was taken to be the larger of the two outputted values (i.e. the average head along the slope).

MATERIAL PROPERTIES

Tables 1 and 2 present typical geotechnical properties of mineral soils and typical interface friction values for geosynthetic liner components. In a veneer slope stability analysis, the unit weight and strength of the material that buttress the veneer at the toe of the slope (i.e. the protective drainage layer) and the strength of the weakest interface are required to calculate the factor of safety. Values used in this veneer slope stability analysis were selected with guidance from typical values presented in Tables 1 and 2 as well as laboratory results for interface shear testing of actual materials installed at landfills in Maryland (Attachment 2). Table 3 presents the estimated soil properties and interface shear strengths representative of the proposed liner system. The critical interfaces are identified as those between the geocomposite and the textured geomembrane and between the textured geomembrane and the hydraulic barrier soil (clay). The interface of the geomembrane and geocomposite has an estimated friction angle of 9° with an adhesion of 237 psf (large displacement), and the interface of the geomembrane and hydraulic barrier soil has an estimated friction angle of 17° with an adhesion of 107 pounds per square foot (psf).

RESULTS

The analysis output is shown in Table 4. The calculation demonstrated that the factor of safety against veneer instability above and below the geomembrane are 4.76 and 2.63, respectively. Both values exceed the U.S. EPA guidelines of a factor of safety of 1.25, indicating that veneer slope stability failure is unlikely to occur.

It is recommended to conduct conformance testing on all interfaces in the proposed liner system prior to construction to confirm the stability of the liner system.

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TABLES

Table 1. Typical Properties of Compacted Soils (after NAVFAC, 1986)

Tolson Rubble Landfill, Crofton, Anne Arundel County, Maryland

Group Symbol	Soil Type	Range of Maximum Dry Unit Weight (pcf)	Range of Optimum Moisture Content (%)	Typical Strength Characteristics			
				Cohesion (as compacted) (psf)	Cohesion (saturated) (psf)	Effective-Stress Envelope, ϕ (deg)	$\tan\phi$
SP	Poorly graded clean sands, sand-gravel mix.	100 - 120	12-21	0	0	37	0.74
SM	Silty sands, poorly graded sand-silt mix.	110 - 125	11-16	1,050	420	34	0.67
SM-SC	Sand-silt clay mix. with slightly plastic fines	110 - 130	11-15	1,050	300	33	0.66
SC	Clayey sands, poorly-graded sand-clay mix.	105 - 125	11-19	1,550	230	31	0.6
ML	Inorganic silts and clayey silts	95 - 120	12-24	1,400	190	32	0.62
CL	Inorganic clays of low to medium plasticity	95 - 120	12-24	1,800	270	28	0.54
CH	Inorganic clays of high plasticity	75 - 105	19-36	2,150	230	19	0.35

Table 2: Summary of Documented Interface Friction Values

Tolson Rubble Landfill, Crofton, Anne Arundel County, Maryland

Geosynthetic / Geosynthetic	**Peak Interface Friction Angle, δ_p (deg)**	**Large Displacement Interface Friction Angle, δ_{ld} (deg)**
Smooth HDPE Geomembrane / Nonwoven Geotextile	7 - 12	6 - 11
Smooth LLDPE Geomembrane / Nonwoven Geotextile	10 - 12	
Textured HDPE Geomembrane / Nonwoven Geotextile	22 - 35	
Smooth HDPE Geomembrane / Geonet	7 - 15	
Textured HDPE Geomembrane / Geonet	7 - 15	
Textured HDPE Geomembrane / Geocomposite	17 - 29	13 - 20
Geonet / Nonwoven Geotextile	13 - 22	
Smooth HDPE Geomembrane / GCL (hydrated)	8 - 12	
Textured HDPE Geomembrane / GCL (hydrated)	18 - 37	6 - 10
Geosynthetic / Soil	**$\tan(\delta_p)$ / $\tan(\phi_p)$**	**$\tan(\delta_{ld})$ / $\tan(\phi_{ld})$**
Smooth HDPE Geomembrane / Clay	0.4 - 0.7	0.3 - 0.7
Textured HDPE Geomembrane / Clay	0.8 - 0.9	0.6 - 0.9
Smooth HDPE Geomembrane / Sand	0.5 - 0.6	
Textured HDPE Geomembrane / Sand	0.7 - 0.8	
Needlepunched Nonwoven Geotextile / Sand	0.8 - 1.0	
Needlepunched Nonwoven Geotextile / Angular Gravel	0.7 - 0.9	
Needlepunched Nonwoven Geotextile / Rounded Gravel	0.6 - 0.8	

Note:

1. Adapted from tests by Martin et al. [1984], Williams and Houlihan [1986, 1987], Koerner et al. [1986], Williams and Luna [1987], Eid and Stark [1997], Sabatini et al. [1998], Stark et al. [1998], manufacturer's literature, and unpublished results from Geosyntec Consultants.

Table 3: Design Properties of Protective Cover Soil and Interfaces of the Liner System

Tolson Rubble Landfill, Crofton, Anne Arundel County, Maryland

Material/Interface	Unit Weight (pcf)	Friction Angle (deg)	Cohesion/Adhesion (psf)
Protective Cover (Sand)	120	33	0
Protective Cover/Geocomposite	N/A	29	0
Geocomposite/Textured Geomembrane	N/A	9	237
Textured Geomembrane/Hydraulic Barrier Layer (Clay)	N/A	17	107

Table 4: Veneer Stability Analysis - Liner System

Tolson Rubble Landfill, Crofton, Anne Arundel County, Maryland

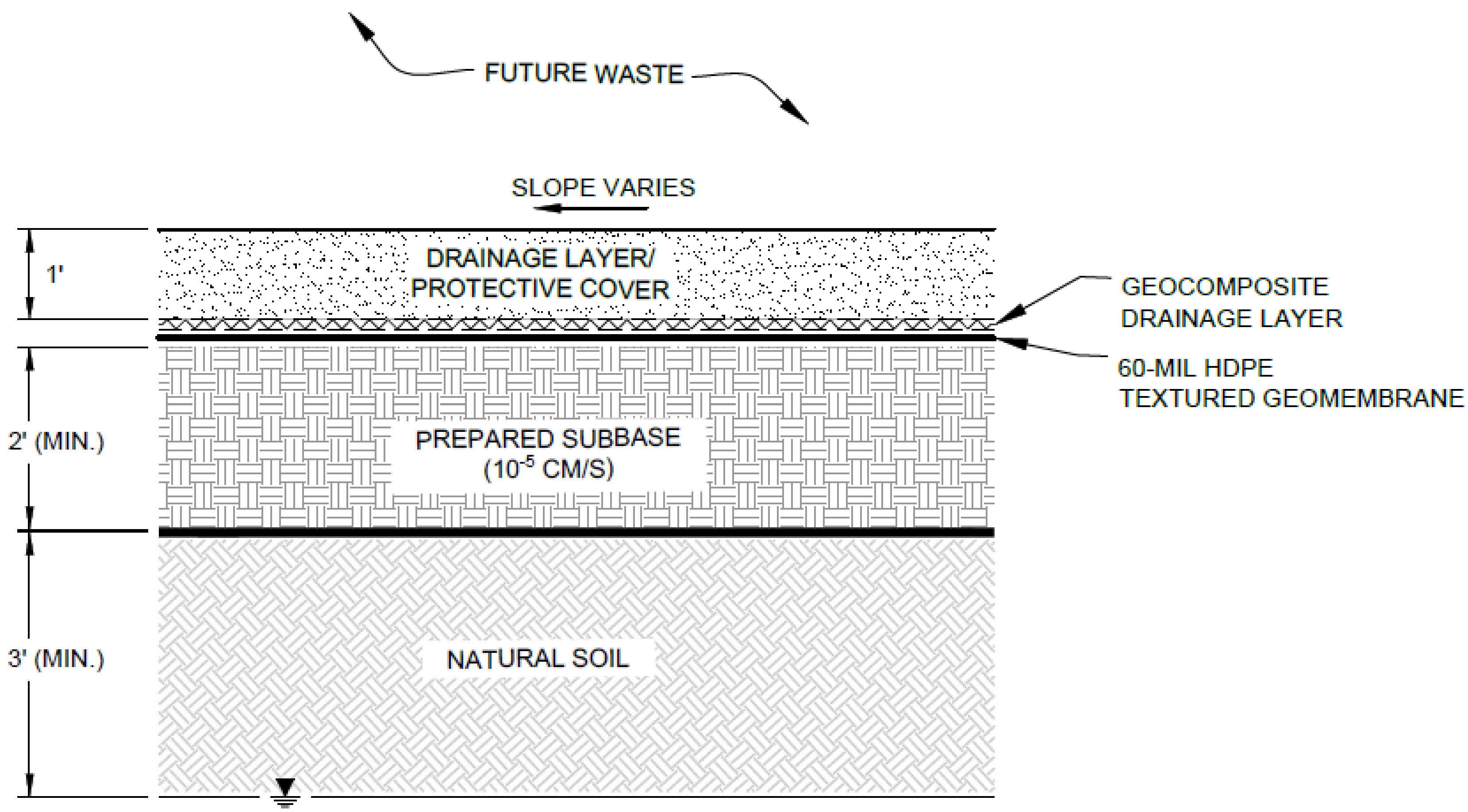
Material Properties (Above Geomembrane)	
Data	**Value**
Total Unit Weight (soil above slope), $\gamma_{t,s}$ (pcf)	120
Saturated Unit Weight (soil above slope), $\gamma_{sat,s}$ (pcf)	130
Buoyant Unit Weight (soil above slope), $\gamma_{b,s}$ (pcf)	67.6
Total Unit Weight (soil at toe of slope), $\gamma_{t,t}$ (pcf)	120
Saturated Unit Weight (soil at toe of slope), $\gamma_{sat,t}$ (pcf)	130
Buoyant Unit Weight (soil at toe of slope), $\gamma_{b,t}$ (pcf)	67.6
Friction Angle (soil at toe of slope), ϕ (deg)	33
Friction Angle (soil at toe of slope), ϕ (rad)	0.576
tan(dp) / tan(fp)	-
Cohesion (soil at toe of slope), c (psf)	0.0
Interface Friction Angle, δ (deg)	9.0
Interface Friction Angle, δ (rad)	0.157
Adhesion, a (psf)	237.0
Tension, T (lb/ft)	0.0
λ (Above Geomembrane)	0.992

Material Properties (Below Geomembrane)	
Data	**Value**
Total Unit Weight (soil above slope), $\gamma_{t,s}$ (pcf)	120
Saturated Unit Weight (soil above slope), $\gamma_{sat,s}$ (pcf)	130
Buoyant Unit Weight (soil above slope), $\gamma_{b,s}$ (pcf)	67.6
Total Unit Weight (soil at toe of slope), $\gamma_{t,t}$ (pcf)	120
Saturated Unit Weight (soil at toe of slope), $\gamma_{sat,t}$ (pcf)	130
Buoyant Unit Weight (soil at toe of slope), $\gamma_{b,t}$ (pcf)	67.6
Friction Angle (soil at toe of slope), ϕ (deg)	33
Friction Angle (soil at toe of slope), ϕ (rad)	0.576
tan(dp) / tan(fp)	0.800
Cohesion (soil at toe of slope), c (psf)	0.0
Interface Friction Angle, δ (deg)	17.10
Interface Friction Angle, δ (rad)	0.298
Adhesion, a (psf)	107.0
Tension, T (lb/ft)	0.0
λ (Below Geomembrane)	1.0

Slope Geometry	
Data	**Value**
Protective Soil Thickness, t (ft)	1.0
Water Depth along Slope, t_w (ft)	0.016
Water Depth at Toe, t_w* (ft)	0.030
Slope (X:1)	2.000
Slope Angle, β (deg)	26.6
Slope Angle, β (rad)	0.464
Slope Height, h (ft)	68

Factor of Safety	
Data	**Value**
Factor of Safety Above Geomembrane	4.74
Factor of Safety Below Geomembrane	2.63

FIGURES



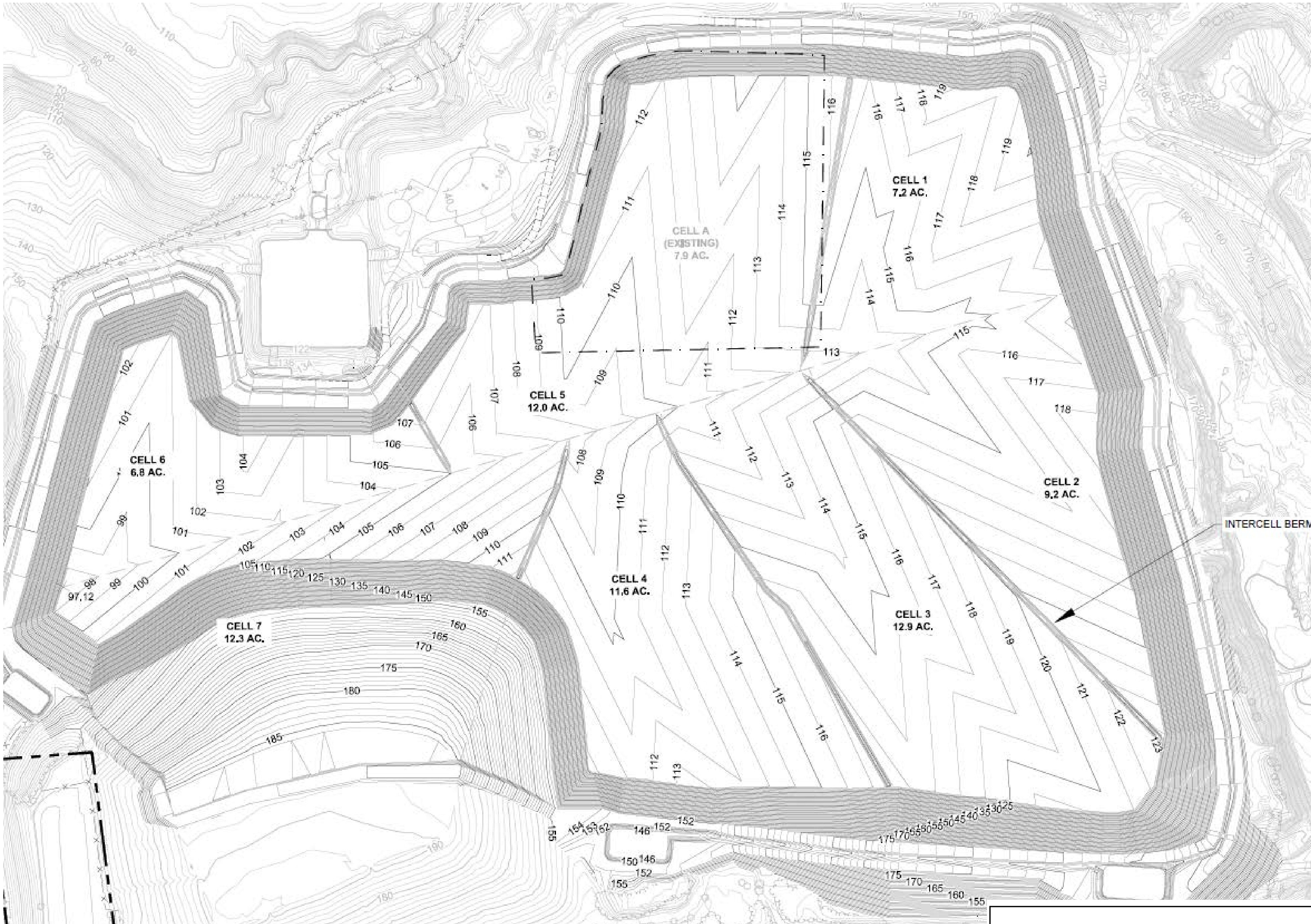
LINER DETAIL
Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Geosyntec consultants

Figure

E-2.1

Columbia, Maryland | July 2020



PROPOSED BASE GRADES
Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Geosyntec consultants

Figure

E-2.2

Columbia, Maryland | July 2020

ATTACHMENT 1

HELP Analysis Output

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    C:\HELP3\TLSN_P.D4
TEMPERATURE DATA FILE:      C:\HELP3\TLSN_T.D7
SOLAR RADIATION DATA FILE:  C:\HELP3\TLSN_SR.D13
EVAPOTRANSPIRATION DATA:    C:\HELP3\TLSN_ET.D11
SOIL AND DESIGN DATA FILE:  C:\HELP3\TLSN_VS.D10
OUTPUT DATA FILE:           C:\HELP3\TLSN_VS.OUT


TIME:  16:53     DATE:   2/11/2020


******************************************************************************

     TITLE:  Tolson Expansion Veneer Stability

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
```

```
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =     12.00   INCHES
POROSITY                     =      0.4530 VOL/VOL
FIELD CAPACITY               =      0.1900 VOL/VOL
WILTING POINT                =      0.0850 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.1999 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC


                        LAYER  2
                        --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =      0.25   INCHES
POROSITY                     =      0.8500 VOL/VOL
FIELD CAPACITY               =      0.0100 VOL/VOL
WILTING POINT                =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.1199 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =   7.87400007000     CM/SEC
SLOPE                        =     50.00   PERCENT
DRAINAGE LENGTH              =    152.0    FEET


                        LAYER  3
                        --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                    =      0.06   INCHES
POROSITY                     =      0.0000 VOL/VOL
FIELD CAPACITY               =      0.0000 VOL/VOL
WILTING POINT                =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY          =      2.00   HOLES/ACRE
FML INSTALLATION DEFECTS     =      2.00   HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD


                        LAYER  4
                        --------
```

```
            TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER   0
   THICKNESS                   =     24.00   INCHES
   POROSITY                    =      0.4270 VOL/VOL
   FIELD CAPACITY              =      0.4180 VOL/VOL
   WILTING POINT               =      0.3670 VOL/VOL
   INITIAL SOIL WATER CONTENT  =      0.4178 VOL/VOL
   EFFECTIVE SAT. HYD. COND.   =  0.999999997000E-06 CM/SEC
```

```
          GENERAL DESIGN AND EVAPORATIVE ZONE DATA
          ----------------------------------------

 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
          SOIL DATA BASE USING SOIL TEXTURE # 6 WITH BARE
          GROUND CONDITIONS, A SURFACE SLOPE OF 50.% AND
          A SLOPE LENGTH OF  152. FEET.

 SCS RUNOFF CURVE NUMBER             =     87.30
 FRACTION OF AREA ALLOWING RUNOFF    =     50.0    PERCENT
 AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
 EVAPORATIVE ZONE DEPTH              =     12.2    INCHES
 INITIAL WATER IN EVAPORATIVE ZONE   =      2.428  INCHES
 UPPER LIMIT OF EVAPORATIVE STORAGE  =      5.606  INCHES
 LOWER LIMIT OF EVAPORATIVE STORAGE  =      1.021  INCHES
 INITIAL SNOW WATER                  =      0.000  INCHES
 INITIAL WATER IN LAYER MATERIALS    =     12.457  INCHES
 TOTAL INITIAL WATER                 =     12.457  INCHES
 TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR
```

```
            EVAPOTRANSPIRATION AND WEATHER DATA
            -----------------------------------

 NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
          BALTIMORE             MARYLAND

      STATION LATITUDE                          =  39.18 DEGREES
      MAXIMUM LEAF AREA INDEX                   =   0.00
      START OF GROWING SEASON (JULIAN DATE)     =    102
      END OF GROWING SEASON (JULIAN DATE)       =    300
      EVAPORATIVE ZONE DEPTH                    =  12.2  INCHES
```

AVERAGE ANNUAL WIND SPEED = 9.30 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY = 62.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY = 65.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 71.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 68.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BALTIMORE MARYLAND

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.00	2.98	3.72	3.35	3.44	3.76
3.89	4.62	3.46	3.11	3.11	3.40

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BALTIMORE MARYLAND

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
32.70	34.70	43.30	54.00	63.40	72.20
76.80	75.60	68.90	56.90	46.30	36.50

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BALTIMORE MARYLAND
AND STATION LATITUDE = 39.18 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC

PRECIPITATION

TOTALS	3.01	3.05	3.63	3.43	3.75	4.65
	3.91	4.80	4.31	3.25	2.31	3.43
STD. DEVIATIONS	1.93	1.13	1.09	2.20	1.38	2.52
	2.27	2.38	1.29	1.51	1.21	2.48

RUNOFF

TOTALS	0.372	0.409	0.495	0.054	0.056	0.121
	0.339	0.221	0.358	0.147	0.001	0.085
STD. DEVIATIONS	0.666	0.559	1.041	0.091	0.057	0.192
	0.687	0.182	0.280	0.282	0.002	0.164

EVAPOTRANSPIRATION

TOTALS	1.151	1.299	2.602	2.816	2.886	4.042
	3.458	3.178	2.093	2.608	1.790	1.117
STD. DEVIATIONS	0.587	0.601	0.484	0.848	0.961	1.583
	1.094	1.663	0.569	0.468	0.510	0.321

LATERAL DRAINAGE COLLECTED FROM LAYER 2

TOTALS	1.2079	1.1137	1.9412	0.2236	0.7531	0.6764
	0.6884	1.0823	1.2328	1.0567	0.3379	1.4518
STD. DEVIATIONS	2.3714	1.2266	1.6775	0.3030	0.8650	0.8375
	1.3254	0.6750	1.0944	0.5842	0.2046	2.5691

PERCOLATION/LEAKAGE THROUGH LAYER 3

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

```
------------------------------------------------------------------------------
               AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
------------------------------------------------------------------------------


  DAILY AVERAGE HEAD ON TOP OF LAYER  3
  -------------------------------------
    AVERAGES              0.0003   0.0007   0.0027   0.0001   0.0002   0.0002
                          0.0004   0.0003   0.0003   0.0003   0.0001   0.0004

    STD. DEVIATIONS       0.0007   0.0011   0.0051   0.0001   0.0002   0.0002
                          0.0007   0.0002   0.0003   0.0002   0.0001   0.0007

******************************************************************************


******************************************************************************

     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH    5
------------------------------------------------------------------------------
                                    INCHES            CU. FEET       PERCENT
                               -------------------  -------------   ---------
 PRECIPITATION                 43.52    (   5.339)     157977.6     100.00

 RUNOFF                         2.659   (  1.1305)       9650.92      6.109

 EVAPOTRANSPIRATION            29.039   (  2.6602)     105412.54     66.726

 LATERAL DRAINAGE COLLECTED    11.76567 (  4.05940)     42709.379   27.03508
   FROM LAYER  2

 PERCOLATION/LEAKAGE THROUGH    0.00000 (  0.00000)         0.014    0.00001
   LAYER  3

 AVERAGE HEAD ON TOP            0.000 (    0.000)
   OF LAYER  3

 PERCOLATION/LEAKAGE THROUGH    0.00000 (  0.00000)         0.000    0.00000
   LAYER  4

 CHANGE IN WATER STORAGE        0.056   (  1.4114)        204.76      0.130

******************************************************************************
```

****

PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	5.68	20618.398
RUNOFF	1.566	5683.0957
DRAINAGE COLLECTED FROM LAYER 2	2.56185	9299.51367
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.000003	0.01175
AVERAGE HEAD ON TOP OF LAYER 3	0.354	
MAXIMUM HEAD ON TOP OF LAYER 3	0.194	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	0.0 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000000	0.00000
SNOW WATER	2.15	7788.7402

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4595
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0837

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

****

****

FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	2.6792	0.2233
2	0.0321	0.1283
3	0.0000	0.0000
4	10.0274	0.4178
SNOW WATER	0.000	

****
****

ATTACHMENT 2

Interface Shear Laboratory Results

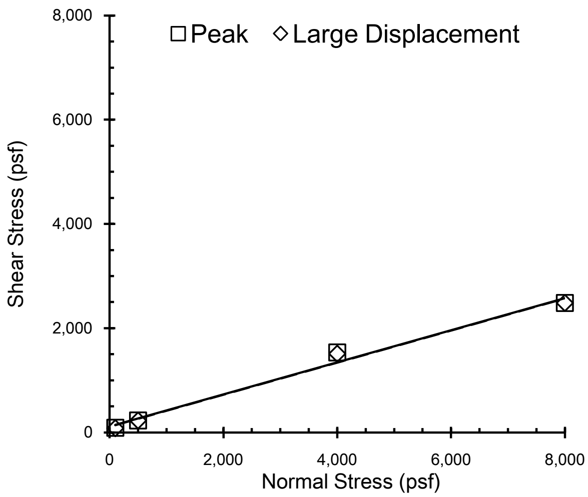
Shear Strength of Soil-Geosynthetic Interface by Direct Shear (ASTM D5321)

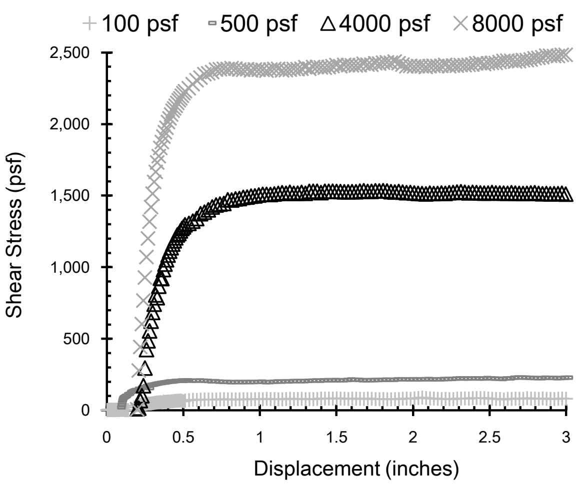
Client: Geosyntec Consultants — TRI Log #: 39571-1

Project: Midshore 2 Landfill — Richard S. Lacey, P.E. 1/10/2019

Analysis & Quality Review/Date

Select Clay vs.
Agru 60 mil HDPE MSGM (G18D002463) - shiny side up





Test Results, Linear Regression			
Mohr-Coulomb Parameters		Peak	Large Displacement
Friction Angle	Degrees	17.1	17.1
Y-intercept or Adhesion	psf	116	107
Minimum Secant Angle	Degrees	17.2	17.2

Note - Large Displacement Values Reported for 3.0 inches of Displacement

Test Conditions		
Upper Box	Select Clay ω = 17.4 % γ_d = 102.9 pcf	
Lower Box	Agru 60 mil HDPE MSGM (G18D002463) - shiny side up	
Conditioning	Wet - Loading applied and Interface flooded for a minimum of 24 hours prior to shear.	
Shearing Rate	inches/minute	0.04

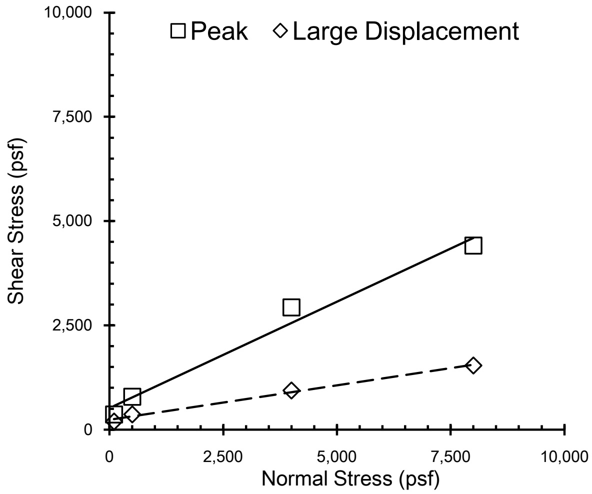
Test Notes
Shearing occurred at the interface at all stresses.

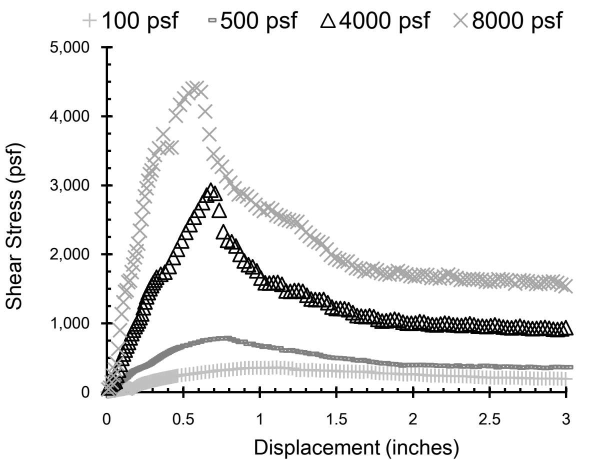
Specimen No.		-	1	2	3	4
Normal Stress		psf	100	500	4,000	8,000
Box Edge Dimension		in	12	12	12	12
Equivalent Bearing Slide Resist. Correction		psf	9	13	46	84
Peak	Shear Stress	psf	89	230	1,535	2,484
	Secant Angle	deg.	41.8	24.7	21.0	17.2
Large Displacement	Shear Stress	psf	81	229	1,511	2,484
	Secant Angle	deg.	39.0	24.6	20.7	17.2
Asperity Height, Avg. of 5 Meas.		mils	34	34	34	32

Shear Strength of Geosynthetic-Geosynthetic Interface by Direct Shear (ASTM D5321)

Client:	Geosyntec Consultants	TRI Log #:	39571-2
Project:	Midshore 2 Landfill	Jeffrey A. Kuhn, Ph.D., P.E.,	3/4/2019
		Analysis & Quality Review/Date	

Skaps DSGC TN 450-2-8(85301010106) vs.
Agru 60 mil HDPE MSGM (G18D002463) - Dull side up





Test Results, Linear Regression

Mohr-Coulomb Parameters		Peak	Large Displacement
Friction Angle	Degrees	27.0	9.4
Y-intercept or Adhesion	psf	515	237
Minimum Secant Angle	Degrees	28.9	10.9

Note - Large Displacement Values Reported for 3.0 inches of Displacement

Test Conditions

Upper Box	Skaps DSGC TN 450-2-8(85301010106)	
Lower Box	Agru 60 mil HDPE MSGM (G18D002463) - Dull side up	
Conditioning	Wet - Loading applied and Interface flooded for a minimum of 1 hour prior to shear.	
Shearing Rate	inches/minute	0.04

Test Notes

Shearing occurred at the interface at all stresses.

Specimen No.		-	1	2	3	4
Normal Stress		psf	100	500	4,000	8,000
Box Edge Dimension		in	12	12	12	12
Equivalent Bearing Slide Resist. Correction		psf	9	13	46	84
Peak	Shear Stress	psf	361	786	2,930	4,412
	Secant Angle	deg.	74.5	57.6	36.2	28.9
Large Displacement	Shear Stress	psf	193	363	937	1,536
	Secant Angle	deg.	62.6	36.0	13.2	10.9
Asperity Height, Avg. of 5 Meas.		mils	34	35	42	40

Appendix E.4: Overlay Liner Toe Drain Pipe Flow Capacity Check

COMPUTATION COVER SHEET

Client: Tolson & Associates **Project:** TRL Vertical Expansion **Project #:** ME1606 **Task #:** 03

TITLE OF COMPUTATIONS OVERLAY LINER TOE DRAIN PIPE FLOW CAPACITY CHECK

COMPUTATIONS BY: Signature Jintai Wang 01/28/2021 DATE

Printed Name and Title: Jintai Wang, P.E. Senior Staff Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY: (Peer Reviewer) Signature Zichang Li 02/01/2021 DATE

Printed Name and Title: Zichang Li, P.E. Engineer

COMPUTATIONS CHECKED BY: Signature Zichang Li 02/01/2021 DATE

Printed Name and Title: Zichang Li, P.E. Engineer

COMPUTATIONS BACKCHECKED BY: (Originator) Signature Jintai Wang 02/01/2021 DATE

Printed Name and Title: Jintai Wang, P.E. Senior Staff Engineer

APPROVED BY: (PM or Designate) Signature Simone Smith 02/01/2021 DATE

Printed Name and Title: Simone Smith, P.E. Senior Engineer

APPROVAL NOTES:

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

OVERLAY LINER TOE DRAIN PIPE FLOW CAPACITY CHECK

PURPOSE

The purpose of this analysis is to verify the flow capacity of the 4-inch high-density polyethylene (HDPE) perforated pipe installed in the toe-drain proposed for the liner overlay. The toe-drain is intended to divert infiltration that might have entered into the overlay area between the final cover system of the Cunningham Landfill and the liner for the proposed vertical expansion of Tolson Rubble Landfill (TRL).

BACKGROUND

The TRL expansion liner system is to overlay the Cunningham Landfill cover system to the south. Due to the top deck of the Cunningham Landfill slopes toward the new liner system, stormwater runoff will run flow to the perimeter embankment of the TRL on the top of the Cunningham Landfill. While the runoff is expected to be retained in the road channels and route down off the Cunningham Landfill in the east and west, infiltration may drain to the north along the side slopes above the cover of the Cunningham Landfill between the TRL liner system and the Cunningham cover system. Geosyntec proposes to install a toe-drain with a 4-HDPE perforated pipe to divert the potential infiltration from the overlay area. The location and detail of the toe drain are presented in Attachment 1 and Figure 1, respectively.

PIPE SELECTION

The proposed pipe product for the toe-drain is HDPE perforated pipe with a nominal diameter of 4 inches.

WATER INFILTRATION THROUGH COVER SYSTEM

The Hydrologic Evaluation of Landfill Performance (HELP) model Version 3.07 [USEPA, 1997] was used to estimate the water infiltration above the geomembrane in this calculation. The area analyzed was the top deck of the Cunningham Landfill. The total area to drain to the perimeter channel in the north is approximately 2.82 acres. The area is approximate rectangular in shape; a one-acre area was analyzed in the HELP program. In the HELP input, the maximum drainage distance is determined to be 250 ft. The top deck slope is sloped at approximately 1.6 percent, but it is conservatively assumed 0.6 percent in the analysis (the smallest drainage slope allowed in HELP). The simulation was conducted for a 30-year period. The detailed results of HELP modeling are presented in Attachment 2.

As shown in Attachment 2, the HELP results indicates the peak daily inflow is 20.45 ft^3/day/ac. The analysis was conducted for a one-acre area with a drainage distance of 250 ft. That is, the analyzed area is approximately 175 ft wide, yielding to 0.874 gal/lf/day/ac. The remaining area of the top deck is 2.82 acres, yielding the peak inflow of 57.7 ft^3/day.

PIPE FLOW CAPACITY

The pipe flow capacity is defined as the flow rate when the entire cross-section of the internal pipe is filled with liquid driven by gravity along the longitudinal slope of the pipe. The pipe flow capacity determined here is the minimum pipe flow rate when the pipe is full. The pipe flow capacity can be calculated using Manning's equation:

$$Q_0 = \frac{1.486}{n} A R_h^{2/3} S^{1/2} \tag{1}$$

where:

- Q_0 = available flow rate (ft^3/s)
- A = cross-sectional flow area (ft^2). As the pipe is filled with liquid, $A = \pi D^2 / 4$
- D = pipe inner diameter (ID) (ft)
- R_h = hydraulic radius (ft) (wetted area/wetted perimeter). For pipe filled with liquid, $R_h = [A/(\pi D)] = D/4$
- S = hydraulic gradient, equal to the longitudinal slope along the pipe (ft/ft)
- n = Manning's roughness coefficient of inner pipe surface

The slope of the pipe is estimated to be 0.01 ft/ft (0.010 or 1.0 percent). Smooth HDPE pipes have a Manning's roughness coefficient (n) of 0.009. Attachment 3 presents the dimension chart of HDPE pipes. The detailed calculation procedures are summarized in Attachment 4. The flow capacity of HDPE pipe with a nominal dimeter of 4 inches is summarized below.

Nominal Pipe Size, in	SDR	Average ID (D), in	Flow Capacity (Eq.1), Q_0 (1), ft^3/s
4 (OD 4.5 inches)	11	3.633	0.213

Notes:

(1) Estimated minimum pipe flow rate when pipe is full. n = 0.009, S = 0.01.

Maximum Allowable Perforation Opening

The maximum allowable opening of the perforation in the PIPE to provide particle retention of finer particles may be determined as follows [USEPA, 1983]:

$$d_{h\max} = \frac{d_{85}}{F} \tag{2}$$

where:

- $d_{h\,max}$ = Maximum hole opening to provide particle retention (in.)
- d_{85} = Particle size of the surrounding material for which 85 percent by weight of the particles are finer (in.)
- F = Factor varying between 1.2 to 2 for perforation, used 1.5 in calculation.

The perforated pipe is to be installed within AASHTO No. 57 aggregate. The d_{85} of AASHTO No. 57 aggregate is approximately 0.75 in. The maximum allowable opening of the perforation is 0.5 in. Geosyntec recommends the hole pattern per ASTM F758, which is summarized below:

- Hole Size = 3/8”
- Hole Spacing = 3” ± ¼ ”
- Hole Rows = 2 @ 90° (± 3°)

CONCLUSION

The calculated minimum pipe flow capacity when pipe is full is 0.213 ft^3/s (18,403.2 ft^3/day). The calculated water infiltration rate is 57.7 ft^3/day. The pipe flow capacity of the 4-in diameter perforated HDPE pipe is 318.5 (= 18,403.2 ft^3/day /57.7 ft^3/day) times the potential water infiltration. The proposed pipe meets the flow capacity requirement.

The analysis presented herein is based on the available data as provided and their interpretation. If the actual design and the inputs vary considerably from the assumptions as discussed above, the Engineer shall be informed, and the analysis may need to be updated.

REFERENCES

JC Smith INC, HDPE PRODUCTS. Available from: http://www.jcsmithinc.com/pdf/hdpe.pdf . Accessed 28 January 2021.

Plastics Pipe Institute (PPI), 2008. *Handbook of Polyethylene Pipe*. Second Edition. https://plasticpipe.org/publications/pe-handbook.html

Schroeder, P. Rs., Aziz, N. M., Lloyd, C. M. and Zappi, P. A. (1994). "The Hydrologic Evaluation of Landfill Performance (HELP) Model: User’s Guide for Version 3," EPA/600/R-94/168a, September 1994, U.S. Environmental Protection Agency Office of Research and Development, Washington, DC.

FIGURES

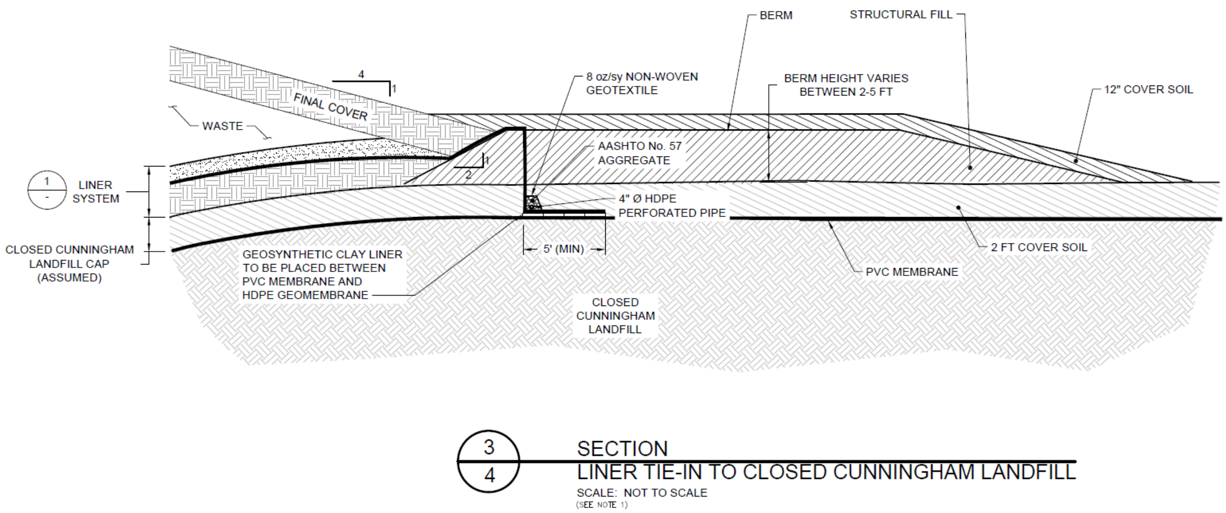
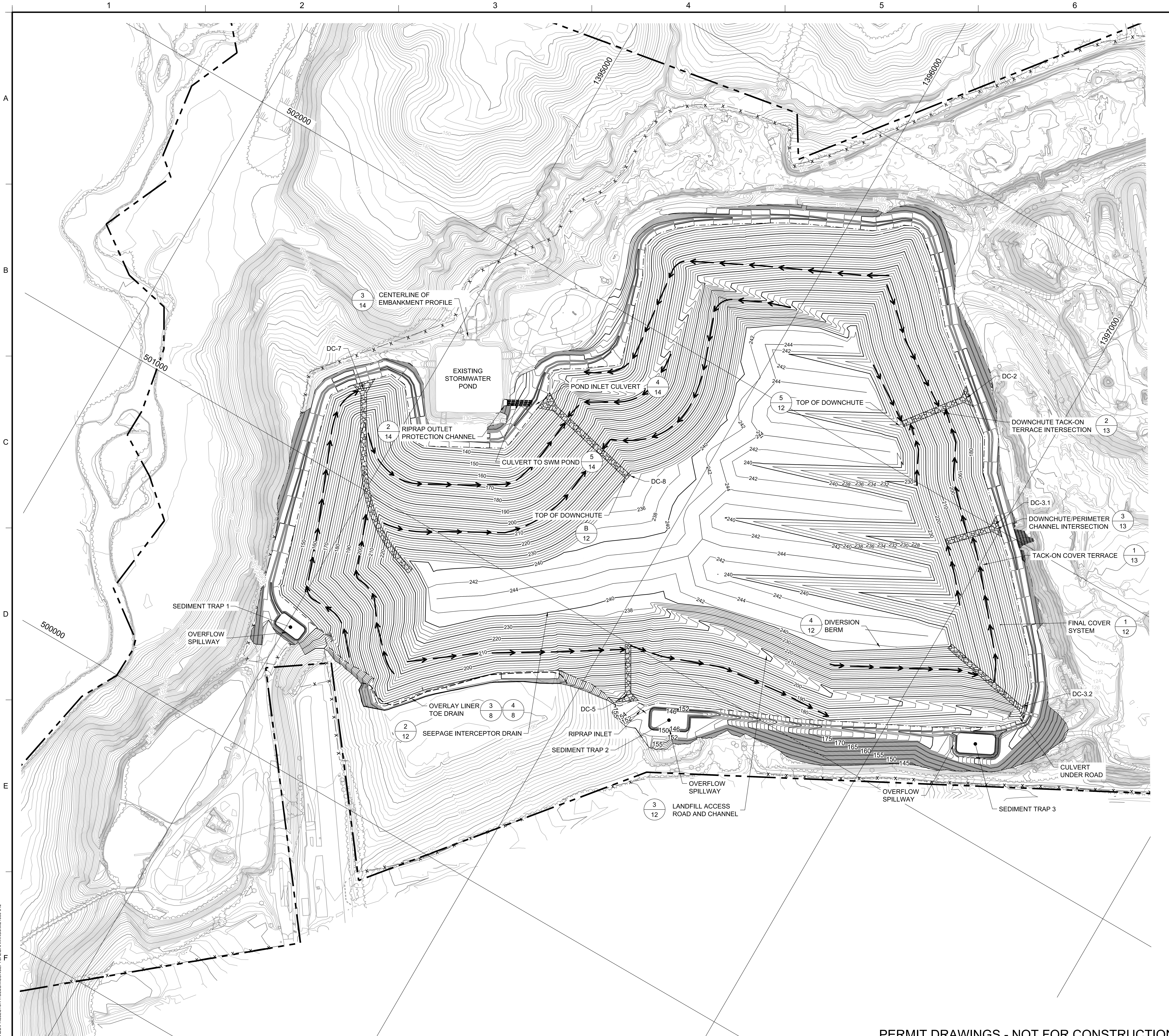


Figure 1 Toe Drain Design Detail

ATTACHMENT 1

Location of Toe Drain



N

0 160 320
SCALE IN FEET

LEGEND

- EXISTING CONTOURS (FEET, MSL)
- EXISTING TREE LINE
- EXISTING FENCE
- EXISTING ELECTRIC POLES
- EXISTING ELECTRIC LINE
- EXISTING UNDERGROUND ELECTRIC LINE
- EXISTING ROAD
- PROPOSED CONTOUR GRADE (FEET, MSL)
- PROPERTY BOUNDARY
- PROPOSED DRAINAGE TERRACE
- PROPOSED DOWNCHUTE
- LIMITS OF FINAL COVER GRADING
- OVERLAY LINER TOE DRAIN

NOTES:

1. CONTOURS SHOWN REPRESENT TOP OF FINAL COVER GRADE.

REV	DATE	DESCRIPTION	DRN	APP
1	NOV 2020	UPDATED PER MDE COMMENTS	AM/TJ	CHP

Geosyntec consultants
10211 WINCOPIN CIRCLE, FLOOR 4
COLUMBIA, MARYLAND 21044
PHONE: (410) 381-4333

TOLSON AND ASSOCIATES, LLC
24024 FREDERICK ROAD
CLARKSBURG, MARYLAND 20871

TITLE: FINAL COVER GRADING AND STORMWATER MANAGEMENT SYSTEM

PROJECT: **VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL**

SITE: **TOLSON RUBBLE LANDFILL**

DESIGN BY:	SS	DATE:	JULY 2020
DRAWN BY:	ANA	PROJECT NO.:	ME1606
CHECKED BY:	SS	FILE:	ME1606-012
REVIEWED BY:	---	DRAWING NO.:	
APPROVED BY:	CHP	11 OF 18	

SIGNATURE
11-06-2020
DATE

ATTACHMENT 2

Infiltration Output in HELP

```
********************************************************************************
********************************************************************************
**                                                                            **
**                                                                            **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                 **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                  **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                     **
**                    USAE WATERWAYS EXPERIMENT STATION                       **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY                **
**                                                                            **
**                                                                            **
********************************************************************************
********************************************************************************


PRECIPITATION DATA FILE:    C:\ME1606\DATA4.D4
TEMPERATURE DATA FILE:      C:\ME1606\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\ME1606\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\ME1606\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\ME1606\OL2SM5.D10
OUTPUT DATA FILE:           C:\ME1606\OL2SM5.OUT


TIME:  15:39     DATE:   1/15/2021


********************************************************************************

     TITLE:  Infiltration through existing cover of Cunnigham LF

********************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   5
           THICKNESS                 =      3.00   INCHES
           POROSITY                  =      0.4570 VOL/VOL
           FIELD CAPACITY            =      0.1310 VOL/VOL
           WILTING POINT             =      0.0580 VOL/VOL
           INITIAL SOIL WATER CONTENT  =      0.3521 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


                                   LAYER  2
                                   --------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER   5
           THICKNESS                 =     21.00   INCHES
           POROSITY                  =      0.4570 VOL/VOL
           FIELD CAPACITY            =      0.1310 VOL/VOL
           WILTING POINT             =      0.0580 VOL/VOL
           INITIAL SOIL WATER CONTENT  =      0.4570 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC
           SLOPE                     =      0.60   PERCENT
           DRAINAGE LENGTH           =    250.0    FEET


                                   LAYER  3
                                   --------

                     TYPE 4 - FLEXIBLE MEMBRANE LINER
                         MATERIAL TEXTURE NUMBER  37
           THICKNESS                 =      0.06   INCHES
           POROSITY                  =      0.0000 VOL/VOL
           FIELD CAPACITY            =      0.0000 VOL/VOL
           WILTING POINT             =      0.0000 VOL/VOL
           INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.199999999000E-10 CM/SEC
           FML PINHOLE DENSITY       =      2.00   HOLES/ACRE
           FML INSTALLATION DEFECTS  =      1.00   HOLES/ACRE
           FML PLACEMENT QUALITY     =  3 - GOOD


                                   LAYER  4
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  18
           THICKNESS                 =    120.00   INCHES
```

```
   POROSITY                    =      0.6710 VOL/VOL
   FIELD CAPACITY              =      0.2920 VOL/VOL
   WILTING POINT               =      0.0770 VOL/VOL
   INITIAL SOIL WATER CONTENT  =      0.2895 VOL/VOL
   EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

```
 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE # 5 WITH A
         GOOD STAND OF GRASS, A SURFACE SLOPE OF  1.%
         AND A SLOPE LENGTH OF  250. FEET.

SCS RUNOFF CURVE NUMBER            =     53.60
FRACTION OF AREA ALLOWING RUNOFF   =    100.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
EVAPORATIVE ZONE DEPTH             =      9.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE   =      3.798  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE  =      4.113  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE  =      0.522  INCHES
INITIAL SNOW WATER                 =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS    =     45.394  INCHES
TOTAL INITIAL WATER                =     45.394  INCHES
TOTAL SUBSURFACE INFLOW            =      0.00   INCHES/YEAR
```

EVAPOTRANSPIRATION AND WEATHER DATA

```
 NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
         BALTIMORE             MARYLAND

     STATION LATITUDE                        =  39.18 DEGREES
     MAXIMUM LEAF AREA INDEX                 =   0.00
     START OF GROWING SEASON (JULIAN DATE)   =    102
     END OF GROWING SEASON (JULIAN DATE)     =    300
     EVAPORATIVE ZONE DEPTH                  =   9.0  INCHES
     AVERAGE ANNUAL WIND SPEED               =   9.30 MPH
     AVERAGE 1ST QUARTER RELATIVE HUMIDITY   =  62.00 %
     AVERAGE 2ND QUARTER RELATIVE HUMIDITY   =  65.00 %
     AVERAGE 3RD QUARTER RELATIVE HUMIDITY   =  71.00 %
     AVERAGE 4TH QUARTER RELATIVE HUMIDITY   =  68.00 %
```

```
 NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
         COEFFICIENTS FOR    BALTIMORE           MARYLAND
```

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.00	2.98	3.72	3.35	3.44	3.76
3.89	4.62	3.46	3.11	3.11	3.40

```
 NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
         COEFFICIENTS FOR    BALTIMORE           MARYLAND
```

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
32.70	34.70	43.30	54.00	63.40	72.20
76.80	75.60	68.90	56.90	46.30	36.50

```
 NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
         COEFFICIENTS FOR    BALTIMORE           MARYLAND
           AND STATION LATITUDE  =  39.18 DEGREES
```

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS   1 THROUGH   30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.50	3.30	3.36	3.35	3.77	3.77
	3.77	5.57	3.38	2.65	2.96	3.00
STD. DEVIATIONS	1.25	1.51	1.27	1.69	1.70	2.29
	1.76	2.71	2.41	1.41	1.46	1.56

RUNOFF

TOTALS	1.098	1.864	1.342	0.454	0.514	0.945
	0.912	1.917	1.276	0.588	0.769	1.175
STD. DEVIATIONS	1.304	1.273	1.336	0.710	0.933	1.288
	1.302	1.786	1.624	0.819	0.973	1.441

EVAPOTRANSPIRATION

TOTALS	1.161	1.048	2.269	2.661	2.928	2.652
	2.633	3.040	1.959	1.600	1.627	1.169
STD. DEVIATIONS	0.405	0.438	0.490	0.829	0.856	1.092
	0.762	1.023	0.783	0.602	0.390	0.252

LATERAL DRAINAGE COLLECTED FROM LAYER 2

TOTALS	0.1341	0.1133	0.1472	0.1416	0.1449	0.1390
	0.1422	0.1472	0.1403	0.1446	0.1465	0.1530
STD. DEVIATIONS	0.0275	0.0285	0.0127	0.0079	0.0075	0.0091
	0.0102	0.0121	0.0095	0.0087	0.0107	0.0126

PERCOLATION/LEAKAGE THROUGH LAYER 3

TOTALS	0.1675	0.1456	0.1780	0.1722	0.1769	0.1703
	0.1749	0.1784	0.1712	0.1766	0.1755	0.1824
STD. DEVIATIONS	0.0211	0.0221	0.0096	0.0055	0.0053	0.0065
	0.0075	0.0089	0.0068	0.0062	0.0075	0.0088

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.1827	0.1714	0.1775	0.1639	0.1762	0.1752
	0.2001	0.1808	0.1668	0.1772	0.1708	0.1684
STD. DEVIATIONS	0.0738	0.0538	0.0714	0.0556	0.0502	0.0539
	0.0505	0.0563	0.0557	0.0477	0.0635	0.0488

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	20.0087	18.9769	21.4077	21.4037	21.2656	21.1362
	20.9956	21.4640	21.2674	21.2282	21.8638	21.9976

STD. DEVIATIONS	2.8292	3.2417	1.2956	0.7702	0.7194	0.9068
	1.0126	1.1951	0.9466	0.8401	1.0401	1.1865

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.37 (6.611)	150156.2	100.00
RUNOFF	12.855 (4.7789)	46662.89	31.076
EVAPOTRANSPIRATION	24.747 (2.9305)	89830.84	59.825
LATERAL DRAINAGE COLLECTED FROM LAYER 2	1.69376 (0.05936)	6148.350	4.09464
PERCOLATION/LEAKAGE THROUGH LAYER 3	2.06956 (0.04384)	7512.498	5.00312
AVERAGE HEAD ON TOP OF LAYER 3	21.085 (0.511)		
PERCOLATION/LEAKAGE THROUGH LAYER 4	2.11101 (0.22530)	7662.960	5.10333
CHANGE IN WATER STORAGE	-0.041 (0.7935)	-148.86	-0.099

PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	5.68	20618.398
RUNOFF	5.058	18361.0645
DRAINAGE COLLECTED FROM LAYER 2	0.00563	20.45454

```
     PERCOLATION/LEAKAGE THROUGH LAYER  3       0.006363        23.09785

     AVERAGE HEAD ON TOP OF LAYER  3           24.000

     MAXIMUM HEAD ON TOP OF LAYER  3           28.038

     LOCATION OF MAXIMUM HEAD IN LAYER  2
           (DISTANCE FROM DRAIN)              165.4 FEET

     PERCOLATION/LEAKAGE THROUGH LAYER  4       0.042174       153.09193

     SNOW WATER                                 3.90         14161.6172


     MAXIMUM VEG. SOIL WATER (VOL/VOL)                  0.4570

     MINIMUM VEG. SOIL WATER (VOL/VOL)                  0.1658


      ***  Maximum heads are computed using McEnroe's equations.  ***

           Reference:  Maximum Saturated Depth over Landfill Liner
                       by Bruce M. McEnroe, University of Kansas
                       ASCE Journal of Environmental Engineering
                       Vol. 119, No. 2, March 1993, pp. 262-270.

******************************************************************************


******************************************************************************

                FINAL WATER STORAGE AT END OF YEAR   30
    ----------------------------------------------------------------------
                 LAYER       (INCHES)       (VOL/VOL)
                 -----       --------       ---------
                   1           1.0695         0.3565

                   2           9.5969         0.4570

                   3           0.0000         0.0000

                   4          33.4974         0.2791

               SNOW WATER      0.000


******************************************************************************
******************************************************************************
```

ATTACHMENT 3

HDPE Pipe Specifications

Table 8: DriscoPlex® 1000/1700 Series ASTM D3035 and ASTM F714 Outside Diameter Controlled HDPE Pipe (IPS/SDR)

Common Dimension Ratio's for DriscoPlex® 1000/1700 IPS Pipe
(Custom DR's available. Contact Performance Pipe)

IPS		DR 21			DR 17			DR 13.5			DR 11			DR 9		
ASTM F714 PR		PR = 100 psi			PR = 125 psi			PR = 160 psi			PR = 200 psi			PR = 250 psi		
Pipe Size in.	OD, in.	Min Wall in.	Avg. ID in.	Wgt. lbs/ft	Min Wall in.	Avg. ID in.	Wgt. lbs/ft	Min Wall in.	Avg. ID in.	Wgt. lbs/ft	Min Wall in.	Avg. ID in.	Wgt. lbs/ft	Min Wall in.	Avg. ID in.	Wgt. lbs/ft
2	2.375				0.140	2.078	0.43	0.176	2.002	0.53	0.216	1.917	0.64	0.264	1.815	0.77
3	3.50				0.206	3.063	0.94	0.259	2.951	1.16	0.318	2.826	1.39	0.389	2.675	1.66
4	4.50	0.214	4.046	1.27	0.265	3.938	1.55	0.333	3.794	1.92	0.409	3.633	2.31	0.500	3.440	2.75
6	6.63	0.315	5.957	2.75	0.390	5.798	3.36	0.491	5.584	4.15	0.602	5.349	5.00	0.736	5.065	5.96
8	8.63	0.411	7.754	4.66	0.507	7.550	5.69	0.639	7.270	7.04	0.784	6.963	8.47	0.958	6.594	10.11
10	10.75	0.512	9.665	7.24	0.632	9.410	8.83	0.796	9.062	10.93	0.977	8.679	13.16	1.194	8.219	15.70
12	12.75	0.607	11.463	10.19	0.750	11.160	12.43	0.944	10.749	15.38	1.159	10.293	18.51	1.417	9.746	22.08
14	14.00	0.667	12.586	12.28	0.824	12.253	14.98	1.037	11.802	18.54	1.273	11.301	22.32	1.556	10.701	26.63
16	16.00	0.762	14.385	16.04	0.941	14.005	19.57	1.185	13.488	24.22	1.455	12.915	29.15	1.778	12.231	34.78
18	18.00	0.857	16.183	20.30	1.059	15.755	24.77	1.333	15.174	30.65	1.636	14.532	36.89	2.000	13.760	44.02
20	20.00	0.952	17.982	25.07	1.176	17.507	30.58	1.481	16.860	37.84	1.818	16.146	45.54	2.222	15.289	54.34
22	22.00	1.048	19.778	30.33	1.294	19.257	37.00	1.630	18.544	45.79	2.000	17.760	55.10	2.444	16.819	65.75
24	24.00	1.143	21.577	36.10	1.412	21.007	44.03	1.778	20.231	54.49	2.182	19.374	65.58	2.667	18.346	78.25
26	26.00	1.238	23.375	42.36	1.529	22.759	51.67	1.926	21.917	63.95	2.364	20.988	76.96	2.889	19.875	91.84
28	28.00	1.333	25.174	49.13	1.647	24.508	59.93	2.074	23.603	74.17	2.545	22.605	89.26	3.111	21.405	106.51
30	30.00	1.429	26.971	56.40	1.765	26.258	68.80	2.222	25.289	85.14	2.727	24.219	102.47	3.333	22.934	122.27
32	32.00	1.524	28.769	64.17	1.882	28.010	78.28	2.370	26.976	96.87	2.909	25.833	116.58	3.556	24.462	139.12
34	34.00	1.619	30.568	72.44	2.000	29.760	88.37	2.519	28.660	109.36	3.091	27.447	131.61			
36	36.00	1.714	32.366	81.21	2.118	31.510	99.07	2.667	30.346	122.60	3.273	29.061	147.55			
42	42.00	2.000	37.760	110.54	2.471	36.761	134.84	3.111	35.405	166.88	3.818	33.905	200.84			
48	48.00	2.286	43.154	144.38	2.824	42.013	176.12									
54	54.00	2.571	48.549	182.73	3.176	47.266	222.90									

Please visit www.performancepipe.com for additional size and dimension. Pressure Ratings are based on operating temperature up to 80°F. Pressure Rating is based on a 0.63 Design Factor per PPI TR-41. Temperature, Chemical and Environmental use considerations may require additional design factors.

Average inside diameter is calculated using Nominal OD and Minimum Wall plus 6% for use in estimating fluid flow. Actual ID will vary. When designing components to fit the pipe ID, refer to pipe dimensions and tolerances in the applicable pipe manufacturing specification.

ATTACHMENT 4

Flow Capacity Calculation

Pipe Flow Capacity

Manning's roughness coefficient of inner pipe surface $n := 0.009$

Pipe inner diameter (ID) (ft) $D := \frac{3.633}{12} = 0.303$

Cross-sectional flow area (ft2) $A := \pi \cdot \frac{D^2}{4} = 0.072$

Hydraulic radius (ft) (wetted area/wetted perimeter).
For pipe filled with liquid: $R_h := \frac{D}{4} = 0.076$

Hydraulic gradient $S := 0.01$

Available flow rate (ft3/s) $Q := \frac{1.486}{n} \cdot A \cdot \left(R_h\right)^{\frac{2}{3}} \cdot S^{\frac{1}{2}} = 0.213$ **(cu ft/s)**

Available flow rate (ft3/day) $Q := 24 \cdot 60 \cdot 60 \cdot Q = 18.4 \cdot 10^3$ **(cu ft/day)**

Calculated infiltration from HELP (ft3/day) $Q_{inflow} := 57.7$

Factor of Safety: $FOS := \frac{Q}{Q_{inflow}} = 318.5$

Appendix F: Slope Stability Analysis

Geosyntec consultants

COMPUTATION COVER SHEET

Client: Tolson & Associates **Project:** TRL Vertical Expansion **Project #:** ME1606 **Task #:** 03

TITLE OF COMPUTATIONS SLOPE STABILITY ANALYSIS

COMPUTATIONS BY: Signature Zichang Li — DATE 01/24/2020

Printed Name and Title: Zichang Li, Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY: (Peer Reviewer) Signature Jenny Ramirez — DATE 03/04/2020

Printed Name and Title: Jenny Ramirez, Professional

COMPUTATIONS CHECKED BY: Signature Jenny Ramirez — DATE 03/04/2020

Printed Name and Title: Jenny Ramirez, Professional

COMPUTATIONS BACKCHECKED BY: (Originator) Signature Zichang Li — DATE 03/05/2020

Printed Name and Title: Zichang Li, Engineer

APPROVED BY: (PM or Designate) Signature — DATE 08/03/2020

Printed Name and Title: David Espinoza, Senior Principal

APPROVAL NOTES:

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

SLOPE STABILITY ANALYSIS
TRL EXPANSION DESIGN

PURPOSE

The objective of this calculation package is to evaluate the static and seismic slope stability of the proposed Tolson Rubble Landfill Expansion (TRL Expansion) located in Crofton, Anne Arundel County, Maryland.

CROSS-SECTIONS AND IDEALIZED STRATIGRAPHY

The slope stability of the proposed landfill is governed by the shear strength of the waste mass, the interface friction characteristics of the liner system, and the upper layers of the foundation soils. Figure 1 shows the proposed base grades for the proposed TRL expansion. Figure 2 shows the proposed final grades of the TRL.

The subsurface stratigraphy beneath the proposed TRL expansion is inferred from recent borings prepared by Geosyntec in 2019, as shown in Attachment 1. Historical borings prepared by ERM [2016, 2006] were also used to confirm the information. The following subsurface strata were encountered during these investigations:

- The Magothy Aquifer (0-50 ft thick; Upper Aquifers 1-4) was identified in all boring locations. While much of this layer has been excavated due to mining activities at the Site, the lower area of the Magothy Formation remains, and is characterized by interbedded layers of sand and white to light gray clay, with some coarse gravel.
- Four discontinuous layers of clay to clayey sands (~0-5 ft thick; Clay Lenses 1-4) were identified in many boring locations within the Magothy Aquifer at elevations of approximately 100-130 feet above mean sea level (ft-msl). These layers are characteristic of the lower area of the Magothy Formation.
- The Patapsco Formation (~0-200+ ft thick; Confining Units 1-4 and Lower Aquifer) was encountered in many deeper boreholes. This formation is the upper-most layer of three lithographic layers which make up the Potomac Group. The Patapsco Formation contains alternating aquifers and confining units.
- Three discontinuous layers of sand to silty sand (~0-10 ft thick: Sand Lenses 1-3) were identified in deeper boring locations extending into the Confining Unit of the Patapsco Formation. These lenses were found between 80 and 30 ft-msl, and are characteristic of the interspersed sand deposits often found in the Patapsco Formation.

Shallow potentiometric surfaces in the Magothy Aquifer range from approximately elevation 95.7 ft-msl to 114.7 ft-msl under the footprint of the TRL expansion. Deep potentiometric surfaces (confined) were found at approximately elevation 70 ft-msl.

The vertical expansion is proposed to increase the height of the landfill to 244 feet above mean sea level (ft-msl) with top of waste at 240 ft-msl (Figure 2). Cross-Sections A-A', B-B', C-C', and D-D', as shown in Figures 1 and 2, were selected for the slope stability analysis. These sections were chosen because they include the highest waste slope (Section A-A'), embankment slopes (Section B-B'), groundwater level (Section B-B'), and/or the portion of the closed former Cunningham Rubble Landfill (Section C-C'), and hence the largest driving forces for slope stability failure.

The location of the groundwater table for the selected cross-sections was chosen based on the elevations recorded during the groundwater monitoring program at the TRL by Geosyntec [2019].

STABILITY CRITERIA

Slope stability analyses were performed to verify that each cross-section has an adequate factor of safety against slope instability. For the static case, the minimum recommended factors of safety against instability for short- and long-term conditions are 1.3 and 1.5, respectively. These criteria conform with the guidance provided by the U.S. Environmental Protection Agency's (USEPA) technical manual entitled, "Solid Waste Disposal Facility Criteria" [USEPA, 1993]. For the seismic case, the minimum recommended factor of safety against slope failure is chosen to be 1.0 per recommendation of USEPA design guidance, entitled "RCRA Subtitle D (258) Seismic Design Guidance for Municipal Solid Waste Landfill Facilities" [USEPA, 1995].

METHODS OF ANALYSIS

The stability of the selected cross-sections was evaluated based on limit equilibrium theory using the method of slices. The computer program SLIDE version 6.0 [Rocscience, 2002] was used to perform the analyses. SLIDE is a two-dimensional slope stability program for evaluating the factor of safety of circular and non-circular (also referred to as block) failure (or slip) surfaces in soils. The procedure used to analyze slope stability at the TRL consisted of analyzing numerous potential failure surfaces for each cross-section to find the critical failure surface that renders the minimum factor of safety for the slope. Circular and non-circular failure surfaces were analyzed using the same material parameters. For both circular and non-circular failure surfaces, the Spencer method [Spencer, 1967] was used. In the Spencer method, both force and moment equilibrium are satisfied in each slice and the slope of the inner slice forces are assumed constant and parallel to each other. For all analyses, 50 slices were considered for each failure surface.

Hundreds of potential failure surfaces were analyzed to find the critical failure surface that results in the minimum factor of safety for the slope. The program was set to search for the most critical surfaces within the entire cross-section to ensure that the most critical surface was captured. This iterative process ensured that a global, not a local minimum, factor of safety was calculated.

For the circular analyses, a search grid with 50 horizontal increments and 50 vertical increments was used to find the slip surface with the minimum factor of safety. SLIDE provides both the minimum factor of safety and contours of the calculated factors of safety. Two types of non-circular analyses were performed: (i) a window search to locate the failure surface with the minimum factor of safety in the slope, and (ii) a multi-line search to target slip surfaces within the liner system. For the window search, two search windows were used to search for the most critical failure surface. The search windows were iteratively placed to obtain the minimum factor of safety for the entire slope. For the multi-line analysis, a line along the base liner system was used to search for the minimum factor of safety for potential sliding within the liner.

Seismic Loading Analysis

According to Section 258.14 of RCRA Subtitle D regulations, 40 CFR Part 258, a seismic impact zone is identified as an area with a ten percent or greater probability that the maximum horizontal acceleration (MHA) in lithified earth material, expressed as a percentage of the earth's gravitational pull (g) will exceed 0.10g in 250 years.

The MHA in bedrock for the TRL site is estimated to be 0.07g, based on the USGS Unified Hazard Tool (Attachment 2) for an event with a return period of 2,475 years and the USGS seismic hazard map with contours of peak acceleration with 2 percent probability of exceedance in 50 years (Figure 3) [USGS, 2014]. Therefore, a seismic stability analysis is not necessary for the TRL.

Cases Analyzed

Two cases have been evaluated for slope stability of the TRL:

1) *Short-term case*. This case assumes as waste is placed to reach final grades, any excess pore pressures generated in the subsurface clay deposits (Clay Seams, Clay 1 and Clay 2) will not dissipate,. Undrained shear strength parameters are used to describe the multiple clay layers. This assumption is conservative.

2) *Long-term case.* This case analyzes the slope stability long after the waste filling has been completed. The excess pore water pressure induced by waste placement is assumed to be fully dissipated and effective shear strength (i.e., drained) parameters are used for the subsurface clay deposits (Clay Seams, Clay 1 and Clay 2) in the analysis.

For both cases, circular and non-circular failure surface were analyzed.

MATERIAL PROPERTIES USED IN ANALYSES

Material properties used in the slope stability analysis are discussed below and summarized in Table 1.

Waste

A typical gate unit weight for CDD at landfill sites varies between 225 pounds per cubic yard (pcy) and 320 pcy. Based on an assumption that efficient landfill operations try to achieve compaction ratio of 4:1 (i.e., the volume occupied by waste in place is approximately one fourth of the volume received at the gate), the in-place unit weight for CDD varies between 900 pcy and 1,280 pcy. For this analysis, an in-place unit weight of 50 pcf (1,350 pcy) is assumed. Waste is a rapid-draining material for the loading conditions considered in these analyses, and therefore no undrained strength parameters are developed for this material.

Limited data is available in the literature on shear strength parameters for CDD waste. An extensive literature review of waste properties, including CDD waste, was performed by Kavazanjian et al. [1995]. From their report, the CDD waste was assumed to have a bilinear shear strength envelope with a minimum strength of 500 psf and ϕ' = 33°.

Fill

Although the majority of the TRL will be constructed by excavating the existing surface soils to base grades, the far northern and southeastern ends of the site will require placement of fill for the subgrade and the embankment (Attachment 1). It is assumed that the areas will be backfilled with material excavated during construction of the TRL. As the majority of the excavated material is expected to be Sand 1 (discussed below), it is assumed that the fill will have the same material properties as Sand 1. The embankments constructed with the fill will be compacted and greater strength is expected. The analysis conservatively uses lower strength as Sand 1 discussed below.

Sand 1

An examination of the boring and piezometer logs from ERM [2016] and Geosyntec [2019], as shown in Attachment 3, indicates a wide range for standard penetration test (SPT) blow counts (*N*) for Sand 1. *N*-values were found to range from 2 to 15 (very loose to medium dense) in dry deposits near the ground surface, and 15 to 30+ (loose to very dense) in moist gravelly deposits at the deeper elevation. It is assumed that the entire layer of Sand 1 is loose sand with an *N*-value of 10. Therefore, the effective friction angle of Sand 1 is estimated to be 30° based on typical correlations between friction angle and *N*-value shown in Figure 4 [Peck et al., 1974]. A typical cohesion of zero for sandy soils is used.

Since SPT *N*-values vary with stress level, overburden stress corrections factors are sued to provide a consistent point of reference to convert *N*-value to corrected *N*-value (N_{60}). The correction for field procedures can be done using Equation 1 [Kulhawy and Mayne 1990]:

$$N_{60} = C_{ER} \cdot C_B \cdot C_S \cdot C_R \cdot Nvalue \qquad (1)$$

where,

C_{ER} = energy ratio, 0.9 for safety hammer

C_B = borehole diameter, 1.05 for 6-inch

C_S = sampling method, 1.0 for standard sampler

C_R = rod length, 1.0 for sampling at greater than 30 ft deep

The corrected *N*-value (N_{60}) for Sand 1 was determined to be 9.5 with a *N*-value of 10. The in-situ moist unit weight of Sand 1 was estimated to be 120 pcf based on correlations with the corrected *N*-value (e.g., N_{60} = 10) in Figure 5 [CalTrans, 2014]. A value of 120 pcf was chosen for this analysis. The saturated unit weight was calculated to be 130 pcf by assuming a porosity of 0.35 and a specific gravity of 2.65.

Clay 1

N-values within Clay 1 vary from 20 to 40 (Attachment 3). One sample was collected and tested in the laboratory (Attachment 4). The plastic limit of this soil was measured to be approximately 16 percent, with a plasticity index of 9 percent. Based on correlations between effective friction angle and plasticity index for undisturbed overconsolidated clay in Equation 2 [Sorenson and Okkels, 2013], the effective friction angle for this layer is estimated to be 30.5°. Values of effective cohesion (c') for clay soils ranges from zero for very soft or normally consolidated clay to more than 2,100 psf stiff clay. Field observations during advancing borings indicates that Clay 1 is too stiff to push Shelby tube samples. The *N*-values also indicate the consistency of Clay 1 is identified to be very stiff. As such, a cohesion of 500 psf (typically for soft clay) is conservatively assumed for Clay 1.

$$\phi' = 44 - 14 \cdot \log(PI) \quad (2)$$

where,

ϕ' = effective friction angle (°)

PI = plasticity index (%).

The corrected *N*-values (N_{60}) vary from 18.9 to 37.8. Correlations between corrected *N*-value and unconfined compressive strength [CalTrans, 2014] (Figure 6) revealed undrained shear strength greater than 2,400 psf for Clay 1. To more precisely determine an appropriate undrained shear strength, a calculation based on the Stress History and Normalized Soil Engineering Parameters (SHANSEP) procedure developed by Ladd and Foot [1974] was performed. For this analysis, an OCR of 2 was assumed based on correlations with *N*-value (Equation 3). Based on these estimation methods, an undrained strength of 3,000 psf was chosen for Clay 1.

$$s_u = S\,\sigma'_{v0}\,(OCR)^m \quad (3)$$

where

s_u = undrained strength (psf); and

S = normalized undrained shear strength ratio for a normally consolidated clay (assumed to be 0.25);

σ'_{v0} = in situ effective vertical stress (psf), at approximately 55 ft deep;

OCR = overconsolidation ratio,

m = empirical coefficient (assumed to be 0.85); and

The in-situ moist unit weight of Clay 1 was estimated to be 125 pcf based upon correlations with the corrected SPT *N*-value [CalTrans, 2014] (Figure 5). The saturated unit weight for this layer was estimated to be 132 pcf based on an assumed dry unit weight of 110 pcf and a specific gravity of 2.65.

Seams of fine sand less than 5 ft thick are present in Clay 1. These seams are not considered in this analysis.

Sand 2

No laboratory or field data was available for Sand 2. A geotechnical investigation for a nearby site, the Millersville Landfill in Anne Arundel County, Maryland located approximately 6 miles north of the TRL, indicates that the *N*-values in Sand 2 ranged from 13 to 50+, with typical values between 25 and 35. The friction angle of Sand 2 was estimated to be 37° based on correlations with SPT *N*-values [Peck et al., 1974] (Figure 4). For this analysis, the friction angle is conservatively modeled as 32° (e.g., medium dense sand). The in-situ moist unit weight of Sand 2 was estimated to be 124 pcf based on correlations with the corrected SPT *N*-value [CalTrans, 2014] (Figure 5). Similar to Sand 1, the saturated unit weight was estimated to be 130 pcf by assuming a porosity of 0.30 and a specific gravity of 2.65.

Clay Seam

Several seams of golden-color sandy clay were encountered within Sand 1. The thicknesses very and are approximate up to 5 ft. *N*-values within Clay Seams vary from 6 to 18 (Attachment 3). Correlations between corrected *N*-value (5.7 to 17.0) and unconfined compressive strength [CalTrans, 2014] (Figure 6) revealed undrained shear strength between 700 psf and 2,000 psf for Clay Seams. Similar to Clay 1, a calculation based on the SHANSEP procedure was performed. For this analysis, an OCR of 2 was assumed based on correlations with *N*-value (Equation 2) [Mayne and Kemper, 1988]. Based on these estimation methods, an undrained strength of 1,100 psf was chosen for Clay Seams (e.g., $N = 9$). The consistency of Clay Seams is identified to be medium to stiff. Some of the clay seams are above shallow groundwater tables and may be dry without discharge from above. As such, the effective cohesion of clay seams is assumed to be zero. No other soil testing was conducted on Clay Seams and Clay Seams are assumed to have the same soil properties (e.g., unit weights) as Clay 1, unless otherwise specified above.

Vegetated Surface Soils

The existing riparian embankment to the west of the proposed landfill is vegetated with tall-grasses and bushes. Site topography as shown in Figure 2 indicates that the riparian area is sloped into the riverbed, at a slope steeper than 2 horizontal to 1 vertical (2H:1V). With a typical friction angle less than 32 degree (with no cohesion) and being saturated, the slope is expected to be unstable. However, the roots of vegetations may get 5 to 10 ft below ground surface (5 ft assumed in the analysis), reinforcing Surface Soils. As such, a layer of Surface Soils on the vegetated riparian sideslopes is considered in the analysis. The soil is assumed to have the same strength as Clay 1, unless otherwise specified. It is notable that Surface Soils are part of the riverbed and erosion may occur due to flooding. The erosion is not expected to affect the stability of the landfill but may result in dysfunction of perimeter access roads and/or stormwater channels. It is recommended that the sideslope of the external slope in the riparian area be examined regularly.

Liner Interface

Figure 7 shows the liner system details, Table 2 summarizes ranges of interface friction angle reported in the literature for typical materials, and Attachment 5 shows laboratory results for interface shear testing of actual materials installed at landfills in Maryland. Both literature values (Table 2) and testing results (Attachment 5) were used to select representative interface properties for the liner system at TRL (Figure 7). The assumed interface friction properties used in this analysis are summarized in Table 3. As shown in Table 3, the most critical interface in the liner system is the geomembrane/clay interface (peak strength values were assumed, as justified below). In the SLIDE analysis, the shear strength of the liner is assumed to be represented by this critical interface friction angle of 9° (as used in the liner veneer stability analysis). Adhesion is conservatively ignored in this analysis. This is the lower end based on the literature reviews on the interface testing of the geomembrane and geocomposite has an estimated.

It is noted that the interface friction angle of the liner system is specified as 15° minimum for this project. The friction angle of 15° selected for slope stability analyses is considered appropriate based on the following: (1) the use of peak shear strength along with a FS of 1.5 has been the state of the practice [Sabatini et al, 2002]; (2) the cell geometry is dominated by relatively flat slopes (less than 5%) and the entire cross-section, including protective cover, will be constructed initially thus insulating and placing a normal load on liner geosynthetics that will reduce the potential for post-construction induced large displacement that may result in a reduction of the peak shear strength interface conditions; (3) the friction angle selected is considered readily achievable using standard geosynthetic products and the liner cross-section used for the TRL; and (4) site-specific conformance testing will be performed to confirm that actual geosynthetic materials used in cell construction meet the minimum 15° friction angle.

RESULTS AND CONCLUSIONS

The results of the SLIDE analysis are presented in Attachment 6 and summarized in Table 4. As shown in Table 4, the factors of safety are greater than the corresponding recommended minimum factors of safety for all analyses. Therefore, assuming verification of the liner interface friction values assumed in Table 3, the TRL can be developed while maintaining adequate factors of safety for global slope stability.

During the preliminary analysis, the existing external slope of the riparian area along Little Patuxent River to the west is found to be steep (less than 2H:1V). The vegetation on Surface Soils assures the stability of the riparian embankment. Surface Soils are part of the riverbed and erosion may occur due to flooding. The erosion is not expected to affect the stability of the landfill but may result in dysfunction of perimeter access roads and/or stormwater channels. It is recommended that the sideslope of the external slope in the riparian area be examined routinely during site operation.

The analysis was conducted based on the available project information as discussed above. If field conditions are different from those assumed herein, the Engineer shall be notified and the calculations be re-evaluated.

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TABLES

Table 1. Material Properties Used in Slope Stability Analyses.

Tolson Rubble Landfill, Odenton, Anne Arundel County, Maryland

Material	**Moist Unit Weight, γ_m (lb/ft^3)**	**Saturated Unit Weight, γ_{sat} (lb/ft^3)**	**Undrained Shear Strength, S_u (lb/ft^2)**	**Effective Cohesion, c' (lb/ft^2)**	**Effective Friction Angle, ϕ' (°)**
Waste	50	-	-	0	33, with a minimum 500 psf (1)
Fill	120	130	-	0	30
Sand 1	120	130	-	0	30
Clay Seam	125	132	1,100	0	30
Clay 1	125	132	3,000	500	30.5
Surface Soils	125	132	1,000	1,000	25
Sand 2	124	130	-	0	32
Liner Interface	125	-	-	0	9

Notes:

(1) A bilinear shear strength drained envelope was used for Waste. In SLIDE, bilinear strength envelopes are defined by three pairs of coordinates with (normal stress, shear stress). For Waste, the following pairs were used: (0, 500), (770, 500) and (50000, 31970)].

Table 2. Summary of Documented Interface Friction Values.

Tolson Rubble Landfill, Odenton, Anne Arundel County, Maryland

Geosynthetic / Geosynthetic	**Peak Interface Friction Angle, δ_p (deg)**	**Large Displacement Interface Friction Angle, δ_{ld} (deg)**
Smooth HDPE Geomembrane / Nonwoven Geotextile	7 - 12	6 - 11
Smooth LLDPE Geomembrane / Nonwoven Geotextile	10 - 12	
Textured HDPE Geomembrane / Nonwoven Geotextile	22 - 35	
Smooth HDPE Geomembrane / Geonet	7 - 15	
Textured HDPE Geomembrane / Geonet	7 - 15	
Textured HDPE Geomembrane / Geocomposite	17 - 29	13 - 20
Geonet / Nonwoven Geotextile	13 - 22	
Smooth HDPE Geomembrane / GCL (hydrated)	8 - 12	
Textured HDPE Geomembrane / GCL (hydrated)	18 - 37	6 - 10
Geosynthetic / Soil	**$\tan(\delta_p) / \tan(\phi_p)$**	**$\tan(\delta_{ld}) / \tan(\phi_{ld})$**
Smooth HDPE Geomembrane / Clay	0.4 - 0.7	0.3 - 0.7
Textured HDPE Geomembrane / Clay	0.8 - 0.9	0.6 - 0.9
Smooth HDPE Geomembrane / Sand	0.5 - 0.6	
Textured HDPE Geomembrane / Sand	0.7 - 0.8	
Needlepunched Nonwoven Geotextile / Sand	0.8 - 1.0	
Needlepunched Nonwoven Geotextile / Angular Gravel	0.7 - 0.9	
Needlepunched Nonwoven Geotextile / Rounded Gravel	0.6 - 0.8	

Note:

1. Adapted from tests by Martin et al. [1984], Williams and Houlihan [1986, 1987], Koerner et al. [1986], Williams and Luna [1987], Eid and Stark [1997], Sabatini et al. [1998], Stark et al. [1998], manufacturer's literature, and unpublished results from Geosyntec Consultants.

Table 3. Design Properties of Protective Cover Soil and Interfaces of the Liner System.

Tolson Rubble Landfill, Odenton, Anne Arundel County, Maryland

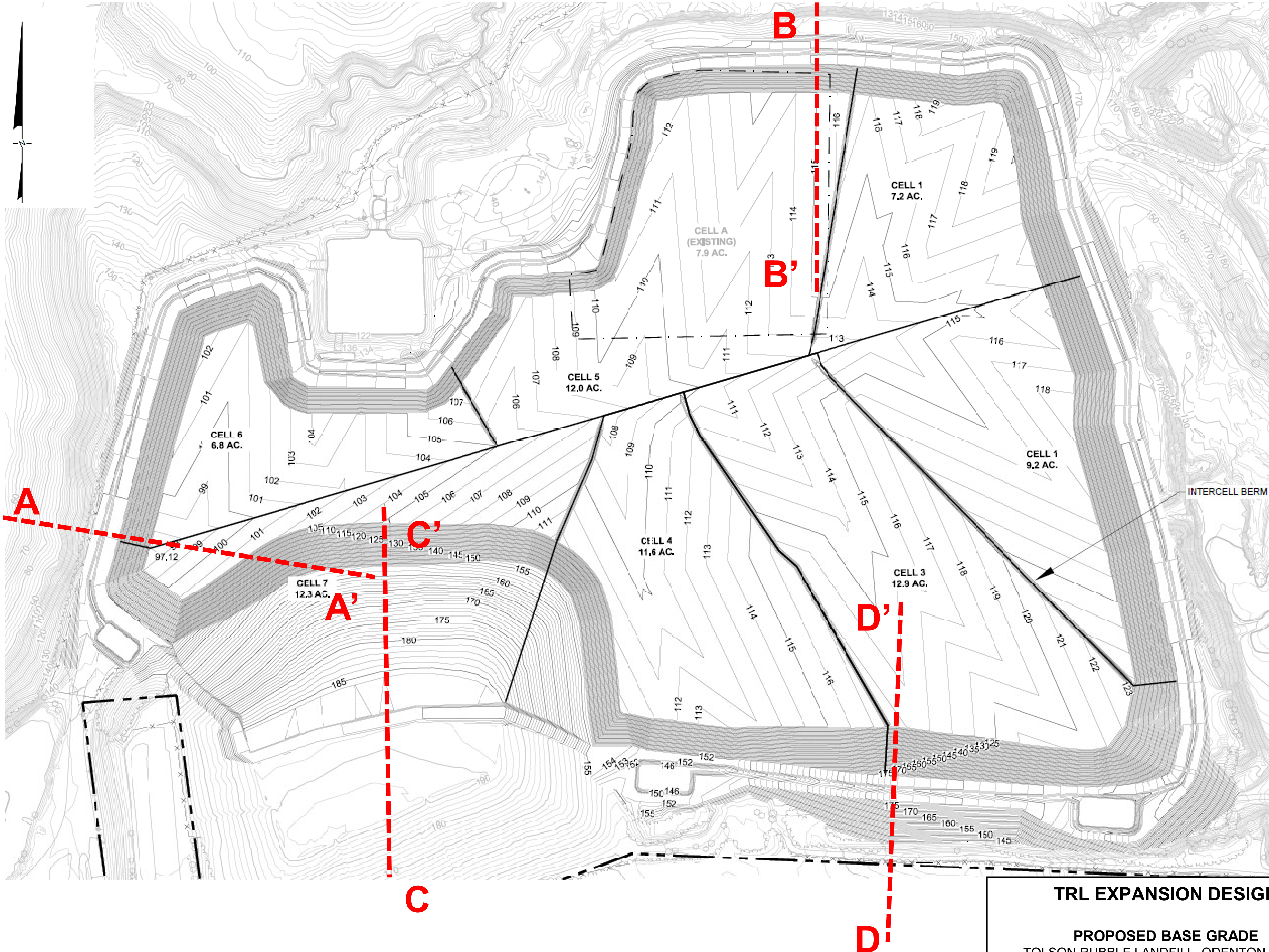
Interface	Assumption	Peak		Large Displacement	
		Friction Angle, δ	Adhesion, a	Friction Angle, δ	Adhesion, a
		(°)	(psf)	(°)	(psf)
Sand Protective Drainage Layer / Geotextile (Geocomposite)	tan(δp) / tan(ϕp) = 0.85, ϕ = 30°	26	0	26	0
Geocomposite / Textured HDPE Geomembrane	Attachment 6 - laboratory value	27	515	9	237
Textured HDPE Geomembrane / Clay	Attachment 6 - laboratory value	17	116	17	107

Table 4. Results of SLIDE Analyses.

Tolson Rubble Landfill, Odenton, Anne Arundel County, Maryland

Cross-Section	Case	Failure Type	Calculated Factor of Safety	Recommended Minimum Factor of Safety
A-A'	1. Short-term (undrained)	Circular	1.84	1.3
		Non-Circular	1.52	
		Non-Circular (liner interface)	1.63	
	2. Long-term (drained)	Circular	1.52	1.5
		Non-Circular	1.63	
		Non-Circular (liner interface)	1.63	
B-B'	1. Short-term (undrained)	Circular	2.84	1.3
		Non-Circular	2.88	
		Non-Circular (liner interface)	1.83	
	2. Long-term (drained)	Circular	2.80	1.5
		Non-Circular	2.97	
		Non-Circular (liner interface)	1.83	
C-C'	1. Short-term (undrained)	Circular	2.53	1.3
		Non-Circular	3.24	
		Non-Circular (liner interface)	1.68	
	2. Long-term (drained)	Circular	2.34	1.5
		Non-Circular	3.70	
		Non-Circular (liner interface)	1.68	
D-D'	1. Short-term (undrained)	Circular	2.60	1.3
		Non-Circular	2.18	
		Non-Circular (liner interface)	2.43	
	2. Long-term (drained)	Circular	2.61	1.5
		Non-Circular	2.18	
		Non-Circular (liner interface)	2.43	

FIGURES

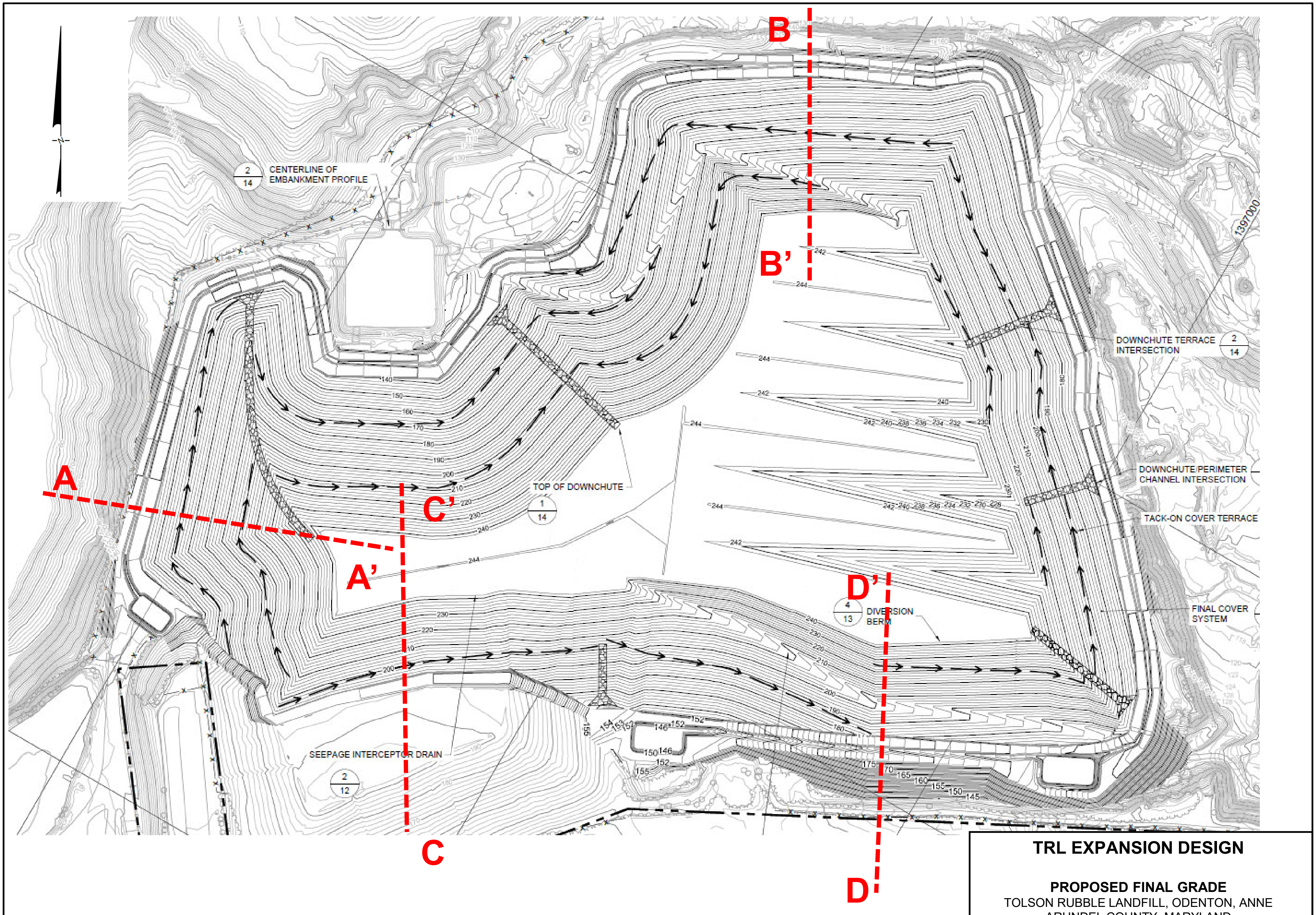


TRL EXPANSION DESIGN

PROPOSED BASE GRADE
TOLSON RUBBLE LANDFILL, ODENTON, ANNE ARUNDEL COUNTY, MARYLAND

Geosyntec consultants

Columbia, MD	July 2020	FIGURE 1



TRL EXPANSION DESIGN

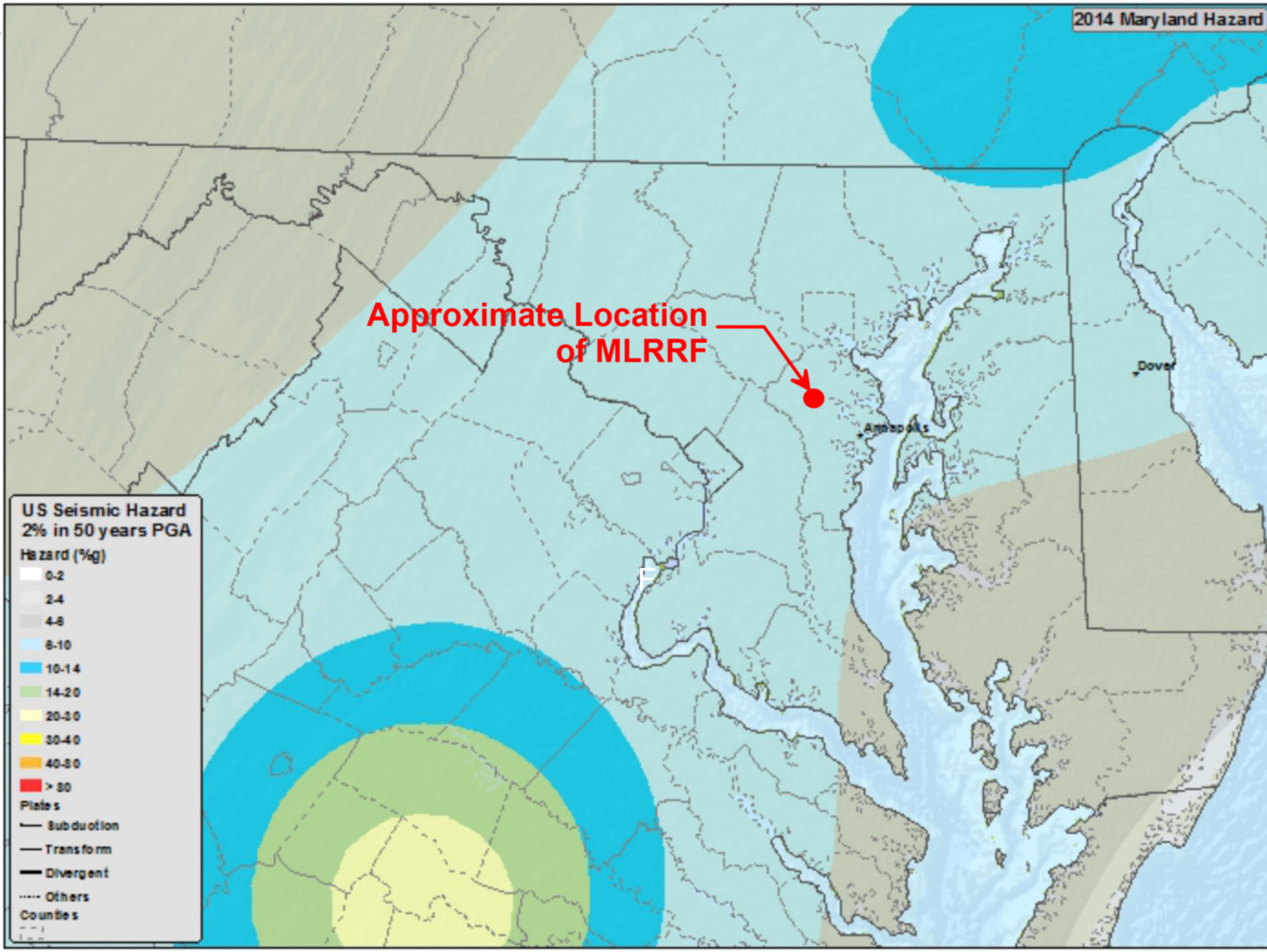
PROPOSED FINAL GRADE

TOLSON RUBBLE LANDFILL, ODENTON, ANNE ARUNDEL COUNTY, MARYLAND

Geosyntec consultants

Columbia, MD | July 2020

FIGURE 2



Reference:
1) Seismic hazard map from United States Geological Survey [2012]

TRL EXPANSION DESIGN

SEISMIC HAZARD MAP (USGS)
TOLSON RUBBLE LANDFILL, ODENTON, ANNE ARUNDEL COUNTY, MARYLAND

Geosyntec consultants

FIGURE 3

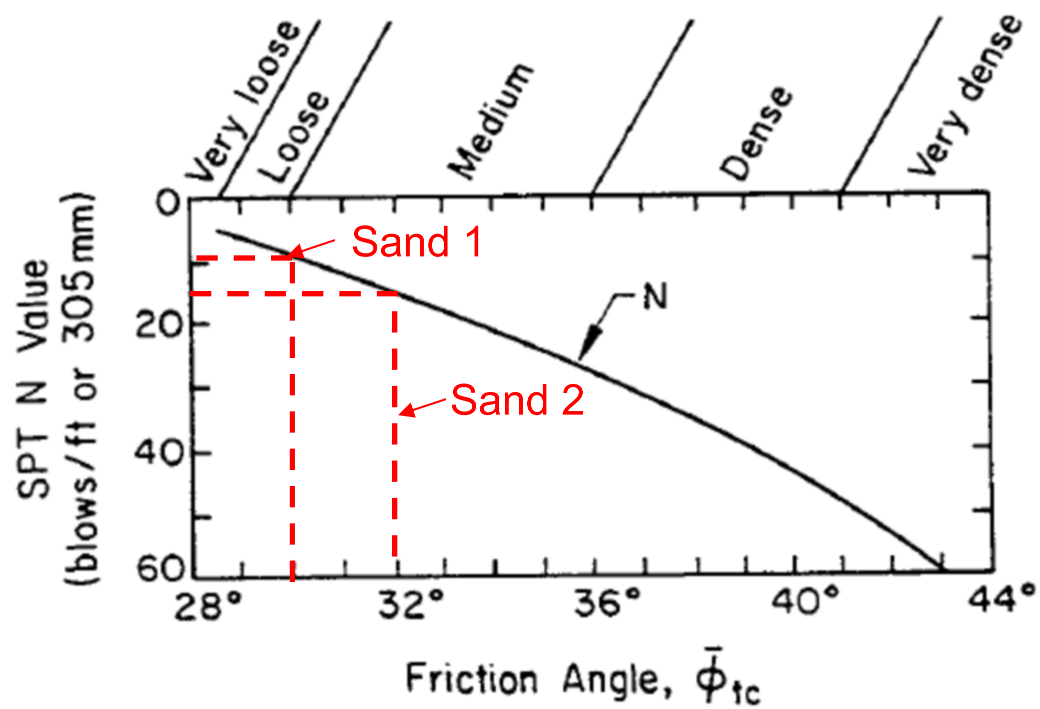
Columbia, MD | February 2020

N Value (blows/ft or 305 mm)	Relative Density	Approximate $\bar{\phi}_{tc}$ (degrees) (a)	(b)
0 to 4	very loose	< 28	< 30
4 to 10	loose	28 to 30	30 to 35
10 to 30	medium	30 to 36	35 to 40
30 to 50	dense	36 to 41	40 to 45
> 50	very dense	> 41	> 45

Sand 1

Sand 2

a - Source: Peck, Hanson, and Thornburn (12), p. 310.
b - Source: Meyerhof (13), p. 17.



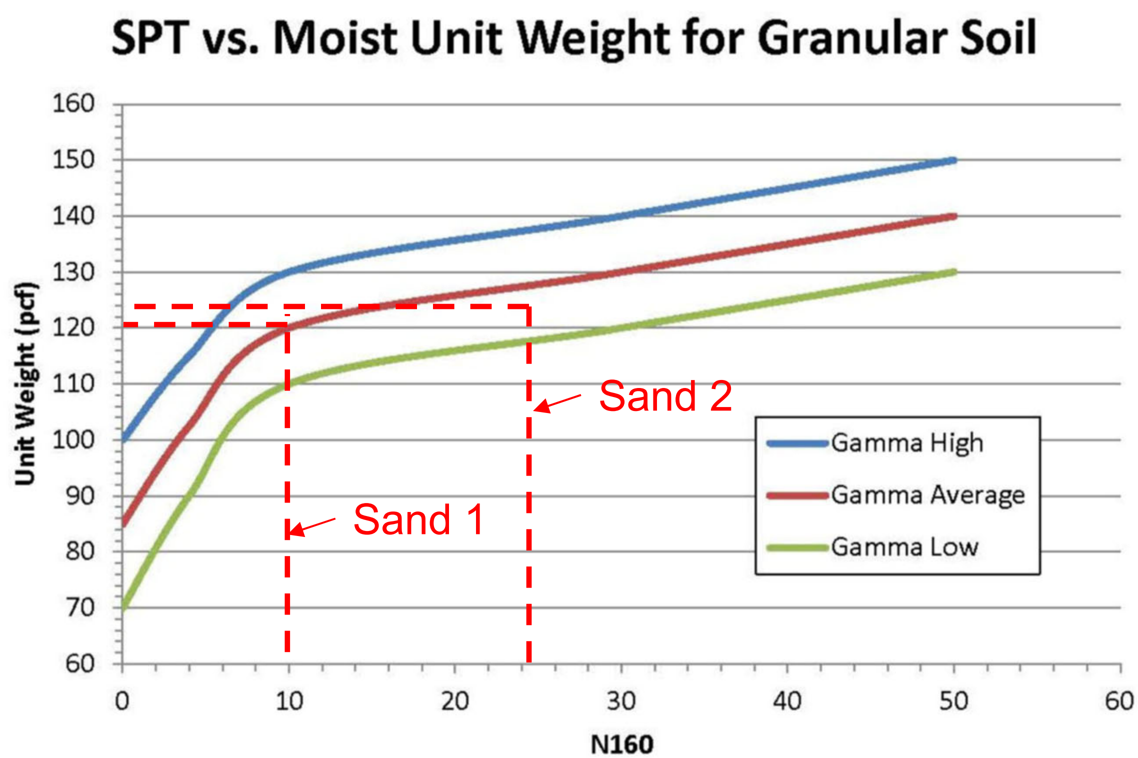
TRL EXPANSION DESIGN

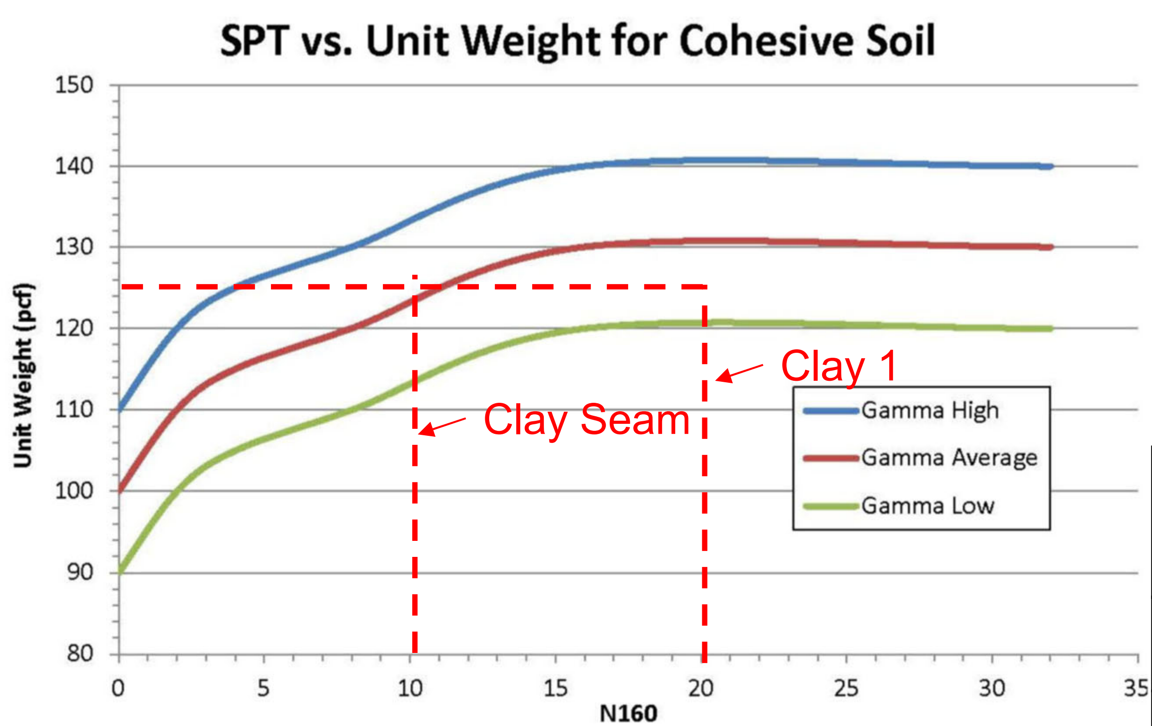
SEISMIC HAZARD MAP (USGS)
TOLSON RUBBLE LANDFILL, ODENTON, ANNE ARUNDEL COUNTY, MARYLAND

Geosyntec consultants

FIGURE 4

Columbia, MD | February 2020





TRL EXPANSION DESIGN

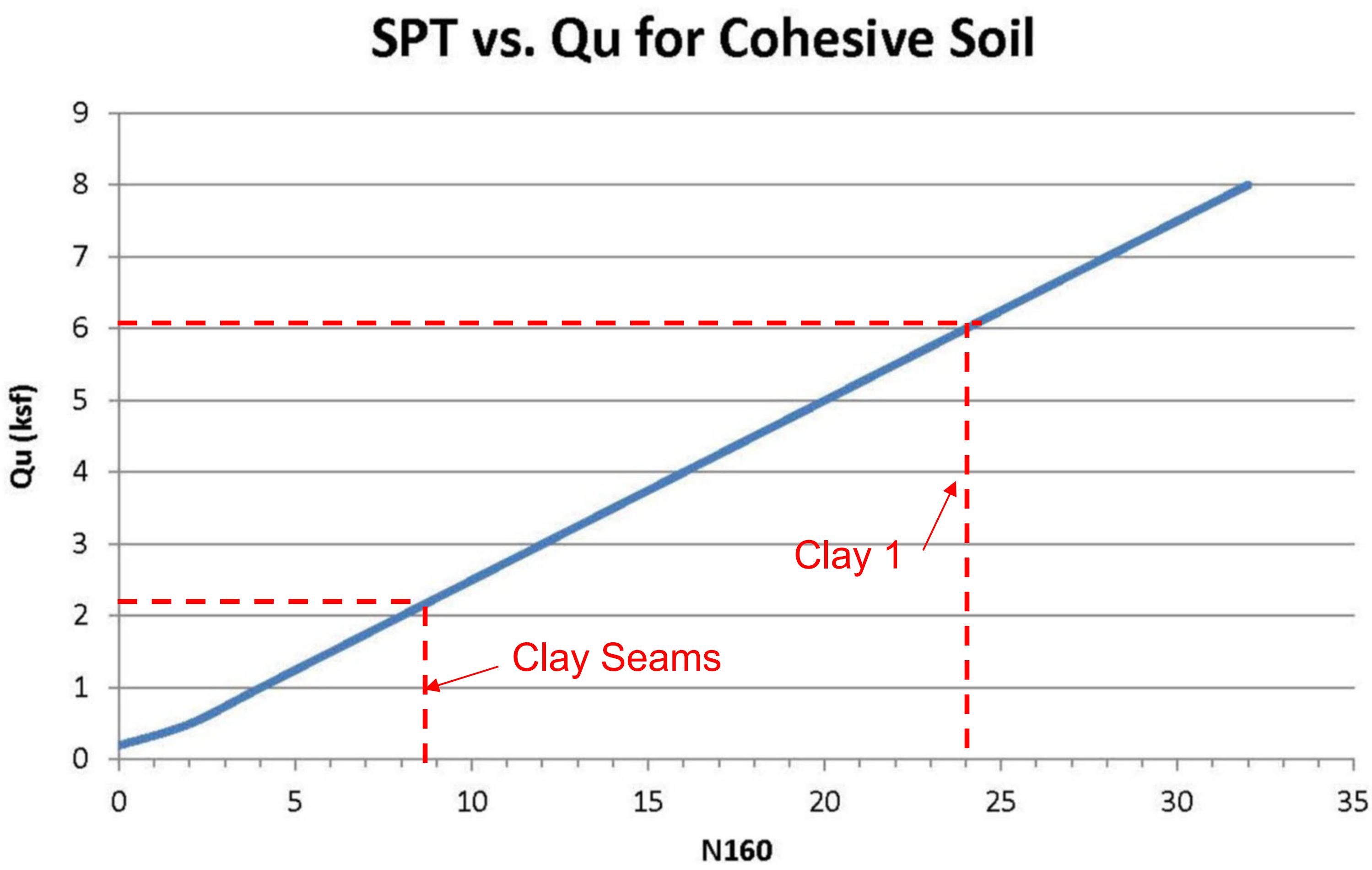
EFFECTIVE FRICTION ANGLE VERSUS N-VALUE

TOLSON RUBBLE LANDFILL, ODENTON, ANNE ARUNDEL COUNTY, MARYLAND

Geosyntec consultants

FIGURE 5

Columbia, MD | February 2020



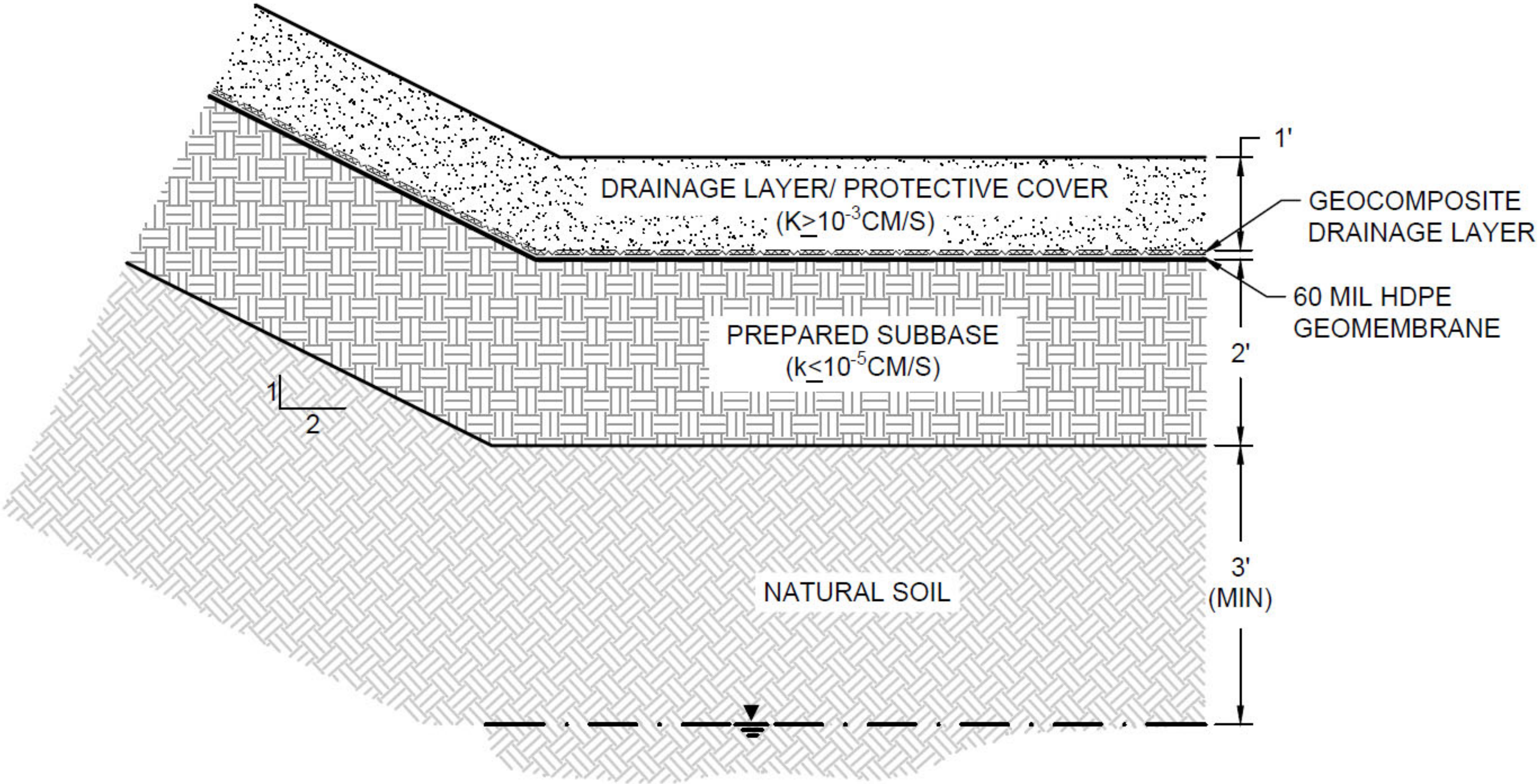
Note: Su = Qu / 2

TRL EXPANSION DESIGN

Q_U VERSUS N_{60}-VALUE
TOLSON RUBBLE LANDFILL, ODENTON, ANNE ARUNDEL COUNTY, MARYLAND

Geosyntec consultants

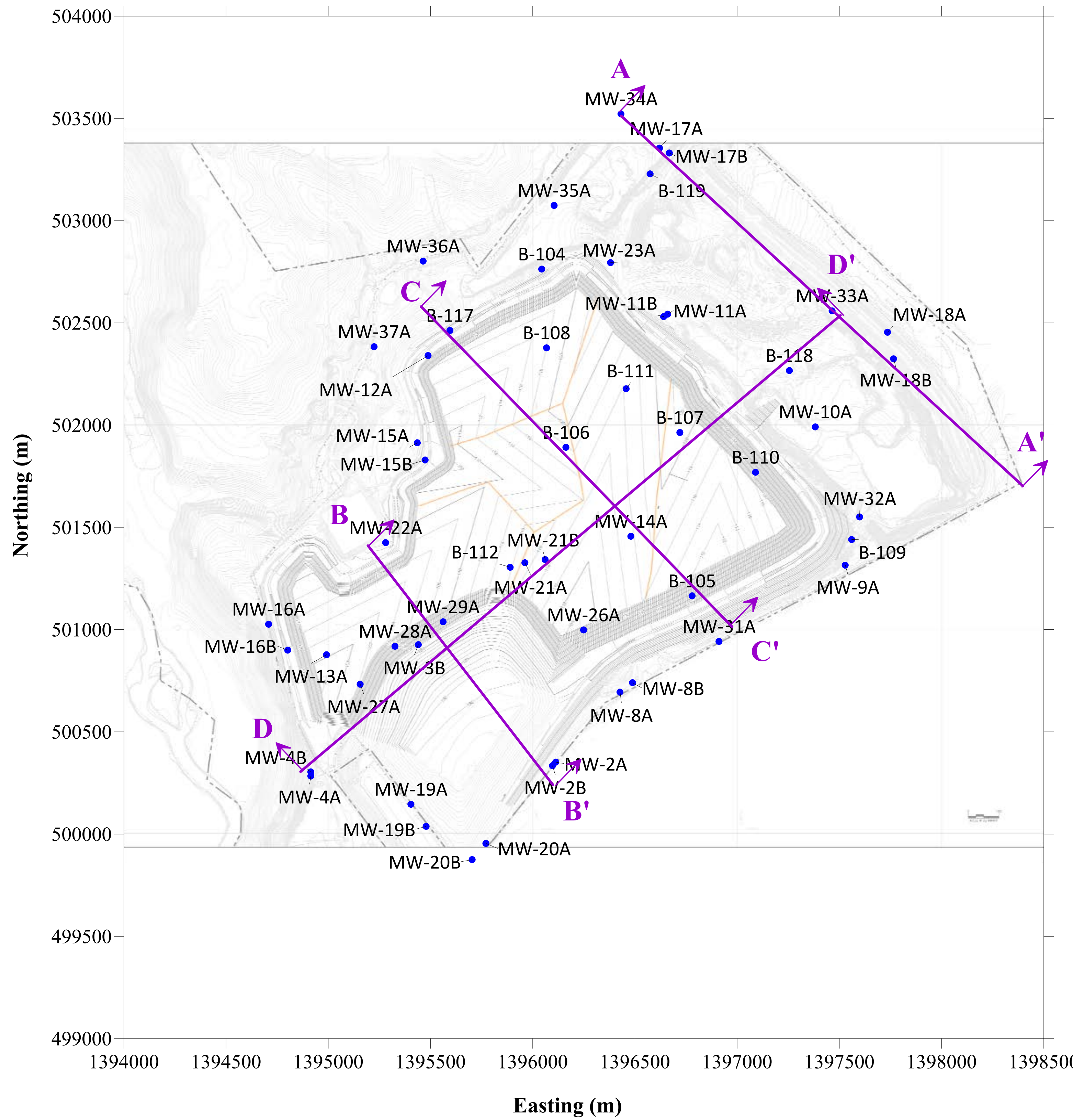
Columbia, MD	February 2020	FIGURE 6

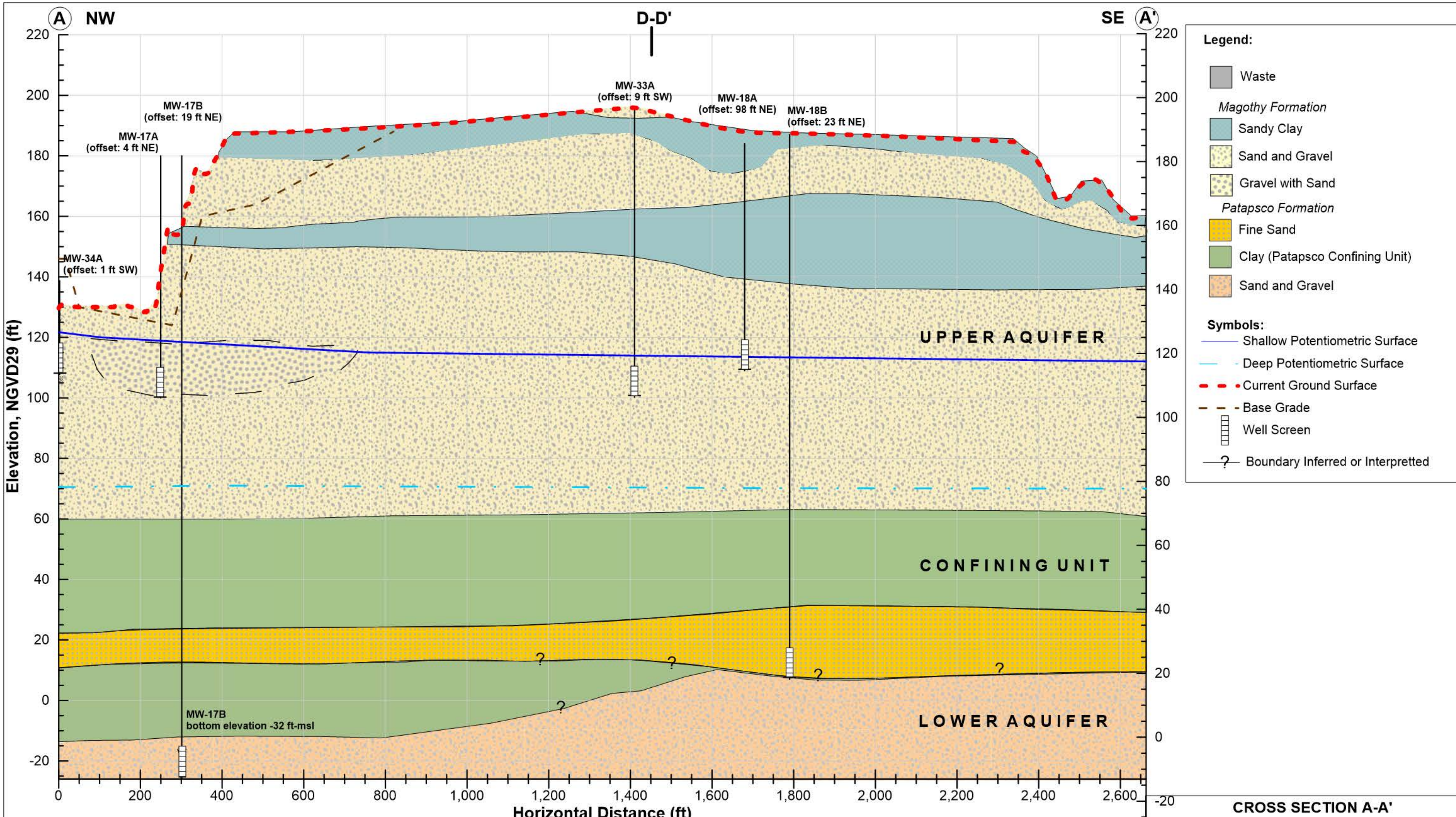


TRL EXPANSION DESIGN		
LINER SYSTEM TOLSON RUBBLE LANDFILL, ODENTON, ANNE ARUNDEL COUNTY, MARYLAND		
Geosyntec consultants		FIGURE 7
Columbia, MD	February 2020	

ATTACHMENT 1

Subsurface Stratigraphy [Geosyntec, 2019]


Northing (m)
Easting (m)
504000
503500
503000
502500
502000
501500
501000
500500
500000
499500
499000
1394000
1394500
1395000
1395500
1396000
1396500
1397000
1397500
1398000
1398500
A
A'
B
B'
C
C'
D
D'
MW-34A
MW-17A
MW-17B
B-119
MW-35A
MW-36A
B-104
MW-23A
MW-11B
MW-11A
MW-33A
MW-18A
MW-18B
B-117
MW-37A
B-108
B-111
B-118
MW-12A
MW-10A
B-107
MW-15A
B-106
MW-15B
B-110
MW-32A
MW-22A
MW-14A
MW-21B
B-112
B-109
MW-21A
MW-9A
B-105
MW-16A
MW-29A
MW-26A
MW-28A
MW-31A
MW-16B
MW-3B
MW-13A
MW-8B
MW-27A
MW-8A
MW-4B
MW-2A
MW-2B
MW-4A
MW-19A
MW-19B
MW-20A
MW-20B



Notes:

1. Soil profiles shown are generalizations based on available drawings, boring logs, and related information.
2. Soil profiles shown between boreholes involve extrapolations and interpolations.Variations from the profile depicted in this section should be expected.
3. Water elevations measured in March 2019.
4. Potentiometric surface infered from March 2019 potentiometric surface map.

CROSS SECTION A-A'

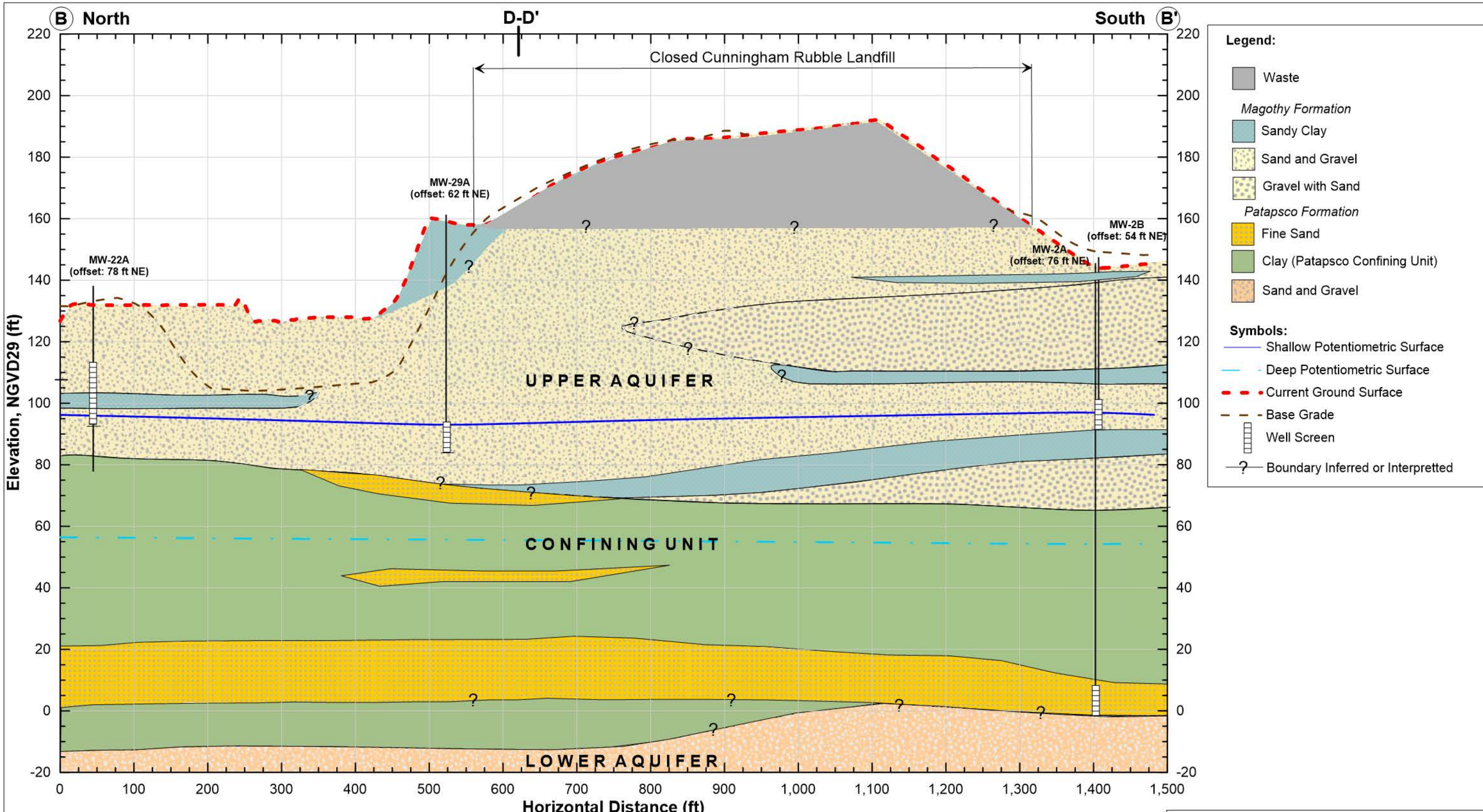
Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Geosyntec consultants

FIGURE

1

Columbia, Maryland | March 2020



Notes:

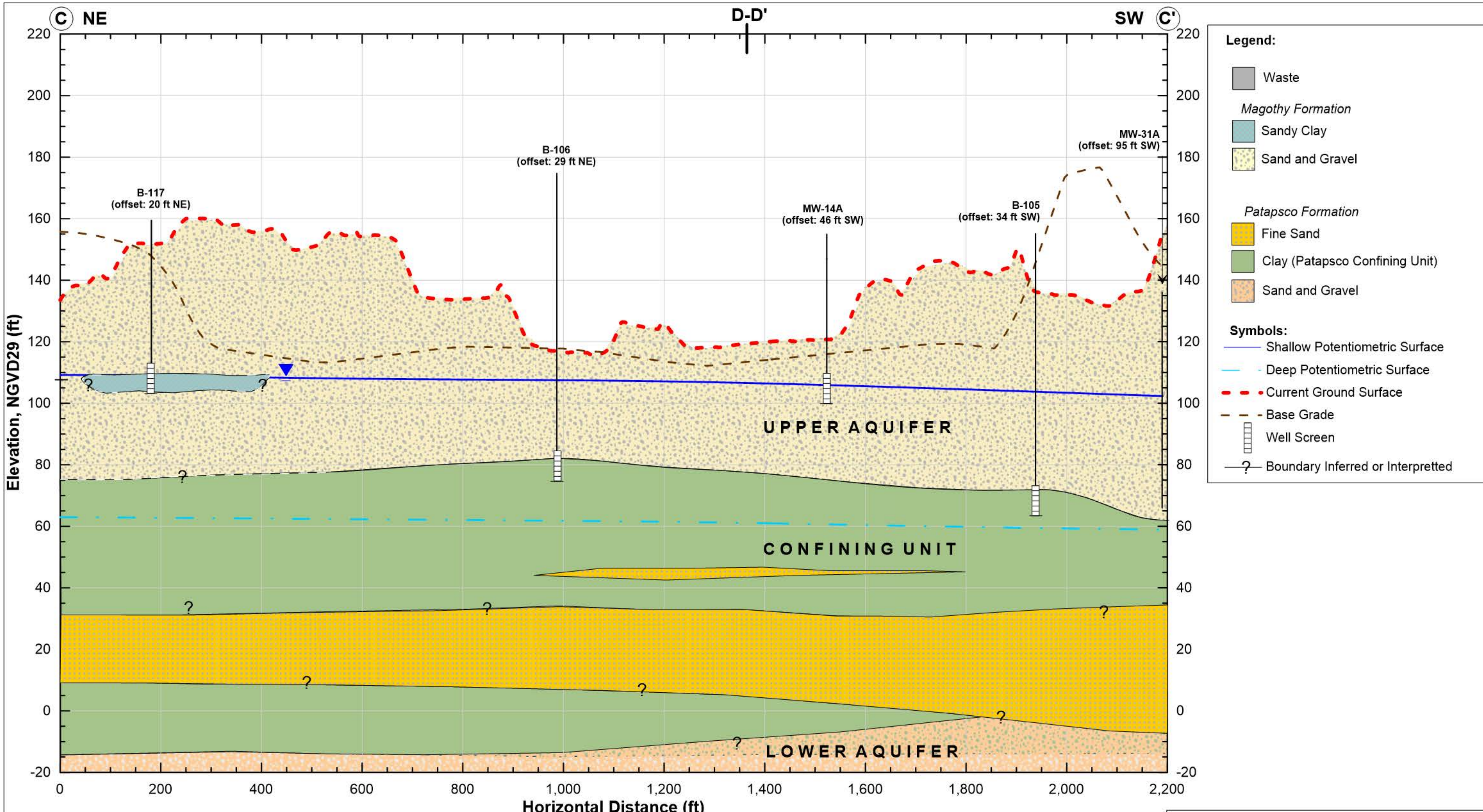
1. Soil profiles shown are generalizations based on available drawings, boring logs, and related information.
2. Soil profiles shown between boreholes involve extrapolations and interpolations.Variations from the profile depicted in this section should be expected.
3. Water elevations measured in March 2019.
4. Potentiometric surface infered from March 2019 potentiometric surface map.

CROSS SECTION B-B'

Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Geosyntec consultants

Columbia, Maryland	March 2020	FIGURE 2



Notes:

1. Soil profiles shown are generalizations based on available drawings, boring logs, and related information.
2. Soil profiles shown between boreholes involve extrapolations and interpolations.Variations from the profile depicted in this section should be expected.
3. Water elevations measured in March 2019.
4. Potentiometric surface infered from March 2019 potentiometric surface map.

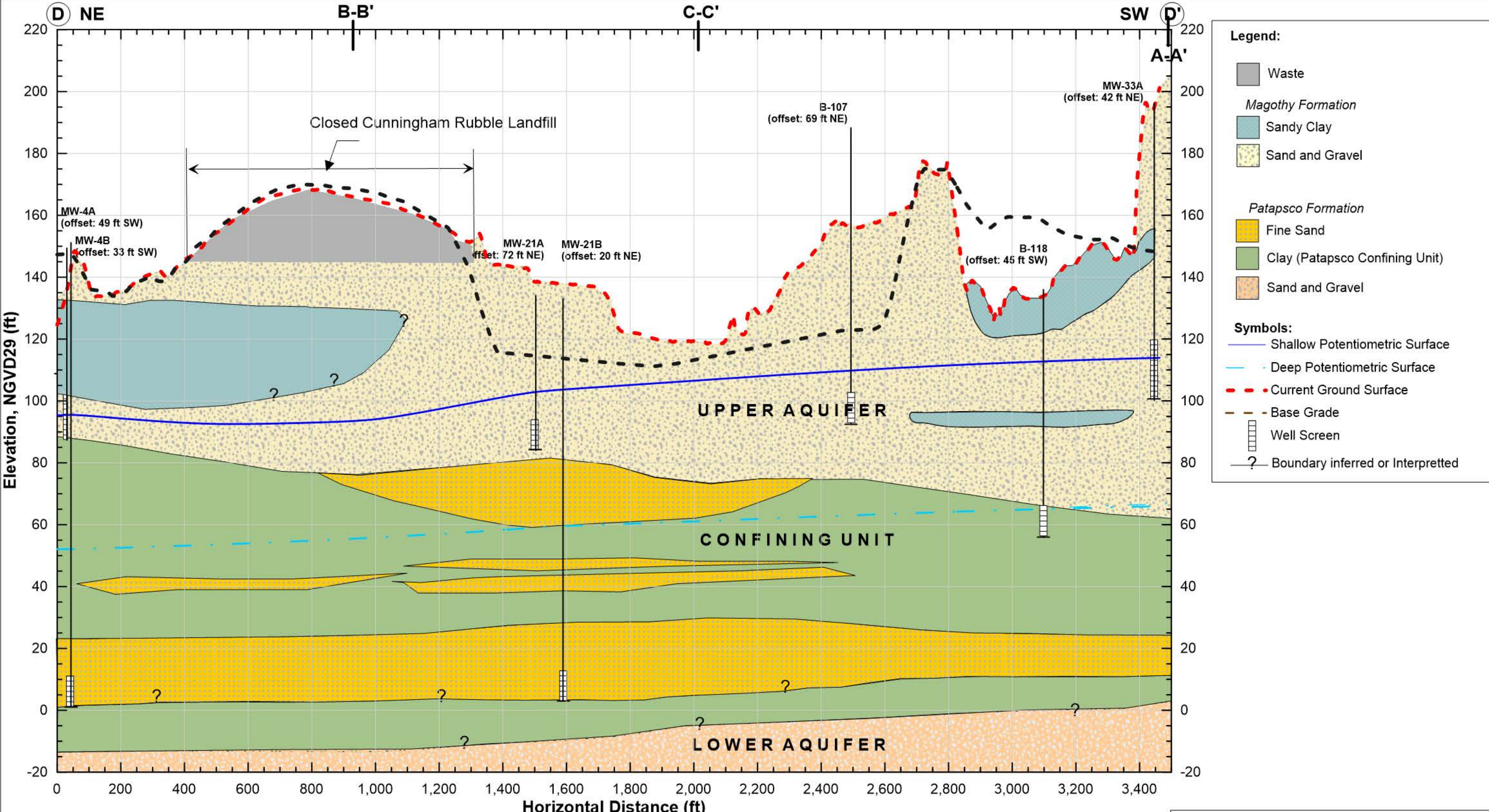
CROSS SECTION C-C'

Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Geosyntec consultants

Columbia, Maryland | March 2020

FIGURE 3



Notes:

1. Soil profiles shown are generalizations based on available drawings, boring logs, and related information.
2. Soil profiles shown between boreholes involve extrapolations and interpolations.Variations from the profile depicted in this section should be expected.
3. Water elevations measured in March 2019.
4. Potentiometric surface infered from March 2019 potentiometric surface map.

CROSS SECTION D-D'

Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Geosyntec consultants

FIGURE 4

Columbia, Maryland | March 2020

ATTACHMENT 2

USGS Unified Hazard Tool Output

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Input

Edition

Conterminous U.S. 2014 (v4.(

Latitude

Decimal degrees

39.041667

Longitude

Decimal degrees, negative values for weste…

-76.708333

Site Class

760 m/s (B/C boundary)

Spectral Period

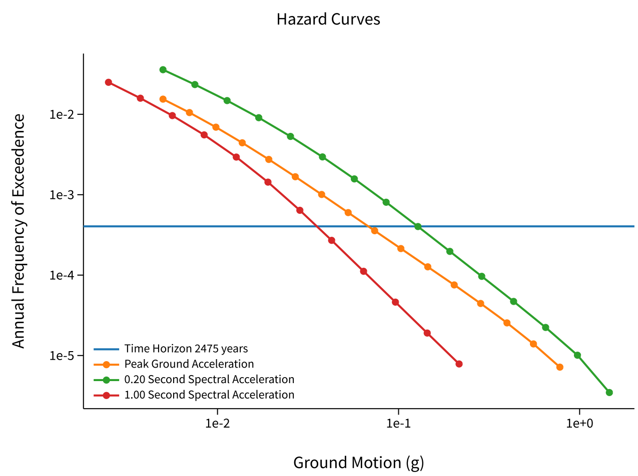
Please select…

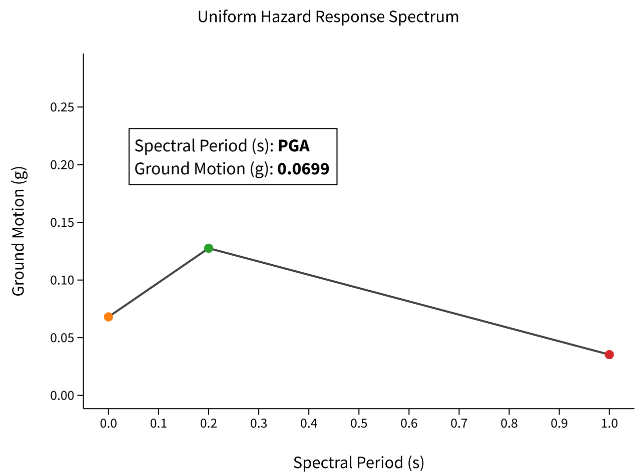
Time Horizon

Return period in years

2475

Hazard Curve





[View Raw Data]

ATTACHMENT 3

Historical Boring and Piezometer Installation Logs

ENVIRONMENTAL RESOURCES MANAGEMENT

Tolson & Associates, LLC

Semi-Annual Monitoring Report June 2017

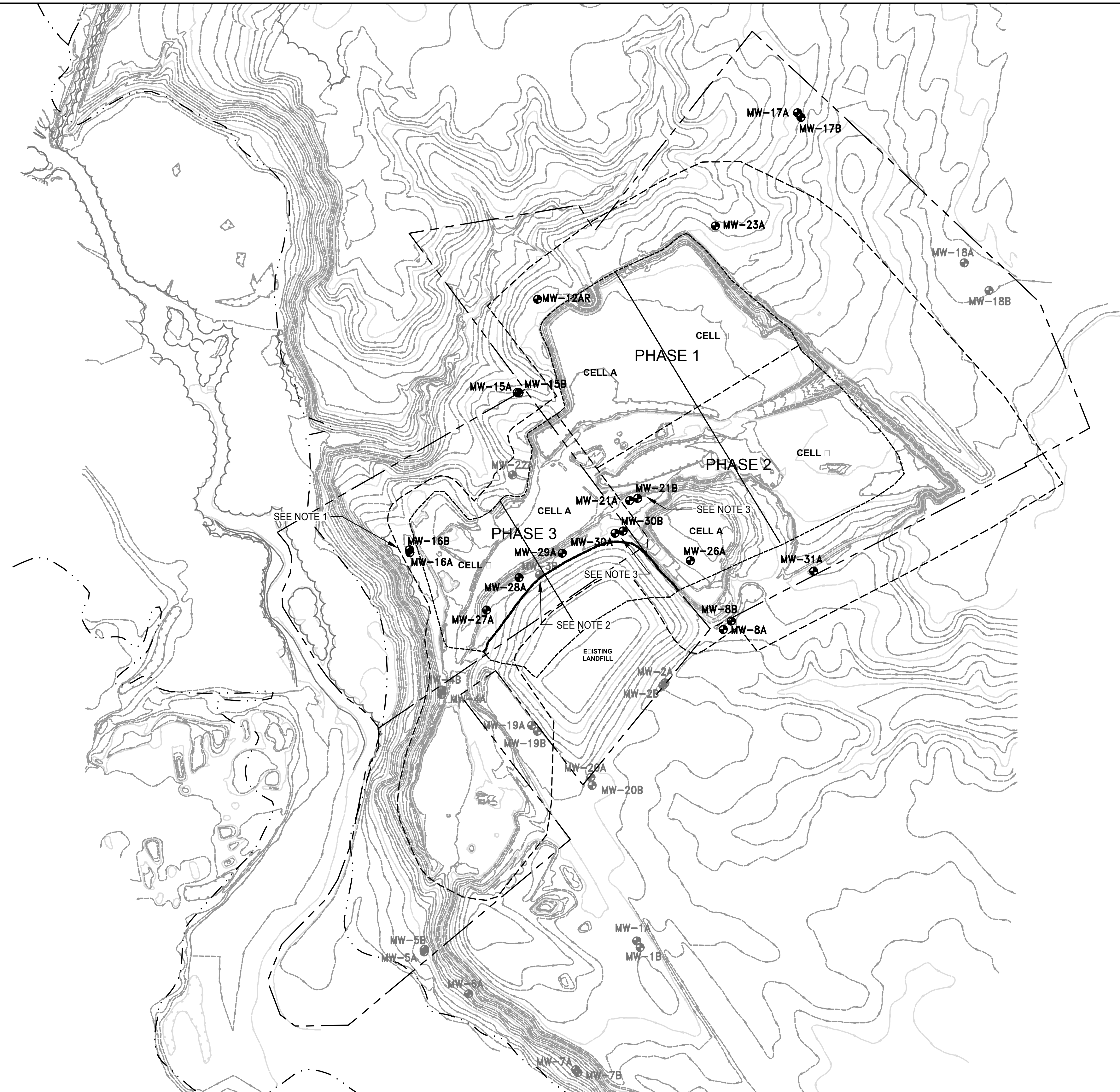
Tolson Rubble Landfill Crofton, Maryland

June 28, 2017

Project Number: 0277353

Environmental Resources Management, Inc.
180 Admiral Cochrane Drive, Suite 400
Annapolis, Maryland 21401

ERM



NOTES:

1. WELLS MW-16A & MW-16B ARE PROPOSED FOR ABANDONMENT AND SUBSEQUENT REINSTALLATION AS MW-16AR & MW-16BR, RESPECTIVELY.
2. WELL MW-3B, NOT INCLUDED FOR GROUNDWATER MONITORING, TO BE ABANDONED DURING CONSTRUCTION OF PHASE 3.
3. WELLS MW-21A AND MW-21B WILL BE ABANDONED AND REPLACED WITH MW-30A AND MW-30B. HOWEVER, MW-21A AND MW-21B WILL REMAIN IN THE NETWORK UNTIL DEMONSTRATED THAT MW-30A AND MW-30B YIELD REPRESENTATIVE SAMPLES.
4. BOLD-SHADED WELLS ARE INCLUDED IN MONITORING PROGRAM.
5. GREY-SHADED WELLS ARE NOT INCLUDED IN MONITORING PROGRAM.
6. WATER LEVEL MEASUREMENTS ARE COLLECTED FROM WELLS MW-2A, MW-2B, MW-18A, AND MW-18B TO SUPPLEMENT MEASUREMENTS FROM THE 19 WELLS INCLUDED IN THE MONITORING PROGRAM.

ENVIRONMENTAL RESOURCES MANAGEMENT, INC.

ERM

N

650 325 0 650

SCALE IN FEET

LEGEND:

PROPERTY LINE

EXISTING WELLS INCLUDED IN MONITORING PROGRAM

EXISTING MONITORING WELLS NOT INCLUDED IN MONITORING PROGRAM

PHASE BOUNDARY

CELL BOUNDARY

FIGURE 2
GROUNDWATER MONITORING WELL NETWORK

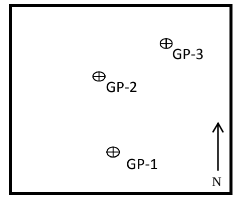
TOLSON RUBBLE LANDFILL
CROFTON, MARYLAND

Q:\Team\DMM\Exton\Tolson\0277353\0277353-01.dwg, GW MONITORING WELL, 6/6/2017 3:31:00 PM, GML

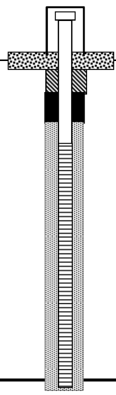
Appendix B
Construction Logs

Environmental Resources Management **GP-1**

WO No:	277353	Project	Tolson Rubble Landfill			
Location	Crofton, MD	Owner	Tolson & Associates, LLC			
Completed	2-Nov-16	Boring Depth (feet)	20		Diameter	6 inches
Northing	501804.00	Surface Elevation	NA	feet, site datum		
Easting	1395411.04	Riser Elevation	148.44	feet, site datum		
Screen	Schedule 40 PVC	Riser Length (feet)	7.5		Diameter	2 inches
Slot Size	0.02 inches					
Riser	Schedule 40 PVC	Length (feet)	15		Diameter	2 inches
Drilling Method	Hollow Stem Auger	Driller(s)	Mike Waller, Marshal Armitts, Ray Peters		Geologist	Skylar Georgius
Drillng Company	Allied Well Drilling					



Location Sketch Map



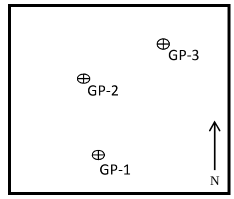
Depth (feet BGS)	Elevation (feet, MSL)	Gas Point Construction Schematic	Interval (feet BGS)	Blow Counts	Recovery (inches)		Sample Description/Classification
0							
4			3-5	1-1-2-3	24	3-4	Moist, loose, hard, brown to dark brown CLAY and SAND with GRAVEL starteing at 3.1 ft BGS.
						4-5	Moist, plastic, brown to dark brown silty SAND, CLAY, and GRAVEL.
8			8-10	2-1-3-3	12	8-9	No recovery.
12						9-10	Moist, loose, brown silty SAND with CLAY and some GRAVEL.
			13-15	2-3-3-4	24		
16						13-14	Moist, loose, brown silty SAND and CLAY with GRAVEL.
						14-15	Moist, brown to dark brown SAND with more CLAY and mottled grey-black coloring.
20			18-20	1-1-1-2	12	18-19	No recovery.
						19-20	Damp to very damp brown, orange, and black, plastic and soft silty SAND and mostly black CLAY for 19.7 to 20 ft BGS.

NOTE: Spoons were taken every five ft BGS with a maximum two ft interval.

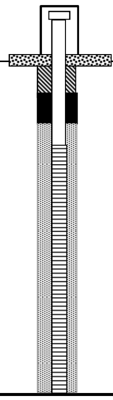
Environmental Resources Management

GP-2

WO No:	277353	Project	Tolson Rubble Landfill			
Location	Crofton, MD	Owner	Tolson & Associates, LLC			
Completed	2-Nov-16	Boring Depth (feet)	20	Diameter	6 inches	
Northing	502190.38	Surface Elevation	NA	feet, site datum		
Easting	1395339.97	Riser Elevation	150.31	feet, site datum		
Screen	Schedule 40 PVC	Riser Length (feet)	7.5	Diameter	2 inches	
Slot Size	0.02 inches					
Riser	Schedule 40 PVC	Length (feet)	15	Diameter	2 inches	
Drilling Method	Hollow Stem Auger	Driller(s)	Mike Waller, Marshal Armitts, Ray Peters	Geologist	Skylar Georgius	
Drillng Company	Allied Well Drilling					



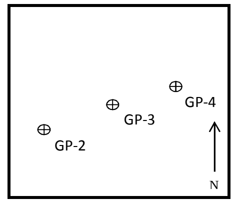
Location Sketch Map

Depth (feet BGS)	Elevation (feet, MSL)	Gas Point / Construction / Schematic	Interval (feet BGS)	Blow Counts	Recovery (inches)		Sample Description/Classification
0							
4			3-5	2-3-3-3	18	3-4.5	Moist, hard to loose, brown to orange-brown silty SAND with fine to medium grained SAND at 4.5 ft BGS.
8							
12			8-10	2-2-4-2	18	8-9	No recovery from 8-8.5 ft BGS, Moist, loose, brown to orange-brown silty SAND with CLAY from 8.5 to 9 ft BGS.
						9-10	Dry, loose, medium to coarse, white and brown SAND with angular to sub angula quartz GRAVEL.
16			13-15	3-3-6-7	12	13-14	No Recovery.
						14-15	Dry, loose, medium to coarse, white and brown SAND with large (~ 1 inch sized angular to sub angular quartz GRAVEL.
20			18-20	1-3-3-5	12	18-19	No Recovery.
						19	Dry, loose, medium to coarse, buff and orange-brown SAND with angular to sub-rounded GRAVEL.

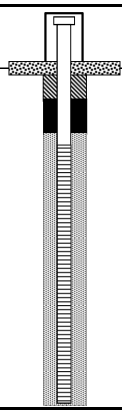
NOTE: Spoons were taken every five ft BGS with a maximum two ft interval.

Environmental Resources Management **GP-3**

WO No:	277353	Project	Tolson Rubble Landfill		
Location	Crofton, MD	Owner	Tolson & Associates, LLC		
Completed	2-Nov-16	Boring Depth (feet)	20	Diameter	6 inches
Northing	502448.04	Surface Elevation	NA	feet, site datum	
Easting	1395485.80	Riser Elevation	153.05	feet, site datum	
Screen	Schedule 40 PVC	Riser Length (feet)	7.5	Diameter	2 inches
Slot Size	0.02 inches				
Riser	Schedule 40 PVC	Length (feet)	15	Diameter	2 inches
Drilling Method	Hollow Stem Auger	Driller(s)	Mike Waller, Marshal Armitts, Ray Peters	Geologist	Skylar Georgius
Drillng Company	Allied Well Drilling				



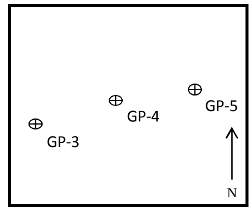
Location Sketch Map

Depth (feet BGS)	Elevation (feet, MSL)	Gas Point / Construction / Schematic	Interval (feet BGS)	Blow Counts	Recovery (inches)		Sample Description/Classification
0							
4			3-5	2-2-2-2	24	3-5	Dry to damp, orange-brown fine to medium grained silty SAND with some loose CLAY.
						5	Same as above with addititional grey SAND.
8			8-10	2-3-5-5	24		
						9-10	Small rounded GRAVELwith loose orange, brown, grey SAND.
12			13-15	2-6-6-8	24	13-14	Hard, red, iron-like Nodules with orange and brown fine grained SAND and lenses of coarse, red mesium SAND and GRAVEL.
16						14-15	Dry, loose, orange and brown, fine to medium grained SAND with some rounded black, cream, and white pea GRAVEL. Wood debris a 14.1 ft BGS. At 15 ft BGS some grey to black sandy CLAY lenses.
			18-20	6-7-8-7	12	18-19	No recovery from 18-19 ft BGS. Orange-red sandstone rock stuck in split-spoon.
20						19-20	Dry, orange-brown to dark-brown, fine to medium grained silty SAND. At 19.4 ft BGS a piece of dry wood.

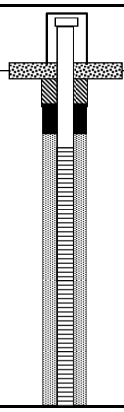
NOTE: Spoons were taken every five ft BGS with a maximum two ft interval.

Environmental Resources Management **GP-4**

WO No:	277353	Project	Tolson Rubble Landfill		
Location	Crofton, MD	Owner	Tolson & Associates, LLC		
Completed	1-Nov-16	Boring Depth (feet)	20	Diameter	6 inches
Northing	502635.00	Surface Elevation	NA	feet, site datum	
Easting	1395762.28	Riser Elevation	159.43	feet, site datum	
Screen	Schedule 40 PVC	Riser Length (feet)	7.5	Diameter	2 inches
Slot Size	0.02 inches				
Riser	Schedule 40 PVC	Length (feet)	15	Diameter	2 inches
Drilling Method	Hollow Stem Auger	Driller(s)	Mike Waller, Marshal Armitts, Ray Peters	Geologist	Skylar Georgius
Drillng Company	Allied Well Drilling				



Location Sketch Map



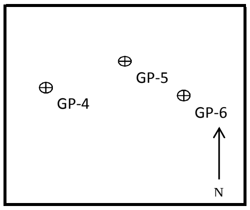
Depth (feet BGS)	Elevation (feet, MSL)	Gas Point Construction Schematic	Interval (feet BGS)	Blow Counts	Recovery (inches)	Sample Description/Classification
0						
4			4-6	2-3-13-11	20	4-5 Dry, brown, fine-grained SAND and GRAVEL.
						5-6 Moist, brown silty CLAY with quartz clasts.
8						9-9.5 Dry, brown, fine-grained SAND and GRAVEL.
12			9-11	9-8-9-9	18	9.5-10.5 Moist, brown silty CLAY with GRAVELS.
16			14-16	4-4-3-5	16	14-14.25 Moist, brown silty CLAY with GRAVELS.
						14.25-15.75 Moist, brown-black silty CLAY.
20			19-21	33-33-43-50/4	24	19-19.5 Moist, brown-black silty CLAY.
						19.5-21 Dry, brown to grey, fine-grained SAND.

NOTE: Spoons were taken every five ft BGS with a maximum two ft interval.

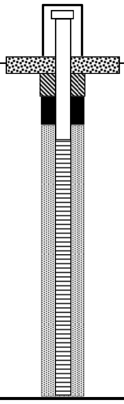
Environmental Resources Management

GP-5

WO No:	277353	Project	Tolson Rubble Landfill		
Location	Crofton, MD	Owner	Tolson & Associates, LLC		
Completed	2-Nov-16	Boring Depth (feet)	20	Diameter	6 inches
Northing	502832.04	Surface Elevation	NA	feet, site datum	
Easting	1396144.92	Riser Elevation	169.57	feet, site datum	
Screen	Schedule 40 PVC	Riser Length (feet)	7.5	Diameter	2 inches
Slot Size	0.02 inches				
Riser	Schedule 40 PVC	Length (feet)	15	Diameter	2 inches
Drilling Method	Direct Push Geoprobe	Driller(s)	Mike Waller, Marshal Armitts, Ray Peters	Geologist	Skylar Georgius
Drillng Company	Allied Well Drilling				



Location Sketch Map

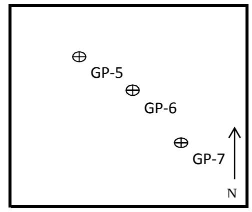


Depth (feet BGS)	Elevation (feet, MSL)	Gas Point Construction Schematic	Interval (feet BGS)	Blow Counts	Recovery (inches)	Sample Description/Classification	
0							
4			0-5	Direct Push	48	0-4	Dry, compressed, fine-grain SAND.
8			5-10	Direct Push	60	5-10	Dry, compressed, fine-grain SAND.
12			10-15	Direct Push	60	10-11.5	Dry, compressed, fine-grain SAND.
						11.5-15	Moist, grey to brown silty CLAY.
16			15-20	Direct Push	36	15-18	Dry, loose, fine-grained SAND.
20							

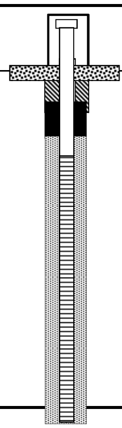
Environmental Resources Management

GP-6

WO No:	277353	Project	Tolson Rubble Landfill		
Location	Crofton, MD	Owner	Tolson & Associates, LLC		
Completed	27-Oct-16	Boring Depth (feet)	20	Diameter	6 inches
Northing	502722.64	Surface Elevation	NA	feet, site datum	
Easting	1396355.59	Riser Elevation	175.19	feet, site datum	
Screen	Schedule 40 PVC	Riser Length (feet)	7.5	Diameter	2 inches
Slot Size	0.02 inches				
Riser	Schedule 40 PVC	Length (feet)	15	Diameter	2 inches
Drilling Method	Hollow Stem Auger	Driller(s)	Mike Waller, Marshal Armitts, Ray Peters	Geologist	Skylar Georgius
Drillng Company	Allied Well Drilling				



Location Sketch Map

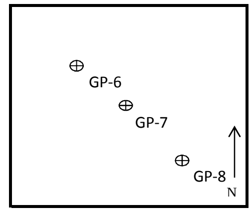


Depth (feet BGS)	Elevation (feet, MSL)	Gas Point / Construction / Schematic	Interval (feet BGS)	Blow Counts	Recovery (inches)	Sample Description/Classification	
0							
4			4-6	2-2-3-3	22	4-4.25	GRAVELS with quartz and sandstone.
						4.25-5.75	Moist, brown silty CLAY with fine-grained SAND and quartz GRAVELS.
8							
			9-11	3-2-3-5	18	9-10.5	Moist, brown silty CLAY with fine-grained SAND and quartz GRAVELS.
12							
16			14-16	4-2-4-3	19	14-15.5	Moist, brown silty CLAY with SAND and GRAVELS with dry, red CLAY from 14.5 to 15 ft bgs.
20			19-21	2-4-5-4	22	19-21	Moist brown to red-brown silty CLAY with golden fine-grained SAND.

NOTE: Spoons were taken every five ft BGS with a maximum two ft interval.

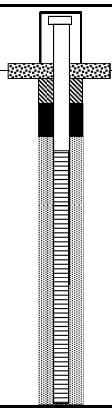
Environmental Resources Management **GP-7**

WO No:	277353	Project	Tolson Rubble Landfill			
Location	Crofton, MD	Owner	Tolson & Associates, LLC			
Completed	1-Nov-16	Boring Depth (feet)	20		Diameter	6 inches
Northing	502529.10	Surface Elevation	NA	feet, site datum		
Easting	1396559.03	Riser Elevation	156.24	feet, site datum		
Screen	Schedule 40 PVC	Riser Length (feet)	7.5		Diameter	2 inches
Slot Size	0.02 inches					
Riser	Schedule 40 PVC	Length (feet)	15		Diameter	2 inches
Drilling Method	Hollow Stem Auger and Direct Push	Driller(s)	Mike Waller, Marshal Armitts, Ray Peters		Geologist	Skylar Georgius
Drillng Company	Allied Well Drilling					



Location Sketch Map

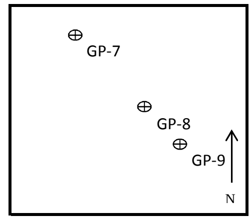
Depth (feet BGS)	Elevation (feet, MSL)	Gas Point / Construction / Schematic	Interval (feet BGS)	Blow Counts	Recovery (inches)	Sample Description/Classification	
0							
4							
8			4-6	16-40-32-41	24	4-6	Dry, brown silty CLAY with fine-grained SAND and GRAVEL.
12			9-11	11-13-21-27	18	9-10.5	Dry, brown and grey fine-grainedSAND.
16			14-16	12-12-17-21	18	14-15.5	Dry, tan, fine-grained SAND and GRAVEL.
20			19-21	Direct Push	14	19-19.25	Moist, orange-brown fine-grained SAND.
						19.25-20	Moist, tan and black, fine-grained SAND.



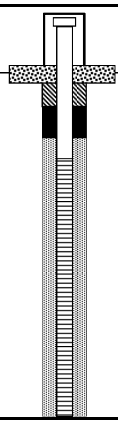
NOTE: Spoons were taken every five ft BGS with a maximum two ft interval.

Environmental Resources Management **GP-8**

WO No:	277353	Project	Tolson Rubble Landfill				
Location	Crofton, MD	Owner	Tolson & Associates, LLC				
Completed	1-Nov-16	Boring Depth (feet)	20		Diameter	6 inches	
Northing	502335.70	Surface Elevation	NA	feet, site datum			
Easting	1396759.08	Riser Elevation	164.70	feet, site datum			
Screen	Schedule 40 PVC	Riser Length (feet)	7.5		Diameter	2 inches	
Slot Size	0.02 inches						
Riser	Schedule 40 PVC	Length (feet)	15		Diameter	2 inches	
Drilling Method	Direct Push Geoprobe	Driller(s)	Mike Waller, Marshal Armitts, Ray Peters		Geologist	Skylar Georgius	
Drillng Company	Allied Well Drilling						



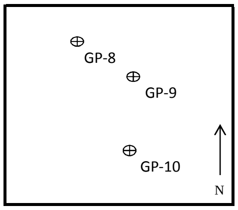
Location Sketch Map



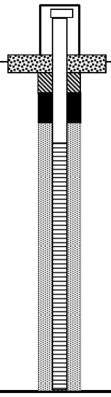
Depth (feet BGS)	Elevation (feet, MSL	Gas Point Construction Schematic	Interval (feet BGS)	Blow Counts	Recovery (inches)	Sample Description/Classification	
0							
4			0-5	Direct Push	48	0-4	Dry, brown fine to medium grained SAND and GRAVEL.
8			5-10	Direct Push	48	5-9	Moist, brown, silty CLAY with fine-grained SAND.
12			10-15	Direct Push	60	10-15	Dry, medium to fine grained SAND and GRAVEL.
16			15-20	Direct Push	60	15-18	Dry, medium to fine grained SAND and GRAVEL.
20						18-20	Moist, brown silty CLAY and fine-grained SAND.

Environmental Resources Management **GP-9**

WO No:	277353	Project	Tolson Rubble Landfill		
Location	Crofton, MD	Owner	Tolson & Associates, LLC		
Completed	3-Nov-16	Boring Depth (feet)	20	Diameter	6 inches
Northing	502109.38	Surface Elevation	NA	feet, site datum	
Easting	1396946.29	Riser Elevation	176.11	feet, site datum	
Screen	Schedule 40 PVC	Riser Length (feet)	7.5	Diameter	2 inches
Slot Size	0.02 inches				
Riser	Schedule 40 PVC	Length (feet)	15	Diameter	2 inches
Drilling Method	Direct Push Geoprobe	Driller(s)	Mike Waller, Marshal Armitts, Ray Peters	Geologist	Skylar Georgius
Drillng Company	Allied Well Drilling				



Location Sketch Map

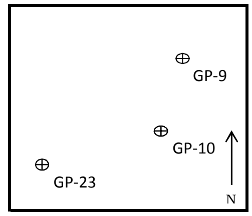


Depth (feet BGS)	Elevation (feet, MSL	Gas Point / Construction / Schematic	Interval (feet BGS)	Blow Counts	Recovery (inches)	Sample Description/Classification	
0							
4			0-5	Direct Push	24	0-2	Moist, brown, fine-grained SAND.
8			5-10	Direct Push	30	5-6.5	Moist, brown, fine-grained SAND.
						6.5-7.5	Moist, brown, silty CLAY.
12			10-15	Direct Push	60	10-15	Moist, brown, silty CLAY.
16			15-20	Direct Push	60	15-20	Moist, brown, silty CLAY.
20							

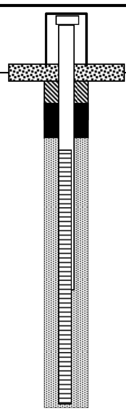
Environmental Resources Management

GP-10

WO No:	277353	Project	Tolson Rubble Landfill		
Location	Crofton, MD	Owner	Tolson & Associates, LLC		
Completed	2-Nov-16	Boring Depth (feet)	20	Diameter	6 inches
Northing	501762.91	Surface Elevation	NA	feet, site datum	
Easting	1396640.18	Riser Elevation	131.77	feet, site datum	
Screen	Schedule 40 PVC	Riser Length (feet)	7.5	Diameter	2 inches
Slot Size	0.02 inches				
Riser	Schedule 40 PVC	Length (feet)	15	Diameter	2 inches
Drilling Method	Direct Push Geoprobe	Driller(s)	Mike Waller, Marshal Armitts, Ray Peters	Geologist	Skylar Georgius
Drillng Company	Allied Well Drilling				



Location Sketch Map

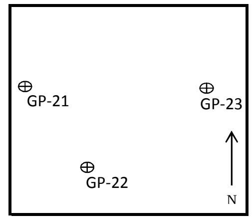


Depth (feet BGS)	Elevation (feet, MSL	Gas Point / Construction / Schematic	Interval (feet BGS)	Blow Counts	Recovery (inches)	Sample Description/Classification	
0							
4			0-5	Direct Push	24	0-2	Dry, golden-brown silty CLAY with fine-grained SAND.
8			5-10	Direct Push	6	5-5.5	Dry, golden-brown silty CLAY with fine-grained SAND.
12			10-15	Direct Push	60	10-15	Dry, golden-brown silty CLAY with fine-grained SAND.
16			15-20	Direct Push	24	15-16.5	Dry, golden-brown silty CLAY with fine-grained SAND.
20						16.5-17	Moist, golden-brown, fine-grained SAND. Refusal at 17 ft BGS.

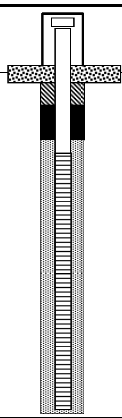
Environmental Resources Management

GP-21

WO No:	277353	Project	Tolson Rubble Landfill		
Location	Crofton, MD	Owner	Tolson & Associates, LLC		
Completed	2-Nov-16	Boring Depth (feet)	20	Diameter	6 inches
Northing	501502.89	Surface Elevation	NA	feet, site datum	
Easting	1395449.03	Riser Elevation	133.49	feet, site datum	
Screen	Schedule 40 PVC	Riser Length (feet)	7.5	Diameter	2 inches
Slot Size	0.02 inches				
Riser	Schedule 40 PVC	Length (feet)	15	Diameter	2 inches
Drilling Method	Direct Push Geoprobe	Driller(s)	Mike Waller, Marshal Armitts, Ray Peters	Geologist	Skylar Georgius
Drillng Company	Allied Well Drilling				



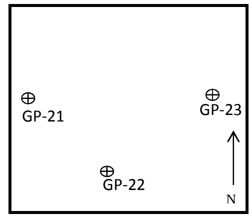
Location Sketch Map



Depth (feet BGS)	Elevation (feet, MSL	Gas Point Construction Schematic	Interval (feet BGS)	Blow Counts	Recovery (inches)	Sample Description/Classification	
0							
4			0-5	Direct Push	60	<u>0-5</u>	Dry, brown, fine-grained SAND.
8			5-10	Direct Push	60	<u>5-6.5</u>	Dry, brown, fine-grained SAND.
						<u>6.5-10</u>	Dry, brown, silty CLAY and SAND.
12			10-15	Direct Push	60	<u>10-15</u>	Dry, brown, silty CLAY and SAND.
16			15-20	Direct Push	48	<u>15-19</u>	Dry, brown, silty CLAY and SAND.
20							

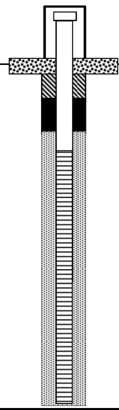
Environmental Resources Management **GP-22**

WO No:	277353	Project	Tolson Rubble Landfill			
Location	Crofton, MD	Owner	Tolson & Associates, LLC			
Completed	3-Nov-16	Boring Depth (feet)	20		Diameter	6 inches
Northing	501280.36	Surface Elevation	NA	feet, site datum		
Easting	1395884.89	Riser Elevation	144.14	feet, site datum		
Screen	Schedule 40 PVC	Riser Length (feet)	7.5		Diameter	2 inches
Slot Size	0.02 inches					
Riser	Schedule 40 PVC	Length (feet)	15		Diameter	2 inches
Drilling Method	Direct Push Geoprobe	Driller(s)	Mike Waller, Marshal Armitts, Ray Peters		Geologist	Skylar Georgius
Drillng Company	Allied Well Drilling					



Location Sketch Map

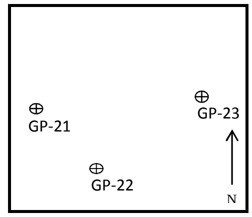
Depth (feet BGS)	Elevation (feet, MSL	Gas Point Construction Schematic	Interval (feet BGS)	Blow Counts	Recovery (inches)		Sample Description/Classification
0							
4			N/A	N/A	N/A	0-20	Brown to dark brown silty SAND with some CLAY.
8							
12							
16							
20							



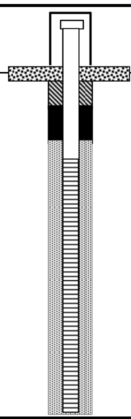
Environmental Resources Management

GP-23

WO No:	277353	Project	Tolson Rubble Landfill		
Location	Crofton, MD	Owner	Tolson & Associates, LLC		
Completed	3-Nov-16	Boring Depth (feet)	20	Diameter	6 inches
Northing	501709.73	Surface Elevation	NA	feet, site datum	
Easting	1396015.98	Riser Elevation	126.90	feet, site datum	
Screen	Schedule 40 PVC	Riser Length (feet)	7.5	Diameter	2 inches
Slot Size	0.02 inches				
Riser	Schedule 40 PVC	Length (feet)	15	Diameter	2 inches
Drilling Method	Direct Push Geoprobe	Driller(s)	Mike Waller, Marshal Armitts, Ray Peters	Geologist	Skylar Georgius
Drillng Company	Allied Well Drilling				



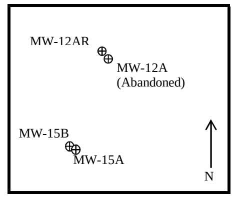
Location Sketch Map

Depth (feet BGS)	Elevation (feet, MSL	Gas Point Construction Schematic	Interval (feet BGS)	Blow Counts	Recovery (inches)		Sample Description/Classification
0							
4			0-5	Direct Push	48	0-4	Dry, compact, brown, fine-grained SAND.
8			5-10	Direct Push	54	5-5.5	Moist, black, silty CLAYwith VOCs of 5.0 ppm.
						5.5-9	Moist, brown, silty CLAY and fine-grained SAND.
12						9-9.5	Moist, loose, brown, fine-grained SAND.
			10-15	Direct Push	54	10-12.5	Moist, alternating layers of black CLAY and brown, fine-grained SAND.
16						12.5-14.5	Moist, grey-tan, fine-grained SAND.
			15-20	Direct Push	42	15-18.5	Moist, alternating layers of tan CLAY and fine-grained SAND.
20							

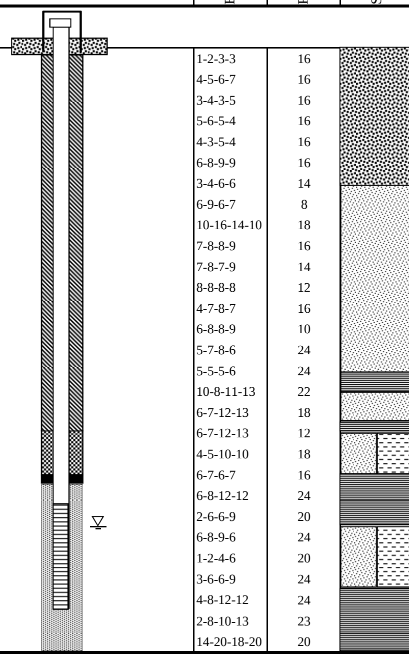
Environmental Resources Management

MW-12AR

WO No:	277353	Project	Tolson Rubble Landfill		
Location	Crofton, MD	Owner	Tolson & Associates, LLC		
Completed	22-Sep-16	Boring Depth (feet)	58	Diameter	6 inches
Northing		Surface Elevation	feet, site datum		
Easting	.	Riser Elevation	feet, site datum		
Screen	Schedule 40 PVC	Length (feet)	10	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	feet BGS		
Riser	Schedule 40 PVC	Length (feet)	46.5	Diameter	2 inches
Drilling Method	Hollow Stem Auger	Driller(s)	Mike Waller, Marshal Armitts, Chrys Lindhors, Ray Peters	Geologist	Skylar Georgius
Drillng Company	Allied Well Drilling			Well Permit #	



Location Sketch Map



Depth (feet BGS)	Elevation (feet, MSL)	Blow Counts	Recovery (inches)	Sample Description/Classification
	0			
		1-2-3-3	16	0 - 13.5 Dry, golden brown to fine grained SAND with pebble sized quartz and wood chips
		4-5-6-7	16	
4		3-4-3-5	16	
		5-6-5-4	16	
8		4-3-5-4	16	
		6-8-9-9	16	
12		3-4-6-6	14	13.5-31 Moist, golden to orange-brown medium grained SAND.
		6-9-6-7	8	
16		10-16-14-10	18	
		7-8-8-9	16	
20		7-8-7-9	14	
		8-8-8-8	12	
24		4-7-8-7	16	
		6-8-8-9	10	
28		5-7-8-6	24	
		5-5-5-6	24	31-34.5 Moist, pink-brown CLAY
32		10-8-11-13	22	34.5-36 Moist, golden to orange-brown medium grained SAND.
		6-7-12-13	18	
36		6-7-12-13	12	36-37 Moist, pink-brown CLAY
		4-5-10-10	18	37-43 Moist, golden to orange-brown SILTY-SAND
40		6-7-6-7	16	43-46 Wet, pink-brown CLAY
		6-8-12-12	24	
44		2-6-6-9	20	46-54 Wet, golden to orange-brown SILTY-SAND and fine-grained SAND
		6-8-9-6	24	
48		1-2-4-6	20	
		3-6-6-9	24	
52		4-8-12-12	24	54-58 Wet, black CLAY
		2-8-10-13	23	
56		14-20-18-20	20	

Monitoring Well Construction Specifications

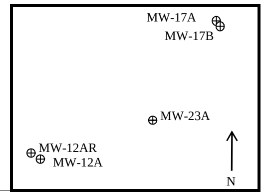
Surface completion is a above grade protective casing (6 inches round X 4 foot long) with lock anchored into the cement collar and surface pad. The well is equipped with a PVC top cap.

6" Outer Steel Casing	(Feet BGS)	Portland Cement	(Feet BGS)
Top	-2.5	Top	0
Bottom	0	Bottom	37
PVC Riser Interval	(Feet BGS)	Hydrated Bentonite Chip Seal	(Feet BGS)
Top	-2.5	Top	37
Bottom	44	Bottom	41
PVC Screen Interval	(Feet BGS)	Choker Sand	(Feet BGS)
Top	44	Top	41
Bottom	54	Bottom	42
		Filter Sand	(Feet BGS)
		Top	42
		Bottom	58

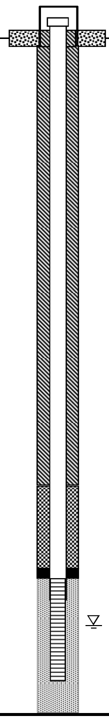
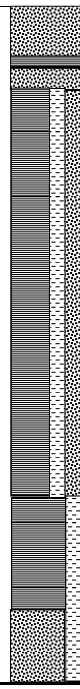
Environmental Resources Management

MW-23A

WO No:	277353	Project	Tolson Rubble Landfill		
Location	Crofton, MD	Owner	Tolson & Associates, LLC		
Completed	23-Sep-16	Boring Depth (feet)	66	Diameter	6 inches
Northing		Surface Elevation	161	feet, site datum	
Easting	.	Riser Elevation		feet, site datum	
Screen	Schedule 40 PVC	Length (feet)	10	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	57	feet BGS	
Riser	Schedule 40 PVC	Length (feet)	55.5	Diameter	2 inches
Drilling Method	Hollow Stem Auger	Driller(s)	Marshal Armitts, Chrys Lindhors, Ray Peters	Geologist	Skylar Georgius
Drillng Company	Allied Well Drilling			Well Permit #	



Location Sketch Map

Elevation (feet, MSL): 0

Depth (feet BGS)	Blow Counts	Recovery (inches)	Interval	Sample Description/Classification
	2-9-9-9	20	0-5	Dry, fine-grain, orange-brown SAND with pebbles and wood
4	7-12-15-8	20		
	9-9-9-9	24	5-6	Dry, red CLAY
8	17-11-10-8	24	6-8	Dry, fine-grain, orange-brown SAND with pebbles and wood
	2-2-1-3	19	8-48	Moist, brown CLAY and golden-brown silty-SAND
12	3-4-4-3	4		
	1-2-2-2	6		
16	1-1-1-3	18		
	3-3-2-3	22		
20	1-1-4-3	12		
	4-6-15-13	22		
24	12-10-10-11	22		
	2-2-4-6	15		
28	6-6-6-6	24		
	2-3-4-5	24		
32	6-7-9-9	24		
	5-6-7-7	24		
36	2-3-5-5	22		
	5-4-6-6	24		
40	3-2-3-4	10		
	3-3-4-5	24		
44	4-3-6-4	22		
	1-2-5-6	24		
48	6-5-6-5	24		
	2-2-3-3	24	48-57	Moist, golden brown silty-CLAY
52	4-4-5-4	24		
	4-7-9-8	24		
56	2-2-4-5	24		
	3-5-6-7	24		
60	3-5-7-9	24	57-66	Wet, brown silty-SAND
	4-5-6-11	24		
64	4-5-6-6	24		
	4-7-18-24	14		

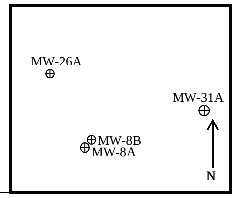
Monitoring Well Construction Specifications

Surface completion is a above grade protective casing (6 inches round X 4 foot long) with lock anchored into the cement collar and surface pad. The well is equipped with a PVC top cap.

Item		(Feet BGS)
6" Outer Steel Casing	Top	-2.5
	Bottom	0
PVC Riser Interval	Top	0
	Bottom	53
PVC Screen Interval	Top	53
	Bottom	63
Portland Cement	Top	0
	Bottom	44
Hydrated Bentonite Chip Seal	Top	44
	Bottom	51.5
Choker Sand	Top	51.5
	Bottom	52.5
Filter Sand	Top	52.5
	Bottom	66

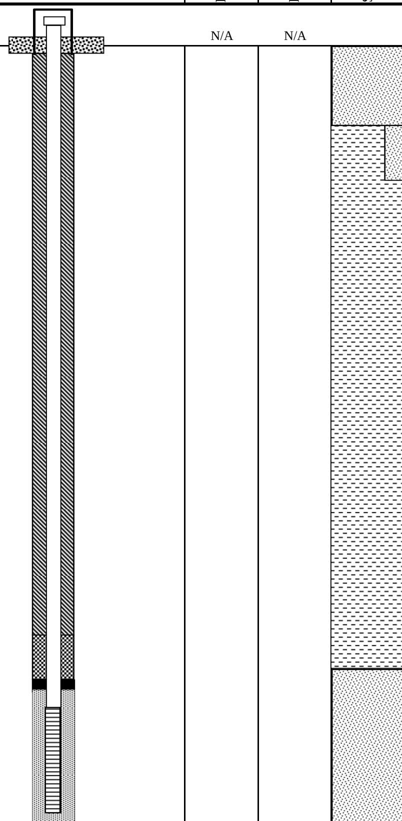
Environmental Resources Management **MW-26A**

WO No:	277353	Project	Tolson Rubble Landfill		
Location	Crofton, MD	Owner	Tolson & Associates, LLC		
Completed	31-Oct-16	Boring Depth (feet)	75	Diameter	6 inches
Northing		Surface Elevation		feet, site datum	
Easting	.	Riser Elevation		feet, site datum	
Screen	Schedule 40 PVC	Length (feet)	10	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	51	feet BGS	
Riser	Schedule 40 PVC	Length (feet)	66.5	Diameter	2 inches
Drilling Method	Hollow Stem Auger	Driller(s)	Mike Waller, Marshal Armitts, Ray Peters	Geologist	Skylar Georgius
Drillng Company	Allied Well Drilling			Well Permit #	



Location Sketch Map

Depth (feet BGS)	Elevation (feet, MSL	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment		Sample Description/Classification
	0		N/A	N/A			
4						0-10	Dry to Moist, brown to dark brown, fine-grained SAND. Pungent oder but no VOC readings
8						10-15	Moist, brown SILTY CLAY and fine-grained SAND with woodchips and roots throughout
12						15-60	Moist, brown-black silty CLAY with strong oder and rubber tire parts and tree stumps throughout
16							
20							
24							
28							
32							
36							
40							
44							
48							
52							
56							
60						60-75	Wet, brown, fine-grained running SANDS
64							
68							
72							
76							



Monitoring Well Construction Specifications

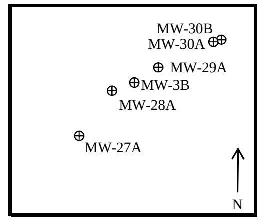
Surface completion is a above grade protective casing (4 inches round X 4 foot long) with lock anchored into the cement collar and surface pad. The well is equipped with a PVC top cap.

6" Outer Steel Casing	(Feet BGS)		Portland Cement	(Feet BGS)
Top	-2.5		Top	0
Bottom	0		Bottom	57
PVC Riser Interval	(Feet BGS)		Hydrated Bentonite Chip Seal	(Feet BGS)
Top	-2.5		Top	57
Bottom	64		Bottom	61
PVC Screen Interval	(Feet BGS)		Choker Sand	(Feet BGS)
Top	64		Top	61
Bottom	74		Bottom	62
			Filter Sand	(Feet BGS)
			Top	62
			Bottom	75

Environmental Resources Management

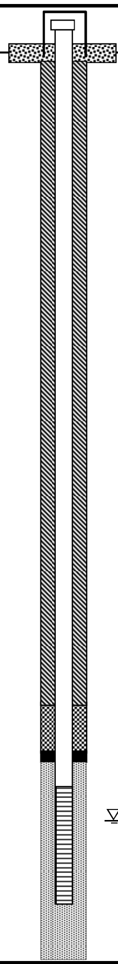
MW-27A

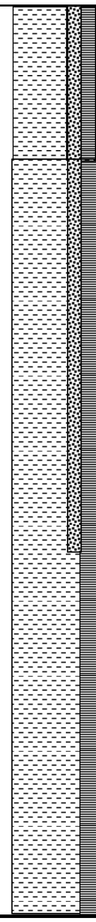
WO No:	277353	Project	Tolson Rubble Landfill		
Location	Crofton, MD	Owner	Tolson & Associates, LLC		
Completed	27-Oct-16	Boring Depth (feet)	78	Diameter	6 inches
Northing		Surface Elevation		feet, site datum	
Easting	.	Riser Elevation		feet, site datum	
Screen	Schedule 40 PVC	Length (feet)	10	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	65	feet BGS	
Riser	Schedule 40 PVC	Length (feet)	65.5	Diameter	2 inches
Drilling Method	Hollow Stem Auger	Driller(s)	Mike Waller, Marshal Armitts, Ray Peters	Geologist	Skylar Georgius
Drillng Company	Allied Well Drilling			Well Permit #	



Location Sketch Map

Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment	Sample Description/Classification
	0		N/A	N/A		
4					0-17	Dry, brown, loose, SILTY SAND with traces of CLAY and GRAVELS
8						
12					12-17	Damp, plastic, brown SILTY SAND with some CLAY and traces of white fine-grained SAND
16					17-47	Damp, loose, brown, SILTY SAND with minor CLAY lenses and some brown GRAVELS
20						
24						
28						
32						
36						
40						
44						
48					47-53	Wet, soft, light brown, SILTY SAND with mixed fine- to medium-grained SAND and some CLAY
52					53-78	Damp, loose to plastic, brown SILTY SAND with some CLAY
56						
60						
64						
68						
72						
76						





Monitoring Well Construction Specifications

Surface completion is a above grade protective casing (4 inches round X 4 foot long) with lock anchored into the cement collar and surface pad. The well is equipped with a PVC top cap.

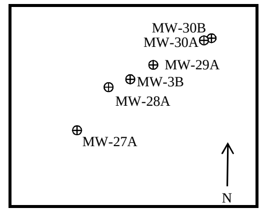
	(Feet BGS)
6" Outer Steel Casing	
Top	-2.5
Bottom	0
PVC Riser Interval	
Top	-2.5
Bottom	63
PVC Screen Interval	
Top	63
Bottom	73

	(Feet BGS)
Portland Cement	
Top	0
Bottom	56
Hydrated Bentonite Chip Seal	
Top	56
Bottom	60
Choker Sand	
Top	60
Bottom	61
Filter Sand	
Top	61
Bottom	78

Environmental Resources Management

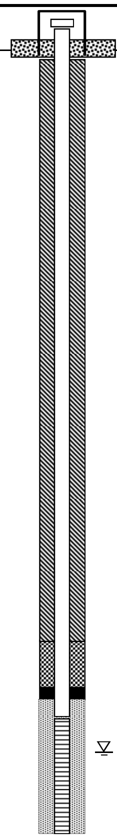
MW-28A

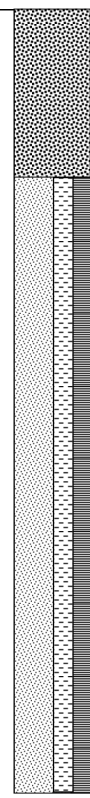
WO No:	277353	Project	Tolson Rubble Landfill		
Location	Crofton, MD	Owner	Tolson & Associates, LLC		
Completed	30-Sep-16	Boring Depth (feet)	70	Diameter	6 inches
Northing		Surface Elevation		feet, site datum	
Easting	.	Riser Elevation		feet, site datum	
Screen	Schedule 40 PVC	Length (feet)	10	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	63	feet BGS	
Riser	Schedule 40 PVC	Length (feet)	62.5	Diameter	2 inches
Drilling Method	Hollow Stem Auger	Driller(s)	Marshal Armitts, Mike Waller, Ray Peters	Geologist	Skylar Georgius
Drillng Company	Allied Well Drilling			Well Permit #	



Location Sketch Map

Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment	Sample Description/Classification
	0		N/A	N/A		
2						0-15 Dry, brown, GRAVEL and fine grained SAND
6						
10						
14						15-59 Moist, golden to orange-brown, fine-grained SAND and silty-CLAY
18						
22						
26						
30						
34						
38						
42						
46						
50						
54						
58						59-70 Wet, brown, fine-grained SAND and silty-CLAY
62						
66						
70						





Monitoring Well Construction Specifications

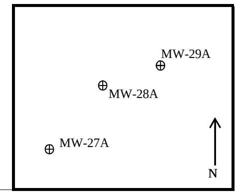
Surface completion is a above grade protective casing (6 inches round X 4 foot long) with lock anchored into the cement collar and surface pad. The well is equipped with a PVC top cap.

6" Outer Steel Casing	(Feet BGS)	
	Top	-2.5
	Bottom	0
PVC Riser Interval	(Feet BGS)	
	Top	-2.5
	Bottom	60
PVC Screen Interval	(Feet BGS)	
	Top	60
	Bottom	70

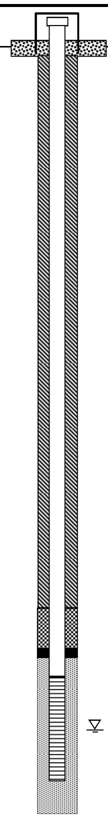
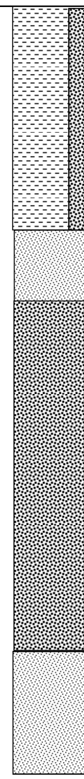
Portland Cement	(Feet BGS)	
	Top	0
	Bottom	53
Hydrated Bentonite Chip Seal	(Feet BGS)	
	Top	53
	Bottom	57
Choker Sand	(Feet BGS)	
	Top	57
	Bottom	58
Filter Sand	(Feet BGS)	
	Top	58
	Bottom	70

Environmental Resources Management **MW-29A**

WO No:	277353	Project	Tolson Rubble Landfill		
Location	Crofton, MD	Owner	Tolson & Associates, LLC		
Completed	20-Oct-16	Boring Depth (feet)	75	Diameter	6 inches
Northing		Surface Elevation		feet, site datum	
Easting	.	Riser Elevation		feet, site datum	
Screen	Schedule 40 PVC	Length (feet)	10	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	67	feet BGS	
Riser	Schedule 40 PVC	Length (feet)	64.5	Diameter	2 inches
Drilling Method	Hollow Stem Auger	Driller(s)	Mike Waller, Marshal Armitts, Ray Peters	Geologist	Skylar Georgius
Drillng Company	Allied Well Drilling			Well Permit #	



Location Sketch Map

Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment		Sample Description/Classification
	0		N/A	N/A			
						0-22	Dry to moist, brown, SILTY CLAY with some dark brown fine-grained SAND and GRAVELS
4							
8							
12							
16							
20							
						22-29	Moist to wet, brown, fine-grained SAND with a beer can and tape found at 28' bgs
24							
28							
						29-40	Dry, brown, fine- to medium-grained SAND and GRAVELS
32							
36							
40							
						40-63	Moist, brown, fine-grained SAND and GRAVELS
44							
48							
52							
56							
60							
						63-75	Wet, brown, fine-grained SAND
64							
68							
72							
76							

Monitoring Well Construction Specifications

Surface completion is a above grade protective casing (4 inches round X 4 foot long) with lock anchored into the cement collar and surface pad. The well is equipped with a PVC top cap.

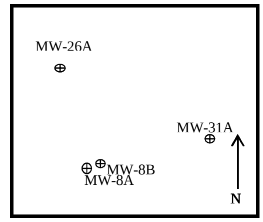
	(Feet BGS)
6" Outer Steel Casing	
Top	-2.5
Bottom	0
PVC Riser Interval	
Top	-2.5
Bottom	62
PVC Screen Interval	
Top	62
Bottom	72

	(Feet BGS)
Portland Cement	
Top	0
Bottom	55
Hydrated Bentonite Chip Seal	
Top	55
Bottom	59
Choker Sand	
Top	59
Bottom	60
Filter Sand	
Top	60
Bottom	75

Environmental Resources Management

MW-31A

WO No:	277353	Project	Tolson Rubble Landfill		
Location	Crofton, MD	Owner	Tolson & Associates, LLC		
Completed	24-Oct-16	Boring Depth (feet)	69	Diameter	6 inches
Northing		Surface Elevation		feet, site datum	
Easting	.	Riser Elevation		feet, site datum	
Screen	Schedule 40 PVC	Length (feet)	10	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	58	feet BGS	
Riser	Schedule 40 PVC	Length (feet)	58.5	Diameter	2 inches
Drilling Method	Hollow Stem Auger	Driller(s)	Mike Waller, Marshal Armitts, Ray Peters	Geologist	Skylar Georgius
Drillng Company	Allied Well Drilling			Well Permit #	

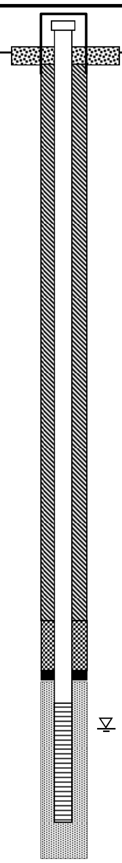


Location Sketch Map

Depth (feet BGS): 4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48, 52, 56, 60, 64, 68, 72

Elevation (feet, MSL): 0

Well Construction Schematic



Blow Counts	Recovery (inches)	Sediment	Sample Description/Classification
6-5-7-7	14	0-40	Dry to moist , brown, fine-grained SAND and white quartz GRAVELS
15-15-18-18	20		
6-6-7-9	24		
6-7-8-8	13		
4-4-5-6	24		
6-6-7-6	22		
12-16-20-20	18		
7-15-15-20	16		
41-49-50/5	11		
---	16		
---	20		
---	14		
7---	8		
2-1-4-2	12		
2-7-50/4	10		
12-50/3	9		
13-50/4	10		
50/5	5		
50/1	5		
---	10		
---	---	40-56	Moist to wet, brown, fine-grained SAND
---	---		
---	---		
24040-50/3	14		
50/5	14		
50/5	9		
50/5	11		
50/4	8		
46-50/5	24	56-69	Saturated, brown, running SANDS
13-38-50/2	24		
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Monitoring Well Construction Specifications

Surface completion is a above grade protective casing (4 inches round X 4 foot long) with lock anchored into the cement collar and surface pad. The well is equipped with a PVC top cap.

4" Outer Steel Casing		(Feet BGS)	Portland Cement		(Feet BGS)
	Top	-2.5		Top	0
	Bottom	0		Bottom	49
PVC Riser Interval		(Feet BGS)	Hydrated Bentonite Chip Seal		(Feet BGS)
	Top	-2.5		Top	49
	Bottom	56		Bottom	53
PVC Screen Interval		(Feet BGS)	Choker Sand		(Feet BGS)
	Top	56		Top	53
	Bottom	66		Bottom	54
			Filter Sand		(Feet BGS)
				Top	54
				Bottom	69

LOG OF BORING NO. B-104

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL **Surf. El.:** 158.8 (+/-) ft.	REMARKS
0						0'	Red brown moist medium dense silty fine-coarse sand (SM)	
5		1	DS	8 16-16	16			
10		2	DS	10 16-15	18			
						13'	Tan and brown moist very dense fine-coarse sand (SW)	
15		3	DS	11 20-20	18			
20		4	DS	26 51/5	10			
						23'	Tan and brown moist very dense fine-coarse sand & gravel (GW)	
25								

REMARKS: Encountered water at 48'

Continued on next page

Completion Depth: 91.5'
Date: 11/4/91

DEPTH TO WATER: AT COMPLETION: WATER 48'

Marshall Engineering, Inc.

LOG OF BORING NO. B-104

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL Surf. El.: 158.8 (+/-) ft.	REMARKS
25		5	DS	8 37-51/4	16		Tan and brown moist very dense fine-coarse sand & gravel (GW)	
30		6	DS	21 26-47	18	33'		
35		7	DS	10 11-12	18	38'	Brown and red brown moist medium dense clayey fine coarse sand (SM-SC).	
40		8	DS	4 7-5	10	43'	Red brown moist stiff sandy clay (CL)	
45		9	DS	11 9-17	18	48'	Tan and red brown moist medium dense silty fine-coarse sand (SM)	
50							Tan wet medium dense fine-medium sand (SW)	

REMARKS: Encountered water at 48'

Continued on next page

Completion Depth: 91.5' **Date:** 11/4/91	**DEPTH TO WATER:** AT COMPLETION: WATER 48'

Marshall Engineering, Inc.

LOG OF BORING NO. B-104

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL Surf. El.: 158.8 (+/-) ft.	REMARKS
50	10	DS	14 16-13	18		Tan wet medium dense fine-medium sand (SW)	
55	11	DS	20 19-17	18			
60	12	DS	5 11-24	18			
65	13	DS	20 44-40	18			
70	14	DS	26 31-44	18			
75							

REMARKS: Encountered water at 48'

Continued on next page

Completion Depth: 91.5'
Date: 11/4/91

DEPTH TO WATER: AT COMPLETION: WATER 48'

Marshall Engineering, Inc.

LOG OF BORING NO. B-104

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL Surf. El.: 158.8 (+/-) ft.	REMARKS
75		15	DS	29 38-45	16	78'	Tan wet medium dense fine-medium sand (SW)	
80		16	DS	19 26-31	12	83'	Black and dark gray wet very dense clayey fine sand (SC)	
85		17	DS	23 26-27	8		Gray and red brown moist hard silty clay (CL)	
90		18	DS	26 31-49				
95							Bottom of Boring 91.5'	

REMARKS: Encountered water at 48'

Completion Depth: 91.5'
Date: 11/4/91

DEPTH TO WATER: AT COMPLETION: WATER 48'

Marshall Engineering, Inc.

LOG OF BORING NO. B-105

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL Surf. El.: 155.1 (+/-) ft.	REMARKS
0						0'	Brown moist very stiff silty clay (CL)	
5		1	DS	7 6-18	18	7'		
							Red brown and tan moist very dense fine-coarse sand (SW) - trace of gravel below 35'	
10		2	DS	9 16-24	12			
15		3	DS	26 46-51	18			
20		4	DS	51/5	5			
25								

REMARKS: Encountered water at 40'

Continued on next page

Completion Depth: 91.5'
Date: 11/14/91

DEPTH TO WATER: AT COMPLETION: DRY, CAVED 36'

Marshall Engineering, Inc.

LOG OF BORING NO. B-105

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL Surf. El.: 155.1 (+/-) ft.	REMARKS
25		5	DS	51/4	4		Red brown and tan moist very dense fine-coarse sand (SW)	
							- trace of gravel below 35'	
30		6	DS	51/3	3			
35		7	DS	51/5	5			
						38'		
							Tan wet very dense silty fine-coarse sand (SM-SW) with silty clay seams and layers	
40		8	DS	23 24-51	18			
45		9	DS	22 44-56	18			
50								

REMARKS: Encountered water at 40'

Continued on next page

Completion Depth: 91.5'
Date: 11/14/91

DEPTH TO WATER: AT COMPLETION: DRY, CAVED 36'

Marshall Engineering, Inc.

LOG OF BORING NO. B-105

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL **Surf. El.:** 155.1 (+/-) ft.	REMARKS
75		15	DS	48 51- 70/5	17	78'	Gray wet very dense fine-coarse sand (SW)	
80		16	DS	30 50- 62/3	15	83'	Dark to wet very dense fine-medium sand (SP)	
85		17	DS	75 135/6	12		Red brown moist hard silty clay (CL)	
90		18	DS	50 52/5	10			
95							Bottom of Boring 91.5'	

REMARKS: Encountered water at 40'

Completion Depth: 91.5'
Date: 11/14/91

DEPTH TO WATER: AT COMPLETION: DRY, CAVED 36'

Marshall Engineering, Inc.

LOG OF BORING NO. B-106

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL Surf. El.: 174.7 (+/-) ft.	REMARKS
25		5	DS	19 8-21	14		Light gray and tan moist medium dense fine-coarse sand (SW) - very dense below 35' - traces of gravel below 40'	
30		6	DS	8 14-11	14			
35		7	DS	75/6	6			
40		8	DS	60/4	4			
45		9	DS	72/3	3			
						48'	Tan moist very dense fine sand (SP) - clayey seams & wet below 63'	
50								

REMARKS: Encountered water at 64'

Continued on next page

Completion Depth: 100' **Date:** 11/15/91	**DEPTH TO WATER:** AT COMPLETION: DRY, CAVED 53'

Marshall Engineering, Inc.

LOG OF BORING NO. B-106

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL Surf. El.: 174.7 (+/-) ft.	REMARKS
50		10	DS	44 51/4	10		Tan moist very dense fine sand (SP) - clayey seams & wet below 63'	
55		11	DS	27 46-51/3	15			
60		12	DS	34 51/4	10			
65		13	DS	72/1	6			
70		14	DS	41 49-51/1	11			
75								

REMARKS: Encountered water at 64'

Continued on next page

Completion Depth: 100'
Date: 11/15/91

DEPTH TO WATER: AT COMPLETION: DRY, CAVED 53'

Marshall Engineering, Inc.

LOG OF BORING NO. B-106

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL	REMARKS
							Surf. El.: 174.7 (+/-) ft.	
75		15	DS	51/5	5		Tan moist very dense fine sand (SP)	
						78'	- clayey seams & wet below 63'	
80		16	DS	51/4	4		Red brown wet very dense silty fine-coarse sand (SM-SW)	
85		17	DS	51/5				
90		18	DS	42 51/5	5			
						93'		
95		19	DS	41 46-51/5	17		Red and light gray moist hard silty clay (CL)	
100		20	DS	44 49-51/3	15			

Bottom of Boring 100'

REMARKS: Encountered water at 64'

Completion Depth: 100'
Date: 11/15/91

DEPTH TO WATER: AT COMPLETION: DRY, CAVED 53'

Marshall Engineering Inc

LOG OF BORING NO. B-107

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL Surf. El.: 188.3 (+/-) ft.	REMARKS
0						0'	Red brown moist dense silty fine-medium sand (SM)	
5		1	DS	15 15-20	16	8'		
							Tan moist dense fine sand (SP)	
10		2	DS	10 15-23	16	13'		
							Tan moist medium dense clayey fine sand (SC)	
15		3	DS	10 8-8	18			
20		4	DS	4 3-6	18	23'		
25							Tan moist medium stiff sandy clay (CL)	

REMARKS: Encountered water at 80' (Augers locking up at 90'

Continued on next page

Completion Depth: 95.5'
Date: 11/18/91

DEPTH TO WATER: AT COMPLETION: WATER 80'

Marshall Engineering, Inc.

LOG OF BORING NO. B-107

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL Surf. El.: 188.3 (+/-) ft.	REMARKS
25		5	DS	3 3-4	18	28'	Tan moist medium stiff sandy clay (CL)	
30		6	DS	4 4-6	18	33'	Tan moist medium dense clayey fine sand (SC)	
35		7	DS	2 2-7	18		Tan and light gray moist loose fine-coarse sand (SW) - clay seams to 36' (+/-) - very dense below 55', trace of gravel	
40		8	DS	5 2-2	18			
45		9	DS	1 5-12	10			
50								

REMARKS: Encountered water at 80' (Augers locking up at 90')

Continued on next page

Completion Depth: 95.5'
Date: 11/18/91

DEPTH TO WATER: AT COMPLETION: WATER 80'

Marshall Engineering, Inc.

LOG OF BORING NO. B-107

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL **Surf. El.:** 188.3 (+/-) ft.	REMARKS
50		10	DS	7 10-18	8		Tan and light gray moist loose fine-coarse sand (SW) - clay seams to 36' (+/-) - very dense below 55', trace of gravel	
55		11	DS	100/6	6			
60		12	DS	21 15-51/4	16			
65		13	DS	100/6	6	68'		
70		14	DS	42 51/4			Tan moist very dense fine-medium sand (SP) - wet below 80'	
75								

REMARKS: Encountered water at 80' (Augers locking up at 90')

Continued on next page

Completion Depth: 95.5'
Date: 11/18/91

DEPTH TO WATER: AT COMPLETION: WATER 80'

Marshall Engineering, Inc.

LOG OF BORING NO. B-107

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL **Surf. El.:** 188.3 (+/-) ft.	REMARKS
75		15	DS	10 40-51/4	16		Tan moist very dense fine-medium sand (SP) - wet below 80'	
80		16	DS	36 51/5	10	83'		
85		17	DS	27 51/5	10	88'	Tan and light gray moist hard sandy clay (CL)	
90		18	DS	100/4			Red brown wet very dense fine-medium sand (SP)	
95							Bottom of Boring 95.5'	
100								

REMARKS: Encountered water at 80' (Augers locking up at 90')

Completion Depth: 95.5'
Date: 11/18/91

DEPTH TO WATER: AT COMPLETION: WATER 80'

Marshall Engineering, Inc.

LOG OF BORING NO. B-108

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL Surf. El.: 163.1 (+/-) ft.	REMARKS
0						0'	Brown and gray moist stiff sandy clay (CL)	
5		1	DS	3 4-6	18	8'		
10		2	DS	15 34-34	18		Tan and light gray moist very dense fine sand (SP)	
15		3	DS	6 18-25	12	18'		
20		4	DS	9 14-32	16		Tan and light gray moist very dense fine-coarse sand (SW)	
25								

REMARKS: Encountered water at 50'

Continued on next page

Completion Depth: 91.5'
Date: 11/19/91

DEPTH TO WATER: AT COMPLETION: DRY, CAVED 35'

Marshall Engineering, Inc.

LOG OF BORING NO. B-108

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL Surf. El.: 163.1 (+/-) ft.	REMARKS
25	5	DS	26 51/4	10		Tan and light gray moist very dense fine-coarse sand (SW)	
30	6	DS	100/6	6			
35	7	DS	36 26-29	14	38'		
40	8	DS	9 5-51	16		Red brown moist very dense silty fine sand (SM)	
45	9	DS	100/5	5	48'		
50						Brown wet very dense silty fine-coarse sand (SM-SW)	

REMARKS: Encountered water at 50'

Continued on next page

Completion Depth: 91.5'
Date: 11/19/91

DEPTH TO WATER: AT COMPLETION: DRY, CAVED 35'

Marshall Engineering, Inc.

LOG OF BORING NO. B-108

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL Surf. El.: 163.1 (+/-) ft.	REMARKS
50	10	DS	38 25-49	18	53'	Brown wet very dense silty fine-coarse sand (SM-SW)	
55	11	DS	28 26-34	18		Light gray and green wet very dense clayey fine sand (SC)	
60	12	DS	34 51/6	12	63'		
65	13	DS	34 51/6	12	68'	Light gray wet very dense silty fine sand (SP)	
70	14	DS	28 51/5	17	73'	Light gray wet very dense clayey fine sand (SC)	
75						Brown wet very dense fine-coarse sand (SW)	

REMARKS: Encountered water at 50'

Continued on next page

Completion Depth: 91.5'
Date: 11/19/91

DEPTH TO WATER: AT COMPLETION: DRY, CAVED 35'

Marshall Engineering, Inc.

LOG OF BORING NO. B-108

ANNE ARUNDEL COUNTY, MD.

BORING METHOD: HOLLOW STEM AUGERS **LOCATION:** SEE BORING PLAN

DEPTH IN FEET	SAMPLES	SAMPLE NO.	SAMPLE TYPE	STD. PENET. TEST BLOWS / 6 - IN.	RECOVERY IN	STRATA DEPTH	DESCRIPTION OF MATERIAL **Surf. El.:** 163.1 (+/-) ft.	REMARKS
75		15	DS	100/6	6	78'	Brown wet very dense fine-coarse sand (SW)	
80		16	DS	50 51/6	12		Red and light gray moist hard silty clay (CL)	
85		17	DS	50 51/6	11			
90		18	DS	50 51/4	10			
95							Bottom of Boring 91.5'	

REMARKS: Encountered water at 50'

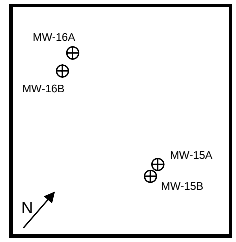
Completion Depth: 91.5'
Date: 11/19/91

DEPTH TO WATER: AT COMPLETION: DRY, CAVED 35'

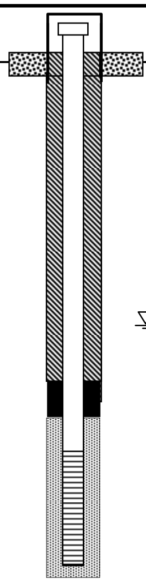
Marshall Engineering, Inc.

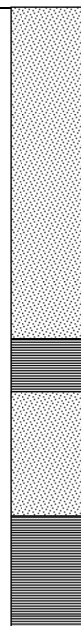
Environmental Resources Management **MW-15A**

WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment		
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham		
Completed	29-Aug-06	Boring Depth (feet)	56.5	Diameter	4 inches
Northing	na	Surface Elevation	na	feet, site datum	
Easting	na	Riser Elevation	na	feet, site datum	
Screen	Sch. 40 PVC	Length (feet)	10	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	24	feet BGS	
Riser	Sch. 40 PVC	Length (feet)	37	Diameter	2 inches
Drilling Method		Driller(s)	Bill Kimes	Geologist	Nat Warner
Drillng Company	Summit Site Services			Well Permit #	



Location Sketch Map





Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment	Sample Description/Classification
	na				?	* See log ERM-X for detailed unsaturated soil characterization.
			3-3-7-10	10		0 - 13 Dry, orange & tan medium to fine SAND with pebble sized quartz minerals (fill)
5	#VALUE!		50/4	8		
10	#VALUE!		11-16-20	13		13 - 30 Moist, orange & tan silty SAND & fine SAND
15	#VALUE!		9-11-12	12		
20	#VALUE!		8-9-10	12		
25	#VALUE!		3-4-5	16		
30	#VALUE!		9-11-15	15		30 - 36 Grey CLAY & grey/tan clayey SAND
35	#VALUE!		8-9-8	15		37 - 45 Tan, moist moving to a wet, medium moving to a coarse, SAND
40	#VALUE!		50/4	5		
45	#VALUE!		13-18-22	14		46 - 56.5 Dense, red and grey CLAY
50	#VALUE!		8-16-22	0		Lab Sample MW-15A-50/55 Lab Sample MW-15A-55
55	#VALUE!		10-16-19	14		
60	#VALUE!					

Monitoring Well Construction Specifications

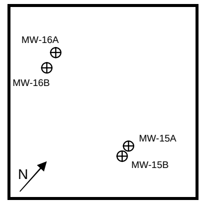
Surface completion is a above grade protective casing (6 inches round X 4 foot long) with lock anchored into the cement collar and surface pad. The well is equipped with a PVC top cap.

6" Outer Steel Casing	(Feet BGS)		Portland Cement		(Feet BGS)
	Top	-2.5		Top	0.0
	Bottom	1.5		Bottom	29.0
PVC Riser Interval	(Feet BGS)		Hydrated Bentonite Chip Seal		(Feet BGS)
	Top	-2.0		Top	29.0
	Bottom	35.1		Bottom	32.0
PVC Screen Interval	(Feet BGS)		Filter Sand		(Feet BGS)
	Top	35.1		Top	32.0
	Bottom	45.1		Bottom	46.0

Environmental Resources Management

MW-15B

WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment		
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham		
Completed	31-Aug-06	Boring Depth (feet)	160	Diameter	4 inches
Northing	na	Surface Elevation	na feet, site datum		
Easting	na	Riser Elevation	na feet, site datum		
Screen	Sch. 40 PVC	Length (feet)	10	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	feet BGS		
Riser	Sch. 40 PVC	Length (feet)	152	Diameter	2 inches
Drilling Method		Driller(s)	Bill Kimes	Geologist	Nat Warner
Drillng Company	Summit Site Services			Well Permit #	

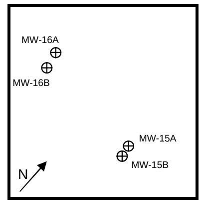


Location Sketch Map

Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment	Sample Description/Classification
	na					
			3-3-7-10	10		0 - 13 Dry, orange & tan medium to fine SAND with pebble sized quartz minerals (fill)
5	#VALUE!		50/4	8		
10	#VALUE!		11-16-20	13		13 - 30 Moist, orange & tan silty SAND & fine SAND
15	#VALUE!		9-11-12	12		
20	#VALUE!		8-9-10	12		
25	#VALUE!		3-4-5	16		
30	#VALUE!		9-11-15	15		30 - 36 Grey CLAY & grey/tan clayey SAND
35	#VALUE!		8-9-8	15		37 - 45 Tan, moist moving to a wet, medium moving to a coarse, SAND
40	#VALUE!		50/4	5		
45	#VALUE!		13-18-22	14		46 - 95 Very hard, dense, red-maroon and grey-dark grey CLAY
50	#VALUE!		8-16-22	0		Lab Sample MW-15A-50/55
55	#VALUE!		10-16-19	14		
60	#VALUE!		14-16-17	6		
65	#VALUE!		NA			
70	#VALUE!		NA			
75	#VALUE!		50/5	4		
80	#VALUE!		NA			
85	#VALUE!		NA			
90						

Environmental Resources Management **MW-15B**

WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment		
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham		
Completed	31-Aug-06	Boring Depth (feet)	160	Diameter	4 inches
Northing	na	Surface Elevation	na feet, site datum		
Easting	na	Riser Elevation	na feet, site datum		
Screen	Sch. 40 PVC	Length (feet)	10	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	feet BGS		
Riser	Sch. 40 PVC	Length (feet)	152	Diameter	2 inches
Drilling Method		Driller(s)	Bill Kimes	Geologist	Nat Warner
Drillng Company	Summit Site Services			Well Permit #	



Location Sketch Map

Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment	Sample Description/Classification
90			27-50/4	0		
95	#VALUE!		NA			96 - 105 Dry, tan silty-sandy mixture with grey CLAY
100	#VALUE!		NA			
105	#VALUE!		50/4	2		106 - 112 Suspected loose SAND layer (quick drilling)
110	#VALUE!		NA			113 - 125 Dark grey, wet, clayey SILT
115	#VALUE!		NA			
120	#VALUE!		50/1	<1		
125	#VALUE!		NA			126 - 135 Wet silty SAND
130	#VALUE!		50/2	2		
135	#VALUE!		NA			136 - 143 Off-white, dry, clayey SILT
140	#VALUE!		50/2	2		143 - 145 Suspected loose SAND layer (quick drilling)
145	#VALUE!		NA			146 - 149 Sandy SILT from slurry cuttings
150	#VALUE!		NA			150 - 160 Grey, moist medium to fine SAND
155	#VALUE!		50/4	3		Lab Sample MW-15B-155
160	#VALUE!					
165	#VALUE!					

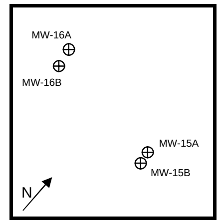
Monitoring Well Construction Specifications

Surface completion is a above grade protective casing (6 inches round X 4 foot long) with lock anchored into the cement collar and surface pad. The well is equipped with a PVC top cap.

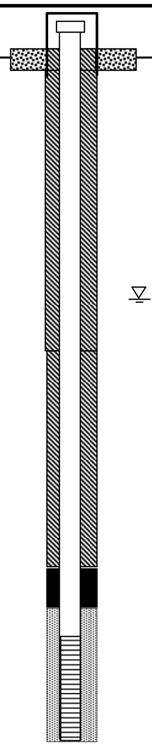
	(Feet BGS)		(Feet BGS)
6" Outer Steel Casing		Portland Cement	
Top	-2.5	Top	0.0
Bottom	1.5	Bottom	139.0
PVC Riser Interval		Hydrated Bentonite Chip Seal	
Top	-2.0	Top	139.0
Bottom	150.0	Bottom	144.0
PVC Screen Interval		Filter Sand	
Top	150.0	Top	144.0
Bottom	160.0	Bottom	160.0

Environmental Resources Management **MW-16A**

WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment		
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham		
Completed	29-Aug-06	Boring Depth (feet)	75	Diameter	4 inches
Northing	na	Surface Elevation	na	feet, site datum	
Easting	na	Riser Elevation	na	feet, site datum	
Screen	Sch. 40 PVC	Length (feet)	10	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW		feet BGS	
Riser	Sch. 40 PVC	Length (feet)	68	Diameter	2 inches
Drilling Method		Driller(s)	Bill Kimes	Geologist	Nat Warner
Drillng Company	Summit Site Services			Well Permit #	



Location Sketch Map



Depth (feet BGS)	Elevation (feet, MSL)	Blow Counts	Recovery (inches)	Sediment	Sample Description/Classification
	na			?	* See log ERM-X for detailed unsaturated soil characterization.
		2-3-4	6		0-27 Dry fine, medium, coarse sand (larger sized grains at lower depths), tan/white SAND with 1/8 to 1/4 inch gravel and quartz minerals
5	#VALUE!	5-7-10	11		
10	#VALUE!	9-14-22	16		
15	#VALUE!	50/2	2		
20	#VALUE!	18-11-14	12		
25	#VALUE!	10-17-38	8		
30	#VALUE!	50/2	4		28 - 32 Moist, dense, dark tan medium SAND
35	#VALUE!	28-23-32	7		33 - 37 Moist, light tan medium to coarse SAND
40	#VALUE!	22-25-23	15		38 - 44 Moist to wet, tan silty fine SAND, somewhat consolidated
45	#VALUE!	30-50/4	12		45 - 46 Hard dry white CLAY
50	#VALUE!	50/2	3		47 - 67 Moist to wet, dense medium to coarse, tan, SAND with some quartz minerals
55	#VALUE!	50/2	9		
60	#VALUE!	50/2	1		
65	#VALUE!	32-32-29			
70	#VALUE!	13-25-32	3		68 - 75 Hard grey and red CLAY
75	#VALUE!	30-23-27			
80	#VALUE!				

Monitoring Well Construction Specifications

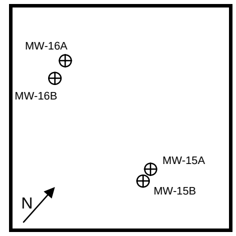
Surface completion is a above grade protective casing (6 inches round X 4 foot long) with lock anchored into the cement collar and surface pad. The well is equipped with a PVC top cap.

	(Feet BGS)		(Feet BGS)
6" Outer Steel Casing		Portland Cement	
Top	-3.0	Top	0.0
Bottom	1.0	Bottom	50.0
PVC Riser Interval		Hydrated Bentonite Chip Seal	
Top	-2.5	Top	50.0
Bottom	57.0	Bottom	54.0
PVC Screen Interval		Filter Sand	
Top	57.0	Top	54.0
Bottom	67.0	Bottom	67.0

Environmental Resources Management

MW-16B

WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment		
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham		
Completed	31-Aug-06	Boring Depth (feet)	150	Diameter	4 inches
Northing	na	Surface Elevation	na	feet, site datum	
Easting	na	Riser Elevation	na	feet, site datum	
Screen	Sch. 40 PVC	Length (feet)	10	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW		feet BGS	
Riser	Sch. 40 PVC	Length (feet)	141.5	Diameter	2 inches
Drilling Method		Driller(s)	Bill Kimes	Geologist	Nat Warner
Drillng Company	Summit Site Services			Well Permit #	



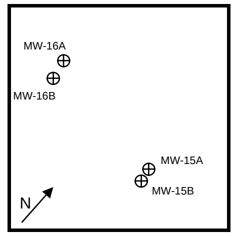
Location Sketch Map

Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment	Sample Description/Classification
	na					
			2-3-4	6	0-27	Dry fine, medium, coarse sand (larger sized grains at lower depths), tan/white SAND with 1/8 to 1/4 inch gravel and quartz minerals
5	#VALUE!					
			5-7-10	11		
10	#VALUE!					
			9-14-22	16		
15	#VALUE!					
			50/2	2		
20	#VALUE!					
			18-11-14	12		
25	#VALUE!					
			10-17-38	8		
					28 - 32	Moist, dense, dark tan medium SAND
30	#VALUE!					
			50/2	4		
					33 - 37	Moist, light tan medium to coarse SAND
35	#VALUE!					
			28-23-32	7		
					38 - 44	Moist to wet, tan silty fine SAND, somewhat consolidated
40	#VALUE!					
			22-25-23	15		
					45 - 46	Hard dry white CLAY
45	#VALUE!					
			30-50/4	12		
					47 - 67	Moist to wet, dense medium to coarse, tan, SAND with some quartz minerals
50	#VALUE!					
			50/2	3		
55	#VALUE!					
			50/2	9		
60	#VALUE!					
			50/2	1		
65	#VALUE!					
			32-32-29			
					68 - 118	Hard grey and red CLAY Lab Sample MW-16B-90
70	#VALUE!					
			13-25-32	3		
75	#VALUE!					
			30-23-27			
80	#VALUE!					
			NA			
85	#VALUE!					
			NA			
90						

Environmental Resources Management

MW-16B

WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment		
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham		
Completed	31-Aug-06	Boring Depth (feet)	150	Diameter	4 inches
Northing	na	Surface Elevation	na	feet, site datum	
Easting	na	Riser Elevation	na	feet, site datum	
Screen	Sch. 40 PVC	Length (feet)	10	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW		feet BGS	
Riser	Sch. 40 PVC	Length (feet)	141.5	Diameter	2 inches
Drilling Method		Driller(s)	Bill Kimes	Geologist	Nat Warner
Drillng Company	Summit Site Services			Well Permit #	



Location Sketch Map

Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment		Sample Description/Classification
90			50/4				
95	#VALUE!		NA				
100	#VALUE!		NA				
105	#VALUE!		NA				
110	#VALUE!		NA				
115	#VALUE!		NA			119	Small layer of easily breakable GRAVEL approximately 2 inches in thickness
120	#VALUE!		NA			120 - 127	Hard grey CLAY
125	#VALUE!		NA			128 - 136	Dense SILT or consolidated fine SAND (from slurry cuttings)
130	#VALUE!		NA				
135	#VALUE!		50/1	0		137 - 150	Medium to coarse, loose SAND (from slurry cuttings) Lab Sample MW-16B-145
140	#VALUE!		NA				
145	#VALUE!		NA				
150	#VALUE!		NA				
155	#VALUE!		NA				

Monitoring Well Construction Specifications

Surface completion is a above grade protective casing (6 inches round X 4 foot long) with lock anchored into the cement collar and surface pad. The well is equipped with a PVC top cap.

6" Outer Steel Casing	(Feet BGS)	Portland Cement	(Feet BGS)
Top	-3.0	Top	0.0
Bottom	1.0	Bottom	133.0
PVC Riser Interval	(Feet BGS)	Hydrated Bentonite Chip Seal	(Feet BGS)
Top	-2.5	Top	133.0
Bottom	139.0	Bottom	136.0
PVC Screen Interval	(Feet BGS)	Filter Sand	(Feet BGS)
Top	139.0	Top	136.0
Bottom	149.0	Bottom	150.0

Environmental Resources Management, Inc.
Boring Log

Boring Number: B-109

Site Name & Location Tolson Rubble Landfill, Crofton, MD	Project Number 0052940	Date & Time Started Date & Time Completed	8/24/06 1000 8/24/06 1530	
Drilling Company Summit Site Services	Driller Bill Kimes	Sampler(s) Nat Warner & Matt Fortin	Sampler Depth 5 foot intervals	
Drilling Equipment Truck mounted Hollow Stem Auger	Method Split Spoon	Elevation & Datum na	Completion Depth 65 feet	Rock Depth na
Bit Size 2 inch	Core Barrel (s) 2-foot soil core	North Coordinate na		
Geologist(s) Nat Warner		East Coordinate na		

DEPTH (ft below base of Concrete)	SAMPLES Sample Number	Recovery (inches)	Blow Counts	Sed-iment	SOIL DESCRIPTION	REMARKS
0	1	13.0	3 5 5 6		SAND (fill)	
5	2	14.0	3 4 4 4		SAND (fill)	
10	3	13.0	3 3 4 4		Clayey SAND	
15	4	8.0	2 2 3 4		Red to brown clayey SAND with some gravel	
20	5	8.0	4 4 5 4		Well sorted, native, clayey SAND with pebbles	
25	6	7.0	3 4 6 6		Well sorted clayey SAND with pebbles	
30	7	10.0	9 9 11 20		Grey soft CLAY	
35	8	4.0	50/1		Grey soft CLAY to a grey SILT	
40	9	3.0	50/2		Grey SILT with yellow streaks to orange/reddish grey SILT	
45	10	<1.0	50/2		Small amount of slurry saturated Gravel (Most likely dragged from above during sampling)	
50	11	3.0	50/1		Saturated medium SAND	Water Table @ ~49 feet Lab Sample B-109-50 submitted to ____ for analysis of moisture content and grain size.
55	12	8.0	19 26 30		Moist dark grey hard CLAY	Lab Sample B-109-55 submitted to ____ for analysis of moisture content, grain size, and atterburg limits.
60	13	8.0	29 50/4		Grey hard CLAY with some sand	
65	14		48 50/5		Grey clayey SAND End of boring at 65 feet bgs.	Lab Sample B-109-65 submitted to ____ for analysis of moisture content, grain size, and atterburg limits.
						Slow drilling from 60-65 feet

Environmental Resources Management, Inc.
Boring Log

Boring Number: B-110

Site Name & Location Tolson Rubble Landfill, Crofton, MD	Project Number 0052940	Date & Time Started Date & Time Completed	8/25/06 800 8/25/06 1200	
Drilling Company Summit Site Services	Driller Bill Kimes	Sampler(s) Matt Fortin	Sampler Depth 5 foot intervals	
Drilling Equipment Truck mounted Hollow Stem Auger	Method Split Spoon	Elevation & Datum na	Completion Depth 57 feet	Rock Depth na
Bit Size 2 inch	Core Barrel (s) 2-foot soil core	North Coordinate na		
Geologist(s) Nat Warner		East Coordinate na		

DEPTH (ft below base of Concrete)	SAMPLES Sample Number	Recovery (inches)	Blow Counts	Sed-iment	SOIL DESCRIPTION	REMARKS
0	1	6.0	4		Fine SAND (fill)	
			5			
			7			
			7			
5	2		6		Dry, tan, fine SAND with pebbles	Difficulty augering to 10 feet
			9			
			10			
			12			
10	3	12.0	10		Dry, tan, dense, fine SAND to	
			11		grey, moist clayey SAND	
			22			
			9			
15	4	15.0	12		Moist, maluable grey CLAY	
			16			
			19			
20	5	16.0	22		Grey to tan, moist, dense SILT with a red streak	
			27			
			40			
25	6	3.0	50/2		Saturated, medium SAND	Water Table @ ~24 feet Lab Sample B-110-25 submitted to ____ for analysis of moisture content and grain size.
30	7	3.0	50/2		Saturated, light brown, medium SAND	
35	8	5.0	50/5		Saturated, light brown, medium SAND to grey sandy CLAY	
40	9	16.0	50/3		Grey to tan, moist, dense, sandy/silty CLAY	First two sample attempts provided no recovery. Lab Sample B-110-40 submitted to ____ for analysis of moisture content, grain size, and atterburg limits.
45	10	3.0	50/1		Moist silty SAND	First two sample attempts provided no recovery.
50	11	6.0	50/1		Wet, coarse, dark, tan SAND	
55	12	8.0	50/1		Moist, grey, medium SAND End of boring at 57 feet bgs.	Slow drilling from 55 to 57 feet Refusal at 57 feet (very dense and consolidated/petrified sand)

Environmental Resources Management, Inc.
Boring Log

Boring Number: B-111

Site Name & Location Tolson Rubble Landfill, Crofton, MD	Project Number 0052940	Date & Time Started Date & Time Completed	8/25/06 1330 8/25/06 1620
Drilling Company Summit Site Services	Driller Bill Kimes	Sampler(s) Matt Fortin	Sampler Depth 5 foot intervals
Drilling Equipment Truck mounted Hollow Stem Auger	Method Split Spoon	Elevation & Datum na	Completion Depth 43 feet / Rock Depth na
Bit Size 2 inch	Core Barrel (s) 2-foot soil core	North Coordinate na	
Geologist(s) Nat Warner		East Coordinate na	

DEPTH (ft below base of Concrete)	SAMPLES Sample Number	Recovery (inches)	Blow Counts	Sed-iment	SOIL DESCRIPTION	REMARKS
0	1	14.0	3 5 6 5		Moist, fine, brown SAND with silt (fill)	Material was noted by Mr. Cunningham to have been deposited within the last year
5	2	3.0	2 2 6 11		Wet silty CLAY to orange brownish clayey SAND to 0.5" fine white SAND to orange brownish clayey SAND	
10	3	14.0	5 3 3 3		Light brown, fine sand to moist, clayey SAND	Refusal at 7 feet, hole reset 3 feet to the south
15	4	7.0	50/5		Wet coarse SAND	
20	5	4.0	50/4		Grey to orange, moist, sandy SILT	
25	6	8.0	50/3		Moist to wet, brown/orange, medium SAND with pebbles	Water Table @ ~ 27 feet Lab Sample B-111-25 submitted to ____ for analysis of moisture content and grain size.
30	7	9.0	50/3		Wet brown medium SAND	
35	8	4.0	50/3		Grey to brown, moist sand/silty CLAY	
40	9	10.0	50/5		Grey, moist CLAY End of boring at 43 feet bgs.	Lab Sample B-111-40 submitted to ____ for analysis of moisture content, grain size, and atterburg limits. Slow drilling from 40 to 43 feet Refusal at 43 feet (1 inch over 20 minutes)

Environmental Resources Management, Inc.
Boring Log

Boring Number: B-112

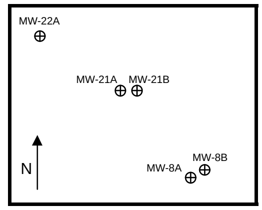
Site Name & Location Tolson Rubble Landfill, Crofton, MD	Project Number 0052940	Date & Time Started Date & Time Completed	8/28/06 830 8/28/06 1630
Drilling Company Summit Site Services	Driller Bill Kimes	Sampler(s) Nat Warner & Matt Fortin	Sampler Depth 5 foot intervals
Drilling Equipment Truck mounted Hollow Stem Auger	Method Split Spoon	Elevation & Datum na	Completion Depth: 70 feet Rock Depth: na
Bit Size 2 inch	Core Barrel (s) 2-foot soil core	North Coordinate na	
Geologist(s) Nat Warner		East Coordinate na	

DEPTH (ft below base of Concrete)	SAMPLES: Sample Number	Recovery (inches)	Blow Counts	Sed-iment	SOIL DESCRIPTION	REMARKS
0		na			Asphalt Medium, brown SAND	Asphalt layer ~ 3 inches
5	1	8.0	5 9 10 14		Moist, brown, medium, coarse SAND	
10	2	4.0	8 50/4		Silty CLAY with full wood fragments	Hole took entire bentonite slurry mixture. Hole reset with 15 feet of augers
15	3	3.0	7 2 2		Dry, medium, tan SAND with gravel to a moist tan, sandy CLAY	
20	4	8.0	8 9 10		Coarse to medium, brown, wet SAND to light grey, moist CLAY	
25	5	14.0	15 25 34		Tan, medium, moist SAND	Lab Sample B-112-25 submitted to ____ for analysis of moisture content and grain size.
30	6	16.0	18 28 32		Moist, grey CLAY	Lab Sample B-112-30 submitted to ____ for analysis of moisture content and grain size.
35	7	20.0	11 11 17		Moist brown/reddish CLAY	Clay was sealing hole around bit preventing slurry from reaching surface. Regular bit replaced with a bit designed for clay.
40	8	6.0	50/3		Tan, moist, coarse clayey SAND	
45	9	18.0	36 40 38		Wet, light brown, silty SAND to light grey moist sandy CLAY	300 gallons of water used between 30 and 45 feet
50	10	3.0	50/1		Coarse to medium, moist, tan SAND	
55	11	8.0	19 26 30		Wet coarse to medium, tan SAND	Water Table @ ~54 feet Lab Sample B-112-55 submitted to ____ for analysis of moisture content and grain size.
60	12		50/3		Wet coarse to medium, tan SAND	300 gallons of water used between 45 and 65 feet.
65	13	18.0	50/5 50/12		Dark, wet coarse SAND to Grey, dry to moist CLAY	Red clay observed in slurry at 66 feet. 250 gallons of water used between 65 and 70 feet.
70	14	4.0	50/4		Grey CLAY with a little red CLAY End of boring at 70 feet bgs.	Lab Sample B-112-70 submitted to ____ for analysis of moisture content, grain size, and atterburg limits.

Environmental Resources Management

MW-8B

WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment		
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham		
Complete	20-Jul-07	Boring Depth (feet)	163	Diameter	6 inches
Northing	na	Surface Elevation	na	feet, site datum	
Easting	na	Riser Elevation	na	feet, site datum	
Screen	Sch. 40 PVC	Length (feet)	20	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	91.2	feet BGS	
Riser	Sch. 40 PVC	Length (feet)	146	Diameter	2 inches
Drilling Method	mud rotary	Driller(s)	Tim Schultes	Geologist	Jacquelyn Hess
Drillng Company	A.C. Schultes			Well Permit #	AA-95-3053



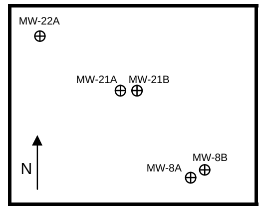
Location Sketch Map

Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment		Sample Description/Classification
	na		na	na			
						0-5	fine to medium SAND and debris with small GRAVEL (non-native)
5						5.0-10	grey CLAY with small to medium GRAVEL and asphalt (non-native)
10						11-28	coarse SAND and GRAVEL (non-native) and wood
15							
20							
25						28-30	fine to coarse SAND with little white CLAY and some wood
30						30-35	coarse SAND and small to medium GRAVEL with some medium SAND and little white CLAY
35						35-37	fine to coarse SAND with some white CLAY
						38-48	very coarse and coarse GRAVEL and fine sandy reddish-white CLAY
40							
45						48-53	fine to medium SAND with some medium to coarse GRAVEL and some white CLAY
50						53-55	fine to medium SAND and silty white.light grey CLAY with little medium GRAVEL
55						56-60	purplish brown mottled silty CLAY
60						60-70	orange-red and grey mottled clay with some medium SAND and coarse GRAVEL
65							
70						70-80	white silty CLAY with some medium SAND
75							
80						80-85	silty fine SAND with trace medium GRAVEL
85						85-87	medium SAND with some small GRAVEL
						87-90	red silty CLAY eith some medium SAND
90		∇				90-95	red and grey mottled CLAY with some medium to coarse sand and medium GRAVEL
95						95-96	red clay with med. to coarse SAND and coarse GRAVEL
						96-105	grey and white mottled silty CLAY with fine to medium SAND, little red CLAY and trace small GRAVEL
100							
105						105-110	fine to medium SAND with little white and grey CLAY
110						110-120	fine to medium SAND with some white and grey CLAY and some coarse SAND
115							

Environmental Resources Management

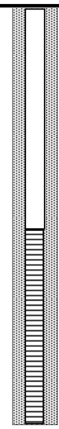
MW-8B

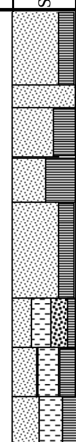
WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment		
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham		
Complete	20-Jul-07	Boring Depth (feet)	163	Diameter	6 inches
Northing	na	Surface Elevation	na	feet, site datum	
Easting	na	Riser Elevation	na	feet, site datum	
Screen	Sch. 40 PVC	Length (feet)	20	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	91.2	feet BGS	
Riser	Sch. 40 PVC	Length (feet)	146	Diameter	2 inches
Drilling Method	mud rotary	Driller(s)	Tim Schultes	Geologist	Jacquelyn Hess
Drillng Company	A.C. Schultes			Well Permit #	AA-95-3053



Location Sketch Map

Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment		Sample Description/Classification
120						120-127	fine to medium SAND with some white and grey silty CLAY
125							
130						127-131	fine to medium SAND with trace coarse SAND
						131-135	fine to medium SAND with grey silty clay
135						135-140	fine to medium SAND and silvery-grey CLAY
140						140-150	fine to medium SAND with some silvery grey CLAY
145							
150						150-155	fine to coarse SAND and silt with some small GRAVEL and little white CLAY
155						155-160	fine to medium SAND and silt with silty white CLAY
160						160-163	fine to medium SAND and silt with some silty white CLAY
165							





Monitoring Well Construction Specifications

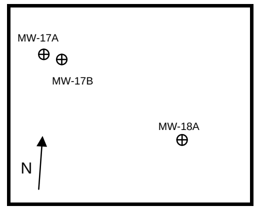
Surface completion is a above grade, locking steel protective casing (4 inches square X 5 foot long) anchored into the cement collar and surface pad. The well is equipped with a PVC top cap.

	(Feet BGS)		(Feet BGS)
4" Outer Casing	(Feet BGS)	Portland Cement	(Feet BGS)
Top	-3.0	Top	0.0
Bottom	2.0	Bottom	115.0
PVC Riser Interval	(Feet BGS)	Hydrated Bentonite Chip Seal	(Feet BGS)
Top	-3.0	Top	115.0
Bottom	143.0	Bottom	121.0
PVC Screen Interval	(Feet BGS)	Filter Sand	(Feet BGS)
Top	143.0	Top	121.0
Bottom	163.0	Bottom	163.0

Environmental Resources Management

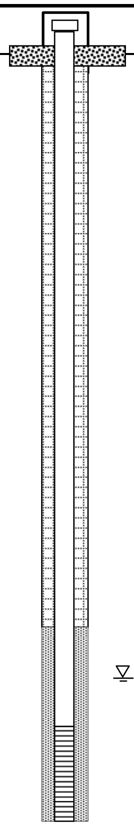
MW-17A

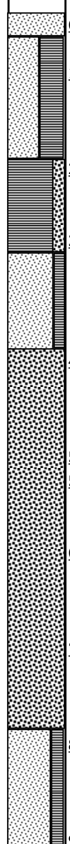
WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment		
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham		
Complete	8-Jun-07	Boring Depth (feet)	90	Diameter	6 inches
Northing	na	Surface Elevation	na	feet, site datum	
Easting	na	Riser Elevation	na	feet, site datum	
Screen	Sch. 40 PVC	Length (feet)	10	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	65.25	feet BGS	
Riser	Sch. 40 PVC	Length (feet)	73	Diameter	2 inches
Drilling Method	mud rotary	Driller(s)	Randall Melson	Geologist	Megan Kennedy
Drillng Company	A.C. Schultes			Well Permit #	AA-95-2966



Location Sketch Map

Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment	Sample Description/Classification
	na		na	na		
5						6-7 sandstone
10						10-20 fine to medium dark grey SAND and brown clay
15						
20						20-30 thick brown silty CLAY with some fine to medium dark grey sand and small gravel
25						
30						30-40 medium to coarse SAND with some clay
35						
40						40-50 medium to coarse SAND and small GRAVEL
45						
50						50-53 medium to coarse SAND and small GRAVEL
55						53-60 coarse SAND and medium GRAVEL
60						60-70 medium GRAVEL with some coarse SAND
65						
70						70-80 small and medium GRAVEL with some coarse SAND
75						
80						80-90 fine to medium SAND with some small GRAVEL and clay
85						
90						90 fine to medium SAND with trace small gravel and some white clay
						*bore hole backfilled from 90-80 feet BGS





Monitoring Well Construction Specifications

Surface completion is a above grade, locking steel protective casing (4 inches square X 5 foot long) anchored into the cement collar and surface pad. The well is equipped with a PVC top cap.

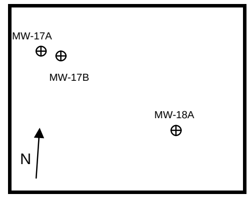
	(Feet BGS)		(Feet BGS)
4" Outer Casing		Portland Cement	
Top	-3.0	Top	na*
Bottom	2.0	Bottom	na*
PVC Riser Interval		Hydrated Bentonite Chip Seal	
Top	-3.0	Top	na*
Bottom	70.0	Bottom	na*
PVC Screen Interval		Filter Sand	
Top	70.0	Top	60.0
Bottom	80.0	Bottom	80.0

*NOTE: MW-17A completed with BenSeal bentonite 'grout' from 0-60 feet BGS; in direct contact with filter sand

Environmental Resources Management

MW-17B

WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment		
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham		
Complete	13-Jun-07	Boring Depth (feet)	212	Diameter	6 inches
Northing	na	Surface Elevation	na feet, site datum		
Easting	na	Riser Elevation	na feet, site datum		
Screen	Sch. 40 PVC	Length (feet)	10	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	114.09 feet BGS		
Riser	Sch. 40 PVC	Length (feet)	201	Diameter	2 inches
Drilling Method	mud rotary	Driller(s)	Ted Oliver	Geologist	Megan Kennedy
Drillng Company	A.C. Schultes			Well Permit #	AA-95-2965



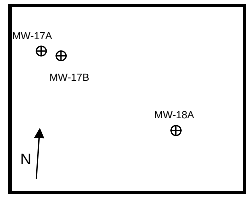
Location Sketch Map

Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment	Sample Description/Classification
	na		na	na		
6						6 sandstone
10-20						fine to medium SAND and brown silty CLAY
20-30						thick brown silty CLAY
30-40						medium to coarse SAND with silty clay
40-50						medium to coarse SAND and small GRAVEL
50-60						medium to coarse SAND and small GRAVEL
60-70						small and medium GRAVEL with some coarse SAND
70-80						medium GRAVEL with some coarse SAND and small gravel
80-90						fine and medium SAND with some coarse sand
90-100						medium SAND
100-110						medium and coarse SAND with some silt and clay
110-114						medium GRAVEL and white silty clay
114-120						small GRAVEL and reddish-grey silty clay
120-135						dark grey silty CLAY with some medium gravel

Environmental Resources Management

MW-17B

WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment		
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham		
Complete	13-Jun-07	Boring Depth (feet)	212	Diameter	6 inches
Northing	na	Surface Elevation	na feet, site datum		
Easting	na	Riser Elevation	na feet, site datum		
Screen	Sch. 40 PVC	Length (feet)	10	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	114.09 feet BGS		
Riser	Sch. 40 PVC	Length (feet)	201	Diameter	2 inches
Drilling Method	mud rotary	Driller(s)	Ted Oliver	Geologist	Megan Kennedy
Drillng Company	A.C. Schultes			Well Permit #	AA-95-2965



Location Sketch Map

Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment	Sample Description/Classification
125						
130						135-145 dark grey, silty CLAY
135						
140						
145						145-162 dark grey, silty CLAY
150						
155						
160						162-170 small to medium SAND
165						
170						170-180 dark grey, silty CLAY
175						
180						180-190 dark grey, silty CLAY with trace small gravel
185						
190						190-197 dark grey silty CLAY with trace small gravel
195						197-200 fine to medium SAND with silt and clay
200						200-210 fine SAND with silt
205						
210						210-212 silty fine SAND with some medium sand
215						*bore hole backfilled from 212-208 feet BGS

Monitoring Well Construction Specifications

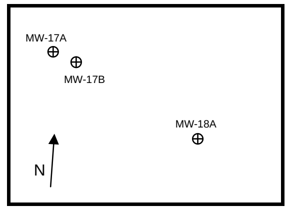
Surface completion is a above grade, locking steel protective casing (4 inches square X 5 foot long) anchored into the cement collar and surface pad. The well is equipped with a PVC top cap.

4" Outer Casing	(Feet BGS)	Portland Cement	(Feet BGS)
Top	-3.0	Top	0.0
Bottom	2.0	Bottom	192.0
PVC Riser Interval	(Feet BGS)	**Hydrated Bentonite Chip Seal**	(Feet BGS)
Top	-3.0	Top	192.0
Bottom	198.0	Bottom	196.0
PVC Screen Interval	(Feet BGS)	**Filter Sand**	(Feet BGS)
Top	198.0	Top	196.0
Bottom	208.0	Bottom	208.0

Environmental Resources Management

MW-18A

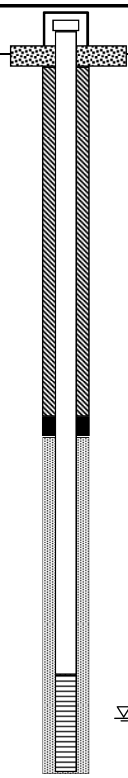
WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham
Complete	15-Jun-07	Boring Depth (feet)	75 Diameter 6 inches
Northing	na	Surface Elevation	na feet, site datum
Easting	na	Riser Elevation	na feet, site datum
Screen	Sch. 40 PVC	Length (feet)	10 Diameter 2 inches
Slot Size	0.01 inches	Stabilized DTW	69.29 feet BGS
Riser	Sch. 40 PVC	Length (feet)	68 Diameter 2 inches
Drilling Method	mud rotary	Driller(s)	Ted Oliver Geologist Megan Kennedy
Drillng Company	A.C. Schultes	Well Permit #	AA-95-2967

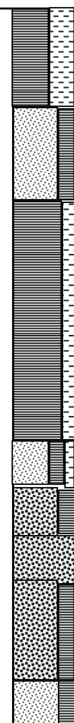


Location Sketch Map

Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment		Sample Description/Classification
	na		na	na			
						0-8	red-brown silty CLAY with sandstone
						10-20	fine to medium silty SAND with red-brown clay and sandstone
						20-30	light brown silty CLAY and sandstone
						30-40	red-orange and black silty CLAY
						40-46	red-brown and black silty CLAY
						46-50	red-brown and black silty clay and medium SAND
						50-55	coarse SAND and small GRAVEL with some black clay
						55-60	medium and coarse SAND and small GRAVEL
						60-70	medium to coarse SAND and medium GRAVEL with some white clay
						70-75	medium to coarse silty SAND with white clay

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75





Monitoring Well Construction Specifications

Surface completion is a above grade, locking steel protective casing (4 inches square X 5 foot long) anchored into the cement collar and surface pad. The well is equipped with a PVC top cap.

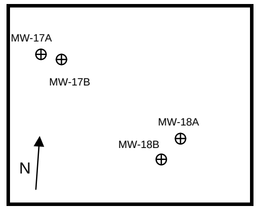
	(Feet BGS)		(Feet BGS)
4" Outer Casing		Portland Cement	
Top	-3.0	Top	0.0
Bottom	2.0	Bottom	38.0
PVC Riser Interval		Hydrated Bentonite Chip Seal	
Top	-3.0	Top	38.0
Bottom	65.0	Bottom	40.0
PVC Screen Interval		Filter Sand	
Top	65.0	Top	na*
Bottom	75.0	Bottom	75.0

*NOTE: borehole inadvertently backfilled with native sand/gravel after placing 6 bags of filter sand around screen annulus; top of filter sand unknown

Environmental Resources Management

MW-18B

WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment		
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham		
Complete	30-Aug-07	Boring Depth (feet)	180	Diameter	8 inches
Northing	na	Surface Elevation	na feet, site datum		
Easting	na	Riser Elevation	na feet, site datum		
Screen	Sch. 40 PVC	Length (feet)	20	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	feet BGS		
Riser	Sch. 40 PVC	Length (feet)	160	Diameter	2 inches
Drilling Method	mud rotary	Driller(s)	Tim Schultes	Geologist	Jacquelyn Hess
Drillng Company	A.C. Schultes			Well Permit #	AA-95-2968



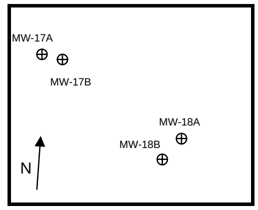
Location Sketch Map

Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment	Sample Description/Classification
	na		na	na		
					0-3	orange CLAY with some fine SAND
5					3-5.0	fine to medium sandy whitish CLAY with some small to medium GRAVEL
					5-7	sandstone
10					7-20	fine to medium SAND with coarse SAND and trace white silty CLAY
15						
20					21-29	fine sandy tan CLAY with little fine to medium sandy orange CLAY and little fine SAND
25						
30					30-36	grey silty CLAY
35					37-39	grey silty CLAY with little orange fine sandy CLAY
40					40-49	fine to medium SAND and grey silty CLAY
45						
50					50-56	fine to medium SAND and small to medium GRAVEL with some coarse GRAVEL
55					57-60	fine to medium SAND with small to medium GRAVEL
60					60-62	fine to coarse SAND with, some small to medium GRAVEL, silty silver grey CLAY, little coarse GRAVEL
65					62-69	fine to coarse SAND with medium to coarse GRAVEL some silvery grey CLAY
70					70-79	small to coarse GRAVEL and fine to coarse SAND, with some silvery grey clay, some fine to medium sandy orange brown CLAY, and trace silty white CLAY
75						
80					80-89	fine to caorse SAND and small GRAVEL with some medium GRAVEL and some silvery-purple grey CLAY
85						
90					90-96	fine to medium SAND with small GRAVEL and some silvery-purple grey CLAY
95					97-99	fine to coarse SAND with small to medium GRAVEL
100					100-107	fine to coarse SAND with small to medium GRAVEL, silvery-purple grey CLAY and white silty CLAY
105					108-124	medium to coarse SAND and small to medium GRAVEL
110						
115						
120						

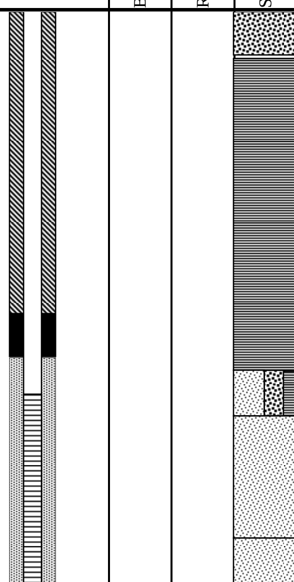
Environmental Resources Management

MW-18B

WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment		
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham		
Complete	30-Aug-07	Boring Depth (feet)	180	Diameter	8 inches
Northing	na	Surface Elevation	na	feet, site datum	
Easting	na	Riser Elevation	na	feet, site datum	
Screen	Sch. 40 PVC	Length (feet)	20	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW		feet BGS	
Riser	Sch. 40 PVC	Length (feet)	160	Diameter	2 inches
Drilling Method	mud rotary	Driller(s)	Tim Schultes	Geologist	Jacquelyn Hess
Drillng Company	A.C. Schultes			Well Permit #	AA-95-2968



Location Sketch Map



Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment	Sample Description/Classification
125						125-134 silvery-purple CLAY with little borwnish orange CLAY, little red CLAY, and trace white silty CLAY
130						
135						135-139 silver CLAY and red CLAY with some medium sandy white CLAY and some brownigh orange CLAY
140						140-149 grey CLAY and red CLAY with little white CLAY
145						
150						150-158 red CLAY with little medium sandy whitish-grey CLAY
155						
160						158-162 fine to coarse SAND with small GRAVEL and some light grey CLAY
165						163-180 medium to coarse SAND
170						
175						
180						*log from 124' to 0' bgs from previous borehole made less than 5' away (more accurate log kept for previous borehole)

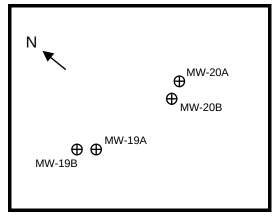
Monitoring Well Construction Specifications

Surface completion is a above grade, locking steel protective casing (4 inches square X 5 foot long) anchored into the cement collar and surface pad. The well is equipped with a PVC top cap.

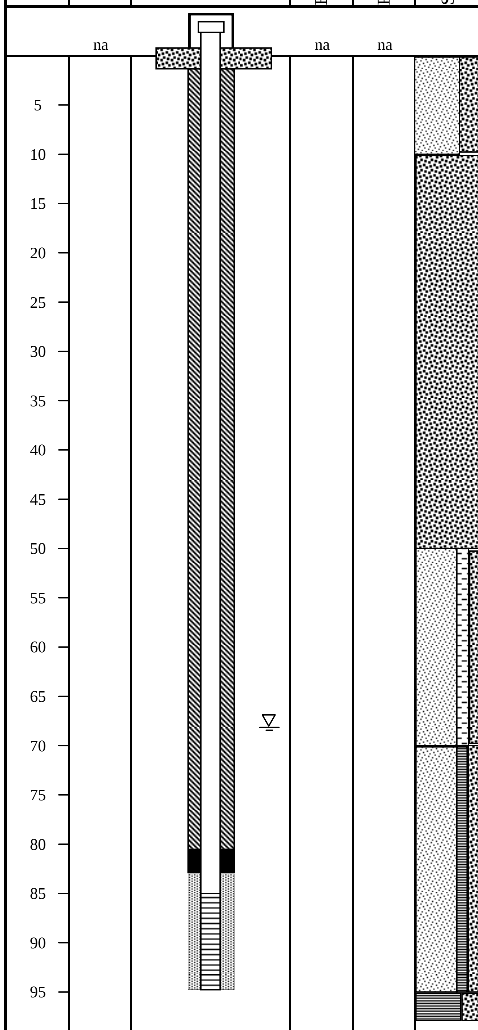
4" Outer Casing	(Feet BGS)	Portland Cement	(Feet BGS)
Top	-3.0	Top	0.0
Bottom	2.0	Bottom	152.0
PVC Riser Interval	(Feet BGS)	Hydrated Bentonite Chip Seal	(Feet BGS)
Top	-3.0	Top	152.0
Bottom	160.0	Bottom	156.0
PVC Screen Interval	(Feet BGS)	Filter Sand	(Feet BGS)
Top	160.0	Top	156.0
Bottom	180.0	Bottom	180.0

Environmental Resources Management **MW-19A**

WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment		
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham		
Complete	26-Jun-07	Boring Depth (feet)	95	Diameter	6 inches
Northing	na	Surface Elevation	na	feet, site datum	
Easting	na	Riser Elevation	na	feet, site datum	
Screen	Sch. 40 PVC	Length (feet)	10	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	68.00	feet BGS	
Riser	Sch. 40 PVC	Length (feet)	88	Diameter	2 inches
Drilling Method	mud rotary	Driller(s)	Tim Schultes	Geologist	Dusty Aeiker
Drillng Company	A.C. Schultes			Well Permit #	AA-95-3048



Location Sketch Map



Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment	Sample Description/Classification
	na		na	na		
0-10						light brown medium to coarse SAND w/ small gravel
10-20						light brown to red-brown medium to coarse SAND and coarse GRAVEL
30-40						light brown medium to coarse SAND and GRAVEL
40-50						light brown medium to coarse SAND and small GRAVEL (gravel decreasing with depth)
50-60						light brown medium SAND with silt and some small gravel
60-70						light brown medium to coarse SAND with some silt and small gravel
70-80						light brown medium to coarse SAND with trace white clay and silt and small gravel
80-90						light brown medium to coarse SAND with silt and trace gravel and red clay
90-95						light brown fine silty SAND with some red clay and trace small gravel
95						red silty CLAY with some light brown silty sand and small gravel

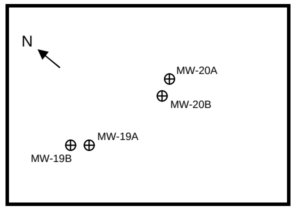
Monitoring Well Construction Specifications

Surface completion is a above grade, locking steel protective casing (4 inches square X 5 foot long) anchored into the cement collar and surface pad. The well is equipped with a PVC top cap.

4" Outer Casing	(Feet BGS)	Portland Cement	(Feet BGS)
Top	-3.0	Top	0.0
Bottom	2.0	Bottom	81.0
PVC Riser Interval	(Feet BGS)	Hydrated Bentonite Chip Seal	(Feet BGS)
Top	-3.0	Top	81.0
Bottom	85.0	Bottom	83.0
PVC Screen Interval	(Feet BGS)	Filter Sand	(Feet BGS)
Top	85.0	Top	83.0
Bottom	95.0	Bottom	95.0

Environmental Resources Management **MW-19B**

WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment		
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham		
Complete	28-Jun-07	Boring Depth (feet)	160	Diameter	6 inches
Northing	na	Surface Elevation	na	feet, site datum	
Easting	na	Riser Elevation	na	feet, site datum	
Screen	Sch. 40 PVC	Length (feet)	15	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	100.95	feet BGS	
Riser	Sch. 40 PVC	Length (feet)	148	Diameter	2 inches
Drilling Method	mud rotary	Driller(s)	Tim Schultes	Geologist	Dusty Aeiker
Drillng Company	A.C. Schultes			Well Permit #	AA-95-3051



Location Sketch Map

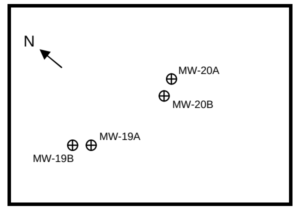
Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment	Sample Description/Classification
	na		na	na		
					0-10	orange to brown silty SAND with some gravel
					10-20	light brown medium to coarse SAND and small GRAVEL
					20-30	light brown medium to coarse SAND and GRAVEL
					30-40	light brown coarse SAND and small GRAVEL
					40-50	medium to coarse GRAVEL with some light brown medium sand
					45-50	pieces of sandstone and coarse GRAVEL with trace grey clay
					50-60	coarse GRAVEL with some white silty clay and medium to coarse sand
					60-70	small to medium GRAVEL with some silty white to grey clay and silty light brown sand
					70-80	fine to medium silty SAND with some brown clay and trace small gravel
					80-84	fine to medium silty SAND and medium to coarse GRAVEL and trace red silty clay
					84-90	medium to coarse GRAVEL with some red to grey silty clay
					90-100	red and grey mottled CLAY with trace medium to small gravel and silty sand
					100-110	red CLAY with some silty sand and trace lignite
					110-120	grey silty CLAY with trace small gravel

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120

Environmental Resources Management

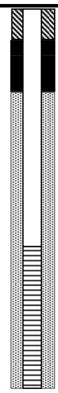
MW-19B

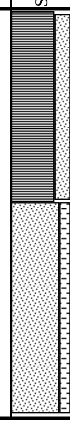
WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment		
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham		
Complete	28-Jun-07	Boring Depth (feet)	160	Diameter	6 inches
Northing	na	Surface Elevation	na	feet, site datum	
Easting	na	Riser Elevation	na	feet, site datum	
Screen	Sch. 40 PVC	Length (feet)	15	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	100.95	feet BGS	
Riser	Sch. 40 PVC	Length (feet)	148	Diameter	2 inches
Drilling Method	mud rotary	Driller(s)	Tim Schultes	Geologist	Dusty Aeiker
Drillng Company	A.C. Schultes			Well Permit #	AA-95-3051



Location Sketch Map

Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment	Sample Description/Classification
125						120-130 grey silty CLAY with some medium silty sand
130						130-140 white and grey mottled silty CLAY with some silty fine sand
135						
140						140-150 light brown fine silty SAND
145						
150						150-160 light brown medium SAND with some silt
155						
160						160 light brown medium SAND with some silt





Monitoring Well Construction Specifications

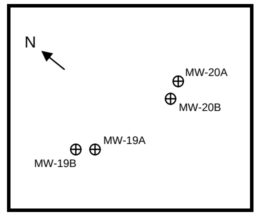
Surface completion is a above grade, locking steel protective casing (4 inches square X 5 foot long) anchored into the cement collar and surface pad. The well is equipped with a PVC top cap.

4" Outer Casing	(Feet BGS)	Portland Cement	(Feet BGS)
Top	-3.0	Top	0.0
Bottom	2.0	Bottom	124.0
PVC Riser Interval	(Feet BGS)	Hydrated Bentonite Chip Seal	(Feet BGS)
Top	-3.0	Top	124.0
Bottom	145.0	Bottom	129.0
PVC Screen Interval	(Feet BGS)	Filter Sand	(Feet BGS)
Top	145.0	Top	129.0
Bottom	160.0	Bottom	160.0

Environmental Resources Management

MW-20A

WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham
Complete	2-Jul-07	Boring Depth (feet)	95 Diameter 6 inches
Northing	na	Surface Elevation	na feet, site datum
Easting	na	Riser Elevation	na feet, site datum
Screen	Sch. 40 PVC	Length (feet)	10 Diameter 2 inches
Slot Size	0.01 inches	Stabilized DTW	67.13 feet BGS
Riser	Sch. 40 PVC	Length (feet)	95 Diameter 2 inches
Drilling Method	mud rotary	Driller(s)	Tim Schultes Geologist Dusty Aeiker
Drillng Company	A.C. Schultes	Well Permit #	AA-95-3049



Location Sketch Map

Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment	Sample Description/Classification
	na		na	na		
0-10						gray-brown, silty SAND with gravel
10-20						light-brown, medium to coarse SAND with small gravel
20-28						light-brown, medium to coarse SAND with small gravel
28-35						small GRAVEL with medium to coarse sand
35-43						brown, medium to coarse SAND with small gravel
43-50						light brown, coarse SAND and small GRAVEL
50-57						medium GRAVEL with trace white clay
57-65						medium to coarse SAND with some small gravel
65-70						fine to medium SAND with some small gravel
70-80						silty, fine SAND with some small gravel and trace white clay
80-88						silty, fine SAND with some small gravel and trace white clay
88-95						silty, fine SAND with white clay

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95

*bore hole backfilled from 95-92 feet BGS

Monitoring Well Construction Specifications

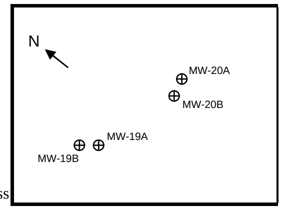
Surface completion is a above grade, locking steel protective casing (4 inches square X 5 foot long) anchored into the cement collar and surface pad. The well is equipped with a PVC top cap.

4" Outer Casing	(Feet BGS)	Portland Cement/Bentonite Mix	(Feet BGS)
Top	-3.0	Top	0.0
Bottom	2.0	Bottom	71.0
PVC Riser Interval	(Feet BGS)	**Hydrated Bentonite Chip Seal**	(Feet BGS)
Top	-3.0	Top	71.0
Bottom	92.0	Bottom	78.0
PVC Screen Interval	(Feet BGS)	**Filter Sand**	(Feet BGS)
Top	82.0	Top	78.0
Bottom	92.0	Bottom	92.0

Environmental Resources Management

MW-20B

WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment		
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham		
Complete	6-Jul-07	Boring Depth (feet)	160	Diameter	6 inches
Northing	na	Surface Elevation	na	feet, site datum	
Easting	na	Riser Elevation	na	feet, site datum	
Screen	Sch. 40 PVC	Length (feet)	20	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	98.30	feet BGS	
Riser	Sch. 40 PVC	Length (feet)	138	Diameter	2 inches
Drilling Method	mud rotary	Driller(s)	Keith Watson	Geologist	M. Kennedy, J. Hess
Drillng Company	A.C. Schultes			Well Permit #	AA-95-3050



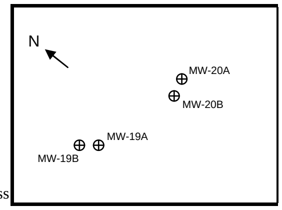
Location Sketch Map

Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment	Sample Description/Classification
	na		na	na		
0-8						red-brown silty CLAY
8-10						sandstone
10-20						fine silty SAND
20-30						same as above
30-40						medium to coarse SAND
40-50						fine to medium SAND
50-60						same as above
60-70						same as above
70-76						fine to medium SAND with some small GRAVEL and trace white CLAY
76-80						fine to coarse SAND with some small GRAVEL and trace red-brown CLAY
80-85						same as above
85-90						fine to coarse SAND with small GRAVEL and trace white CLAY
90-91						coarse SAND with trace white CLAY
91-98						fine to medium SAND with trace white CLAY
98-100						fine SAND with some light grey CLAY
100-110						light gret silty clay with some fine SAND and trace small GRAVEL
110-115						CLAY (no cuttings)
115-120						medium sand-sized pieces of white CLAY and silt

Environmental Resources Management

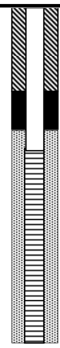
MW-20B

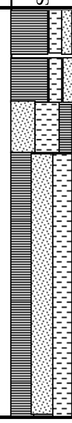
WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment		
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham		
Complete	6-Jul-07	Boring Depth (feet)	160	Diameter	6 inches
Northing	na	Surface Elevation	na	feet, site datum	
Easting	na	Riser Elevation	na	feet, site datum	
Screen	Sch. 40 PVC	Length (feet)	20	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	98.30	feet BGS	
Riser	Sch. 40 PVC	Length (feet)	138	Diameter	2 inches
Drilling Method	mud rotary	Driller(s)	Keith Watson	Geologist	M. Kennedy, J. Hess
Drillng Company	A.C. Schultes			Well Permit #	AA-95-3050



Location Sketch Map

Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment	Sample Description/Classification
125						120-130 CLAY with some silty CLAY and little fine SAND
130						130-135 fine SAND and silt with some white CLAY
135						135-142 CLAY and fine SAND and silt
140						
145						142-155 same as above
150						
155						
160						





Monitoring Well Construction Specifications

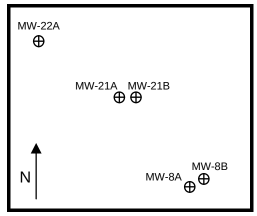
Surface completion is a above grade, locking steel protective casing (4 inches square X 5 foot long) anchored into the cement collar and surface pad. The well is equipped with a PVC top cap.

4" Outer Casing	(Feet BGS)	Portland Cement	(Feet BGS)
Top	-3.0	Top	0.0
Bottom	2.0	Bottom	129.0
PVC Riser Interval	(Feet BGS)	Hydrated Bentonite Chip Seal	(Feet BGS)
Top	-3.0	Top	129.0
Bottom	135.0	Bottom	133.0
PVC Screen Interval	(Feet BGS)	Filter Sand	(Feet BGS)
Top	135.0	Top	133.0
Bottom	155.0	Bottom	155.0

Environmental Resources Management

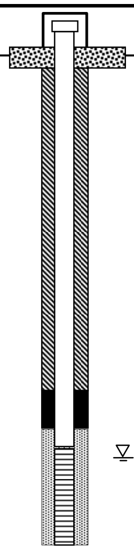
MW-21A

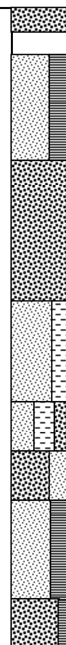
WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment		
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham		
Complete	9-Jul-07	Boring Depth (feet)	50	Diameter	6 inches
Northing	na	Surface Elevation	na	feet, site datum	
Easting	na	Riser Elevation	na	feet, site datum	
Screen	Sch. 40 PVC	Length (feet)	10	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	41.27	feet BGS	
Riser	Sch. 40 PVC	Length (feet)	43	Diameter	2 inches
Drilling Method	mud rotary	Driller(s)	Tim Schultes	Geologist	Megan Kennedy
Drillng Company	A.C. Schultes			Well Permit #	AA-95-3054



Location Sketch Map

Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment		Sample Description/Classification
	na		na	na			
						0-2	SAND and GRAVEL (non-native)
						2-3	something hard, but not sandstone
5						3-16	silty fine SAND with some sillty red-brown CLAY and debris
10							
15						17-30	SAND and small GRAVEL and debris
20							
25							
30						30-37	fine to medium silty SAND
35							
40						40-45	fine SAND and silt with small GRAVEL
45						45-50	small to medium GRAVEL with fine SAND
50						50-55	coarse SAND with some white silty CLAY
55						55-60	same as above
60						60	medium SAND and small GRAVEL with trace white silty CLAY
70							*backfilled from 60' to 50'





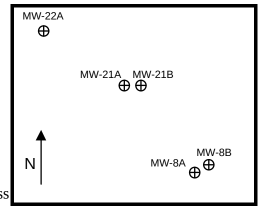
Monitoring Well Construction Specifications

Surface completion is a above grade, locking steel protective casing (4 inches square X 5 foot long) anchored into the cement collar and surface pad. The well is equipped with a PVC top cap.

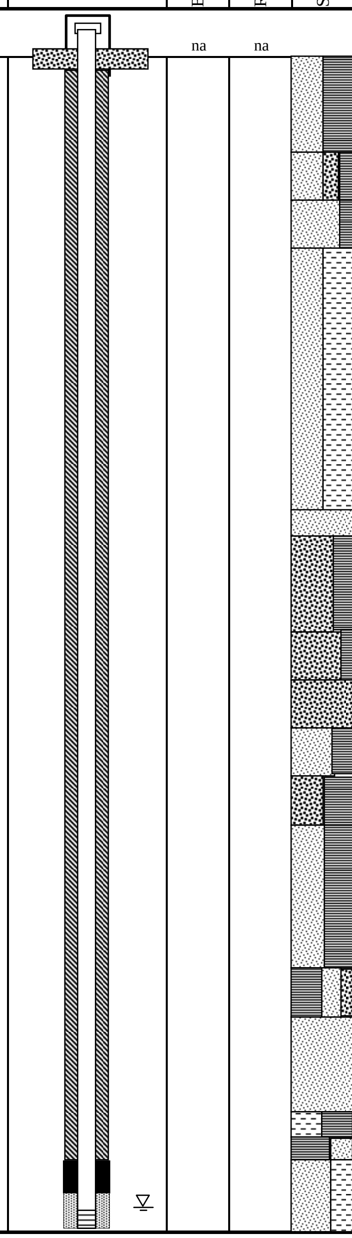
4" Outer Casing	(Feet BGS)	Portland Cement	(Feet BGS)
Top	-3.0	Top	0.0
Bottom	2.0	Bottom	34.0
PVC Riser Interval	(Feet BGS)	Hydrated Bentonite Chip Seal	(Feet BGS)
Top	-3.0	Top	34.0
Bottom	40.0	Bottom	38.0
PVC Screen Interval	(Feet BGS)	Filter Sand	(Feet BGS)
Top	40.0	Top	38.0
Bottom	50.0	Bottom	50.0

Environmental Resources Management **MW-21B**

WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment		
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham		
Complete		Boring Depth (feet)	130	Diameter	6 inches
Northing	na	Surface Elevation	na	feet, site datum	
Easting	na	Riser Elevation	na	feet, site datum	
Screen	Sch. 40 PVC	Length (feet)	10	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	120.58	feet BGS	
Riser	Sch. 40 PVC	Length (feet)	123	Diameter	2 inches
Drilling Method	mud rotary	Driller(s)	Tim Schultes	Geologist	M. Kennedy, J. Hess
Drillng Company	A.C. Schultes			Well Permit #	AA-95-3055



Location Sketch Map



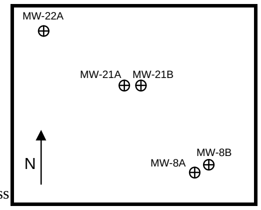
Depth (feet BGS)	Elevation (feet, MSL)	Blow Counts	Recovery (inches)	Sample Description/Classification	
	na	na	na		
				0-10	fine to medium SAND and red brown silty CLAY
				13-14	medium SAND with some small GRAVEL and black silty CLAY
				14-17	medium to coarse SAND with little white/light grey and black silty CLAY and little woody debris
				17-37	drilling blind b/c mud being taken, cuttings are fine SAND and silt
				47-50	medium to coarse SAND
				50-60	coarse SAND and small GRAVEL with some white CLAY
				60-65	medium silty SAND and small GRAVEL with trace white CLAY
				65-70	coarse SAND and GRAVEL
				70-75	medium SAND with some white and red-brown mottled CLAY
				75-80	very coarse GRAVEL and CLAY
				80-83	coarse SAND and red CLAY
				95-100	red CLAY with fine to medium SAND and some small GRAVEL
				100-103	fine SAND
				110-114	very fine silt and CLAY
				114-115	red CLAY with fine to medium SAND
				115-120	fine to medium SAND with some silt
				120-125	fine SAND with some silt and medium SAND

Depth scale (feet BGS): 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120

Environmental Resources Management

MW-21B

WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment		
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham		
Complete		Boring Depth (feet)	130	Diameter	6 inches
Northing	na	Surface Elevation	na	feet, site datum	
Easting	na	Riser Elevation	na	feet, site datum	
Screen	Sch. 40 PVC	Length (feet)	10	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	120.58	feet BGS	
Riser	Sch. 40 PVC	Length (feet)	123	Diameter	2 inches
Drilling Method	mud rotary	Driller(s)	Tim Schultes	Geologist	M. Kennedy, J. Hess
Drillng Company	A.C. Schultes			Well Permit #	AA-95-3055



Location Sketch Map

Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment	Sample Description/Classification
125						125-130 fine to coarse SAND
130						130 medium to coarse SAND
135						
140						
145						
150						
155						
160						

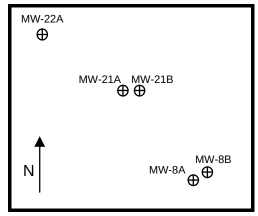
Monitoring Well Construction Specifications

Surface completion is a above grade, locking steel protective casing (4 inches square X 5 foot long) anchored into the cement collar and surface pad. The well is equipped with a PVC top cap.

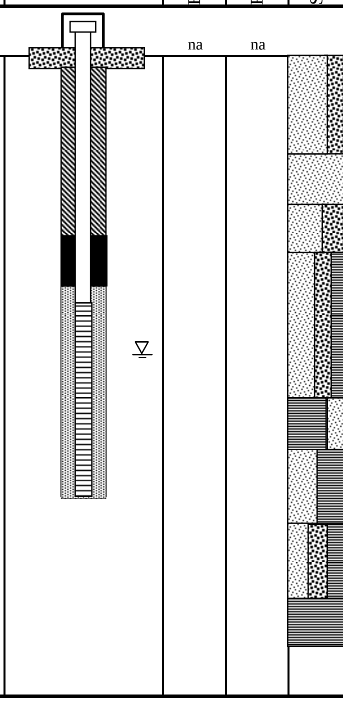
4" Outer Casing	(Feet BGS)	Portland Cement	(Feet BGS)
Top	-3.0	Top	0.0
Bottom	2.0	Bottom	108.0
PVC Riser Interval	(Feet BGS)	Hydrated Bentonite Chip Seal	(Feet BGS)
Top	-3.00	Top	108.0
Bottom	120.0	Bottom	112.0
PVC Screen Interval	(Feet BGS)	Filter Sand	(Feet BGS)
Top	120.0	Top	112.0
Bottom	130.0	Bottom	130.0

Environmental Resources Management **MW-22A**

WO No:	0052940	Project	Tolson Rubble Landfill Phase II Assessment		
Location	Tolson Rubble Landfill	Owner	Mr. James Cunningham		
Complete	16-Jul-07	Boring Depth (feet)	58	Diameter	6 inches
Northing	na	Surface Elevation	na feet, site datum		
Easting	na	Riser Elevation	na feet, site datum		
Screen	Sch. 40 PVC	Length (feet)	20	Diameter	2 inches
Slot Size	0.01 inches	Stabilized DTW	30.93 feet BGS		
Riser	Sch. 40 PVC	Length (feet)	28	Diameter	2 inches
Drilling Method	mud rotary	Driller(s)	Tim Schultes	Geologist	Jacquelyn Hess
Drillng Company	A.C. Schultes			Well Permit #	AA-95-3052



Location Sketch Map



Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Blow Counts	Recovery (inches)	Sediment	Sample Description/Classification
	na		na	na		
0-5						reddish brown medium to coarse SAND with little small GRAVEL
10-16						reddish brown coarse SAND with some medium SAND
16-20						light reddish brown medium to coarse SAND with small GRAVEL
20-30						light reddish brown coarse SAND with small to medium GRAVEL and trace white CLAY
30-33						fine to medium SAND with some medium GRAVEL and some white fine sandy CLAY
36-40						silty white clay with some fine SAND and little red CLAY
40-48						fine to medium SAND and silty white CLAY and red CLAY
48-50						medium SAND and small GRAVEL and red CLAY
55-58						red CLAY *backfilled from 58' to 45' bgs

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

Monitoring Well Construction Specifications

Surface completion is a above grade, locking steel protective casing (4 inches square X 5 foot long) anchored into the cement collar and surface pad. The well is equipped with a PVC top cap.

	(Feet BGS)		(Feet BGS)
4" Outer Casing		Portland Cement/Bentonite Mix	
Top	-3.0	Top	0.0
Bottom	2.0	Bottom	18.0
PVC Riser Interval		Hydrated Bentonite Chip Seal	
Top	-3.0	Top	18.0
Bottom	25.0	Bottom	24.0
PVC Screen Interval		Filter Sand	
Top	25.0	Top	24.0
Bottom	45.0	Bottom	45.0

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BORING B117

CLIENT Tolson and Associates, LLC
PROJECT NAME Tolson Rubble Landfill
PROJECT NUMBER ME1606
PROJECT LOCATION Crofton, MD
DATE STARTED 3/15/19 **COMPLETED** 3/15/19
NORTHING Unknown **EASTING** Unknown
DRILLER Hynes & Associates
GROUND ELEVATION ---
DRILLING METHOD Hollow Stem Auger
TOP OF CASING ELEVATION ---
SAMPLING METHOD Split Spoon
BORING DIAMETER 6.25 in
RIG TYPE Geoprobe 7822
LOGGED BY MLM **CHECKED BY** MB

DEPTH (ft)	RUN RECOVERY	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION
0		2-5-5-7 (10)		SILTY SAND, fine to medium grained, dry, reddish brown
				WELL GRADED SAND WITH GRAVEL, medium to coarse grained, dry, light reddish brown, subrounded
				WELL GRADED SAND WITH SILT, fine grained, dry, reddish brown
5		3-6-8-9 (14)		WELL GRADED SAND, fine to coarse grained, dry, light reddish brown light whiteish brown
				WELL GRADED SAND, fine to coarse grained, dry, whiteish gray reddish brown
10		2-3-6-7 (9)		WELL GRADED SAND, fine to coarse grained, dry, reddish brown
15		2-3-6-7 (9)		WELL GRADED SAND WITH GRAVEL, medium grained, dry, reddish brown, subrounded
20		5-7-6-10 (13)		WELL GRADED SAND WITH GRAVEL, fine grained, moist, orangeish brown, subrounded
25		2-7-11-10 (18)		POORLY GRADED SAND, fine grained, moist, brown light gray
		4-6-6-8		

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CLIENT Tolson and Associates, LLC
PROJECT NAME Tolson Rubble Landfill
PROJECT NUMBER ME1606
PROJECT LOCATION Crofton, MD

DEPTH (ft)	RUN RECOVERY	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION
30		(12)		POORLY GRADED SAND, fine grained, moist, brown light gray
35		5-5-8-10 (13)		WELL GRADED SAND, fine to coarse grained, wet, reddish brown, subrounded
40		4-7-13-19 (20)		POORLY GRADED SAND, fine grained, wet, light gray
45		2-3-5-11 (8)		
				SILT, moist, light gray
		2-3-12-13 (15)		POORLY GRADED SAND, fine grained, wet, light brown
50		4-7-7-9 (14)		
				LEAN CLAY, moist, dark gray
		6-5		
55				
				Bottom of borehole at 56.0 feet.
60				

CLIENT Tolson and Associates, LLC	**PROJECT NAME** Tolson Rubble Landfill
PROJECT NUMBER ME1606	**PROJECT LOCATION** Crofton, MD
DATE STARTED 3/14/19 **COMPLETED** 3/14/19	**NORTHING** Unknown **EASTING** Unknown
DRILLER Hynes & Associates	**GROUND ELEVATION** ---
DRILLING METHOD Hollow Stem Auger	**TOP OF CASING ELEVATION** ---
SAMPLING METHOD Split Spoon	**BORING DIAMETER** 6.25 in
RIG TYPE Geoprobe 7822	**LOGGED BY** MLM **CHECKED BY** MB

DEPTH (ft)	RUN RECOVERY	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION
0		2-2-2-4 (4)		LEAN CLAY, wet, reddish brown gray
5		2-2-2-3 (4)		
10		15-5-6-5 (11)		
15		1-1-2-2 (3)		WELL GRADED SAND WITH SILT, fine grained, wet, grayish green reddish brown
20		6-9-3-5 (12)		
25		5-11-15-8 (26)		WELL GRADED SAND, fine to medium grained, wet
		4-5-16-17		WELL GRADED SAND, fine to coarse grained, moist, orangeish red reddish brown

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BORING B118

CLIENT Tolson and Associates, LLC
PROJECT NAME Tolson Rubble Landfill
PROJECT NUMBER ME1606
PROJECT LOCATION Crofton, MD

DEPTH (ft)	RUN RECOVERY	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION
30		(21)		WELL GRADED SAND, fine to coarse grained, moist, orangeish red reddish brown
35		25-30-50 (80)		POORLY GRADED SAND, fine to medium grained, saturated, reddish brown light whiteish gray, rounded
40		5-7-17-28 (24)		LEAN CLAY, moist, dark gray
45		5-9-17-31 (26)		POORLY GRADED SAND, medium to coarse grained, saturated, tan reddish brown
50		4-6-20-11 (26)		WELL GRADED GRAVEL, fine grained, saturated, rounded
				WELL GRADED SAND WITH SILT, fine grained, moist
55		2-4-6-18 (10)		WELL GRADED SAND WITH SILT, fine grained, moist
60		2-4-5-6 (9)		SILTY SAND, fine to coarse grained, moist, dark brown
				LEAN CLAY, moist, dark gray

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CLIENT Tolson and Associates, LLC
PROJECT NAME Tolson Rubble Landfill
PROJECT NUMBER ME1606
PROJECT LOCATION Crofton, MD

DEPTH (ft)	RUN RECOVERY	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION
65		50		WELL GRADED SAND WITH CLAY, wet, dark gray reddish orange, subrounded
70		9-50		
75				LEAN CLAY, moist, dark gray
80		16-19-18-20 (37)		
85		11-21-31-50 (52)		
90				
95				

Bottom of borehole at 86.0 feet.

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BORING B119

CLIENT Tolson and Associates, LLC
PROJECT NAME Tolson Rubble Landfill
PROJECT NUMBER ME1606
PROJECT LOCATION Crofton, MD
DATE STARTED 3/19/19 **COMPLETED** 3/19/19
NORTHING Unknown **EASTING** Unknown
DRILLER Hynes & Associates
GROUND ELEVATION ---
DRILLING METHOD Hollow Stem Auger
TOP OF CASING ELEVATION ---
SAMPLING METHOD Split Spoon
BORING DIAMETER 6.25 in
RIG TYPE Geoprobe 7822
LOGGED BY MLM **CHECKED BY** MB

DEPTH (ft)	RUN RECOVERY	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION
0		3-9-16-19 (25)		POORLY GRADED SAND WITH GRAVEL, dry, light brown
5		3-5-5-5 (10)		LEAN CLAY, dry, light gray reddish brown
				LEAN CLAY, dry, light gray reddish brown
10		2-4-6-7 (10)		POORLY GRADED SAND WITH SILT, dry, light gray reddish brown
15		2-3-3-3 (6)		SILT, dry, light gray reddish brown
		2-10-12-7 (22)		LEAN CLAY, moist, gray red
20				SILT, moist, red
				WELL GRADED SAND, dry, reddish brown
				WELL GRADED SAND, dry, reddish brown
25		29-50		WELL GRADED SAND, medium to coarse grained, dry, white light brown
				WELL GRADED SAND, medium to coarse grained, dry, white light brown
				WELL GRADED SAND, fine to medium grained, dry, white light brown, rounded

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CLIENT Tolson and Associates, LLC **PROJECT NAME** Tolson Rubble Landfill
PROJECT NUMBER ME1606 **PROJECT LOCATION** Crofton, MD

DEPTH (ft)	RUN RECOVERY	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION
30		19-50		WELL GRADED SAND, fine to medium grained, dry, white light brown, rounded
				WELL GRADED SAND, fine to medium grained, dry, white light brown, subrounded
35		15-50		WELL GRADED SAND, fine to medium grained, dry, white light brown, rounded
40		50		WELL GRADED SAND, fine to medium grained, dry, white light brown, rounded
45				WELL GRADED SAND, fine to medium grained, dry, white light brown, rounded
50		19-21-30-50 (51)		WELL GRADED SAND, fine grained, dry, dark red brown, rounded
				WELL GRADED SAND, fine to medium grained, dry, white, rounded
				WELL GRADED SAND, fine to medium grained, wet, white light brown, rounded
55		1-9-16-23 (25)		FAT CLAY, moist, dark gray, medium plasticity
60		5-17-22-29 (39)		SILTY SAND, fine to medium grained, moist, reddish brown light white

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CLIENT Tolson and Associates, LLC
PROJECT NAME Tolson Rubble Landfill
PROJECT NUMBER ME1606
PROJECT LOCATION Crofton, MD

DEPTH (ft)	RUN RECOVERY	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION
65		17-23-24-31 (47)		WELL GRADED SAND, fine to medium grained, wet, reddish brown WELL GRADED SAND, fine to medium grained, wet, light gray dark reddish brown, rounded
70		12-17-19-24 (36)		WELL GRADED SAND WITH SILT, fine grained, wet, light gray light reddish brown SILTY GRAVEL, fine to medium grained, saturated, brown, subrounded SILTY SAND, medium grained, saturated, light gray light reddish brown
75		42-50		WELL GRADED SAND, medium to coarse grained, wet, reddish brown, rounded POORLY GRADED SAND WITH SILT, medium grained, wet, reddish brown
80		9-11-14-20 (25)		POORLY GRADED SAND WITH SILT, fine grained, saturated, light gray light brown
85		10-38-50 (88)		
90		21-50		WELL GRADED SAND WITH GRAVEL, fine grained, saturated, light gray light brown, rounded
95		50		LEAN CLAY, dry, light gray

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BORING B119

CLIENT Tolson and Associates, LLC **PROJECT NAME** Tolson Rubble Landfill

PROJECT NUMBER ME1606 **PROJECT LOCATION** Crofton, MD

DEPTH (ft)	RUN RECOVERY	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION
100		21-50		LEAN CLAY, dry, light gray
105				
				Bottom of borehole at 106.0 feet.
110				
115				
120				
125				
130				

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MONITORING WELL MW-32A

CLIENT Tolson and Associates, LLC		**PROJECT NAME** Tolson Rubble Landfill	
PROJECT NUMBER ME1606		**PROJECT LOCATION** Crofton, MD	
DATE STARTED 2/12/19	**COMPLETED** 3/12/19	**NORTHING** 501551.0 ft	**EASTING** 1397599.3 ft
DRILLER Hynes & Associates		**GROUND ELEVATION** ---	
DRILLING METHOD Hollow Stem Auger		**TOP OF CASING ELEVATION** 139.30 ft	
SAMPLING METHOD Split Spoon		**BORING DIAMETER** 10 in	
RIG TYPE Geoprobe 7822		**LOGGED BY** MLM	**CHECKED BY** MB

DEPTH (ft)	RUN RECOVERY	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	WELL DETAILS
0		2-3-7-10 (10)		WELL GRADED SAND WITH SILT, moist, light brown		**WELL CASING** Interval: -2.5-35 ft Diameter: 2 in
4		2-3-5-10 (8)		WELL GRADED SAND WITH SILT, fine grained, moist, tan with reddish brown, mottled		**ANNULUS SEAL** Interval: 0-31 ft
5						**FILTER PACK SEAL** Interval: 31-33 ft
9		3-7-8-12 (15)		WELL GRADED SAND WITH SILT, fine to coarse grained, moist, reddish brown and orange		**FILTER PACK** Interval: 33-45 ft
10						**WELL SCREEN** Interval: 35-45 ft Material: #10 Slot Screen Slot Size: 0.01 in Diameter: 2 in
14		9-9-19-20 (28)		WELL GRADED SAND WITH GRAVEL, moist, white and tan		
15						
19		50		POORLY GRADED GRAVEL WITH SAND, fine to coarse grained, moist, tan and orangeish brown, subangular		
20						
24		50				
25						
26				SILTY CLAY, fine grained, moist, dark gray and orangeish red		
29		9-16-20-22				

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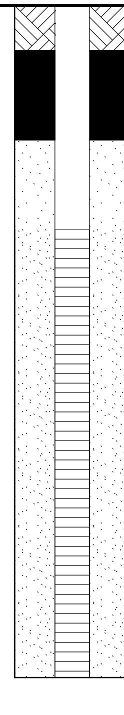
CLIENT Tolson and Associates, LLC
PROJECT NAME Tolson Rubble Landfill
PROJECT NUMBER ME1606
PROJECT LOCATION Crofton, MD

DEPTH (ft)	RUN RECOVERY	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	WELL DETAILS
30		(36)		SILTY CLAY, fine grained, moist, dark gray and orangeish red		
				POORLY GRADED SAND WITH CLAY, fine grained, wet, light reddish orange		
35		3-5-7-15 (12)		POORLY GRADED SAND WITH SILT, wet, brown light gray, subrounded		
40		6-8-24-28 (32)				
45		18-18-30-50 (48)		WELL GRADED SAND WITH GRAVEL, fine grained, saturated, light brown		



Bottom of borehole at 46.0 feet.

50

55

60

MONITORING WELL MW-33A

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CLIENT	Tolson and Associates, LLC	**PROJECT NAME**	Tolson Rubble Landfill
PROJECT NUMBER	ME1606	**PROJECT LOCATION**	Crofton, MD
DATE STARTED	3/13/19 **COMPLETED** 3/13/19	**NORTHING**	502558.4 ft **EASTING** 1397465.0 ft
DRILLER	Hynes & Associates	**GROUND ELEVATION**	---
DRILLING METHOD	Hollow Stem Auger	**TOP OF CASING ELEVATION**	198.90 ft
SAMPLING METHOD	Split Spoon	**BORING DIAMETER**	10 in
RIG TYPE	Geoprobe 7822	**LOGGED BY**	MLM **CHECKED BY** MB

DEPTH (ft)	RUN RECOVERY	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	WELL DETAILS
0		3-7-10-9 (17)		WELL GRADED SAND WITH SILT, fine to coarse grained, moist, dark brown		**WELL CASING** Interval: -2.5-85 ft Diameter: 2 in
						ANNULUS SEAL Interval: 0-81 ft
5		3-4-6-7 (10)		CLAYEY SAND, wet, reddish brown		
				LEAN CLAY, fine to coarse grained, moist, grayish brown		**FILTER PACK SEAL** Interval: 81-83 ft
						FILTER PACK Interval: 83-95 ft
10		2-4-6-7 (10)		WELL GRADED SAND WITH SILT, fine grained, moist, tan orangeish red		**WELL SCREEN** Interval: 85-95 ft Material: #10 Slot Screen Slot Size: 0.01 in Diameter: 2 in
15		2-5-6-9 (11)				
20		3-5-6-6 (11)				
25		3-5-6-6 (11)		WELL GRADED SAND WITH SILT, fine grained, moist, light orangeish brown		
		3-3-5-6				

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CLIENT Tolson and Associates, LLC **PROJECT NAME** Tolson Rubble Landfill
PROJECT NUMBER ME1606 **PROJECT LOCATION** Crofton, MD

DEPTH (ft)	RUN RECOVERY	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	WELL DETAILS
30		(8)		WELL GRADED SAND WITH SILT, fine grained, moist, light orangeish brown		
35		3-4-5-6 (9)		SILT, fine grained, moist, light orangeish brown tan		
40		1-2-3-4 (5)		LEAN CLAY, fine grained, moist, light gray light brown		
45		1-2-4-5 (6)		LEAN CLAY, fine grained, moist, dark gray		
50		10-50		WELL GRADED SAND, fine to medium grained, moist, white light gray		
55		12-50				
60		1-2-4-50 (6)		WELL GRADED SAND, fine to coarse grained, dry, white light orange		

(Continued Next Page)

MONITORING WELL MW-33A

Geosyntec consultants
engineers | scientists | innovators

CLIENT Tolson and Associates, LLC
PROJECT NAME Tolson Rubble Landfill
PROJECT NUMBER ME1606
PROJECT LOCATION Crofton, MD

DEPTH (ft)	RUN RECOVERY	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	WELL DETAILS
65		50		WELL GRADED SAND, fine to coarse grained, dry, white light orange		
70		30-50		WELL GRADED SAND WITH GRAVEL, fine to coarse grained, dry, white light orangeish brown, rounded		
75		15-50				
80		30-50				
				POORLY GRADED SAND, fine grained, moist, light gray orangeish red		
85		20-33-50 (83)		POORLY GRADED SAND WITH SILT, fine grained, wet, light gray		
90		10-34-10 (44)				
95		12-27-50 (77)		WELL GRADED SAND, fine to coarse grained, saturated, light brownish gray		

Bottom of borehole at 96.0 feet.

PAULS BH / TP / WELL - DEFAULT.GDT - 7/2/19 16:16 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\68TH STREET BORING LOGS.GPJ

MONITORING WELL MW-34A

Geosyntec consultants
engineers | scientists | innovators

CLIENT Tolson and Associates, LLC		**PROJECT NAME** Tolson Rubble Landfill	
PROJECT NUMBER ME1606		**PROJECT LOCATION** Crofton, MD	
DATE STARTED 3/11/19	**COMPLETED** 3/11/19	**NORTHING** 503522.1 ft	**EASTING** 1396432.3 ft
DRILLER Hynes & Associates		**GROUND ELEVATION** ---	
DRILLING METHOD Hollow Stem Auger		**TOP OF CASING ELEVATION** 141.10 ft	
SAMPLING METHOD Split Spoon		**BORING DIAMETER** 10 in	
RIG TYPE Geoprobe 7822		**LOGGED BY** MLM	**CHECKED BY** MB

DEPTH (ft)	RUN RECOVERY	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	WELL DETAILS
0		7-12-15-10 (27)		SILTY SAND, fine grained, dry, reddish brown, subangular		**WELL CASING** Interval: -2.5-20 ft Diameter: 2 in
		2-3-2-3 (5)		POORLY GRADED SAND, fine grained, moist, tan		**ANNULUS SEAL** Interval: 0-16 ft
5						**FILTER PACK SEAL** Interval: 16-18 ft
						FILTER PACK Interval: 18-30 ft
10		3-5-9-28 (14)		LEAN CLAY, moist, tan		**WELL SCREEN** Interval: 20-30 ft Material: #10 Slot Screen Slot Size: 0.01 in Diameter: 2 in
				Hard, SILTY SAND, fine to coarse grained, moist, reddish brown		
15		8-9-15-19 (24)		WELL GRADED SAND WITH SILT, medium grained, moist, white		
				SILT, moist, white orangeish brown		
				WELL GRADED SAND WITH SILT, fine grained, moist, white		
20		5-15-28-23 (43)		SILT, moist, reddish orange		
				WELL GRADED SAND WITH SILT, medium to coarse grained, wet, white		
25		5-20-37-50 (57)		LEAN CLAY, moist, white		
				WELL GRADED SAND, fine to medium grained, wet, red		
		7-9-15-21		WELL GRADED SAND, fine to medium grained, wet, grayish white		

(Continued Next Page)

CLIENT Tolson and Associates, LLC
PROJECT NAME Tolson Rubble Landfill
PROJECT NUMBER ME1606
PROJECT LOCATION Crofton, MD

DEPTH (ft)	RUN RECOVERY	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	WELL DETAILS
30		(24)		LEAN CLAY, moist, light grayish white		
				Bottom of borehole at 31.0 feet.		
35						
40						
45						
50						
55						
60						

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MONITORING WELL MW-35A

Geosyntec consultants
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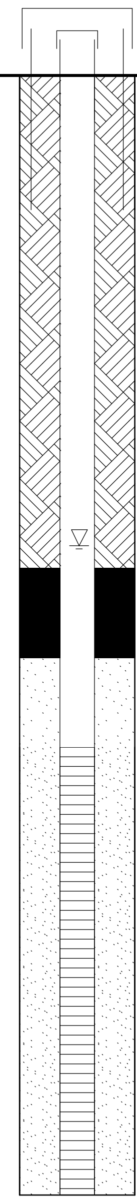
CLIENT Tolson and Associates, LLC		**PROJECT NAME** Tolson Rubble Landfill	
PROJECT NUMBER ME1606		**PROJECT LOCATION** Crofton, MD	
DATE STARTED 3/12/19	**COMPLETED** 3/12/19	**NORTHING** 503074.3 ft	**EASTING** 1396105.5 ft
DRILLER Hynes & Associates		**GROUND ELEVATION** ---	
DRILLING METHOD Hollow Stem Auger		**TOP OF CASING ELEVATION** 132.10 ft	
SAMPLING METHOD Split Spoon		**BORING DIAMETER** 10 in	
RIG TYPE Geoprobe 7822		**LOGGED BY** MLM	**CHECKED BY** MB

DEPTH (ft)	RUN RECOVERY	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION
0		4-9-23-19 (32)		WELL GRADED SAND, fine grained, moist, tan
				WELL GRADED SAND WITH SILT, fine to coarse grained, moist, reddish brown
5		2-8-9-11 (17)		WELL GRADED SAND WITH SILT, fine to medium grained, moist, tan, subangular
10		5-10-11-11 (21)		WELL GRADED SAND WITH SILT, fine grained, moist, tan
15		2-7-9-12 (16)		WELL GRADED SAND, fine grained, saturated, reddish brown
20		2-7-11-14 (18)		WELL GRADED SAND, fine to medium grained, saturated, reddish brown tan
25		4-17-23-28 (40)		
		3-9-23-29		

WELL DIAGRAM



WELL DETAILS

WELL CASING
Interval: -2.5-15 ft
Diameter: 2 in

ANNULUS SEAL
Interval: 0-11 ft

FILTER PACK SEAL
Interval: 11-13 ft

FILTER PACK
Interval: 13-25 ft

WELL SCREEN
Interval: 15-25 ft
Material: #10 Slot
Screen Slot Size: 0.01 in
Diameter: 2 in

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CLIENT Tolson and Associates, LLC
PROJECT NAME Tolson Rubble Landfill
PROJECT NUMBER ME1606
PROJECT LOCATION Crofton, MD

DEPTH (ft)	RUN RECOVERY	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	WELL DETAILS
30		(32)		WELL GRADED SAND, fine to medium grained, saturated, reddish brown tan		
35		4-11-21-26 (32)				

Bottom of borehole at 36.0 feet.

Depth scale: 40, 45, 50, 55, 60

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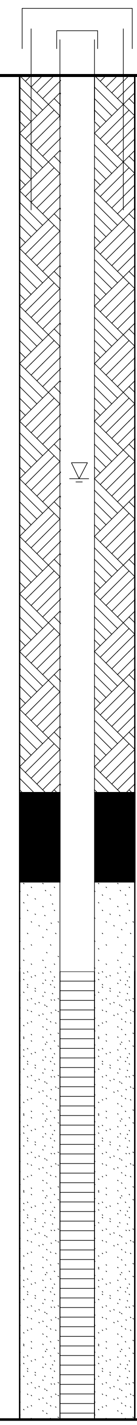
MONITORING WELL MW-36A

CLIENT Tolson and Associates, LLC
PROJECT NAME Tolson Rubble Landfill
PROJECT NUMBER ME1606
PROJECT LOCATION Crofton, MD
DATE STARTED 3/18/19 **COMPLETED** 3/18/19
NORTHING 502802.0 ft **EASTING** 1395464.5 ft
DRILLER Hynes & Associates
GROUND ELEVATION ---
DRILLING METHOD Hollow Stem Auger
TOP OF CASING ELEVATION 124.10 ft
SAMPLING METHOD Split Spoon
BORING DIAMETER 10 in
RIG TYPE Geoprobe 7822
LOGGED BY MLM **CHECKED BY** MB

DEPTH (ft)	BLOW COUNTS (N VALUE)	MATERIAL DESCRIPTION
0	1-1-1-0 (2)	POORLY GRADED SAND, fine to medium grained, dry, reddish brown, subrounded
5	1-2-3-3 (5)	
		ELASTIC SILT, fine grained, moist, reddish brown
		WELL GRADED GRAVEL, fine grained, wet, reddish brown
10	1-2-3-2 (5)	LEAN CLAY, fine grained, wet, reddish brown
		LEAN CLAY, wet, gray orange
15	3-6-7-7 (13)	POORLY GRADED SAND, fine grained, wet, reddish brown
		POORLY GRADED SAND, fine grained, wet, orangeish brown
20	3-3-5-5 (8)	
25	12-28-14-16 (42)	
	3-11-21-18	

WELL DIAGRAM



WELL DETAILS

WELL CASING
Interval: -2.5-20 ft
Diameter: 2 in

ANNULUS SEAL
Interval: 0-16 ft

FILTER PACK SEAL
Interval: 16-18 ft

FILTER PACK
Interval: 18-30 ft

WELL SCREEN
Interval: 20-30 ft
Material: #10 Slot
Screen Slot Size: 0.01 in
Diameter: 2 in

(Continued Next Page)

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MONITORING WELL MW-36A

CLIENT Tolson and Associates, LLC

PROJECT NAME Tolson Rubble Landfill

PROJECT NUMBER ME1606

PROJECT LOCATION Crofton, MD

DEPTH (ft)	RUN RECOVERY	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	WELL DETAILS
30		(32)		LEAN CLAY, moist, dark gray		
				Bottom of borehole at 31.0 feet.		
35						
40						
45						
50						
55						
60						

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MONITORING WELL MW-37A

Geosyntec consultants
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CLIENT Tolson and Associates, LLC		**PROJECT NAME** Tolson Rubble Landfill	
PROJECT NUMBER ME1606		**PROJECT LOCATION** Crofton, MD	
DATE STARTED 3/15/19	**COMPLETED** 3/15/19	**NORTHING** 502383.5 ft	**EASTING** 1395224.6 ft
DRILLER Hynes & Associates		**GROUND ELEVATION** ---	
DRILLING METHOD Hollow Stem Auger		**TOP OF CASING ELEVATION** 125.50 ft	
SAMPLING METHOD Split Spoon		**BORING DIAMETER** 10 in	
RIG TYPE Geoprobe 7822		**LOGGED BY** MLM	**CHECKED BY** MB

DEPTH (ft)	BLOW COUNTS (N VALUE)	MATERIAL DESCRIPTION
0	1-1-3-5 (4)	POORLY GRADED SAND, coarse grained, moist, brown
5	1-3-2-6 (5)	
10	3-9-18-20 (27)	SILTY SAND, fine to coarse grained, moist, reddish brown
15	3-6-8-9 (14)	SILT, fine grained, moist, light whiteish gray
		WELL GRADED SAND WITH SILT, fine grained, moist, orangeish brown
		SILT, fine grained, moist, light whiteish brown
		WELL GRADED SAND, fine grained, moist, orangeish brown
		WELL GRADED SAND, fine grained, moist, light whiteish gray
20	2-2-9-6 (11)	SILT, fine grained, wet, light whiteish gray
		SILTY SAND, fine grained, wet, reddish orange whiteish gray
25	1-2-4-6 (6)	SILT, moist, gray
		LEAN CLAY, saturated, gray
	2-4-7-8	

WELL DETAILS

WELL CASING
Interval: -2.5-15 ft
Diameter: 2 in

ANNULUS SEAL
Interval: 0-11 ft

FILTER PACK SEAL
Interval: 11-13 ft

FILTER PACK
Interval: 13-35 ft

WELL SCREEN
Interval: 15-25 ft
Material: #10 Slot
Screen Slot Size: 0.01 in
Diameter: 2 in

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CLIENT Tolson and Associates, LLC
PROJECT NAME Tolson Rubble Landfill
PROJECT NUMBER ME1606
PROJECT LOCATION Crofton, MD

DEPTH (ft)	RUN RECOVERY	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM	WELL DETAILS
30		(11)		LEAN CLAY, saturated, gray		
35		2-4-5-8 (9)				

Bottom of borehole at 36.0 feet.

40

45

50

55

60

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1A

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED

COUNTY NUMBER 02

PERMIT NO. FROM "PERMIT TO DRILL WELL"

DATE WELL COMPLETED

Depth of Well (TO NEAREST FOOT)

OWNER CUNNINGHAM JAMES First name TOWN CROFTON

SECTION LOT

WELL LOG

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION	FROM	TO	
Fine Brown SAND	0	18	
[illegible] SAND	18	22	
Coarse Sand, gravel and weathered [illegible]	22	27	
[illegible] Sand	27	45	Water
[illegible]	45	[illegible]	
[illegible] Coarse Sand [illegible]	65	83	

GROUTING RECORD

WELL HAS BEEN GROUTED Y N

TYPE OF GROUTING MATERIAL: CEMENT CM BENTONITE CLAY BC

NO. OF BAGS NO. OF POUNDS

GALLONS OF WATER

DEPTH OF GROUT SEAL (to nearest foot) from to 63

(enter 0 if from surface)

CASING RECORD

casing types (insert appropriate code below): ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE PL — Nominal diameter top (main) casing (nearest inch) — Total depth of main casing (nearest foot)

OTHER CASING (if used): diameter inch, depth (feet) from to

SCREEN RECORD: ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

02

DEPTH (nearest ft.) PL

SLOT SIZE

DIAMETER OF SCREEN (NEAREST INCH)

GRAVEL PACK from 65 to 83

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX

OFFICE USE ONLY (NOT TO BE FILLED IN BY DRILLER): Y, W.A.Q.S., WQ — TELESCOPE CASING, LOG INDICATOR, OTHER DATA

C 3

PUMPING TEST

HOURS PUMPED (nearest hour)

PUMPING RATE (gal. per min. to nearest gal.)

METHOD USED TO MEASURE PUMPING RATE

WATER LEVEL (distance from land surface)

BEFORE PUMPING

WHEN PUMPING

TYPE OF PUMP USED (for test): A air, P piston, T turbine, C centrifugal, R rotary, O other, J jet, S submersible

Pete Estey

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE YES or NO) YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE

CAPACITY: GALLONS PER MINUTE (To nearest gallon)

PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height) + above, − below LAND SURFACE

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

CIRCLE APPROPRIATE LETTER

A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED

B ELECTRIC LOG OBTAINED

C TEST WELL CONVERTED TO PRODUCTION WELL

DRILLER'S LICENSE NO. WWD 236

DRILLER'S SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

SITE SUPERVISOR

ORIGINAL

1B

UU220 (OEP USE ONLY)
THIS NUMBER IS TO BE PUNCHED IN COLS. 3-8 ON ALL CARDS)

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

45 DAYS AFTER WELL IS COMPLETED.
COUNTY NUMBER 02

DATE Received
DATE WELL COMPLETED 012396
Depth of Well 150 (TO NEAREST FOOT)
1E
PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-81-5779

OWNER Cunningham Excavating
last name / first name
STREET OR RFD 1073 St. Stevens Rd. TOWN Crownsville, MD 21032
SUBDIVISION Capital Raceway SECTION LOT 1D monitoring well

WELL LOG
Not required for driven wells
STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Fine Brown Sand	0	18	
Gray Silt & Sand	18	22	
Weather Limonite & Rock & Gravel	22	26	
Buff Sand	26	45	
Interbedded Silt & Sand	45	65	
Medium Coarse Sand	65	95	
Buff & Red Clay	95	110	
Red Clay	110	150	

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N
TYPE OF GROUTING MATERIAL
CEMENT CM BENTONITE CLAY BC
NO. OF BAGS 5 NO. OF POUNDS 250
GALLONS OF WATER 125
DEPTH OF GROUT SEAL (to nearest foot)
from 0 ft. to 105 ft.
TOP BOTTOM
(enter 0 if from surface)

CASING RECORD
casing types insert appropriate code below
ST STEEL CO CONCRETE
PL PLASTIC OT OTHER

MAIN CASING TYPE PL
Nominal diameter top (main) casing (nearest inch) 4
Total depth of main casing (nearest foot) 130

OTHER CASING (if used)
EACH CASING diameter inch depth (feet) from to

SCREEN RECORD
screen type or open hole insert appropriate code below
ST STEEL BR BRASS BRONZE HO OPEN HOLE
PL PLASTIC OT OTHER

C2
EACH SCREEN DEPTH (nearest ft.)
PL 130 150

SLOT SIZE 1 .010 2 3
DIAMETER OF SCREEN 4 (NEAREST INCH)

GRAVEL PACK from 125 to 150
IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

C3
PUMPING TEST
HOURS PUMPED (nearest hour)
PUMPING RATE (gal. per min. to nearest gal.)
METHOD USED TO MEASURE PUMPING RATE
WATER LEVEL (distance from land surface)
BEFORE PUMPING
WHEN PUMPING
TYPE OF PUMP USED (for test)
A air P piston T turbine
C centrifugal R rotary O other (describe below)
J jet S submersible

PUMP INSTALLED
DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES NO
IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE
TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX SEE ABOVE
CAPACITY: GALLONS PER MINUTE (to nearest gallon)
PUMP HORSE POWER
PUMP COLUMN LENGTH (nearest ft.)
CASING HEIGHT (circle appropriate box and enter casing height)
+ above
LAND SURFACE
− below
2 (nearest foot)

CIRCLE APPROPRIATE LETTER
A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
E ELECTRIC LOG OBTAINED
P TEST WELL CONVERTED TO PRODUCTION WELL

HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 10.17.13 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE

DRILLERS IDENT. NO. 288
DRILLERS SIGNATURE
MUST MATCH SIGNATURE OF APPLICATION)

OEP USE ONLY
(NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) WQ

LOCATION OF WELL ON LOT
SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)
See attached drawing

2A

(DENV USE ONLY)
THIS NUMBER IS TO BE PUNCHED COLS. 3-6 ON ALL CARDS)

WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

COUNTY NUMBER 02

ST/CO USE ONLY
DATE Received 33B

DATE WELL COMPLETED 12 31 92

Depth of Well 147 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-88-8130

OWNER Cunningham Excavating
last name first name
STREET OR RFD P.O. Box 3698 TOWN Crofton, Maryland 21114
SUBDIVISION ______ SECTION ______ LOT ______

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Top Soil	0	1	
Brown Sand & Clay	1	6	
Gravel	6	34	
White Clay	34	39	
Brown Sand & Gravel	39	52	
Gravel & White Clay	52	63	
Gravel	63	80	
[illegible] white clay	80	137	
Brown Sand	137	147	X

CIRCLE APPROPRIATE LETTER
A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
E ELECTRIC LOG OBTAINED
D TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS IDENT. NO. 288

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

DENTON J. WOLFORD
SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N
TYPE OF GROUTING MATERIAL
CEMENT CM BENTONITE CLAY BC
NO. OF BAGS 11 NO. OF POUNDS 550
GALLONS OF WATER 275
DEPTH OF GROUT SEAL (to nearest foot)
from 3 ft. TOP to 135 ft. BOTTOM
(enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below
ST STEEL CO CONCRETE PL PLASTIC OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	4	140

OTHER CASING (if used)
diameter inch / depth (feet) from to

SCREEN RECORD

screen type or open hole insert appropriate code below
ST STEEL BR BRASS BRONZE HO OPEN HOLE PL PLASTIC OT OTHER

C 2

	Type	DEPTH (nearest ft.) from	to
1	PL	142	147
2			
3			

SLOT SIZE 1 .020 2 ___ 3 ___
DIAMETER OF SCREEN 2 (NEAREST INCH)

GRAVEL PACK from 135 to 147

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

CEP USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W Q
TELESCOPE CASING / LOG INDICATOR / OTHER DATA A

C 3

PUMPING TEST

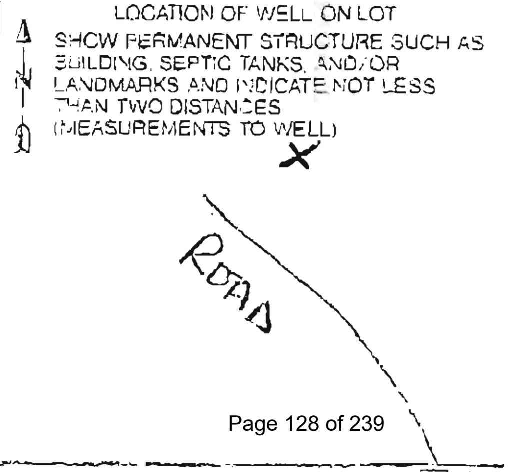
HOURS PUMPED (nearest hour) 2
PUMPING RATE (gal. per min. to nearest gal.) 20
METHOD USED TO MEASURE PUMPING RATE Air
WATER LEVEL (distance from land surface)
BEFORE PUMPING 38
WHEN PUMPING 110
TYPE OF PUMP USED (for test)
A air P piston T turbine
C centrifugal R rotary O other (describe below)
J jet S submersible

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES NO
IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE
TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE:
CAPACITY: GALLONS PER MINUTE (to nearest gallon)
PUMP HORSE POWER
PUMP COLUMN LENGTH (nearest ft.)
CASING HEIGHT (circle appropriate box and enter casing height)
+ above / − below LAND SURFACE 1 (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



2B

(DENV USE ONLY)

THIS NUMBER IS TO BE PUNCHED IN COLS. 3-8 ON ALL CARDS)

WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

COUNTY NUMBER

ST/CO USE ONLY DATE Received: JN 2 1993

DATE WELL COMPLETED: 1 23 7 92

Depth of Well: 56 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL": AA-88-9057

OWNER: CUNNINGHAM EXCAVATING (last name / first name)

STREET OR RFD: P.O. BOX 3698 TOWN: CROFTON MD. 21114

SUBDIVISION: CAPITAL RACEWAY SECTION: WELL #2B LOT:

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
TOP SOIL	0	1	
BROWN SAND & CLAY	1	6	
GRAVEL	6	33	
WHITE CLAY	33	41	
GRAVEL & BROWN SAND	41	56	x

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box): yes Y / no N — Y circled

TYPE OF GROUTING MATERIAL: CEMENT CM / BENTONITE CLAY BC — BC circled

NO. OF BAGS 6 NO. OF POUNDS 300

GALLONS OF WATER 175

DEPTH OF GROUT SEAL (to nearest foot): from 3 ft. (TOP) to 45 ft. (BOTTOM) (enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below: ST STEEL, CO CONCRETE, PL PLASTIC (circled), OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	4	46

EACH CASING — OTHER CASING (if used): diameter inch, depth (feet) from, to

SCREEN RECORD

screen type or open hole insert appropriate code below: ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC (circled), OT OTHER

C2

EACH SCREEN	Type	DEPTH (nearest ft.) from	to
1	PL	46	56
2			
3			

SLOT SIZE 1. 020 2. ___ 3. ___

DIAMETER OF SCREEN 4 (NEAREST INCH)

GRAVEL PACK from 41 to 56

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 58

PUMPING TEST

C3

HOURS PUMPED (nearest hour) 2

PUMPING RATE (gal. per min. to nearest gal.) 1

METHOD USED TO MEASURE PUMPING RATE: AIR

WATER LEVEL (distance from land surface)

BEFORE PUMPING 51

WHEN PUMPING 56

TYPE OF PUMP USED (for test): A air (circled), P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO): YES NO — NO circled

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE:

CAPACITY: GALLONS PER MINUTE (to nearest gallon)

PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height): + above / − below LAND SURFACE — above circled; 1 (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

SEE ATTACHED

CIRCLE APPROPRIATE LETTER

A — A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED (circled)

E — ELECTRIC LOG OBTAINED

P — TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS IDENT. NO. 288

[signature]

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

DENTON J. WOLFORD

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

DEP USE ONLY (NOT TO BE FILLED IN BY DRILLER)

T TELESCOPE CASING / (E.R.O.S.) LOG INDICATOR / W.Q. OTHER DATA: 1A

3B

0170 (MDE USE ONLY)

S NUMBER IS TO BE PUNCHED COLS. 3-6 ON ALL CARDS)

WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

COUNTY NUMBER: 02

ST/CO USE ONLY DATE Received: AUG 27 1998

DATE WELL COMPLETED: 08 06 98

Depth of Well: 130 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL": AA-94-2905

OWNER: Cunningham Excavating

STREET OR RFD: Rt #3 Capital Raceway Road TOWN: Odenton

SUBDIVISION: Capital Raceway SECTION: LOT:

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	check if water bearing
MONITORING WELL			
Sand Fine Silt & Gravel	0	50	
Sand Fine Medium	50	70	
Sand Med Course	70	80	
Sand Fine Course Silt	80	90	
Red Clay	90	130	
Gray Clay	130	133	
Sand Fine To Course	133	135	
Gray Clay/Fine To Course Sand	135	150	xx

NUMBER OF UNSUCCESSFUL WELLS: ___

WELL HYDROFRACTURED: Y / N

CIRCLE APPROPRIATE LETTER
- A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED (circled)
- E ELECTRIC LOG OBTAINED
- P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

TYPE MWD/MSD/MGD (MWD circled)

DRILLERS LIC. NO. 288

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

LIC. NO. MWD 288

Denton J. Wolford

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box): Y (circled) / N

TYPE OF GROUTING MATERIAL (Circle one): CEMENT CM; BENTONITE CLAY BC (circled)

NO. OF BAGS 10 NO. OF POUNDS 500

GALLONS OF WATER 250

DEPTH OF GROUT SEAL (to nearest foot): from 3 ft. (TOP) to 122 ft. (BOTTOM) (enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below: ST STEEL; CO CONCRETE; PL PLASTIC (circled); OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	4	140

OTHER CASING (if used): diameter inch; depth (feet) from / to

SCREEN RECORD

screen type or open hole insert appropriate code below: ST STEEL; BR BRASS BRONZE; HO OPEN HOLE; PL PLASTIC (circled); OT OTHER

C 2

EACH SCREEN	TYPE	DEPTH (nearest ft.) from	to
1	PL	140	150
2			
3			

SLOT SIZE 1 .020 2 ___ 3 ___

DIAMETER OF SCREEN: 2 (NEAREST INCH)

GRAVEL PACK from 135 to 150

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W.Q.
TELESCOPE CASING / LOG INDICATOR / OTHER DATA

C 3

PUMPING TEST

HOURS PUMPED (nearest hour): 2

PUMPING RATE (gal. per min.): 20

METHOD USED TO MEASURE PUMPING RATE: AIR

WATER LEVEL (distance from land surface)

BEFORE PUMPING: 104 ft

WHEN PUMPING: 125 ft

TYPE OF PUMP USED (for test): A air (circled); P piston; T turbine; C centrifugal; R rotary; O other (describe below); J jet; S submersible

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO): YES / NO (circled)

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS.

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX 29.

CAPACITY: GALLONS PER MINUTE (to nearest gallon)

PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height): + above / − below LAND SURFACE (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND /OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

See attached drawing

4A

FROM : FAX NO. :4107930798 Jul. 25 2006 11:32AM P4

U421 (DEP USE ONLY)

(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

COUNTY NUMBER 02

DATE Received JAN 2 1986 | 1 2 1 2 8 5

DATE WELL COMPLETED 1 2 3 0 8 5

Depth of Well 61 ~~65~~ (TO NEAREST FOOT) 4 1

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-81-5755

OWNER CUNNINGHAM (last name) JAMES (first name)

STREET OR RFD Rt 3 TOWN CROFTON

SUBDIVISION ______ SECTION ______ LOT ______

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Med. Brown Sand w/ gravel	0	17	
DK gray silt w/ clay, moist	17	47	
Med.-Coarse brown Sand w/ gravel	47	60	✓
Buff clay w/ silt, some red streaks very cohesive, wet	60	62	

CIRCLE APPROPRIATE LETTER

A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED

E ELECTRIC LOG OBTAINED

P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 10.17.13 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE

DRILLERS IDENT. NO. HWD-334

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION) [signature]

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y (circled) no N

TYPE OF GROUTING MATERIAL

CEMENT CM (circled) BENTONITE CLAY BC

NO. OF BAGS ______ NO. OF POUNDS ______

GALLONS OF WATER ______

DEPTH OF GROUT SEAL (to nearest foot) from 0 ~~0~~ ft. TOP to 44 ~~44~~ ft. BOTTOM (enter 0 if from surface)

CASING RECORD

casing types Insert appropriate code below: ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	4 ~~4~~	51 ~~51~~

OTHER CASING (if used) diameter inch / depth (feet) from / to

SCREEN RECORD

screen type or open hole Insert appropriate code below: ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C2

EACH SCREEN	Top	bottom
PL	51 ~~51~~	61 ~~61~~

SLOT SIZE 1 .01 2 ___ 3 ___

DIAMETER OF SCREEN 4 (NEAREST INCH)

GRAVEL PACK from 45 to 61

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

DEP USE ONLY (NOT TO BE FILLED IN BY DRILLER)

T TELESCOPE CASING (E.R.O.S.) LOG INDICATOR WO OTHER DATA

C3

PUMPING TEST

HOURS PUMPED (nearest hour) 1

PUMPING RATE (gal. per min. to nearest gal.) 1

METHOD USED TO MEASURE PUMPING RATE ______

WATER LEVEL (distance from land surface)

BEFORE PUMPING 1

WHEN PUMPING 1

TYPE OF PUMP USED (for test)

A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below) (circled), J jet, S submersible

Data Entry

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES NO (circled)

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE:

CAPACITY: GALLONS PER MINUTE (to nearest gallon)

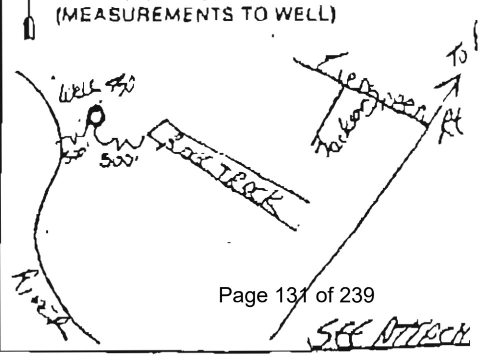
PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height) + above (circled) / − below LAND SURFACE 2 ~~3~~ (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



SEE ATTACH

4B

C1 00227 SEQUENCE NO. (OEP USE ONLY)
(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

STATE OF MARYLAND WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

DATE Received

DATE WELL COMPLETED 0 7 2 3 8 6

Depth of Well 146 (TO NEAREST FOOT)

4B

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-87-3782

OWNER Cunningham Excavating (last name) (first name)
STREET OR RFD 1073 St. Stephens Rd.　TOWN Crownsville, MD 21032
SUBDIVISION Capital Raceway　SECTION　Lot 7-A monitoring well

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Sand & Gravel	0	18	
Gray Silt	18	51	
Sand	51	60	
Buff Silt w/clay & Sand	60	75	
Red Clay	75	125	
Sand	125	150	

CIRCLE APPROPRIATE LETTER
A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
E ELECTRIC LOG OBTAINED
P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 10.17.13 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS IDENT. NO. 288

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) YES Y　NO N
TYPE OF GROUTING MATERIAL
CEMENT CM　BENTONITE CLAY BC
NO. OF BAGS 5　NO. OF POUNDS 250
GALLONS OF WATER 125
DEPTH OF GROUT SEAL (to nearest foot)
from 0 ft. to 105 ft. (enter 0 if from surface)

CASING RECORD

casing types Insert appropriate code below
ST STEEL　CO CONCRETE　PL PLASTIC　OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	4	136

OTHER CASING (if used)
diameter inch　depth (feet) from　to

SCREEN RECORD

screen type or open hole Insert appropriate code below
ST STEEL　BR BRASS BRONZE　HO OPEN HOLE　PL PLASTIC　OT OTHER

C2

EACH SCREEN

Type	DEPTH (nearest ft.) from	to
PL	136	146

SLOT SIZE 1 .010 2 ___ 3 ___
DIAMETER OF SCREEN 4 (NEAREST INCH)

GRAVEL PACK from 131 to 146
IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

OEP USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T　(E.R.O.S.)　WQ

C3

PUMPING TEST

HOURS PUMPED (nearest hour)
PUMPING RATE (gal. per min. to nearest gal.)
METHOD USED TO MEASURE PUMPING RATE
WATER LEVEL (distance from land surface)
BEFORE PUMPING
WHEN PUMPING
TYPE OF PUMP USED (for test)
A air　P piston　T turbine
C centrifugal　R rotary　O other (describe below)
J jet　S submersible

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO)　YES　NO
IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE
TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX SEE ABOVE.
CAPACITY: GALLONS PER MINUTE (to nearest gallon)
PUMP HORSE POWER
PUMP COLUMN LENGTH (nearest ft.)
CASING HEIGHT (circle appropriate box and enter casing height)
+ above　LAND SURFACE
− below　2 (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

See attached drawing

5A

FROM : FAX NO. :4107930798 Jul. 25 2006 11:33AM P6

C 1 - U425 SEQUENCE NO. (OEP USE ONLY)
(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

STATE OF MARYLAND WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

DATE Received	DATE WELL COMPLETED	Depth of Well (TO NEAREST FOOT)	PERMIT NO. FROM "PERMIT TO DRILL WELL"
01 21 86	~~12~~ 12 20 85	25 ~~25~~	AA-81-5831

5A

OWNER CUNNINGHAM (last name) JAMES (first name)

STREET OR RFD RTe 3 TOWN CROFTON

SUBDIVISION ______ SECTION ______ LOT ______

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Fine brown sand w/trace silt and gravel	0	24	L Encountered water at 14'
Lt gray silt w/ some fine sand	24	30	
Interbbed silt and fine sand	30	34	

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) YES **Y** NO N

TYPE OF GROUTING MATERIAL

CEMENT **CM** BENTONITE CLAY BC

NO. OF BAGS ______ NO. OF POUNDS ______

GALLONS OF WATER ______

DEPTH OF GROUT SEAL (to nearest foot)

from 0 TOP ~~0~~ ft. to 9 BOTTOM ~~5~~ ft.

(enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below

ST STEEL CO CONCRETE PL PLASTIC OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	4 ~~4~~	15 ~~15~~

OTHER CASING (if used)

EACH CASING

	diameter inch	depth (feet) from	to

SCREEN RECORD

screen type or open hole insert appropriate code below

ST STEEL BR BRASS BRONZE HO OPEN HOLE PL PLASTIC OT OTHER

C 2

EACH SCREEN

	DEPTH (nearest ft.) Top	Bottom
1 PL	15 ~~15~~	25 ~~25~~
2		
3		

SLOT SIZE 1. .01 2. ____ 3. ____

DIAMETER OF SCREEN 4 ~~4~~ (NEAREST INCH)

GRAVEL PACK from 10 to 25

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

C 3

PUMPING TEST

HOURS PUMPED (nearest hour) 1

PUMPING RATE (gal. per min. to nearest gal.) 1

METHOD USED TO MEASURE PUMPING RATE ______

WATER LEVEL (distance from land surface)

BEFORE PUMPING 1

WHEN PUMPING 1

TYPE OF PUMP USED (for test)

A air P piston T turbine C centrifugal R rotary **O** other (describe below) J jet S submersible

Data Entry

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES **NO**

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE:

CAPACITY: GALLONS PER MINUTE (to nearest gallon)

PUMP HORSE POWER

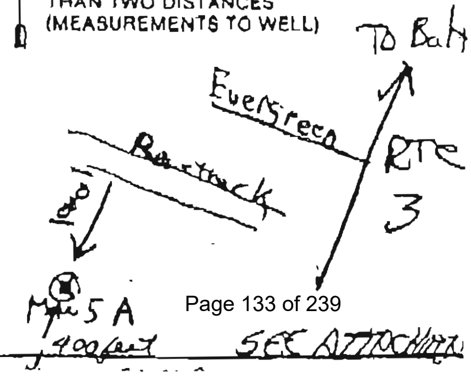
PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height)

+ above / - below LAND SURFACE 2 (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



CIRCLE APPROPRIATE LETTER

A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED

E ELECTRIC LOG OBTAINED

P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 10.17.13 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE

DRILLERS IDENT. NO. MWD-336

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

OEP USE ONLY (NOT TO BE FILLED IN BY DRILLER)

T TELESCOPE CASING (E.R.O.S.) LOG INDICATOR WO OTHER DATA

5B

STATE OF MARYLAND WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

PERMIT NO. FROM "PERMIT TO DRILL WELL"

Depth of Well 60 (TO NEAREST FOOT)

Cunningham, James
Crownsville, Md. 21032
St. Stevens Rd.
Capital Raceway
LOT monitoring well #8

WELL LOG

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION	FROM	TO	Water bearing
Fine Brown sand	0	24	
Lt. Gray silt w/ fine sand	24	30	
Interbedded silt & fine sand	30	40	
Silt & fine sand orange & brown	40	53	
SAnd w/ trace of silt	53	60	X

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) Y N

TYPE OF GROUTING MATERIAL CEMENT CM BENTONITE CLAY BC

NO OF BAGS NO OF POUNDS

GALLONS OF WATER

DEPTH OF GROUT SEAL (to nearest foot) from 0 ft to 44 ft (enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below: ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE PL Nominal diameter top (main) casing (nearest inch) 4 Total depth of main casing (nearest foot) 50

OTHER CASING (if used) diameter inch depth (feet) from to

SCREEN RECORD

screen type or open hole insert appropriate code below: ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C2 DEPTH (nearest ft) PL 50 60

SLOT SIZE .01

DIAMETER OF SCREEN 4 (NEAREST INCH)

GRAVEL PACK from 44 to 60

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX

C3 PUMPING TEST

HOURS PUMPED (nearest hour)

PUMPING RATE (gal. per min to nearest gal.)

METHOD USED TO MEASURE PUMPING RATE

WATER LEVEL (distance from land surface)

BEFORE PUMPING

WHEN PUMPING

TYPE OF PUMP USED (for test): A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

Data Entry

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX SEE ABOVE

CAPACITY GALLONS PER MINUTE (to nearest gallon)

PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft)

CASING HEIGHT (circle appropriate line and enter casing height) + above / - below LAND SURFACE 2 (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

Auto Track

Tree

10'

CIRCLE APPROPRIATE LETTER

A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED

ELECTRIC LOG OBTAINED

TEST WELL CONVERTED TO PRODUCTION WELL

(SIGNATURE ON APPLICATION)

DEP USE ONLY (NOT TO BE FILLED IN BY DRILLER)

T TELESCOPE CASING

(E.R.O.S.) LOG INDICATOR

WO OTHER DATA

6A

6H

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED

COUNTY NUMBER: 02

PERMIT NO FROM "PERMIT TO DRILL WELL"

DATE WELL COMPLETED: [illegible]

DEPTH OF WELL: 50 (TO NEAREST FOOT)

OWNER: Cunningham (last name) James (first name) 5832

STREET OR RFD: Rt 3 TOWN: Crofton

SUBDIVISION: SECTION: LOT:

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Red Brown Sand	0	18	
Fine Brown Sandy Silt	18	26	
Med Coarse Brown-Buff Sand	26	47	✓
Dark Gray-Brown Sand and Silt	47	50	

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box): Y N

TYPE OF GROUTING MATERIAL: CEMENT CM BENTONITE CLAY BC

NO. OF BAGS / NO. OF POUNDS

GALLONS OF WATER

DEPTH OF GROUT SEAL (to nearest foot): from 0 to 10 (enter 0 if from surface)

CASING RECORD
Casing type (insert appropriate code below): ST STEEL; CO CONCRETE; PL PLASTIC; OT OTHER

MAIN CASING TYPE: PL; Nominal diameter top (main casing) (nearest inch): 4; Total depth of main casing (nearest foot): 40

OTHER CASING (if used): Diameter (inches); depth (feet) from; to

SCREEN RECORD
Screen type or open hole (insert appropriate code below): ST STEEL; BR BRASS BRONZE; HO OPEN HOLE; PL PLASTIC; OT OTHER

C2

PL 4 [illegible] 40 50

SLOT SIZE: .01

DIAMETER OF SCREEN: 4 (NEAREST INCH)

GRAVEL PACK: from 30 to 50

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX

C3 PUMPING TEST
HOURS PUMPED (nearest hour)

PUMPING RATE (gal. per min. to nearest gal.)

METHOD USED TO MEASURE PUMPING RATE

WATER LEVEL (distance from land surface): BEFORE PUMPING; WHEN PUMPING

TYPE OF PUMP USED (for test): A Air; P Piston; T Turbine; C Centrifugal; R Rotary; O Other (none); J Jet; S Submersible

Data Entry

PUMP INSTALLED
DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO): YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED (PLACE A,C,J,P,R,S,T,O IN BOX, SEE ABOVE)

CAPACITY: GALLONS PER MINUTE (to nearest gallon)

PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height): + above / − below LAND SURFACE (to nearest foot)

CIRCLE APPROPRIATE LETTER
A — A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED

E — ELECTRIC LOG OBTAINED

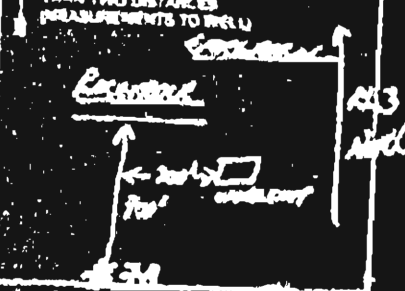
P — TEST WELL CONVERTED TO PRODUCTION WELL

[illegible]

DRILLERS LICENSE NO.: 336

DRILLERS SIGNATURE OR APPLICATOR

LOCATION OF WELL ON LOT
SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



CHP USE ONLY
(NOT TO BE FILLED IN BY DRILLER)

TELESCOPE CASING; E.R.O.S.J. LOG INDICATOR; W.Q. OTHER DATA

ORIGINAL

FROM :   FAX NO. :4107930798   Jul. 25 2006 11:36AM P2

7A

C 1 0427 SEQUENCE NO. (OEP USE ONLY)

(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

STATE OF MARYLAND
WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

JAN 21 1986
DATE Received [illegible]

DATE WELL COMPLETED 1 2 2 85

Depth of Well 35 (TO NEAREST FOOT)

7A

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-81-5830

OWNER CUNNINGHAM (last name) JAMES (first name)

STREET OR RFD RTe 3 TOWN CROFTON

SUBDIVISION ______ SECTION ______ LOT ______

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Med Sand, Silt And gravel Brown - Rust brown	0	8	
Fine - Med. Buff Sand + Silt	8	14	
Med Sand, Trace Silt, well sorted, Moist	14	18	
Coarse Sand + gravel / Tan Colored to grey occasional Silt Lenses	18	33	✓
Fine Sand And Buff Silt	33	41	

CIRCLE APPROPRIATE LETTER

A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED

E ELECTRIC LOG OBTAINED

P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 10.17.13 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE

DRILLERS IDENT. NO. MWD-336

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

SITE SUPERVISOR (sign. of driller or journeyman

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) **Y** (yes) N (no)

TYPE OF GROUTING MATERIAL

CEMENT CM BENTONITE CLAY BC

NO. OF BAGS ______ NO. OF POUNDS ______

GALLONS OF WATER ______

DEPTH OF GROUT SEAL (to nearest foot)

from 0 ft. (TOP) to 11 ft. (BOTTOM) (enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below

ST STEEL   CO CONCRETE   PL PLASTIC   OT OTHER

MAIN CASING TYPE: PL

Nominal diameter top (main) casing (nearest inch): 4

Total depth of main casing (nearest foot): 25

OTHER CASING (if used) diameter inch, depth (feet) from to

EACH CASING

SCREEN RECORD

screen type or open hole insert appropriate code below

ST STEEL   BR BRASS BRONZE   HO OPEN HOLE   PL PLASTIC   OT OTHER

C 2

EACH SCREEN — DEPTH (nearest ft.)

Type	Top	Bottom
PL	25	35

SLOT SIZE 1 .01 2 ___ 3 ___

DIAMETER OF SCREEN 4 (NEAREST INCH)

GRAVEL PACK from 12 to 35

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

OEP USE ONLY (NOT TO BE FILLED IN BY DRILLER)

T — TELESCOPE CASING   (E.R.O.S.) — LOG INDICATOR   WO — OTHER DATA

C 3

PUMPING TEST

HOURS PUMPED (nearest hour) 1

PUMPING RATE (gal. per min to nearest gal.) 1

METHOD USED TO MEASURE PUMPING RATE ______

WATER LEVEL (distance from land surface)

BEFORE PUMPING 1

WHEN PUMPING 1

TYPE OF PUMP USED (for test)

A air   P piston   T turbine
C centrifugal   R rotary   **O other (describe below)**
J jet   S submersible

Data Entry

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES **NO**

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX-SEE ABOVE:

CAPACITY: GALLONS PER MINUTE (to nearest gallon)

PUMP HORSE POWER

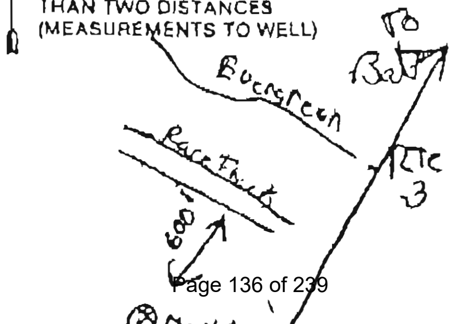
PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height)

+ above / − below LAND SURFACE 2 (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



MWA SEE ATTACHMENT

7B

7B

STATE OF MARYLAND
WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED

SEQUENCE NO (DEP USE ONLY)

COUNTY NUMBER 02

PERMIT NO FROM "PERMIT TO DRILL WELL" AA-91-3453

DATE WELL COMPLETED [illegible]

Depth of Well 112 ft (TO NEAREST FOOT)

OWNER Cunningham, James first name TOWN Crownsville, Md. 21032

STREET OR RFD 1073 St. Stevens Rd LOT monitoring well #5

SUBDIVISION Capital Raceway SECTION

WELL LOG

(not required for driven wells)

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Med. brown sand	0	18	
Fine brown sandy silt	18	26	
Med. coarse brown - buff sand	26	47	
Dark gray & brown sand & silt	47	60	
Red - Brown & buff sand & silt	60	90	
Interbedded buff & Red clay & Silty sand	90	108	
Tan sand	108	112	X

CIRCLE APPROPRIATE LETTER

A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED

E ELECTRIC LOG OBTAINED

P TEST WELL CONVERTED TO PRODUCTION WELL

DRILLERS PERMIT NO. 289

DRILLERS SIGNATURE

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) Y (yes) N

TYPE OF GROUTING MATERIAL CEMENT CM BENTONITE CLAY BC

NO OF BAGS NO OF POUNDS

GALLONS OF WATER

DEPTH OF GROUT SEAL (to nearest foot) from 0 to 80 (enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below

ST STEEL CO CONCRETE PL PLASTIC OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	4	87

OTHER CASING (if used) diameter (inch) depth (feet) from to

SCREEN RECORD

screen type or open hole insert appropriate code below

ST STEEL BR BRASS BRONZE HO OPEN HOLE PL PLASTIC OT OTHER

C2

EACH SCREEN	DEPTH (nearest ft) from	to
PL	87	97

SLOT SIZE

DIAMETER OF SCREEN (NEAREST INCH)

GRAVEL PACK from 80 to 110

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX

DEP USE ONLY (NOT TO BE FILLED IN BY DRILLER)

T TELESCOPE CASING — (R.A.O.S.) LOG INDICATOR — W.O OTHER DATA

C3

PUMPING TEST

HOURS PUMPED (nearest hour) 0

PUMPING RATE (gal. per min to nearest gal) 0

METHOD USED TO MEASURE PUMPING RATE

WATER LEVEL (distance from land surface)

BEFORE PUMPING

WHEN PUMPING

TYPE OF PUMP USED (for test)

A air P piston T turbine C centrifugal R rotary O other describe below J jet S submersible

Data Entry

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX SEE ABOVE

CAPACITY GALLONS PER MINUTE (to nearest gallon)

PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft)

CASING HEIGHT (circle appropriate box and enter casing height) + above - below LAND SURFACE (nearest foot) 2

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

[illegible] X

ORIGINAL

8A

(DENV USE ONLY)

...S NUMBER IS TO BE PUNCHED IN COLS. 3-8 ON ALL CARDS)

STATE OF MARYLAND
WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER

...O USE ONLY Received

DATE WELL COMPLETED 01 19 95

Depth of Well 51 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-93-0268

...R Cunningham Excavating

...ET OR RFD 1073 (last name) Stephens Church Rd (first name) TOWN Crownsville MD 21032

...BDIVISION ______ SECTION 27-3 Capital Raceway LOT Ad...

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

...PTION (Use ...al sheets if needed)	FEET FROM	FEET TO	Check if water bearing
...Tan ...Sand ...& little ...ravel	0	37	
...Tan ...t, Sand	37	50	✓

...D ROCK AREAS, IDENTIFY SPECIFICALLY ...TURATED FRACTURES WERE OBSERVED.

...ELL HYDROFRACTURED yes Y no N

...CLE APPROPRIATE LETTER
...ELL WAS ABANDONED AND SEALED
...EN THIS WELL WAS COMPLETED
...RIC LOG OBTAINED
...WELL CONVERTED TO PRODUCTION

...Y THAT THIS WELL HAS BEEN CONSTRUCTED IN ...ITH COMAR 26.04.04 "WELL CONSTRUCTION" ...ANCE WITH ALL CONDITIONS STATED IN THE ...ED PERMIT, AND THAT THE INFORMATION PRE... ...EIN IS ACCURATE AND COMPLETE TO THE BEST OF ...DG...

...ENT. NO. MW10-413

...NATURE

...SIGNATURE ON APPLICATION)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N

TYPE OF GROUTING MATERIAL: CEMENT CM BENTONITE CLAY BC

NO. OF BAGS 7 NO. OF POUNDS 672

GALLONS OF WATER 57

DEPTH OF GROUT SEAL (to nearest foot) from 0 ft. to 35 ft. (top / bottom) (enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below: ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE: PL

Nominal diameter top (main) casing (nearest inch): 2

Total depth of main casing (nearest foot): 38

OTHER CASING (if used) diameter inch, depth (feet) from ... to

SCREEN RECORD

screen type or open hole Insert appropriate code below: ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C 2

EACH SCREEN — DEPTH (nearest ft.): 1: PL 38 48

SLOT SIZE 1 ____ 2 ____ 3 ____

DIAMETER OF SCREEN ______ (NEAREST INCH)

GRAVEL PACK from 35 to 50

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)

T (E.R.O.S.) W Q

C 3

PUMPING TEST

N/A

HOURS PUMPED (nearest hour)

PUMPING RATE (gal. per min. to nearest gal.)

METHOD USED TO MEASURE PUMPING RATE

WATER LEVEL (distance from land surface)

BEFORE PUMPING

WHEN PUMPING

TYPE OF PUMP USED (for test): A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE:

CAPACITY: GALLONS PER MINUTE (to nearest gallon)

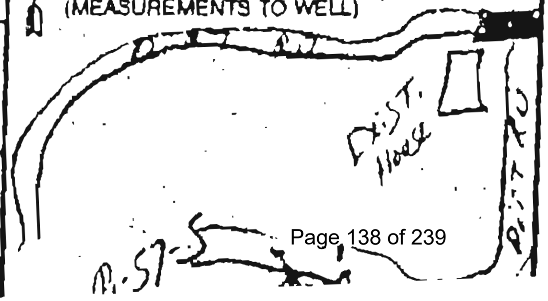
PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height) + above / − below LAND SURFACE 2 (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



9A

(DENV USE ONLY)
(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-8 ON ALL CARDS)

WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

COUNTY NUMBER

CO USE ONLY
DATE Received

DATE WELL COMPLETED 010495

Depth of Well 85 (TO NEAREST FOOT)

PERMIT NO. FROM PERMIT TO DRILL WELL AA-73-0226

OWNER CUNNINGHAM EXCAVATION
last name first name

STREET OR RFD 1023 STEPHENS CHURCH RD
TOWN CRAINSVILLE MD 21032

SUBDIVISION
SECTION RT 3 CAPITAL RACEWAY
LOT MAINTAINING # B-55

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
ORANGE DRY SAND + IRON CEMENTED SAND	0'	17'	
TAN, DRY TO MOIST, CLAY WITH SAND LENSES	17'	44'	
WHITE TO TAN, DRY, COARSE SAND	44'	58'	
DRY TO WET COARSE SAND GRAVEL	58'	85'	✓

IN HARD ROCK AREAS, IDENTIFY SPECIFICALLY WHERE SATURATED FRACTURES WERE OBSERVED.

WELL HYDROFRACTURED yes Y no N

CIRCLE APPROPRIATE LETTER

A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED

E ELECTRIC LOG OBTAINED

P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE

DRILLERS IDENT. NO. MWD 413

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

SITE SUPERVISOR (sign. of driller or journeyman

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N

TYPE OF GROUTING MATERIAL

CEMENT CM BENTONITE CLAY BC

NO. OF BAGS 29 NO. OF POUNDS 1,786

GALLONS OF WATER 114

DEPTH OF GROUT SEAL (to nearest foot)

from 0 ft. to 70 ft. (enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below

ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	2	75

EACH CASING — OTHER CASING (if used) diameter inch, depth (feet) from to

SCREEN RECORD

screen type or open hole insert appropriate code below

ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C 2

EACH SCREEN DEPTH (nearest ft.)

	Type	From	To
1	PL	75	85
2			
3			

SLOT SIZE 1 .010 2 3

DIAMETER OF SCREEN 2 (NEAREST INCH)

GRAVEL PACK from 70 to 85

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)

T (E.R.O.S.) W Q

TELESCOPE LOG OTHER DATA

C 3

N/A

PUMPING TEST

HOURS PUMPED (nearest hour)

PUMPING RATE (gal. per min. to nearest gal.)

METHOD USED TO MEASURE PUMPING RATE

WATER LEVEL (distance from land surface)

BEFORE PUMPING

WHEN PUMPING

TYPE OF PUMP USED (for test)

A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE:

CAPACITY: GALLONS PER MINUTE (to nearest gallon)

PUMP HORSE POWER

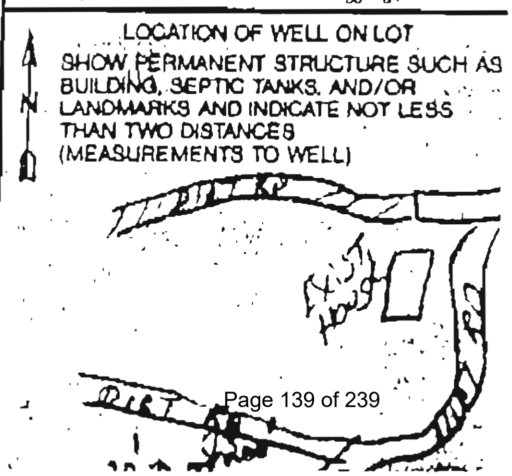
PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height)

+ above, − below LAND SURFACE 2 (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



10A

[illegible]0410 SEQUENCE NO. (DENV USE ONLY)

(THIS NUMBER IS TO BE PUNCHED COLS. 3-8 ON ALL CARDS)

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER

T/CO USE ONLY
DATE Received

DATE WELL COMPLETED 010495

Depth of Well 163 (TO NEAREST FOOT)

PERMIT NO. FROM PERMIT TO DRILL WELL AA-93-0266

OWNER CUNNINGHAM EXCAVATING
last name first name

STREET OR RFD 1623 STEPHEN CHURCH RD TOWN CROWNSVILLE MD. 21032

SUBDIVISION ______ SECTION RT 3 CAPITAL GATEWAY LOT [illegible] #8-54-5

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
[illegible] BROWN [illegible] CLAYEY SAND	0'	20'	
CLAY [illegible] SAND	20'	42'	
BROWN, CLAYEY SAND	42	47	
[illegible] CLAY	47	54	
WHITE TO TAN, [illegible] SAND	54'	91'	
LIGHT GRAY TO [illegible] BROWN, [illegible] SAND	91'	160'	✓

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N

TYPE OF GROUTING MATERIAL

CEMENT CM BENTONITE CLAY BC

NO. OF BAGS 23 NO. OF POUNDS 2162

GALLONS OF WATER 138

DEPTH OF GROUT SEAL (to nearest foot)

from 0 ft. to 75 ft. (enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below

ST STEEL CO CONCRETE PL PLASTIC OT OTHER

MAIN CASING TYPE: PL

Nominal diameter top (main) casing (nearest inch): 2

Total depth of main casing (nearest foot): 90

EACH CASING

OTHER CASING (if used) diameter inch depth (feet) from to

SCREEN RECORD

screen type or open hole insert appropriate code below

ST STEEL BR BRASS BRONZE HO OPEN HOLE PL PLASTIC OT OTHER

C2

EACH SCREEN DEPTH (nearest ft.)

1 PL 90 160

2

3

SLOT SIZE 1 010 2 ___ 3 ___

DIAMETER OF SCREEN 2 (NEAREST INCH)

GRAVEL PACK from 85' to 100'

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

C3

PUMPING TEST

N/A

HOURS PUMPED (nearest hour)

PUMPING RATE (gal. per min. to nearest gal.)

METHOD USED TO MEASURE PUMPING RATE

WATER LEVEL (distance from land surface)

BEFORE PUMPING

WHEN PUMPING

TYPE OF PUMP USED (for test)

A air P piston T turbine

C centrifugal R rotary O other (describe below)

J jet S submersible

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE

CAPACITY: GALLONS PER MINUTE (to nearest gallon)

PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height)

+ above - below LAND SURFACE 3 (nearest foot)

IN HARD ROCK AREAS, IDENTIFY SPECIFICALLY WHERE SATURATED FRACTURES WERE OBSERVED.

WELL HYDROFRACTURED yes Y no N

CIRCLE APPROPRIATE LETTER

A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED

ELECTRIC LOG OBTAINED

TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 WELL CONSTRUCTION AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE

DRILLERS IDENT. NO. MWD 413

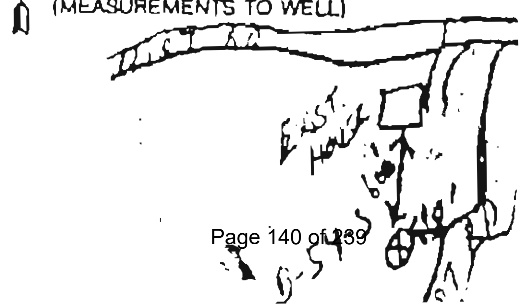
DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)

T (E.R.O.S.) W Q

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



11A

9420 SEQUENCE NO. (DENV USE ONLY)

NUMBER IS TO BE PUNCHED COLS. 3-8 ON ALL CARDS)

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER

CO USE ONLY
DATE Received

DATE WELL COMPLETED 010395

Depth of Well 83 (TO NEAREST FOOT)

PERMIT NO. FROM PERMIT TO DRILL WELL AA-93-[illegible]

OWNER Cunningham Excavating

STREET OR RFD 1023 last name [redacted] St Stephens first name Rd TOWN Crownsville MD 21032

SUBDIVISION SECTION Rt 3 Capital Raceway LOT Industrial A-5

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Tan, dry sand / Iron cement rock	0'	14'	
Tan, damp, clay	14'	24'	
Tan, damp, clayey sand	24'	30'	
White + orange coarse sand	30'	51'	
White + yellow sand + gravel	51'	67'	
Tan, wet, sand	67'	77'	✓
Tan wet sand + clay layers	77'	80'	✓

IN HARD ROCK AREAS, IDENTIFY SPECIFICALLY WHERE SATURATED FRACTURES WERE OBSERVED.

WELL HYDROFRACTURED yes Y no N

CIRCLE APPROPRIATE LETTER
A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
E ELECTRIC LOG OBTAINED
TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS IDENT. NO. MAWD 413

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N

TYPE OF GROUTING MATERIAL
CEMENT CM BENTONITE CLAY BC

NO. OF BAGS 28 NO. OF POUNDS 4,272

GALLONS OF WATER 110

DEPTH OF GROUT SEAL (to nearest foot) from 0 ft. (TOP) to 65 ft. (BOTTOM) (enter 0 if from surface)

CASING RECORD
casing types insert appropriate code below: ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	2	70

EACH CASING — OTHER CASING (if used) diameter inch, depth (feet) from to

SCREEN RECORD
screen type or open hole insert appropriate code below: ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C 2

EACH SCREEN	Type	DEPTH (nearest ft.) from	to
1	PL	70	80
2			
3			

SLOT SIZE .010

DIAMETER OF SCREEN 2 (NEAREST INCH)

GRAVEL PACK from 65' to 80'

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W Q

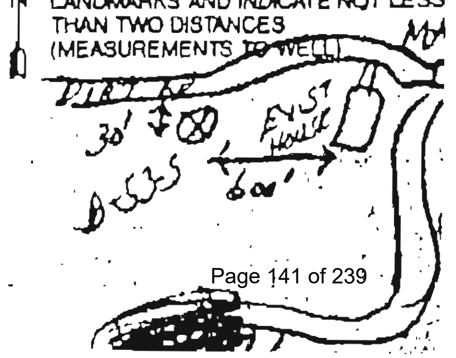
C 3

PUMPING TEST
N/A

HOURS PUMPED (nearest hour)
PUMPING RATE (gal. per min. to nearest gal.)
METHOD USED TO MEASURE PUMPING RATE
WATER LEVEL (distance from land surface)
BEFORE PUMPING
WHEN PUMPING
TYPE OF PUMP USED (for test)
A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

PUMP INSTALLED
DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES
IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE
TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE.
CAPACITY: GALLONS PER MINUTE (to nearest gallon)
PUMP HORSE POWER
PUMP COLUMN LENGTH (nearest ft.)
CASING HEIGHT (circle appropriate box and enter casing height) + above / − below LAND SURFACE 3 (nearest foot)

LOCATION OF WELL ON LOT
SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



11B

7/1 47 SEQUENCE NO (DENV USE ONLY)
THIS NUMBER IS TO BE PUNCHED COLS. 3-8 ON ALL CARDS)

STATE OF MARYLAND WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER

ST/CO USE ONLY
DATE Received

DATE WELL COMPLETED

Depth of Well (TO NEAREST FOOT)

11B

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-92-1985

OWNER Cunningham Excavating
last name first name
STREET OR RFD 1073 St. Stephens Church Rd. TOWN Crownsville, Md., 21032
SUBDIVISION SECTION Rt. #3 Capital Raceway LOT Monitoring Well #53

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Brown Sand & Sand Rock	0	23	
Gravel	23	65	
Red Gray Clay	65	115	
Brown Sand	115	122	X

IN HARD ROCK AREAS, IDENTIFY SPECIFICALLY WHERE SATURATED FRACTURES WERE OBSERVED.

WELL HYDROFRACTURED yes Y no N

CIRCLE APPROPRIATE LETTER
A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
E ELECTRIC LOG OBTAINED
P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS IDENT. NO.

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N
TYPE OF GROUTING MATERIAL
CEMENT CM BENTONITE CLAY BC
NO. OF BAGS 13 NO. OF POUNDS 650
GALLONS OF WATER 325
DEPTH OF GROUT SEAL (to nearest foot)
from 0 ft. to 102 ft.
TOP BOTTOM (enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below
ST STEEL CO CONCRETE PL PLASTIC OT OTHER

MAIN CASING TYPE PL
Nominal diameter top (main) casing (nearest inch) 4
Total depth of main casing (nearest foot) 112

OTHER CASING (if used) diameter inch depth (feet) from to

EACH CASING

SCREEN RECORD

screen type or open hole insert appropriate code below
ST STEEL BR BRASS BRONZE HO OPEN HOLE PL PLASTIC OT OTHER

C 2

EACH SCREEN
DEPTH (nearest ft.) PL 112 122

SLOT SIZE 1 2 3
DIAMETER OF SCREEN 4 (NEAREST INCH)

GRAVEL PACK from 102 to 122
IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W O
TELESCOPE CASING LOG INDICATOR OTHER DATA

C 3

PUMPING TEST

HOURS PUMPED (nearest hour) 2
PUMPING RATE (gal. per min. to nearest gal.) 15
METHOD USED TO MEASURE PUMPING RATE AIR
WATER LEVEL (distance from land surface)
BEFORE PUMPING 91
WHEN PUMPING 115

TYPE OF PUMP USED (for test)
A air P piston T turbine
C centrifugal R rotary O other (describe below)
J jet S submersible

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES NO
IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE
TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE:
CAPACITY: GALLONS PER MINUTE (to nearest gallon)
PUMP HORSE POWER
PUMP COLUMN LENGTH (nearest ft.)
CASING HEIGHT (circle appropriate box and enter casing height)
+ above
− below
LAND SURFACE (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

No Drawing
Refer to Plat

12A

5422 SEQUENCE NO. (DENV USE ONLY)

NUMBER IS TO BE PUNCHED ... S 3-8 ON ALL CARDS)

STATE OF MARYLAND WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER

... USE ONLY
DATE Received

DATE WELL COMPLETED 010395

Depth of Well 55 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-93-[illegible]

OWNER Cunningham Excavating
last name first name

STREET OR RFD 1075 Stephen Church Rd. TOWN Crownsville MD. 21032

SUBDIVISION SECTION RT 3 CAPITAL RACEWAY LOT MAINTENANCE 52-5

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
..., DRY, ...SE, SAND, ... A LITTLE GRAVEL	0'	45'	
... GRAY ... WET ... SAND ... CLAY ...	45'	55'	✓

IN HARD ROCK AREAS, IDENTIFY SPECIFICALLY WHERE SATURATED FRACTURES WERE OBSERVED.

WELL HYDROFRACTURED yes Y no N

CIRCLE APPROPRIATE LETTER
A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
E ELECTRIC LOG OBTAINED
T TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ... MENTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE

DRILLERS IDENT. NO. MWD 413

DRILLERS SIGNATURE
MUST MATCH SIGNATURE ON APPLICATION)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N

TYPE OF GROUTING MATERIAL
CEMENT CM BENTONITE CLAY BC

NO. OF BAGS 12 NO. OF POUNDS 1128
GALLONS OF WATER 72
DEPTH OF GROUT SEAL (to nearest foot)
from 0 ft. to 40 ft.
(enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below
ST STEEL CO CONCRETE PL PLASTIC OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	2	45

EACH CASING — OTHER CASING (if used)
diameter inch, depth (feet) from to

SCREEN RECORD

screen type or open hole insert appropriate code below
ST STEEL BR BRASS BRONZE HO OPEN HOLE PL PLASTIC OT OTHER

C 2

EACH SCREEN — DEPTH (nearest ft.)

	Type	From	To
1	PL	45	55
2			
3			

SLOT SIZE 1 .010 2 3

DIAMETER OF SCREEN 2 (NEAREST INCH)

GRAVEL PACK from 40' to 55'

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY
(NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W O

C 3

PUMPING TEST

N/A

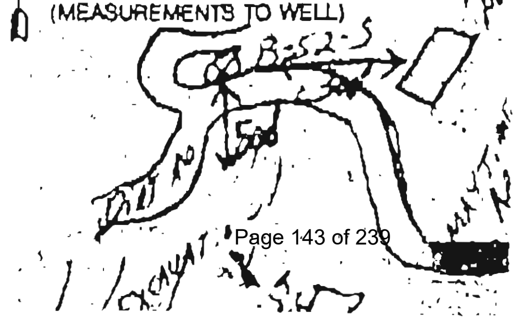
HOURS PUMPED (nearest hour)
PUMPING RATE (gal. per min. to nearest gal.)
METHOD USED TO MEASURE PUMPING RATE
WATER LEVEL (distance from land surface)
BEFORE PUMPING
WHEN PUMPING
TYPE OF PUMP USED (for test)
A air P piston T turbine
C centrifugal R rotary O other (describe below)
J jet S submersible

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES NO
IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE
TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE
CAPACITY GALLONS PER MINUTE (to nearest gallon)
PUMP HORSE POWER
PUMP COLUMN LENGTH (nearest ft.)
CASING HEIGHT (circle appropriate box and enter casing height)
+ above } LAND SURFACE 3 (nearest foot)
− below

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



13A

9421 SEQUENCE NO (DENV USE ONLY)

THIS NUMBER IS TO BE PUNCHED COLS. 3-8 ON ALL CARDS

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

45 DAYS AFTER WELL IS COMPLETED

COUNTY NUMBER

T/CO USE ONLY
DATE Received

DATE WELL COMPLETED 010495

Depth of Well 70 (TO NEAREST FOOT)

PERMIT NO. FROM PERMIT TO DRILL WELL AA-92-[illegible]

OWNER Cunningham Excavation (last name, first name)

STREET OR RFD 1073 Steidher's Church Rd. TOWN Crownsville MD. 21032

SUBDIVISION SECTION Rt 3 Capital Raceway LOT [illegible]

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Reddish Brown to Tan, Dry coarse sand with a little gravel	0'	41'	
light gray tan, sand with clay layers	41'	57'	
orange, wet, medium sand	57'	68'	✓

IN HARD ROCK AREAS, IDENTIFY SPECIFICALLY WHERE SATURATED FRACTURES WERE OBSERVED.

WELL HYDROFRACTURED yes Y no N

CIRCLE APPROPRIATE LETTER
- A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
- E ELECTRIC LOG OBTAINED
- P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS IDENT. NO. MWD 413

DRILLERS SIGNATURE [signature]
(MUST MATCH SIGNATURE ON APPLICATION)

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box) Y (yes) N (no)

TYPE OF GROUTING MATERIAL: CEMENT CM BENTONITE CLAY BC

NO. OF BAGS 15 NO. OF POUNDS 1,410

GALLONS OF WATER 90

DEPTH OF GROUT SEAL (to nearest foot) from 0 ft. (TOP) to 55 ft. (BOTTOM) (enter 0 if from surface)

CASING RECORD
casing types: insert appropriate code below

ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	2	58

OTHER CASING (If used): diameter inch; depth (feet) from / to

SCREEN RECORD
screen type or open hole: insert appropriate code below

ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C2

EACH SCREEN	Type	DEPTH (nearest ft.) from	to
1	PL	58	68
2			
3			

SLOT SIZE 40 2 3

DIAMETER OF SCREEN 2 (NEAREST INCH)

GRAVEL PACK from 55 to 68

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W Q

C3

PUMPING TEST
N/A

HOURS PUMPED (nearest hour)

PUMPING RATE (gal. per min. to nearest gal.)

METHOD USED TO MEASURE PUMPING RATE

WATER LEVEL (distance from land surface)

BEFORE PUMPING

WHEN PUMPING

TYPE OF PUMP USED (for test): A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

PUMP INSTALLED
DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE:

CAPACITY: GALLONS PER MINUTE (to nearest gallon)

PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height): + above / − below LAND SURFACE 3 (nearest foot)

LOCATION OF WELL ON LOT
SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

B-51-S

150'

DIRT RD

EXIST. [illegible] AREA

14A

(DENV USE ONLY)

THIS NUMBER IS TO BE PUNCHED IN COLS. 3-8 ON ALL CARDS

WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER

ST/CO USE ONLY DATE Received

DATE WELL COMPLETED 010395

Depth of Well 58 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL W..." AA-92-0...

OWNER Cunningham Excavation (last name / first name)

STREET OR RFD 1077 Stevens Church Rd TOWN Crownsville MD-2103.

SUBDIVISION ________ SECTION ________ LOT ________

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Tan & Gray Damp Silty Clay	0'	8'	
Tan, Gry, Sand with a little Gravel	8'	47'	
Tan, wet, Sand	47'	55'	✓

IN HARD ROCK AREAS, IDENTIFY SPECIFICALLY WHERE SATURATED FRACTURES WERE OBSERVED.

WELL HYDROFRACTURED Y (yes) N (no)

CIRCLE APPROPRIATE LETTER

A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED

E ELECTRIC LOG OBTAINED

P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE

DRILLERS IDENT. NO. MW 4113

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) Y (yes) N (no) — Y circled

TYPE OF GROUTING MATERIAL: CEMENT CM (circled) BENTONITE CLAY BC

NO. OF BAGS 22 NO. OF POUNDS 1128

GALLONS OF WATER 72

DEPTH OF GROUT SEAL (to nearest foot) from 0 ft. (TOP) to 42 ft. (BOTTOM) (enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below: ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	2	45

EACH CASING — OTHER CASING (if used): diameter inch; depth (feet) from to

SCREEN RECORD

screen type or open hole insert appropriate code below: ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C 2

EACH SCREEN — DEPTH (nearest ft.)

Type	From	To
PL	45	55

SLOT SIZE 1. 010 2. ____ 3. ____

DIAMETER OF SCREEN 2 (NEAREST INCH)

GRAVEL PACK from 42' to 55'

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 38

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)

T (E.R.O.S.) W O

C 3 — PUMPING TEST

N/A

HOURS PUMPED (nearest hour)

PUMPING RATE (gal. per min. to nearest gal.)

METHOD USED TO MEASURE PUMPING RATE

WATER LEVEL (distance from land surface) BEFORE PUMPING / WHEN PUMPING

TYPE OF PUMP USED (for test): A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE:

CAPACITY: GALLONS PER MINUTE (to nearest gallon)

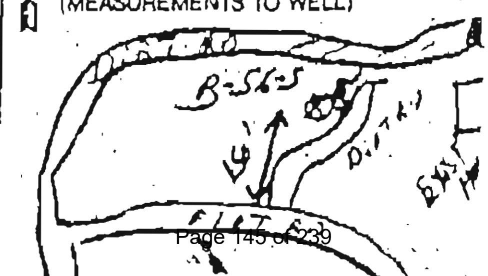
PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height) + above / − below LAND SURFACE 3 (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



MARYLAND DEPARTMENT OF THE ENVIRONMENT, WATER MANAGEMENT ADMINISTRATION
2500 BROENING HIGHWAY, BALTIMORE, MARYLAND 21224, (410) 631-3784

WATER WELL ABANDONMENT-SEALING REPORT FORM

3B abandonment

SUBMIT COPIES OF COMPLETED FORM TO:
COUNTY ENVIRONMENT AGENCY (contact MDE, WMA if address needed)
WELL OWNER
MDE, WATER MANAGEMENT ADMINISTRATION, WELL PROGRAM

DATE WELL ABANDONED: 08-06-98 (month/day/year)

PERMIT NUMBER OF ABANDONED WELL (if any) AA-81-5452

PERMIT NUMBER OF REPLACEMENT WELL AA-94-2905

PERSON ABANDONING WELL: Charles Lowell

WELL DRILLERS LICENSE NUMBER: JSD 05

CIRCLE: MWD/MSD/MGD

OWNER'S NAME: Cunningham Excav.

WELL LOCATION: Rt #3 Capital Raceway
COUNTY: Anne Arundel
NEAREST TOWN: Odenton
TAX MAP ______ BLOCK ______ PARCEL ______
SUBDIVISION: Capital Raceway
SECTION: ______ LOT: ______
NEAREST ROAD ______

MARYLAND GRID COORDINATES
E 880
BOX NUMBER
N 440

000 000 X	

SHOW WELL LOCATION
BY X WITHIN BOX

TYPE OF WELL BEING ABANDONED:

X DRILLED ______ JETTED
______ BORED/AUGUERED ______ HAND DUG
______ OTHER (specify) ______

USE CODE:

X DOMESTIC ______ MUNICIPAL/PUBLIC
______ IRRIGATION ______ INDUSTRIAL
______ TEST/OBSERVATION

TYPE OF CASING:

______ STEEL X PLASTIC
______ CONCRETE ______ OTHER (specify) ______

SIZE OF CASING: 4 INCHES IN DIAMETER

DEPTH OF WELL: 142 FEET DEEP

WAS ANY CASING REMOVED? ____ YES X NO
if yes, length removed, in feet: ______

WAS CASING RIPPED OR PERFORATED? ____ YES X NO

LOG OF SEALING MATERIAL

MATERIAL	FEET FROM	FEET TO
Bentonite Clay	142'	3'
Clean Fill	3'	0

[signature] #288 MWD/MSD/MGD 8-6-98

SIGNATURE-MASTER WELL DRILLER OR SUPERVISING SANITARIAN LICENSE # CIRCLE ONE DATE

...QUENCE NO. ... (MDE USE ONLY)

STATE OF MARYLAND
PERMIT TO DRILL WELL
please print or type

STATE PERMIT NUMBER: AA-94-2905 (70–79)
fill in this form completely

Received (APA) 080598 — MM DD YY 13

OWNER INFORMATION

Cunningham Excavating — Last Name / Owner / First Name (15–34)
P.O. Box 2498 — Street or RFD (55)
Crofton, Md. 21114 — Town (70) / State (72) / Zip (78)

DRILLER INFORMATION

Denton J. Holford — Driller's Name — M H D 288 (76) License No. (81)
Holford's Well & Pump Service, Inc. — Firm Name
4429 Mountain Road-Pasadena, Maryland 21122 — Address
Signature: Denton J Holford — Date: 8-4-98

2 WELL INFORMATION
APPROX. PUMPING RATE (GAL. PER MIN.) 8 (8–12)
AVERAGE DAILY QUANTITY NEEDED (GAL. PER DAY) 300 (14–20)

USE FOR WATER (CIRCLE APPROPRIATE BOX)

- [D] DOMESTIC POTABLE SUPPLY & RESIDENTIAL IRRIGATION
- [F] FARMING (LIVESTOCK WATERING & AGRICULTURAL IRRIGATION
- [I] INDUSTRIAL, COMMERICIAL, DEWATERING
- [P] PUBLIC WATER SUPPLY WELL
- [T] TEST, OBSERVATION, MONITORING
- [G] GEO-THERMAL

APPROXIMATE DEPTH OF WELL 150 (24–28) FEET

APPROXIMATE DIAMETER OF WELL 4" NEAREST INCH

METHOD OF DRILLING (circle one)

BORED (or Augered) — JETTED — Jetted & DRIVEN
AIR-ROTary — AIR-PERcussion — ROTARY (Hydraulic Rotary)
CABLE — REVerse-ROTary — DRive-POINT
other

REPLACEMENT OR DEEPENED WELLS (CIRCLE APPROPRIATE BOX)

- [N] THIS WELL WILL NOT REPLACE AN EXISTING WELL
- [Y] THIS WELL WILL REPLACE A WELL THAT WILL BE ABANDONED AND SEALED
- [S] THIS WELL WILL REPLACE A WELL THAT WILL BE USED AS A STANDBY-CONTACT LOCAL APPROVING AUTHORITY FOR POLICY ON STANDBY WELLS
- [D] THIS WELL WILL DEEPEN AN EXISTING WELL

PERMIT NUMBER OF WELL TO BE REPLACED OR DEEPENED (IF AVAILABLE) 41 AA-81-5442 52

Not to be filled in by driller (MDE OR COUNTY USE ONLY)

APPROP. PERMIT NUMBER 54 GAP 63

PERMIT No AA-94-2905 (70 71 72 73 74 75 76 77 78 79)

SPECIAL CONDITIONS

B 3 **LOCATION OF WELL** 3B

Anne Arundel — 8 COUNTY (21)
Capital Raceway — 23 SUBDIVISION (42)
SECTION (44–46) LOT (48–60)
Odenton — 62 NEAREST TOWN (71)
MILES FROM TOWN (enter 0 if in town) 3 (73) M I (76 77 78)

B 4 — DIRECTION OF WELL FROM TOWN (CIRCLE BOX): N (NW, NE, W, TOWN, E, SW, S, SE)

Rt. 3 Capital Raceway Rd — 11 ON NEAR WHAT ROAD (30)

ON WHICH SIDE OF ROAD (CIRCLE APPROPRIATE BOX): N (NORTH / WEST / EAST / SOUTH)

DISTANCE FROM ROAD 15 (34–37) Ft — ENTER FT OR MI (38 39)

TAX MAP: ____ BLK. ____ PARCEL ____

NOT TO BE FILLED IN BY DRILLER
HEALTH DEPARTMENT APPROVAL

Anne Arundel — COUNTY NAME — 02 COUNTY NO.
STATE SIGNATURE ____ INSERT S → 41
DATE ISSUED 080598 (43 MM DD YY 48) Barry D. Adams — SIGNATURE — 080599 EXP. DATE
NORTH GRID 440000 (50–55) EAST GRID 0883 000 (57–63)

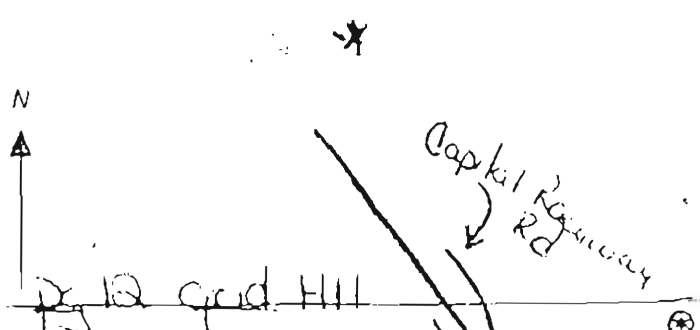
SHOW MAJOR FEATURES OF BOX & LOCATE WELL WITH AN X →

SOURCES OF DRILLING WATER
1. AA-81-0980
2. AA-81-9800
3.

WRITE THE BOX NUMBER FROM THE MAP HERE
E 880
N 440

000
000 X

DRAW A SKETCH BELOW SHOWING LOCATION OF WELL IN RELATION TO NEARBY TOWNS AND ROADS AND GIVE DISTANCE FROM WELL TO NEAREST ROAD JUNCTION



0792 SEQUENCE NO. (MDE USE ONLY)
(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

CO USE ONLY
DATE Received

DATE WELL COMPLETED 080698

Depth of Well 150 (TO NEAREST FOOT)

3B

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-94-2905

OWNER Cunningham Excavating
STREET OR RFD Rt #3 Capital Raceway Road TOWN Odenton
SUBDIVISION Capital Raceway SECTION LOT

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	check if water bearing
MONITORING WELL			
Sand Fine Silt & Gravel	0	50	
Sand Fine Medium	50	70	
Sand Med Course	70	80	
Sand Fine Course Silt	80	90	
Red Clay	90	130	
Gray Clay	130	133	
Sand Fine To Course	133	135	
Gray Clay/Fine To Course Sand	135	150	xx

NUMBER OF UNSUCCESSFUL WELLS

WELL HYDROFRACTURED yes Y no N

CIRCLE APPROPRIATE LETTER
A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
E ELECTRIC LOG OBTAINED
P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE

TYPE MWD/MSD/MGD
DRILLERS LIC. NO 288
DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)
LIC NO MWD 288
Denton J. Wolford
SITE SUPERVISOR (sign. of driller or journeyman)

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N
TYPE OF GROUTING MATERIAL (Circle one)
CEMENT CM BENTONITE CLAY BC
NO. OF BAGS 10 NO. OF POUNDS 500
GALLOWS OF WATER
DEPTH OF GROUT SEAL (to nearest foot)
from 3 ft. to 132 ft
TOP BOTTOM (enter 0 if from surface)

CASING RECORD
casing types insert appropriate code below
ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	1	140

OTHER CASING (if used)
diameter inch, depth (feet) from to

SCREEN RECORD
screen type or open hole insert appropriate code below
ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C 2

DEPTH (nearest ft.)

	Type	From	To
1	PL	140	150
2			
3			

SLOT SIZE 1 .010 2 3
DIAMETER OF SCREEN 1 (NEAREST INCH)

GRAVEL PACK from 135 to
IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 66

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W O
TELESCOPE LOG OTHER DATA

C 3

PUMPING TEST
HOURS PUMPED (nearest hour) 2
PUMPING RATE (gal. per min.) 20.
METHOD USED TO MEASURE PUMPING RATE AIR
WATER LEVEL (distance from land surface)
BEFORE PUMPING 104 ft.
WHEN PUMPING 125 ft.
TYPE OF PUMP USED (for test)
A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

PUMP INSTALLED
DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES NO
IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS.
TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX 29.
CAPACITY: GALLONS PER MINUTE (to nearest gallon)
PUMP HORSE POWER
PUMP COLUMN LENGTH (nearest ft.)
CASING HEIGHT (circle appropriate box and enter casing height)
+ above, − below LAND SURFACE (nearest foot)

LOCATION OF WELL ON LOT
SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND /OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

N

See attached sketch

B 1 9072 SEQUENCE NO. (OP USE ONLY)
(THIS NUMBER IS TO BE PUNCHED IN COLS 3-8 ON ALL CARDS)

STATE OF MARYLAND
APPLICATION FOR PERMIT TO DRILL WELL
please print or type

STATE PERMIT NUMBER: AA-92-1985
fill in this form completely

Date Received (APA) 091294 04 RL

OWNER INFORMATION

Cunningham Excav. — Last Name / Owner / First Name
1653 St. Stephen Church Rd — Street or RFD
Crownsville Md 21032 — Town / State / Zip

LOCATION OF WELL

11B

County: Anne Arundel
Subdivision:
Section: Lot:
Nearest Town: Odenton
Miles from town (enter 0 if in town): 3 MI

DRILLER INFORMATION

MSD/MGD/MWD

Driller's Name: Denton J. Wolford — License No.: 888
Firm Name: Wolford's Well & Pump Service, Inc.
Address: 4429 Mountain Rd → Pasadena, Md.
Signature: Denton J. Wolford — Date: 9-9-94

B 4
DIRECTION OF WELL FROM TOWN (CIRCLE BOX): NW

Rt#3 Capital Raceway Rd — ON NEAR WHAT ROAD

ON WHICH SIDE OF ROAD (CIRCLE APPROPRIATE BOX): NORTH
DISTANCE FROM ROAD: 15
ENTER FT OR MI: FT

TAX MAP ______ BLK ______ PARCEL ______

WELL INFORMATION

B 2
APPROX PUMPING RATE (GAL PER MIN): 8
AVERAGE DAILY QUANTITY NEEDED (GAL PER DAY): 360

NOT TO BE FILLED IN BY DRILLER
HEALTH DEPARTMENT APPROVAL

COUNTY NAME ______ COUNTY NO ______
STATE SIGNATURE ______ INSERT S
DATE ISSUED: 091294 — CO SIGNATURE — EXP DATE
NORTH GRID: 435000 EAST GRID: 0885000

USE FOR WATER (CIRCLE APPROPRIATE BOX)

- D HOME (SINGLE OR DOUBLE HOUSEHOLD UNIT ONLY)
- F FARMING (LIVESTOCK WATERING & AGRICULTURAL IRRIGATION)
- I INDUSTRIAL COMMERCIAL, STATE AND FEDERAL GOV OTHER (REQUIRES APPROPRIATION PERMIT)
- P PUBLIC OR PRIVATE WATER COMPANY (REQUIRES APPROPRIATION PERMIT AND STATE HEALTH DEPARTMENT APPROVAL)
- T TEST OBSERVATION MONITORING (MAY REQUIRE APPROPRIATION PERMIT) #53

SHOW MAJOR FEATURES OF BOX & LOCATE WELL WITH AN X

SOURCES OF DRILLING WATER
1. AA-81-0980
2. AA-81-9800
3.

X

WRITE THE BOX NUMBER FROM THE MAP HERE
E 880
N 430

APPROXIMATE DEPTH OF WELL: 115 FEET

APPROXIMATE DIAMETER OF WELL: 4" NEAREST INCH

METHOD OF DRILLING (circle one)

BORED (or Augered) JETTED Jetted & DRIVEN
AIR-ROTary AIR-PERcussion ROTARY (Hydraulic Rotary)
CABLE REVerse-ROTary DRIVE-POINT
other ______

REPLACEMENT OR DEEPENED WELLS

(CIRCLE APPROPRIATE BOX)

- N THIS WELL WILL NOT REPLACE AN EXISTING WELL
- Y THIS WELL WILL REPLACE A WELL THAT WILL BE ABANDONED AND SEALED
- S THIS WELL WILL REPLACE A WELL THAT WILL BE USED AS A STANDBY-CONTACT LOCAL APPROVING AUTHORITY FOR POLICY ON STANDBY WELLS
- D THIS WELL WILL DEEPEN AN EXISTING WELL

PERMIT NUMBER OF WELL TO BE REPLACED OR DEEPENED (IF AVAILABLE) ______

DRAW A SKETCH BELOW SHOWING LOCATION OF WELL IN RELATION TO NEARBY TOWNS AND ROADS AND GIVE DISTANCE FROM WELL TO NEAREST ROAD JUNCTION

Not to be filled in by driller (OEP USE ONLY)

APPROP PERMIT NUMBER: GAP

FORCE: KT WRITE INITIALS IN BOX — PERMIT No. AA-92-1985

Pg 12 grid J13

SPECIAL CONDITIONS

NOTE = APPROVING AUTHORITIES SHOULD USE SEPARATE SHEET IF NEEDED

ORIGINAL-STATE

(DENV USE ONLY)
(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-8 ON ALL CARDS)

WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

COUNTY NUMBER

ST/CO USE ONLY — DATE Received: FEB 2 3 1995

DATE WELL COMPLETED: 020395

Depth of Well: 155 (TO NEAREST FOOT)

11B

PERMIT NO FROM "PERMIT TO DRILL WELL": AA-92-1985

OWNER: CUNNINGHAM EXCAVATING (last name / first name)

STREET OR RFD: 1073 ST. STEPHENS RD. TOWN: CROWNSVILLE MD 21032

SUBDIVISION: ____ SECTION: RT 3 CAPITAL RACEWAY LOT: MONITORING B-53 (D)

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
TAN, DRY SAND / IRON CEMENTED ROCK	0'	14'	
TAN, DAMP CLAY	14'	24'	
TAN, DAMP, CLAYEY SAND	24'	30'	
WHITE + ORANGE SAND	30'	51'	
ORANGE + YELLOW SAND + GRAVEL	51'	67'	
TAN, WET, SAND	67'	77'	✓
TAN, WET, SAND WITH CLAY LAYERS	77'	91'	✓
TAN, WET, SAND	91'	114'	✓
GRAY TO RED DRY CLAY	114'	144'	
GRAY WET CLAY WITH CLAYEY SAND LAYERS	144'	153'	✓
GRAY, MOIST CLAY	153'	156.5'	

CIRCLE APPROPRIATE LETTER

A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED

E ELECTRIC LOG OBTAINED

P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 WELL CONSTRUCTION AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE

DRILLERS IDENT. NO: MWD 413

DRILLERS SIGNATURE: [signature]
(MUST MATCH SIGNATURE ON APPLICATION)

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box): yes Y / no N — Y

TYPE OF GROUTING MATERIAL: CEMENT CM / BENTONITE CLAY BC — CM

NO OF BAGS: 14 NO. OF POUNDS: 97 EA

GALLONS OF WATER: 84

DEPTH OF GROUT SEAL (to nearest foot): from 0 ft. (TOP) to 140 ft (BOTTOM) (enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below: ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE: PL — Nominal diameter top (main) casing (nearest inch): 2 — Total depth of main casing (nearest foot): 145

OTHER CASING (if used): diameter inch, depth (feet) from / to

SCREEN RECORD

screen type or open hole insert appropriate code below: ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER — PL

C2

	Type	Depth from	Depth to
1	PL	145	155
2			
3			

SLOT SIZE 1. 010 2. ___ 3. ___

DIAMETER OF SCREEN: 2 (NEAREST INCH)

GRAVEL PACK from 140' to 155'

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

OEP USE ONLY (NOT TO BE FILLED IN BY DRILLER)

T — TELESCOPE CASING; (E.R.O.S.) — LOG INDICATOR; W.Q. — OTHER DATA

C3 PUMPING TEST

N/A

HOURS PUMPED (nearest hour)

PUMPING RATE (gal. per min. to nearest gal.)

METHOD USED TO MEASURE PUMPING RATE

WATER LEVEL (distance from land surface): BEFORE PUMPING / WHEN PUMPING

TYPE OF PUMP USED (for test): A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO): YES NO — NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE

CAPACITY, GALLONS PER MINUTE (to nearest gallon)

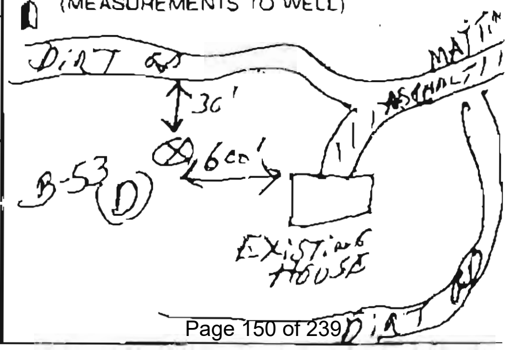
PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height): + above / − below LAND SURFACE — + 3 (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



ORIGINAL

(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

COUNTY NUMBER 02

ST/CO USE ONLY DATE Received: OCT 26 1994

DATE WELL COMPLETED: 1 00 5 94

Depth of Well: 122 (TO NEAREST FOOT) Old 11B

PERMIT NO FROM "PERMIT TO DRILL WELL": AA-93-1985

OWNER Cunningham Excavating (last name / first name)
STREET OR RFD 1073 St. Stephens Church Rd. TOWN Crownsville, Md., 21032
SUBDIVISION ______ SECTION Rt. #3 Capital Raceway LOT Monitoring Well #53

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Brown Sand & Sand Rock	0	23	
Gravel	23	65	
Red Gray Clay	65	115	
Brown Sand	115	122	X

IN HARD ROCK AREAS, IDENTIFY SPECIFICALLY WHERE SATURATED FRACTURES WERE OBSERVED

WELL HYDROFRACTURED yes Y no N

CIRCLE APPROPRIATE LETTER
A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
E ELECTRIC LOG OBTAINED
P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE

DRILLERS IDENT NO. MWD 288

Denton Wolford

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)
Denton J. Wolford

SITE SUPERVISOR (sign of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box): Y (circled) / no N
TYPE OF GROUTING MATERIAL: CEMENT CM / BENTONITE CLAY BC (circled)
NO. OF BAGS 13 NO. OF POUNDS 650
GALLONS OF WATER 325
DEPTH OF GROUT SEAL (to nearest foot): from 0 ft. (TOP) to 100 ft. (BOTTOM) (enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below: ST STEEL, CO CONCRETE, PL PLASTIC (circled), OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	4	112

EACH CASING — OTHER CASING (if used): diameter inch / depth (feet) from / to

SCREEN RECORD

screen type or open hole insert appropriate code below: ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC (circled), OT OTHER

C 2

EACH SCREEN	DEPTH (nearest ft.) from	to
1 PL	112	122
2		
3		

SLOT SIZE .020 2 ___ 3 ___
DIAMETER OF SCREEN 4 (NEAREST INCH)

GRAVEL PACK from 107 to 122
IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T TELESCOPE CASING — (E.R.O.S.) LOG INDICATOR — W Q OTHER DATA

C 3

PUMPING TEST

HOURS PUMPED (nearest hour) 2
PUMPING RATE (gal. per min to nearest gal.) 15
METHOD USED TO MEASURE PUMPING RATE AIR
WATER LEVEL (distance from land surface)
BEFORE PUMPING 96
WHEN PUMPING 105
TYPE OF PUMP USED (for test): A air (circled), P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO): YES NO (circled)
IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE
TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE.
CAPACITY GALLONS PER MINUTE (to nearest gallon)
PUMP HORSE POWER
PUMP COLUMN LENGTH (nearest ft.)
CASING HEIGHT (circle appropriate box and enter casing height): + above (circled) / − below LAND SURFACE: 1 (nearest foot)

LOCATION OF WELL ON LOT
SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

No Drawing
Refer To Plat

ORIGINAL-STATE

B 1 2255 SEQUENCE NO. (MDE USE ONLY)

STATE OF MARYLAND
APPLICATION FOR PERMIT TO DRILL WELL
please type

STATE PERMIT NUMBER AA-95-2965
fill in this form completely

Date Received (APA) 5-10-07 AAM

OWNER INFORMATION

Tolson Landfill
Last Name Owner First Name

1457 Capitol Raceway Road
Street or RFD

Crofton MD 21114
Town State Zip

DRILLER INFORMATION

David B. Hartman M W D 5 1 7
Driller's Name License No.

A.C. Schultes of Maryland, Inc.
Firm Name

24 Old South River Rd, Edgewater, MD 21037
Address

Signature Date 5/10/07

B 3 LOCATION OF WELL

AA
COUNTY

Tolson Landfill
SUBDIVISION

SECTION ____ LOT ____

Crofton
NEAREST TOWN

MILES FROM TOWN (enter 0 if in town) 0 M I

B 4

DIRECTION OF WELL FROM TOWN (CIRCLE BOX)

NW N NE W TOWN E SW S SE

Maytime Dr
NEAR WHAT ROAD

ON WHICH SIDE OF ROAD (CIRCLE APPROPRIATE BOX)
NORTH N, W 32 E, WEST EAST, S SOUTH

TEST

425
DISTANCE FROM ROAD FT
ENTER FT OR MI

TAX MAP: 36 BLK: ____ PARCEL ____

B 2 WELL INFORMATION

APPROX. PUMPING RATE (GAL. PER MIN.) N/A

AVERAGE DAILY QUANTITY NEEDED (GAL. PER DAY) N/A

USE FOR WATER (CIRCLE APPROPRIATE BOX)

- D DOMESTIC POTABLE SUPPLY & RESIDENTIAL IRRIGATION
- F FARMING (LIVESTOCK WATERING & AGRICULTURAL IRRIGATION
- I INDUSTRIAL, COMMERICIAL, DEWATERING
- P PUBLIC WATER SUPPLY WELL
- T TEST, OBSERVATION, MONITORING
- G GEO-THERMAL

NOT TO BE FILLED IN BY DRILLER
HEALTH DEPARTMENT APPROVAL

Anne Arundel 02
COUNTY NAME COUNTY NO.

STATE SIGNATURE ____ INSERT S →

DATE ISSUED 05/17/07 Kara Fellone 05/17/08
MM DD YY CO SIGNATURE EXP/DATE

NORTH GRID 435 000 EAST GRID 885 000

APPROXIMATE DEPTH OF WELL 160' FEET

APPROXIMATE DIAMETER OF WELL 2" NEAREST INCH

METHOD OF DRILLING (circle one)

BORED (or Augered) JETTED Jetted & DRIVEN
AIR-ROTary AIR-PERcussion ROTARY (Hydraulic Rotary)
CABLE REVerse-ROTary DRive-POINT
other ____

REPLACEMENT OR DEEPENED WELLS
(CIRCLE APPROPRIATE BOX)

- N THIS WELL WILL NOT REPLACE AN EXISTING WELL
- Y THIS WELL WILL REPLACE A WELL THAT WILL BE ABANDONED AND SEALED
- S THIS WELL WILL REPLACE A WELL THAT WILL BE USED AS A STANDBY-CONTACT LOCAL APPROVING AUTHORITY FOR POLICY ON STANDBY WELLS
- D THIS WELL WILL DEEPEN AN EXISTING WELL

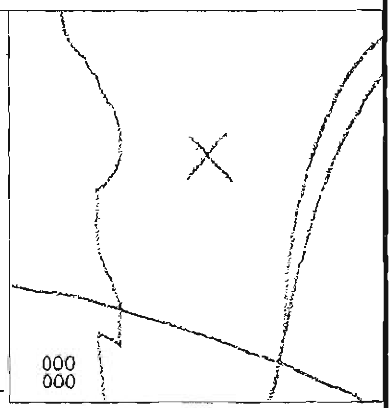
PERMIT NUMBER OF WELL TO BE REPLACED OR DEEPENED (IF AVAILABLE) __ __ - __ __ - __ __ __ __

SHOW MAJOR FEATURES OF BOX & LOCATE WELL WITH AN X

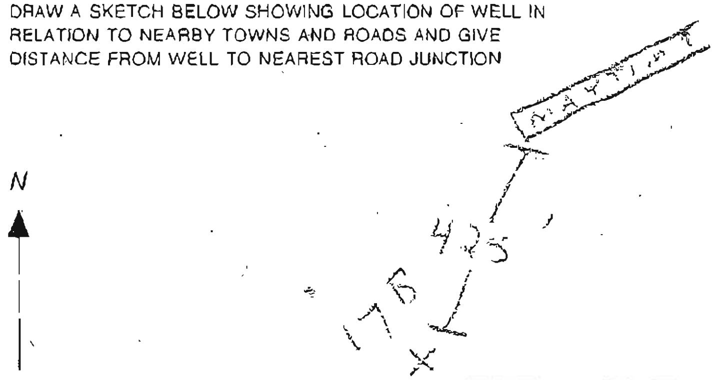
SOURCES OF DRILLING WATER
1.
2.
3.

WRITE THE BOX NUMBER FROM THE MAP HERE

E 885
N 435



DRAW A SKETCH BELOW SHOWING LOCATION OF WELL IN RELATION TO NEARBY TOWNS AND ROADS AND GIVE DISTANCE FROM WELL TO NEAREST ROAD JUNCTION



Not to be filled in by driller (MDE OR COUNTY USE ONLY)

APPROP. PERMIT NUMBER _ _ _ _ _ G _ _

PERMIT No. AA-95-2965

SPECIAL CONDITIONS
NOTE: APPROVING AUTHORITIES SHOULD USE SEPARATE SHEET IF NEEDED

DENV-Permit 97 DRILLER

C 1 9575 (MDE USE ONLY)

1 2 3 6 (THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

STATE OF MARYLAND
WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

ST/CO USE ONLY
DATE Received MM DD YY ____ 13

DATE WELL COMPLETED MM DD YY 6 19 97 (15–20)

Depth of Well 208 (TO NEAREST FOOT) (22–26)

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-95-2965 (28–37)

OWNER Tolson Landfill (last name) (first name)
STREET OR RFD 1457 Capital Raceway Rd. TOWN Crofton
SUBDIVISION Tolson Landfill SECTION [illegible] LOT

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	check if water bearing
Topsoil	0	1	
Fine-med sand	1	10	
Fine-med sand w/clay	10	19	
~~Gray~~ CLAY	19	36	
Med-coarse sand w/clay	36	41	
Med-coarse sand	41	106	
Red, White & Gray clay w/gravel	106	135	
Gray Clay	135	162	
Fine-med sand	152	170	
Gray Clay	170	197	
Fine Sand	197	212	

NUMBER OF UNSUCCESSFUL WELLS: 0

WELL HYDROFRACTURED yes Y no N (circled: N)

CIRCLE APPROPRIATE LETTER
- A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
- E ELECTRIC LOG OBTAINED
- P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS LIC. NO. M W D 517

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

LIC. NO. __ __ D __ __ __

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y (circled) no N (44)

TYPE OF GROUTING MATERIAL (Circle one)
CEMENT CM (circled) (45 46) BENTONITE CLAY BC (45 46)

NO. OF BAGS 6 NO. OF POUNDS 564

GALLONS OF WATER 36

DEPTH OF GROUT SEAL (to nearest foot)
from 0 ft. to 192 ft.
(48 TOP 52) (54 BOTTOM 58)
(enter 0 if from surface)

CASING RECORD
casing types insert appropriate code below

ST STEEL · CO CONCRETE · PL PLASTIC · OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL (60 61)	2 (63 64)	198 (66–70)

OTHER CASING (if used)
EACH CASING — diameter inch — depth (feet) from — to

SCREEN RECORD
screen type or open hole insert appropriate code below

ST STEEL · BR BRASS BRONZE · HO OPEN HOLE · PL PLASTIC · OT OTHER

C 2 (1 2)

DEPTH (nearest ft.)

EACH SCREEN	Type	from	to
1	PL (8 9)	198 (11–15)	208 (17–21)
2	(23 24)	(26–30)	(32–36)
3	(38 39)	(41–45)	(47–51)

SLOT SIZE 1 .020 2 ____ 3 ____

DIAMETER OF SCREEN 2" (NEAREST INCH) (56–60)

GRAVEL PACK from 192 to 212

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68 ____ 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W Q

70 TELESCOPE CASING · 72 LOG INDICATOR · 74 75 76 OTHER DATA

C 3 (1 2)

PUMPING TEST
HOURS PUMPED (nearest hour) 1 (8 9)

PUMPING RATE (gal. per min.) 1/2 (11–15)

METHOD USED TO MEASURE PUMPING RATE SCAL

WATER LEVEL (distance from land surface)

BEFORE PUMPING 114 ft. (17–20)

WHEN PUMPING 154 ft. (22–25)

TYPE OF PUMP USED (for test)
- A air (circled) (27)
- P piston (27)
- T turbine (27)
- C centrifugal (27)
- R rotary (27)
- O other (describe below) (27)
- J jet (27)
- S submersible (27)

PUMP INSTALLED
DRILLER INSTALLED PUMP (CIRCLE) (YES or NO) YES NO (circled: NO)

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS.

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX 29. ____ 29

CAPACITY: GALLONS PER MINUTE (to nearest gallon) (31–35)

PUMP HORSE POWER (37–41)

PUMP COLUMN LENGTH (nearest ft.) (43–47)

CASING HEIGHT (circle appropriate box and enter casing height)
+ above (49) LAND SURFACE
– below (49) 2 (nearest foot) (50 51)

LOCATION OF WELL ON LOT
SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND /OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

N

TEST 17B

DENV-CR00 OWNER

EMERGENCY/TEMP NO. IF ANY 0000-05160703

B 1 2253 SEQUENCE NO. (MDE USE ONLY)

STATE OF MARYLAND
APPLICATION FOR PERMIT TO DRILL WELL
please type

STATE PERMIT NUMBER AA-95-2966
fill in this form completely

Date Received (APA) 5-10-07 AWK

OWNER INFORMATION

Tolson Landfill — Last Name / Owner / First Name

1457 Capitol Raceway Road — Street or RFD

Crofton — Town; MD — State; 21114 — Zip

DRILLER INFORMATION

David B. Hartman — Driller's Name; MWD 5 1 7 — License No.

A.C. Schultes of Maryland, Inc. — Firm Name

24 Old South River Rd. Edgewater, MD 21037 — Address

Signature [signature] — Date 5/11/07

B 2 WELL INFORMATION

APPROX. PUMPING RATE (GAL. PER MIN.): N/A

AVERAGE DAILY QUANTITY NEEDED (GAL. PER DAY): N/A

B 3 LOCATION OF WELL

COUNTY: AA

SUBDIVISION: Tolson Landfill

SECTION ____ LOT ____

NEAREST TOWN: Crofton

MILES FROM TOWN (enter 0 if in town): 0 MI

B 4 DIRECTION OF WELL FROM TOWN (CIRCLE BOX): N, NE, E, SE, S, SW, W, NW — TOWN

NEAR WHAT ROAD: MAYTIME DR

ON WHICH SIDE OF ROAD (CIRCLE APPROPRIATE BOX): NORTH N, WEST W, 32, E EAST, S SOUTH

Rest

DISTANCE FROM ROAD: 420 — ENTER FT OR MI: FT

TAX MAP: 36 BLK: ____ PARCEL ____

USE FOR WATER (CIRCLE APPROPRIATE BOX)

- D DOMESTIC POTABLE SUPPLY & RESIDENTIAL IRRIGATION
- F FARMING (LIVESTOCK WATERING & AGRICULTURAL IRRIGATION
- I INDUSTRIAL, COMMERICIAL, DEWATERING
- P PUBLIC WATER SUPPLY WELL
- T TEST, OBSERVATION, MONITORING
- G GEO-THERMAL

NOT TO BE FILLED IN BY DRILLER
HEALTH DEPARTMENT APPROVAL

COUNTY NAME: Anne Arundel — COUNTY NO. 02

STATE SIGNATURE: [signature] — INSERT S →

OK

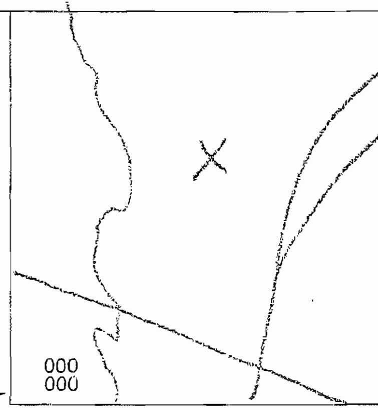
DATE ISSUED: 05/17/07 — CO SIGNATURE: [signature] — EXP. DATE 05/17/08

NORTH GRID 435 000 — EAST GRID 885 000

APPROXIMATE DEPTH OF WELL: 80' FEET

APPROXIMATE DIAMETER OF WELL: 2" NEAREST INCH

SHOW MAJOR FEATURES OF BOX & LOCATE WELL WITH AN X →



SOURCES OF DRILLING WATER
1.
2.
3.

WRITE THE BOX NUMBER FROM THE MAP HERE

E 885

N 435

METHOD OF DRILLING (circle one)

BORED (or Augered)	JETTED	Jetted & DRIVEN
AIR-ROTary	AIR-PERcussion	ROTARY (Hydraulic Rotary)
CABLE	REVerse-ROTary	DRive-POINT

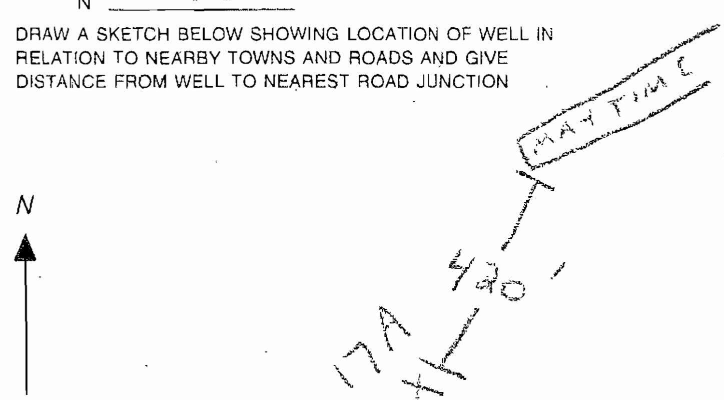
other ____

REPLACEMENT OR DEEPENED WELLS (CIRCLE APPROPRIATE BOX)

- N THIS WELL WILL NOT REPLACE AN EXISTING WELL
- Y THIS WELL WILL REPLACE A WELL THAT WILL BE ABANDONED AND SEALED
- S THIS WELL WILL REPLACE A WELL THAT WILL BE USED AS A STANDBY-CONTACT LOCAL APPROVING AUTHORITY FOR POLICY ON STANDBY WELLS
- D THIS WELL WILL DEEPEN AN EXISTING WELL

PERMIT NUMBER OF WELL TO BE REPLACED OR DEEPENED (IF AVAILABLE) __ __ - __ __ - __ __ __ __

DRAW A SKETCH BELOW SHOWING LOCATION OF WELL IN RELATION TO NEARBY TOWNS AND ROADS AND GIVE DISTANCE FROM WELL TO NEAREST ROAD JUNCTION



Not to be filled in by driller (MDE OR COUNTY USE ONLY)

APPROP. PERMIT NUMBER _ _ _ _ _ _ G _ _ _

PERMIT No. AA-95-2966

SPECIAL CONDITIONS

NOTE - APPROVING AUTHORITIES SHOULD USE SEPARATE SHEET IF NEEDED

DENV-Permit 97 — 4 DRILLER

C 1 9576 (MDE USE ONLY)

1 2 3 6

(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

ST/CO USE ONLY
DATE Received MM DD YY

DATE WELL COMPLETED MM 06 DD 8 YY 07

Depth of Well 80 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-95-2966

OWNER Tolson Landfill

STREET OR RFD 1457 Capital Raceway Rd. TOWN Crofton

SUBDIVISION Tolson Landfill SECTION TM36 LOT

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	check if water bearing
Topsoil	0	1	
Tane &Organge clay w/sand	1	26	
Coarse to fine multi-colored sand	26	34	
Fine -Med sand w/layers of sandstone	34	41	
Pea Gravel	41	67	
Coarse-fine sand w/pea gravel	67	78	
fine -coarse sand w/layers of clay	78	90	

NUMBER OF UNSUCCESSFUL WELLS: 0

WELL HYDROFRACTURED yes Y no N

CIRCLE APPROPRIATE LETTER
- A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
- E ELECTRIC LOG OBTAINED
- P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE

DRILLERS LIC. NO. M W D 517

DRILLERS SIGNATURE
(MUST MATCH SIGNATURE ON APPLICATION)

LIC. NO. D

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N

TYPE OF GROUTING MATERIAL (Circle one) CEMENT C M BENTONITE CLAY B C

NO. OF BAGS 5 NO. OF POUNDS 250

GALLONS OF WATER 125

DEPTH OF GROUT SEAL (to nearest foot) from 0 ft. (TOP) to 60 ft. (BOTTOM) (enter 0 if from surface)

CASING RECORD
casing types insert appropriate code below: S T STEEL, C O CONCRETE, P L PLASTIC, O T OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL	2	80

OTHER CASING (if used) diameter inch, depth (feet) from to

SCREEN RECORD
screen type or open hole insert appropriate code below: S T STEEL, B R BRASS BRONZE, H O OPEN HOLE, P L PLASTIC, O T OTHER

C 2 DEPTH (nearest ft.)

	Type	from	to
1	PL	70	80
2			
3			

SLOT SIZE 1 .020 2 3

DIAMETER OF SCREEN 2" (NEAREST INCH)

GRAVEL PACK from to

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W Q

TELESCOPE CASING LOG INDICATOR OTHER DATA

C 3
PUMPING TEST
HOURS PUMPED (nearest hour) 1

PUMPING RATE (gal. per min.) 1

METHOD USED TO MEASURE PUMPING RATE 5 Gal.

WATER LEVEL (distance from land surface)

BEFORE PUMPING 65 ft.

WHEN PUMPING 70 ft.

TYPE OF PUMP USED (for test): A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

PUMP INSTALLED
DRILLER INSTALLED PUMP (CIRCLE) (YES or NO) YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS.

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX 29.

CAPACITY: GALLONS PER MINUTE (to nearest gallon)

PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height) + above / − below LAND SURFACE 2 (nearest) foot)

LOCATION OF WELL ON LOT
SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND /OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

N

TEST 17A

DENV-CR00 OWNER

EMERGENCY/TEMP NO. IF ANY 0000 - 0516 - 0702

B 1 2254 SEQUENCE NO. (MDE USE ONLY)

STATE OF MARYLAND
APPLICATION FOR PERMIT TO DRILL WELL
please type

STATE PERMIT NUMBER AA-95-2967
fill in this form completely

Date Received (APA) 5-16-07

OWNER INFORMATION

Tolson Landfill
Last Name Owner First Name

1457 Capitol Raceway Road
Street or RFD

Crofton MD 21114
Town State Zip

DRILLER INFORMATION

David B. Hartman M WD 5 1 7
Driller's Name License No.

A.C. Schultes of Maryland, Inc.
Firm Name

24 Old South River Rd, Edgewater, MD 21037
Address

Signature: [signature] Date: 5/16/07

B 3 LOCATION OF WELL

AA
COUNTY

TOLSON LAND FILL
SUBDIVISION

SECTION ____ LOT ____

Crofton
NEAREST TOWN

MILES FROM TOWN (enter 0 if in town) 0 M

B 4
DIRECTION OF WELL FROM TOWN (CIRCLE BOX)

N NE E SE S SW W NW — TOWN

MAYTIME DR
NEAR WHAT ROAD

ON WHICH SIDE OF ROAD (CIRCLE APPROPRIATE BOX)
NORTH N, WEST W, EAST E, SOUTH S

420
DISTANCE FROM ROAD
ENTER FT OR MI Ft

TAX MAP: 36 BLK: ____ PARCEL ____

B 2 WELL INFORMATION

APPROX. PUMPING RATE (GAL. PER MIN.) N/A

AVERAGE DAILY QUANTITY NEEDED (GAL. PER DAY) N/A

USE FOR WATER (CIRCLE APPROPRIATE BOX)

- D DOMESTIC POTABLE SUPPLY & RESIDENTIAL IRRIGATION
- F FARMING (LIVESTOCK WATERING & AGRICULTURAL IRRIGATION
- I INDUSTRIAL, COMMERICIAL, DEWATERING
- P PUBLIC WATER SUPPLY WELL
- T TEST, OBSERVATION, MONITORING
- G GEO-THERMAL

NOT TO BE FILLED IN BY DRILLER
HEALTH DEPARTMENT APPROVAL

Anne Arundel 02
COUNTY NAME COUNTY NO.

STATE SIGNATURE ____ INSERT S →

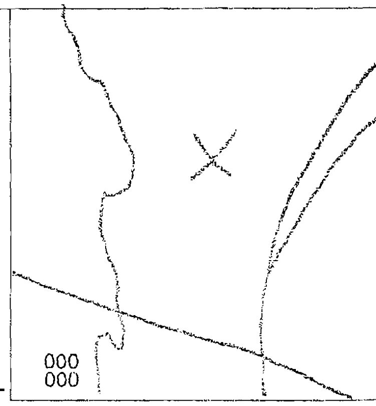
DATE ISSUED 05/17/07 [signature] 05/17/08
CO SIGNATURE EXP. DATE

NORTH GRID 435 000 EAST GRID 885 000

APPROXIMATE DEPTH OF WELL 80 FEET

APPROXIMATE DIAMETER OF WELL 2" NEAREST INCH

SHOW MAJOR FEATURES OF BOX & LOCATE WELL WITH AN X



SOURCES OF DRILLING WATER
1.
2.
3.

WRITE THE BOX NUMBER FROM THE MAP HERE
E 885
N 435

METHOD OF DRILLING (circle one)

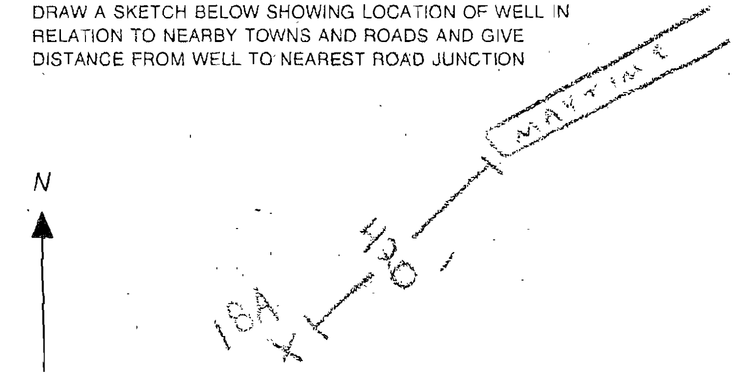
BORED (or Augered) JETTED Jetted & DRIVEN
AIR-ROTary AIR-PERcussion ROTARY (Hydraulic Rotary)
CABLE REVerse-ROTary DRive-POINT
other ____

REPLACEMENT OR DEEPENED WELLS
(CIRCLE APPROPRIATE BOX)

- N THIS WELL WILL NOT REPLACE AN EXISTING WELL
- Y THIS WELL WILL REPLACE A WELL THAT WILL BE ABANDONED AND SEALED
- S THIS WELL WILL REPLACE A WELL THAT WILL BE USED AS A STANDBY-CONTACT LOCAL APPROVING AUTHORITY FOR POLICY ON STANDBY WELLS
- D THIS WELL WILL DEEPEN AN EXISTING WELL

PERMIT NUMBER OF WELL TO BE REPLACED OR DEEPENED (IF AVAILABLE) __ - __ - __

DRAW A SKETCH BELOW SHOWING LOCATION OF WELL IN RELATION TO NEARBY TOWNS AND ROADS AND GIVE DISTANCE FROM WELL TO NEAREST ROAD JUNCTION



Not to be filled in by driller (MDE OR COUNTY USE ONLY)

APPROP. PERMIT NUMBER __ __ __ __ __ G __ __

PERMIT No. AA-95-2967

SPECIAL CONDITIONS
NOTE - APPROVING AUTHORITIES SHOULD USE SEPARATE SHEET IF NEEDED

DENV-Permit 97 ④ DRILLER

C 1 9577 (MDE USE ONLY)
1 2 3 6
(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS.)

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

ST/CO USE ONLY
DATE Received MM DD YY 7 13

DATE WELL COMPLETED MM DD YY 6 15 97 (15–20)

Depth of Well 22 75 26 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-95-2967 (28–37)

OWNER Tolson Landfill (last name / first name)
STREET OR RFD 1457 Capital Raceway TOWN Crofton
SUBDIVISION Tolson Landfill SECTION TW36 LOT

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	check if water bearing
Topsoil	0	1	
Sand w/clay	1	23	
Gray Clay	23	30	
Red Clay	30	46	
Med. Coarse Sand	46	75	
White Clay	75	77	

NUMBER OF UNSUCCESSFUL WELLS: 0

WELL HYDROFRACTURED yes Y no N (circled: N)

CIRCLE APPROPRIATE LETTER
- A — A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
- E — ELECTRIC LOG OBTAINED
- P — TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS LIC. NO. MWD 517

DRILLERS SIGNATURE
(MUST MATCH SIGNATURE ON APPLICATION)

LIC. NO. __ __ D __ __ __

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N (44)

TYPE OF GROUTING MATERIAL (Circle one)
CEMENT C M (45 46) BENTONITE CLAY B C (45 46)

NO. OF BAGS 5 NO. OF POUNDS 250
GALLONS OF WATER 125
DEPTH OF GROUT SEAL (to nearest foot)
from 0 ft. (48 TOP 52) to 62 ft. (54 BOTTOM 58)
(enter 0 if from surface)

CASING RECORD
casing types insert appropriate code below

S T STEEL — C O CONCRETE — P L PLASTIC — O T OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)!	Total depth of main casing (nearest foot)
PL (60 61)	2 (63 64)	65 (66–70)

OTHER CASING (if used)

EACH CASING — diameter inch — depth (feet) from — to

SCREEN RECORD
screen type or open hole insert appropriate code below

S T STEEL — B R BRASS BRONZE — H O OPEN HOLE — P L PLASTIC — O T OTHER

C 2 (1 2) DEPTH (nearest ft.)

EACH SCREEN	type	from	to
1	PL (8 9)	65 (11–15)	75 (17–21)
2	(23 24)	(26–30)	(32–36)
3	(38 39)	(41–45)	(47–51)

SLOT SIZE 1 .020 2 ____ 3 ____

DIAMETER OF SCREEN 2" (56–60) (NEAREST INCH)

GRAVEL PACK from 62 to 77
IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY
(NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W Q
70 72 74 75 76
TELESCOPE CASING — LOG INDICATOR — OTHER DATA

C 3 (1 2)

PUMPING TEST
HOURS PUMPED (nearest hour) 1 (8 9)
PUMPING RATE (gal. per min.) 1/2 (11–15)
METHOD USED TO MEASURE PUMPING RATE 5 Gal.
WATER LEVEL (distance from land surface)
BEFORE PUMPING 68 ft. (17–20)
WHEN PUMPING 70 ft. (22–25)

TYPE OF PUMP USED (for test)
A air (circled) — P piston — T turbine — C centrifugal — R rotary — O other (describe below) — J jet — S submersible (27)

PUMP INSTALLED
DRILLER INSTALLED PUMP (CIRCLE) (YES or NO) YES NO (circled: NO)

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS.

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX 29.
CAPACITY: GALLONS PER MINUTE (to nearest gallon) (31–35)
PUMP HORSE POWER (37–41)
PUMP COLUMN LENGTH (nearest ft.) (43–47)

CASING HEIGHT (circle appropriate box and enter casing height)
+ above (49) LAND SURFACE
− below (49) 2 (50 51) (nearest foot)

LOCATION OF WELL ON LOT
SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND /OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

N

TEST 13A

DENV-CR00 OWNER

B 1 2252 SEQUENCE NO. (MDE USE ONLY)

STATE OF MARYLAND
APPLICATION FOR PERMIT TO DRILL WELL
please type

STATE PERMIT NUMBER: AA-95-2168
fill in this form completely

Date Received (APA)

OWNER INFORMATION

Last Name Owner First Name: Tolson Landfill
Street or RFD: 1457 Capitol Raceway Road
Town: Crofton State: MD Zip: 21114

DRILLER INFORMATION

Driller's Name: David B. Hartman License No.: MD517
Firm Name: A.C. Schultes of Maryland, Inc
Address: 24 Old South River Rd, Edgewater, MD 21037
Signature / Date: 5/15/97

LOCATION OF WELL

B 3
COUNTY: AA
SUBDIVISION: Tolson (L) Fill
SECTION ____ LOT ____
NEAREST TOWN: Crofton
MILES FROM TOWN (enter 0 if in town): 0 MI

B 4
DIRECTION OF WELL FROM TOWN (CIRCLE BOX): N, NE, E, SE, S, SW, W, NW (TOWN)

NEAR WHAT ROAD: Maytime Dr
ON WHICH SIDE OF ROAD (CIRCLE APPROPRIATE BOX): NORTH N, WEST W, 32, E EAST, S SOUTH
TEST
DISTANCE FROM ROAD: 410
ENTER FT OR MI: FT
TAX MAP: 36 BLK: ____ PARCEL ____

WELL INFORMATION

B 2
APPROX. PUMPING RATE (GAL. PER MIN.): N/A
AVERAGE DAILY QUANTITY NEEDED (GAL. PER DAY): N/A

USE FOR WATER (CIRCLE APPROPRIATE BOX)

- D DOMESTIC POTABLE SUPPLY & RESIDENTIAL IRRIGATION
- F FARMING (LIVESTOCK WATERING & AGRICULTURAL IRRIGATION
- I INDUSTRIAL, COMMERICIAL, DEWATERING
- P PUBLIC WATER SUPPLY WELL
- T TEST, OBSERVATION, MONITORING
- G GEO-THERMAL

NOT TO BE FILLED IN BY DRILLER
HEALTH DEPARTMENT APPROVAL
AA

COUNTY NAME: Anne Arundel COUNTY NO.: 02
STATE SIGNATURE ____ INSERT S →
DATE ISSUED: 05/17/97 CO SIGNATURE: [illegible] EXP. DATE: 05/17/98
NORTH GRID: 435 000 EAST GRID: 885 000

APPROXIMATE DEPTH OF WELL: 160' FEET
APPROXIMATE DIAMETER OF WELL: 2" NEAREST INCH

METHOD OF DRILLING (circle one)

BORED (or Augered) | JETTED | Jetted & DRIVEN
AIR-ROTary | AIR-PERcussion | ROTARY (Hydraulic Rotary)
CABLE | REVerse-ROTary | DRive-POINT
other ____

SHOW MAJOR FEATURES OF BOX & LOCATE WELL WITH AN X →
SOURCES OF DRILLING WATER
1.
2.
3.

WRITE THE BOX NUMBER FROM THE MAP HERE
E 885
N 435

X
000
000

REPLACEMENT OR DEEPENED WELLS
(CIRCLE APPROPRIATE BOX)

- N THIS WELL WILL NOT REPLACE AN EXISTING WELL
- Y THIS WELL WILL REPLACE A WELL THAT WILL BE ABANDONED AND SEALED
- S THIS WELL WILL REPLACE A WELL THAT WILL BE USED AS A STANDBY-CONTACT LOCAL APPROVING AUTHORITY FOR POLICY ON STANDBY WELLS
- D THIS WELL WILL DEEPEN AN EXISTING WELL

PERMIT NUMBER OF WELL TO BE REPLACED OR DEEPENED (IF AVAILABLE) __ __ - __ __ - __ __ __ __

DRAW A SKETCH BELOW SHOWING LOCATION OF WELL IN RELATION TO NEARBY TOWNS AND ROADS AND GIVE DISTANCE FROM WELL TO NEAREST ROAD JUNCTION

N
Maytime Dr
410'
165'
X

Not to be filled in by driller (MDE OR COUNTY USE ONLY)

APPROP. PERMIT NUMBER _ _ _ _ G _ _
PERMIT No. AA-95-2168

SPECIAL CONDITIONS
NOTE - APPROVING AUTHORITIES SHOULD USE SEPARATE SHEET IF NEEDED.

Not Drilled

DENV-Permit 97 ④ DRILLER

C 1 9574

SEQUENCE NO. (MDE USE ONLY)

1 2 3 6 (THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

STATE OF MARYLAND
WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

ST/CO USE ONLY
DATE Received (MM DD YY) 8 13

DATE WELL COMPLETED (MM DD YY) 8 31 07 (15 20)

Depth of Well 22 180 26 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-95-2968 (28 29 30 31 32 33 34 35 36 37)

OWNER Tolson Landfill (last name / first name)
STREET OR RFD 1457 Capital Raceway TOWN Crofton
SUBDIVISION Tolson Landfill SECTION TM36 LOT

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	check if water bearing
See DRillers Log			

NUMBER OF UNSUCCESSFUL WELLS: 0

WELL HYDROFRACTURED yes Y no N (N circled)

CIRCLE APPROPRIATE LETTER
- **A** A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
- **E** ELECTRIC LOG OBTAINED
- **P** TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS LIC. NO. M D 517

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

LIC. NO. __ __ D __ __ __

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y (44) no N (44) — Y circled

TYPE OF GROUTING MATERIAL (Circle one)
CEMENT CM (45 46) — circled BENTONITE CLAY BC (45 46)

NO. OF BAGS 3 NO. OF POUNDS 282

GALLONS OF WATER 18

DEPTH OF GROUT SEAL (to nearest foot)
from 48 0 TOP 52 ft. to 54 155 BOTTOM 58 ft.
(enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below: ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)!	Total depth of main casing (nearest foot)
PL (60 61)	2 (63 64)	160 (66 70)

OTHER CASING (if used)

EACH CASING	diameter inch	depth (feet) from	to

SCREEN RECORD

screen type or open hole insert appropriate code below: ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C 2 DEPTH (nearest ft.)

EACH SCREEN	type	from	to
1	PL (8 9)	160 (11 15)	180 (17 21)
2	(23 24)	(26 30)	(32 36)
3	(38 39)	(41 45)	(47 51)

SLOT SIZE 1 .020 2 ___ 3 ___

DIAMETER OF SCREEN 56 2 60 (NEAREST INCH)

	from	to
GRAVEL PACK	155	180

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W Q
70 TELESCOPE CASING 72 LOG INDICATOR 74 75 76 OTHER DATA

C 3 PUMPING TEST

HOURS PUMPED (nearest hour) 1 (8 9)

PUMPING RATE (gal. per min.) 1 (11 15)

METHOD USED TO MEASURE PUMPING RATE 5 Gal

WATER LEVEL (distance from land surface)

BEFORE PUMPING 167 ft. (17 20)

WHEN PUMPING 177 ft. (22 25)

TYPE OF PUMP USED (for test)
- A air (circled) 27
- P piston 27
- T turbine 27
- C centrifugal 27
- R rotary 27
- O other (describe below) 27
- J jet 27
- S submersible 27

PUMP INSTALLED

DRILLER INSTALLED PUMP (CIRCLE) (YES or NO) YES NO (NO circled)

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS.

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX 29. 29

CAPACITY: GALLONS PER MINUTE (to nearest gallon) 31 35

PUMP HORSE POWER 37 41

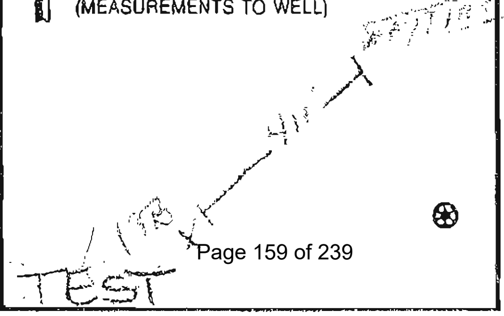
PUMP COLUMN LENGTH (nearest ft.) 43 47

CASING HEIGHT (circle appropriate box and enter casing height)
+ above (49, circled) LAND SURFACE
− below (49)
2 (50 51) (nearest foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND /OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

N



Telephone 410-841-6710
Fax # 410-841-6711

A.C. SCHULTES OF MARYLAND, INC.

24 Old South River Road Edgewater, MD 21037

Driller's Log

Water Well Contractors

CUSTOMER: ERM JOB: H4960

ADDRESS: DATE: 8/30/07

LOCATION: CAPITAL RACEWAY PERMIT NO. AA-95-2968

		FEET FROM GROUND SURFACE	WELL LOG
GROUND		0-10	CLAY W/FINE SAND-SOIL,SANDSTONE
	CASING	10-20	FINE TO MED SAND W/SILTY CLAY
		20-40	SILTY CLAY W/SMALL TO MED GRAVEL
		40-60	FINE TO MED SAND W/COARSE GRAVEL & CLAY
		60-80	FINE TO COARSE SAND W/GRAVEL & CLAY
		80-100	FINE TO MED SAND W/GRAY CLAY
		100-120	MED SAND W/GRAY CLAY
		120-140	GRAY & RED CLAY W/LAYERS OF SILTY SAND
		140-160	RED CLAY
		160-180	MED TO COARSE SAND
	160'		
180' TOTAL DEPTH			
	SCREEN		
	20'		

WELL NO. 18B	DIAMETER OF WELL 2"	DEPT. OF WELL 180'
HOURS PUMPED 1	SLOT SIZE .010	TYPE OF CASING PVC
CAPACITY GPM 1	DRILLING MACHINE NO. CF-15	LENGTH OF CASING 160'
STATIC LEVEL 167	DRILLER K WATSON	DISTANCE TO TOP OF SCREEN 160'
PUMPING LEVEL 177'	GRAVEL 16 BAGS #1	TYPE SCREEN PVC
SPECIFIC CAPACITY .1	3 BAGS OF CEMENT	SIZE OF SCREEN 2"
PUMPED WITH AIR	DATE WELL COMPLETED 8/30/07	OUTER CASING SIZE
DEPTH OF GROUT 155-0	DRILLER'S HELPER T. SCHULTES	OUTER CASING DEPTH
DEPTH GRAVEL PACKED 180-155		

EMERGENCY/TEMP NO. IF ANY 3000 - 0764 - 2557

B 1 | 2256 | SEQUENCE NO. (MDE USE ONLY)

STATE OF MARYLAND
APPLICATION FOR PERMIT TO DRILL WELL
please type

STATE PERMIT NUMBER AA - 95 - 3048
fill in this form completely

Date Received (APA)

OWNER INFORMATION

Tolson Landfill — Last Name / Owner / First Name

1437 Capitol Raceway Rd. — Street or RFD

Crofton — Town | MD — State | 21114 — Zip

DRILLER INFORMATION

David B. Hartman — Driller's Name | MW D 517 — License No.

A.C.Schultes of Maryland, Inc. — Firm Name

24 Old South River Rd. Edgewater, MD 21037 — Address

Signature | Date 6/11/07

B 2 WELL INFORMATION

APPROX. PUMPING RATE (GAL. PER MIN.) ______

AVERAGE DAILY QUANTITY NEEDED (GAL. PER DAY) ______

B 3 LOCATION OF WELL

AA — COUNTY

Tolson Landfill — SUBDIVISION

SECTION ____ LOT ____

Crofton — NEAREST TOWN

MILES FROM TOWN (enter 0 if in town) M

B 4

DIRECTION OF WELL FROM TOWN (CIRCLE BOX): N, NE, E, SE, S, SW, W, NW — TOWN

Maytime Dr. — NEAR WHAT ROAD

ON WHICH SIDE OF ROAD (CIRCLE APPROPRIATE BOX): NORTH N, WEST W, E EAST, S SOUTH

TBD

1925 — DISTANCE FROM ROAD

Ft — ENTER FT OR MI

TAX MAP: 36 BLK: ____ PARCEL ____

USE FOR WATER (CIRCLE APPROPRIATE BOX)

- D DOMESTIC POTABLE SUPPLY & RESIDENTIAL IRRIGATION
- F FARMING (LIVESTOCK WATERING & AGRICULTURAL IRRIGATION
- I INDUSTRIAL, COMMERICIAL, DEWATERING
- P PUBLIC WATER SUPPLY WELL
- T TEST, OBSERVATION, MONITORING (marked)
- G GEO-THERMAL

NOT TO BE FILLED IN BY DRILLER
HEALTH DEPARTMENT APPROVAL

Anne Arundel — COUNTY NAME | 02 — COUNTY NO.

STATE SIGNATURE ______ INSERT S → ____

DATE ISSUED 06/22/07 — CO SIGNATURE — 06/22/08 EXP. DATE

NORTH GRID 435 000 | EAST GRID 885 000

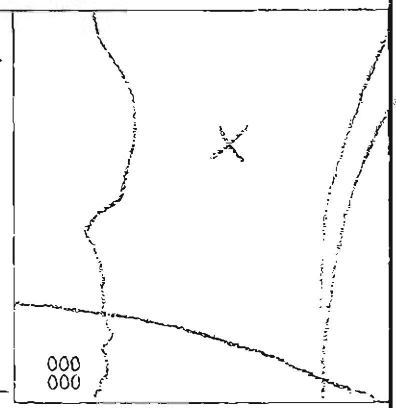
APPROXIMATE DEPTH OF WELL 30 FEET

APPROXIMATE DIAMETER OF WELL 2 NEAREST INCH

METHOD OF DRILLING (circle one)

BORED (or Augered) | JETTED | Jetted & DRIVEN
AIR-ROTary | AIR-PERcussion | ROTARY (Hydraulic Rotary) (circled)
CABLE | REVerse-ROTary | DRive-POINT
other ______

SHOW MAJOR FEATURES OF BOX & LOCATE WELL WITH AN X →



SOURCES OF DRILLING WATER
1.
2.
3.

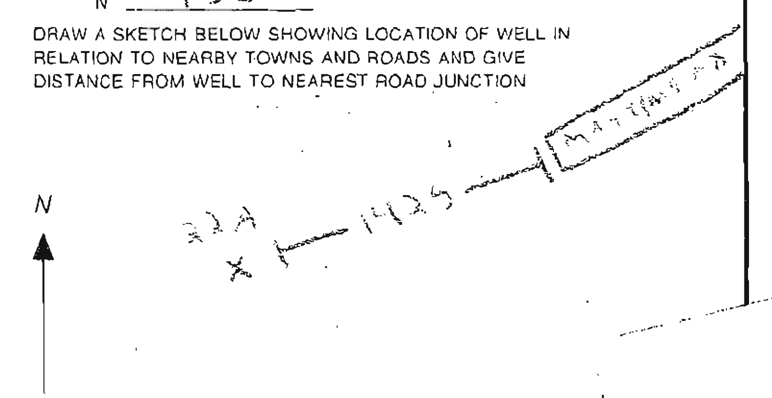
WRITE THE BOX NUMBER FROM THE MAP HERE
E 885
N 435

REPLACEMENT OR DEEPENED WELLS
(CIRCLE APPROPRIATE BOX)

- N THIS WELL WILL NOT REPLACE AN EXISTING WELL (marked)
- Y THIS WELL WILL REPLACE A WELL THAT WILL BE ABANDONED AND SEALED
- S THIS WELL WILL REPLACE A WELL THAT WILL BE USED AS A STANDBY-CONTACT LOCAL APPROVING AUTHORITY FOR POLICY ON STANDBY WELLS
- D THIS WELL WILL DEEPEN AN EXISTING WELL

PERMIT NUMBER OF WELL TO BE REPLACED OR DEEPENED (IF AVAILABLE) __ __ - __ __ - __ __ __ __

DRAW A SKETCH BELOW SHOWING LOCATION OF WELL IN RELATION TO NEARBY TOWNS AND ROADS AND GIVE DISTANCE FROM WELL TO NEAREST ROAD JUNCTION



Not to be filled in by driller (MDE OR COUNTY USE ONLY)

APPROP. PERMIT NUMBER _ _ _ _ _ _ G _ _ _

PERMIT No. AA-95-3048

SPECIAL CONDITIONS
NOTE - APPROVING AUTHORITIES SHOULD USE SEPARATE SHEET IF NEEDED.

DENV-Permit 97

C 1 4939 (MDE USE ONLY)

1 2 3 6
(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

STATE OF MARYLAND
WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

ST/CO USE ONLY DATE Received (MM DD YY) 13	DATE WELL COMPLETED (MM DD YY) 15–20	Depth of Well 22–26	PERMIT NO. FROM "PERMIT TO DRILL WELL" 28–37
	7 2 07	92 (TO NEAREST FOOT)	AA-95-3048

OWNER Tolson Landfill (last name) (first name)
STREET OR RFD 1457 Captial Raceway TOWN Crofton
SUBDIVISION Tolson Landfill SECTION TM36 LOT

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	check if water bearing
Silty Sand w/Med Gravel	0	10	
Brown Med to Coarse Sand w/small gravel	10	20	
Small gravel w/med sand	20	30	
Brown coarse sand w/gravel	30	50	
Med gravel w/trace of white clay	50	60	
Med to coarse sand w/small gravel	60	80	
Fine sand w/white clay	80	95	

NUMBER OF UNSUCCESSFUL WELLS: 0

WELL HYDROFRACTURED yes Y no N (circled: N)

CIRCLE APPROPRIATE LETTER
- **A** A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
- **E** ELECTRIC LOG OBTAINED
- **P** TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS LIC. NO. MA-D-517

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

LIC. NO. __ D ____

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N — 44 (circled: Y)

TYPE OF GROUTING MATERIAL (Circle one)
CEMENT CM 45–46 BENTONITE CLAY BC 45–46
NO. OF BAGS 2 NO. OF POUNDS 188
GALLONS OF WATER 13
DEPTH OF GROUT SEAL (to nearest foot)
from 0 (48 TOP 52) ft. to 72 (54 BOTTOM 58) ft.
(enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below
ST STEEL · CO CONCRETE · PL PLASTIC · OT OTHER

MAIN CASING TYPE (60–61)	Nominal diameter top (main) casing (nearest inch)! (63–64)	Total depth of main casing (nearest foot) (66–70)
PL	2	82

EACH CASING — OTHER CASING (if used)

diameter inch	depth (feet) from	to

SCREEN RECORD

screen type or open hole — insert appropriate code below
ST STEEL · BR BRASS BRONZE · HO OPEN HOLE · PL PLASTIC · OT OTHER

C 2

EACH SCREEN — DEPTH (nearest ft.)

	Type	from	to
1 (8–21)	PL	82	92
2 (23–36)			
3 (38–51)			

SLOT SIZE 1 .020 2 ____ 3 ____

DIAMETER OF SCREEN 2 (56–60) (NEAREST INCH)

	from	to
GRAVEL PACK	72	95

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W Q
70 TELESCOPE CASING · 72 LOG INDICATOR · 74 75 76 OTHER DATA

C 3 PUMPING TEST

HOURS PUMPED (nearest hour) 3 (8–9)
PUMPING RATE (gal. per min.) 1 (11–15)
METHOD USED TO MEASURE PUMPING RATE 5 GAL
WATER LEVEL (distance from land surface)
BEFORE PUMPING 67 ft. (17–20)
WHEN PUMPING 82 ft. (22–25)

TYPE OF PUMP USED (for test)
- A air (circled)
- P piston
- T turbine
- C centrifugal
- R rotary
- O other (describe below)
- J jet
- S submersible

PUMP INSTALLED

DRILLER INSTALLED PUMP (CIRCLE) (YES or NO) YES NO (circled: NO)

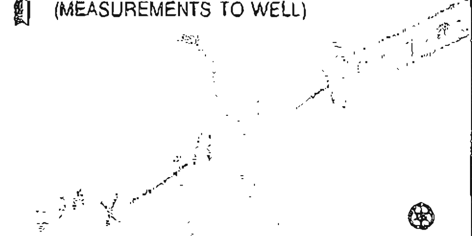
IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS.

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX 29. ____ 29
CAPACITY: GALLONS PER MINUTE (to nearest gallon) ____ 31–35
PUMP HORSE POWER ____ 37–41
PUMP COLUMN LENGTH (nearest ft.) ____ 43–47

CASING HEIGHT (circle appropriate box and enter casing height)
+ above (48, circled) / – below (49) LAND SURFACE 2 (50–51) (nearest foot)

LOCATION OF WELL ON LOT
SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND /OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

N



DENV-CR00 OWNER

EMERGENCY/TEMP NO. IF ANY 0000-0707-2007

B 1 2257 (1 2 3 6)	SEQUENCE NO. (MDE USE ONLY)	STATE OF MARYLAND APPLICATION FOR PERMIT TO DRILL WELL please type	STATE PERMIT NUMBER AA-95-3049 (70–79) fill in this form completely

Date Received (APA)

(8 MM DD YY 13)

OWNER INFORMATION

Tolson Landfill — Last Name / Owner / First Name (15–34)

1457 Capitol Raceway Road. — Street or RFD (36–55)

Crofton — Town (57–70) MD — State (72) 21114 — Zip (76)

DRILLER INFORMATION

David B. Hartman — Driller's Name (76) M W D517 — License No. (81)

A.C.Schultes of Maryland, Inc. — Firm Name

24 Old S.River Rd. Edgewater, MD 21037 — Address

Signature: [signature] Date: 6/19/07

B 3 LOCATION OF WELL

AA — COUNTY (8–21)

Tolson Landfill — SUBDIVISION (23–42)

SECTION ____ (44 46) LOT ____ (48 50)

Crofton — NEAREST TOWN (52–71)

MILES FROM TOWN (enter 0 if in town) 0 M (73 76 77 78)

B 4 DIRECTION OF WELL FROM TOWN (CIRCLE BOX)

N, NE, E, SE, S, SW, W, NW — TOWN

Maytime Dr. — NEAR WHAT ROAD (11–30)

ON WHICH SIDE OF ROAD (CIRCLE APPROPRIATE BOX): NORTH N, WEST W, 32, EAST E, SOUTH S

TEST

1850 — DISTANCE FROM ROAD (34–37)

ENTER FT OR MI: Ft (38 39)

TAX MAP: 36 BLK: ____ PARCEL ____

B 2 WELL INFORMATION

APPROX. PUMPING RATE (GAL. PER MIN.) ____ (8–12)

AVERAGE DAILY QUANTITY NEEDED (GAL. PER DAY) ____ (14–20)

USE FOR WATER (CIRCLE APPROPRIATE BOX)

- D DOMESTIC POTABLE SUPPLY & RESIDENTIAL IRRIGATION
- F FARMING (LIVESTOCK WATERING & AGRICULTURAL IRRIGATION
- I INDUSTRIAL, COMMERICIAL, DEWATERING
- P PUBLIC WATER SUPPLY WELL
- T ☒ TEST, OBSERVATION, MONITORING
- G GEO-THERMAL

NOT TO BE FILLED IN BY DRILLER — HEALTH DEPARTMENT APPROVAL

Anne Arundel — COUNTY NAME; 02 — COUNTY NO.

STATE SIGNATURE ____ INSERT S → (41)

DATE ISSUED 06/22/07 (43 MM DD YY 48) CO SIGNATURE [signature] EXP. DATE 06/22/08

NORTH GRID 435 000 (50–55) EAST GRID 885 000 (57–63)

APPROXIMATE DEPTH OF WELL 70 [redacted] FEET (24–28)

APPROXIMATE DIAMETER OF WELL 2 NEAREST INCH

METHOD OF DRILLING (circle one)

BORED (or Augered)	JETTED	Jetted & DRIVEN
AIR-ROTary	AIR-PERcussion	ROTARY (Hydraulic Rotary) (circled)
CABLE	REVerse-ROTary	DRive-POINT

30 / 37

other ____

SHOW MAJOR FEATURES OF BOX & LOCATE WELL WITH AN X →

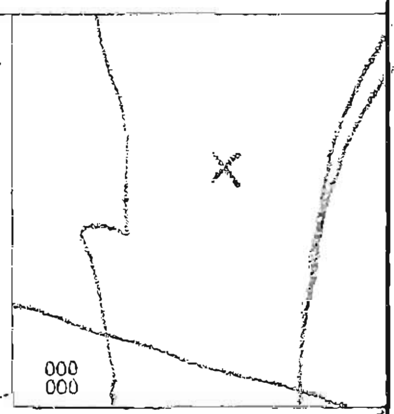
SOURCES OF DRILLING WATER

1.
2.
3.

WRITE THE BOX NUMBER FROM THE MAP HERE

E 885

N 435

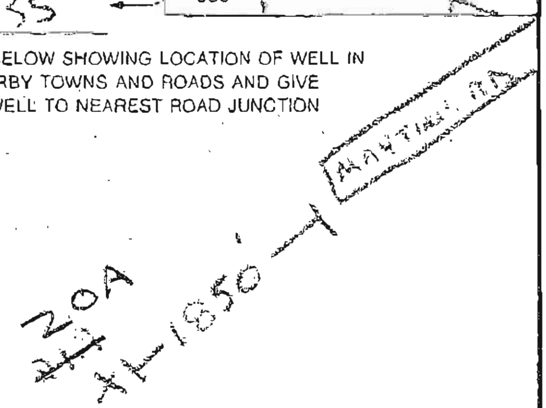


REPLACEMENT OR DEEPENED WELLS (CIRCLE APPROPRIATE BOX)

- N THIS WELL WILL NOT REPLACE AN EXISTING WELL
- Y THIS WELL WILL REPLACE A WELL THAT WILL BE ABANDONED AND SEALED
- 39 S THIS WELL WILL REPLACE A WELL THAT WILL BE USED AS A STANDBY-CONTACT LOCAL APPROVING AUTHORITY FOR POLICY ON STANDBY WELLS
- D THIS WELL WILL DEEPEN AN EXISTING WELL

PERMIT NUMBER OF WELL TO BE REPLACED OR DEEPENED (IF AVAILABLE) 41 __ - __ __ - __ __ __ __ 52

DRAW A SKETCH BELOW SHOWING LOCATION OF WELL IN RELATION TO NEARBY TOWNS AND ROADS AND GIVE DISTANCE FROM WELL TO NEAREST ROAD JUNCTION



Not to be filled in by driller (MDE OR COUNTY USE ONLY)

APPROP. PERMIT NUMBER _ _ _ _ _ G _ _ _

PERMIT No. AA-95-3049 (70 71 72 73 74 75 76 77 78 79)

SPECIAL CONDITIONS

NOTE — APPROVING AUTHORITIES SHOULD USE SEPARATE SHEET IF NEEDED.

WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE TYPE

WELL IS COMPLETED.
COUNTY NUMBER 02

ST/CO USE ONLY
DATE Received MM DD YY

DATE WELL COMPLETED MM 7 DD 7 YY 07

Depth of Well 95 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-95-3049

OWNER Tolson Landfill (last name / first name)
STREET OR RFD 1457 Capital Raceway Rd. TOWN Crofton
SUBDIVISION Tolson Landfill SECTION TM36 LOT

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	check if water bearing
Topsoil	0	1	
Fine-Med Tan Sand	1	23	
Med - Coarse Sand w/gravel	23	68	
Fine - Med Sand	68	92	
Red & White Clay	92	96	

NUMBER OF UNSUCCESSFUL WELLS: 0

WELL HYDROFRACTURED yes Y no N (circled: N)

CIRCLE APPROPRIATE LETTER
- A — A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
- E — ELECTRIC LOG OBTAINED
- P — TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS LIC. NO. M & D 517

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

LIC. NO. __ D ___

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N (circled: Y)

TYPE OF GROUTING MATERIAL (Circle one)
CEMENT CM (circled) BENTONITE CLAY BC

NO. OF BAGS 2 NO. OF POUNDS 188
GALLONS OF WATER 12
DEPTH OF GROUT SEAL (to nearest foot)
from 0 ft. (TOP) to 82 ft. (BOTTOM)
(enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below: ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)!	Total depth of main casing (nearest foot)
PL	2	85

OTHER CASING (if used) — diameter inch, depth (feet) from, to

SCREEN RECORD

screen type or open hole insert appropriate code below: ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C 2

	screen type	DEPTH (nearest ft.) from	to
1	PL	85	95
2			
3			

SLOT SIZE 1 .020 2 ___ 3 ___

DIAMETER OF SCREEN 2" (NEAREST INCH)

GRAVEL PACK from 83 to 96

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W Q
TELESCOPE CASING / LOG INDICATOR / OTHER DATA

C 3

PUMPING TEST

HOURS PUMPED (nearest hour) 1
PUMPING RATE (gal. per min.) 5
METHOD USED TO MEASURE PUMPING RATE 5 Gal
WATER LEVEL (distance from land surface)
BEFORE PUMPING 67 ft.
WHEN PUMPING 87 ft.

TYPE OF PUMP USED (for test): A air (circled), P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

PUMP INSTALLED

DRILLER INSTALLED PUMP (CIRCLE) (YES or NO) YES NO (circled: NO)

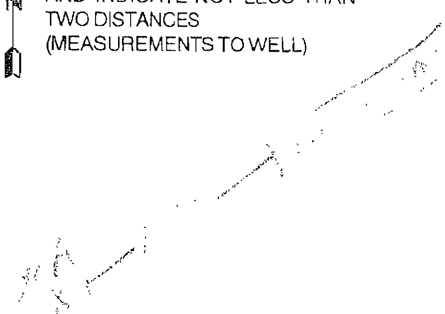
IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS.

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX 29.
CAPACITY: GALLONS PER MINUTE (to nearest gallon)
PUMP HORSE POWER
PUMP COLUMN LENGTH (nearest ft.)
CASING HEIGHT (circle appropriate box and enter casing height) + above (circled) / − below LAND SURFACE 2 (nearest) foot)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURES AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

N



DENV-CR97 ⑤ OWNER

EMERGENCY/TEMP NO. IF ANY 0000-5757-2006

B 1 **2258** SEQUENCE NO. (MDE USE ONLY)

STATE OF MARYLAND
APPLICATION FOR PERMIT TO DRILL WELL
please type

STATE PERMIT NUMBER AA-95-3050
fill in this form completely

Date Received (APA)

OWNER INFORMATION

Tolson Landfill
Last Name Owner First Name

1457 Capitol Raceway Rd.
Street or RFD

Crofton MD 21114
Town State Zip

DRILLER INFORMATION

Dave C. Schulman M W D517
Driller's Name License No.

A.C.Schultes of Maryland, Inc.
Firm Name

24 Old S.River Rd.Edgewater,MD21037
Address

6/19/07
Signature Date

B 2 WELL INFORMATION

APPROX. PUMPING RATE (GAL. PER MIN.) ______

AVERAGE DAILY QUANTITY NEEDED (GAL. PER DAY) ______

B 3 LOCATION OF WELL

AA
COUNTY

Tolson Landfill
SUBDIVISION

SECTION ______ LOT ______

Crofton
NEAREST TOWN

MILES FROM TOWN (enter 0 if in town) 0 M

B 4

DIRECTION OF WELL FROM TOWN (CIRCLE BOX)

N, NE, E, SE, S, SW, W, NW — TOWN

Maytime Dr.
NEAR WHAT ROAD

ON WHICH SIDE OF ROAD (CIRCLE APPROPRIATE BOX)
NORTH N, WEST W, EAST E, SOUTH S

1600
DISTANCE FROM ROAD

ENTER FT OR MI FT

TAX MAP: 36 BLK: ______ PARCEL ______

USE FOR WATER (CIRCLE APPROPRIATE BOX)

- D DOMESTIC POTABLE SUPPLY & RESIDENTIAL IRRIGATION
- F FARMING (LIVESTOCK WATERING & AGRICULTURAL IRRIGATION
- I INDUSTRIAL, COMMERICIAL, DEWATERING
- P PUBLIC WATER SUPPLY WELL
- T TEST, OBSERVATION, MONITORING
- G GEO-THERMAL

NOT TO BE FILLED IN BY DRILLER
HEALTH DEPARTMENT APPROVAL

Anne Arundel 02
COUNTY NAME COUNTY NO.

STATE SIGNATURE ______ INSERT S →

DATE ISSUED
06/22/07 Kara Dellone 06/22/08
MM DD YY CO SIGNATURE EXP. DATE

NORTH GRID 435 000 EAST GRID 885 000

APPROXIMATE DEPTH OF WELL 140 FEET

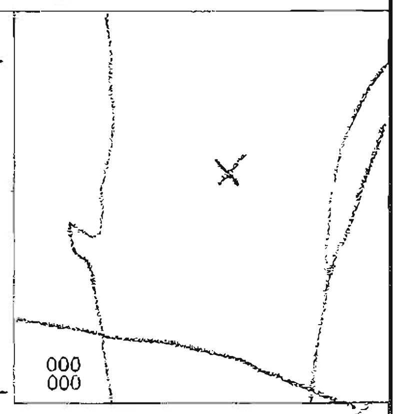
APPROXIMATE DIAMETER OF WELL 2 NEAREST INCH

METHOD OF DRILLING (circle one)

BORED (or Augered) JETTED Jetted & DRIVEN
AIR-ROTary AIR-PERcussion ROTARY (Hydraulic Rotary)
CABLE REVerse-ROTary DRive-POINT
other ______

SHOW MAJOR FEATURES OF BOX & LOCATE WELL WITH AN X

SOURCES OF DRILLING WATER
1.
2.
3.

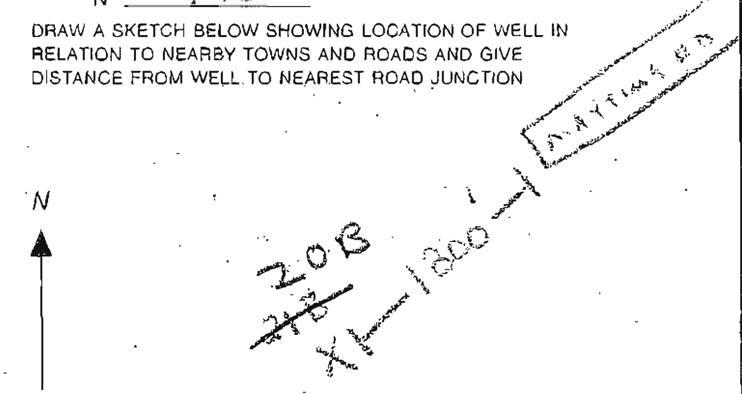


WRITE THE BOX NUMBER FROM THE MAP HERE

E 885

N 435

DRAW A SKETCH BELOW SHOWING LOCATION OF WELL IN RELATION TO NEARBY TOWNS AND ROADS AND GIVE DISTANCE FROM WELL TO NEAREST ROAD JUNCTION



REPLACEMENT OR DEEPENED WELLS
(CIRCLE APPROPRIATE BOX)

- N THIS WELL WILL NOT REPLACE AN EXISTING WELL
- Y THIS WELL WILL REPLACE A WELL THAT WILL BE ABANDONED AND SEALED
- S THIS WELL WILL REPLACE A WELL THAT WILL BE USED AS A STANDBY-CONTACT LOCAL APPROVING AUTHORITY FOR POLICY ON STANDBY WELLS
- D THIS WELL WILL DEEPEN AN EXISTING WELL

PERMIT NUMBER OF WELL TO BE REPLACED OR DEEPENED (IF AVAILABLE) __ __ - __ __ - __ __ __ __

Not to be filled in by driller (MDE OR COUNTY USE ONLY)

APPROP PERMIT NUMBER _ _ _ _ _ _ G _ _ _

PERMIT No. AA-95-3050

SPECIAL CONDITIONS

NOTE - APPROVING AUTHORITIES SHOULD USE SEPARATE SHEET IF NEEDED

C 1 0959 (MDE USE ONLY)

1 2 3 6
(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE TYPE

45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

ST/CO USE ONLY
DATE Received MM DD YY ____ 13

DATE WELL COMPLETED MM 7 DD 5 YY 07 (15–20)

Depth of Well 22 156 26 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-95-3050 (28–37)

OWNER Tolson Landfill (last name, first name)
STREET OR RFD 1437 Capital Raceway Rd. TOWN Crofton
SUBDIVISION Tolson Landfill SECTION n/a LOT ____

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	check if water bearing
Topsoil	0	1	
Fine-Med Sand	1	23	
Fine-Coarse Sand	23	94	
Red, White & Gray Clay	94	128	
Fine-Med Sand	128	160	

NUMBER OF UNSUCCESSFUL WELLS: 0

WELL HYDROFRACTURED yes Y no N

CIRCLE APPROPRIATE LETTER
- A — A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
- E — ELECTRIC LOG OBTAINED
- P — TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS LIC. NO. M W D 517

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

LIC. NO. __ __ D __ __ __

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N (44)

TYPE OF GROUTING MATERIAL (Circle one)
CEMENT CM (45 46) BENTONITE CLAY BC (45 46)

NO. OF BAGS 5 NO. OF POUNDS 470

GALLONS OF WATER 30

DEPTH OF GROUT SEAL (to nearest foot)
from 0 ft. (48 TOP 52) to 134 ft. (54 BOTTOM 58)
(enter 0 if from surface)

CASING RECORD
casing types insert appropriate code below

ST STEEL — CO CONCRETE — PL PLASTIC — OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL (60 61)	2 (63 64)	136 (66–70)

OTHER CASING (if used)

EACH CASING	diameter inch	depth (feet) from	to

SCREEN RECORD
screen type or open hole — insert appropriate code below

ST STEEL — BR BRASS BRONZE — HO OPEN HOLE — PL PLASTIC — OT OTHER

C 2

DEPTH (nearest ft.)

EACH SCREEN	type	from	to
1	PL (8 9)	136 (11–15)	156 (17–21)
2	(23 24)	(26–30)	(32–36)
3	(38 39)	(41–45)	(47–51)

SLOT SIZE 1. .020 2 ____ 3 ____

DIAMETER OF SCREEN 2" (56–60) (NEAREST INCH)

GRAVEL PACK from 134 to 160
IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W Q
70 TELESCOPE CASING — 72 LOG INDICATOR — 74 75 76 OTHER DATA

C 3

PUMPING TEST
HOURS PUMPED (nearest hour) 1 (8 9)

PUMPING RATE (gal. per min.) 1 (11–15)

METHOD USED TO MEASURE PUMPING RATE 5 Gal

WATER LEVEL (distance from land surface)
BEFORE PUMPING 98 ft. (17 20)
WHEN PUMPING 128 ft. (22 25)

TYPE OF PUMP USED (for test)
A air — P piston — T turbine — C centrifugal — R rotary — O other (describe below) — J jet — S submersible (27)

PUMP INSTALLED
DRILLER INSTALLED PUMP (CIRCLE) (YES or NO) YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS.

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX 29.

CAPACITY: GALLONS PER MINUTE (to nearest gallon) (31–35)

PUMP HORSE POWER (37–41)

PUMP COLUMN LENGTH (nearest ft.) (43–47)

CASING HEIGHT (circle appropriate box and enter casing height)
+ above / − below LAND SURFACE 2 (nearest foot) (49; 50 51)

LOCATION OF WELL ON LOT
SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

N

Test

OWNER

DENV-CR00

EMERGENCY/TEMP NO. IF ANY 0000-5700-2005

B 1 2259	SEQUENCE NO. (MDE USE ONLY)	STATE OF MARYLAND APPLICATION FOR PERMIT TO DRILL WELL please type	STATE PERMIT NUMBER AA-95-3051 fill in this form completely

OWNER INFORMATION

Date Received (APA) 6-20-07

Tolson Landfill — Last Name / Owner / First Name

1457 Capitol Raceway Road — Street or RFD

Crofton — Town; MD — State; 21114 — Zip

DRILLER INFORMATION

David B.Hartman — Driller's Name; MW D 517 — License No.

A.C.Schultes of Maryland, Inc. — Firm Name

24 Old s.River Rd.Edgewater, MD21037 — Address

Signature: [signature] Date: 6/19/07

B 2 WELL INFORMATION

APPROX. PUMPING RATE (GAL. PER MIN.) ______

AVERAGE DAILY QUANTITY NEEDED (GAL. PER DAY) ______

USE FOR WATER (CIRCLE APPROPRIATE BOX)

- D DOMESTIC POTABLE SUPPLY & RESIDENTIAL IRRIGATION
- F FARMING (LIVESTOCK WATERING & AGRICULTURAL IRRIGATION
- I INDUSTRIAL, COMMERICIAL, DEWATERING
- P PUBLIC WATER SUPPLY WELL
- T TEST, OBSERVATION, MONITORING
- G GEO-THERMAL

APPROXIMATE DEPTH OF WELL 160 FEET

APPROXIMATE DIAMETER OF WELL 2 NEAREST INCH

METHOD OF DRILLING (circle one)

BORED (or Augered)	JETTED	Jetted & DRIVEN
AIR-ROTary	AIR-PERcussion	ROTARY (Hydraulic Rotary)
CABLE	REVerse-ROTary	DRive-POINT

other ______

REPLACEMENT OR DEEPENED WELLS (CIRCLE APPROPRIATE BOX)

- N THIS WELL WILL NOT REPLACE AN EXISTING WELL
- Y THIS WELL WILL REPLACE A WELL THAT WILL BE ABANDONED AND SEALED
- S THIS WELL WILL REPLACE A WELL THAT WILL BE USED AS A STANDBY-CONTACT LOCAL APPROVING AUTHORITY FOR POLICY ON STANDBY WELLS
- D THIS WELL WILL DEEPEN AN EXISTING WELL

PERMIT NUMBER OF WELL TO BE REPLACED OR DEEPENED (IF AVAILABLE) __ __ - __ __ - __ __ __ __

Not to be filled in by driller (MDE OR COUNTY USE ONLY)

APPROP. PERMIT NUMBER _ _ _ _ _ G _ _

PERMIT No. AA-95-3051

B 3 LOCATION OF WELL

AA — COUNTY

Tolson Landfill — SUBDIVISION

SECTION ______ LOT ______

Croftonis — NEAREST TOWN

MILES FROM TOWN (enter 0 if in town) 0 M

B 4

DIRECTION OF WELL FROM TOWN (CIRCLE BOX): N, NE, E, SE, S, SW, W, NW — TOWN

Maytime DR. — NEAR WHAT ROAD

ON WHICH SIDE OF ROAD (CIRCLE APPROPRIATE BOX): NORTH N, WEST W, 32, E EAST, S SOUTH

TEST

1830 — DISTANCE FROM ROAD; FT — ENTER FT OR MI

TAX MAP: 36 BLK: ______ PARCEL ______

NOT TO BE FILLED IN BY DRILLER HEALTH DEPARTMENT APPROVAL

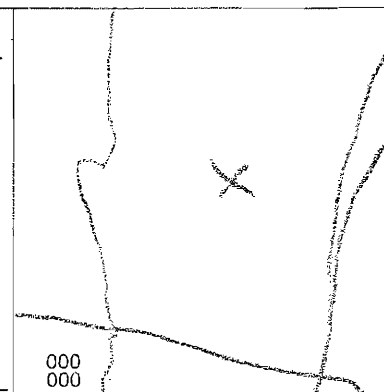
Anne Arundel — COUNTY NAME; 02 — COUNTY NO.

STATE SIGNATURE ______ INSERT S →

DATE ISSUED 06/22/07 — CO SIGNATURE [signature] — EXP. DATE 06/22/08

NORTH GRID 435 000 EAST GRID 885 000

SHOW MAJOR FEATURES OF BOX & LOCATE WELL WITH AN X →



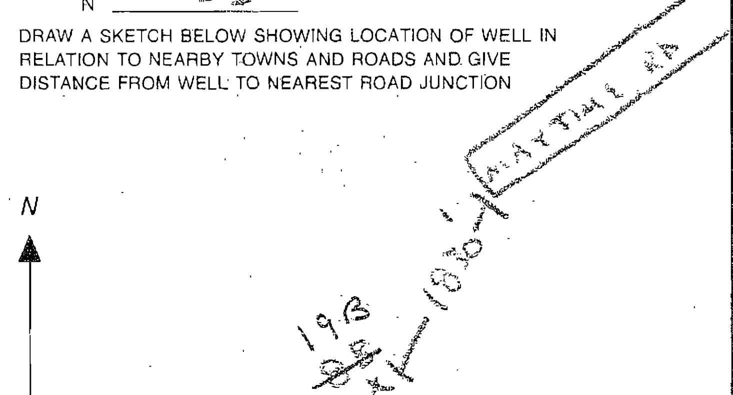
SOURCES OF DRILLING WATER
1.
2.
3.

WRITE THE BOX NUMBER FROM THE MAP HERE

E 885

N 435

DRAW A SKETCH BELOW SHOWING LOCATION OF WELL IN RELATION TO NEARBY TOWNS AND ROADS AND GIVE DISTANCE FROM WELL TO NEAREST ROAD JUNCTION



SPECIAL CONDITIONS

NOTE - APPROVING AUTHORITIES SHOULD USE SEPARATE SHEET IF NEEDED -

C 1 0960 (MDE USE ONLY)

1 2 3 6
(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE TYPE

45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

ST/CO USE ONLY
DATE Received MM DD YY 13

DATE WELL COMPLETED MM DD YY 6 28 97

Depth of Well 22 160 26 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-95-3051

OWNER Tolson Landfill (last name) (first name)
STREET OR RFD 1457 Capital Raceway Rd TOWN Crofton
SUBDIVISION Tolson Landfill SECTION ______ LOT ______

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	check if water bearing
See Drillers Log			

NUMBER OF UNSUCCESSFUL WELLS: 0

WELL HYDROFRACTURED yes Y no N

CIRCLE APPROPRIATE LETTER
A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
E ELECTRIC LOG OBTAINED
P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS LIC. NO. M D 517

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

LIC. NO. __ __ D __ __ __

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N 44
TYPE OF GROUTING MATERIAL (Circle one)
CEMENT CM 45 46 BENTONITE CLAY BC 45 46
NO. OF BAGS 5 NO. OF POUNDS 470
GALLONS OF WATER 20
DEPTH OF GROUT SEAL (to nearest foot)
from 0 (48 TOP 52) ft. to 135 (54 BOTTOM 58) ft.
(enter 0 if from surface)

CASING RECORD
casing types insert appropriate code below
ST STEEL CO CONCRETE PL PLASTIC OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)!	Total depth of main casing (nearest foot)
PL (60 61)	2 (63 64)	145 (66 70)

OTHER CASING (if used)

EACH CASING	diameter inch	depth (feet) from	to

SCREEN RECORD
screen type or open hole insert appropriate code below
ST STEEL BR BRASS BRONZE HO OPEN HOLE PL PLASTIC OT OTHER

C 2 1 2 DEPTH (nearest ft.)

EACH SCREEN	type	from	to
1	PL (8 9)	145 (11 15)	160 (17 21)
2	(23 24)	(26 30)	(32 36)
3	(38 39)	(41 45)	(47 51)

SLOT SIZE 1 .020 2 ____ 3 ____
DIAMETER OF SCREEN 2" (56 60) (NEAREST INCH)

	from	to
GRAVEL PACK	135	160

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W Q
70 72 74 75 76
TELESCOPE CASING LOG INDICATOR OTHER DATA

C 3 1 2

PUMPING TEST
HOURS PUMPED (nearest hour) 1 (8 9)
PUMPING RATE (gal. per min.) 1 (11 15)
METHOD USED TO MEASURE PUMPING RATE 5 Gal
WATER LEVEL (distance from land surface)
BEFORE PUMPING 101 (17 20) ft.
WHEN PUMPING 131 (22 25) ft.
TYPE OF PUMP USED (for test)
A air P piston T turbine C centrifugal R rotary O other (describe below) J jet S submersible (27)

PUMP INSTALLED
DRILLER INSTALLED PUMP (CIRCLE) (YES or NO) YES NO
IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS.
TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX 29.
CAPACITY: GALLONS PER MINUTE (to nearest gallon) 31 35
PUMP HORSE POWER 37 41
PUMP COLUMN LENGTH (nearest ft.) 43 47
CASING HEIGHT (circle appropriate box and enter casing height)
+ above LAND SURFACE − below 2 (nearest) foot (49, 50 51)

LOCATION OF WELL ON LOT
SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND /OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)
N

Test

DENV-CR00 OWNER

Telephone 410-841-6710
Fax # 410-841-6711

A.C. SCHULTES OF MARYLAND, INC.
24 Old South River Road Edgewater, MD 21037

Driller's Log

Water Well Contractors

CUSTOMER: ERM JOB: H5118

ADDRESS: CROFTON DATE: 6/28/07

LOCATION: 1457 CAPITAL RACEWAY RD PERMIT NO. AA-95-3051

GROUND

CASING 145'

160' TOTAL DEPTH

SCREEN 15'

FEET FROM GROUND SURFACE	WELL LOG
0-10	MED. TO COARSE SAND W/GRAVEL
10-20	BROWN MED & COARSE SAND W/GRAVEL
20-30	SAME AS ABOVE
30-40	MED TO COARSE GRAVEL W/MED SAND
40-50	COARSE GRAVEL W/WHITE CLAY W/SAND
50-60	SMALL TO MED GRAVEL W/MULTICOLOR CLAY
60-80	FINE TO MED SAND W/COARSE GRAVEL
80-140	HARD CLAY LAYERS W/SILTY SAND
140-160	MED TO FINE SAND

WELL NO. 19b	DIAMETER OF WELL 2"	DEPT. OF WELL 160'
HOURS PUMPED 1	SLOT SIZE 0.10	TYPE OF CASING PVC
CAPACITY GPM 1/2	DRILLING MACHINE NO.	LENGTH OF CASING 160'
STATIC LEVEL 101	DRILLER T.SCHULTES	DISTANCE TO TOP OF SCREEN 145'
PUMPING LEVEL	GRAVEL #2	TYPE SCREEN PVC
SPECIFIC CAPACITY	5 BAGS OF CEMENT	SIZE OF SCREEN 2"
PUMPED WITH AIR	DATE WELL COMPLETED 6/28/07	OUTER CASING SIZE
DEPTH OF GROUT 135 - 0	DRILLER'S HELPER JACKSON	OUTER CASING DEPTH
DEPTH GRAVEL PACKED 135-160		

EMERGENCY/TEMP NO. IF ANY 0000-0706-2004

B 1	2260	SEQUENCE NO. (MDE USE ONLY)	STATE OF MARYLAND APPLICATION FOR PERMIT TO DRILL WELL please type	STATE PERMIT NUMBER AA-95-3052 (70–79) fill in this form completely

OWNER INFORMATION

Date Received (APA) (8 MM DD YY 13)

Tolson Landfill — Last Name / Owner / First Name (15–34)

1457 Capitol Raceway Road — Street or RFD (36–55)

Crofton — Town (57–70) — MD — State (72) — 21114 — Zip (76)

DRILLER INFORMATION

David R. Hartman — Driller's Name — M W D 517 — License No. (76–81)

A.C.Schultes of Maryland, Inc. — Firm Name

24 Old S.River Rd. Edgewater,MD21037 — Address

Signature — Date 6/19/07

B 3 LOCATION OF WELL

AA — COUNTY (8–21)

Tolson Landfill — SUBDIVISION (23–42)

SECTION ___ (44–46) LOT ___ (48–50)

Crofton — NEAREST TOWN (52–71)

MILES FROM TOWN (enter 0 if in town) 0 MI (73, 76 77 78)

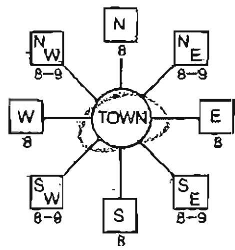
B 2 WELL INFORMATION

APPROX. PUMPING RATE (GAL. PER MIN.) ___ (8–12)

AVERAGE DAILY QUANTITY NEEDED (GAL. PER DAY) ___ (14–20)

B 4

DIRECTION OF WELL FROM TOWN (CIRCLE BOX)



Maytime Dr. — NEAR WHAT ROAD (11–30)

ON WHICH SIDE OF ROAD (CIRCLE APPROPRIATE BOX) NORTH N, WEST W, 32, E EAST, S SOUTH

34 2225 37 DISTANCE FROM ROAD — ENTER FT OR MI: FT (38 39)

TAX MAP: 36 BLK: ___ PARCEL: ___

USE FOR WATER (CIRCLE APPROPRIATE BOX)

- D DOMESTIC POTABLE SUPPLY & RESIDENTIAL IRRIGATION
- F FARMING (LIVESTOCK WATERING & AGRICULTURAL IRRIGATION
- I INDUSTRIAL, COMMERICIAL, DEWATERING
- P PUBLIC WATER SUPPLY WELL
- T TEST, OBSERVATION, MONITORING
- G GEO-THERMAL

NOT TO BE FILLED IN BY DRILLER HEALTH DEPARTMENT APPROVAL

Anne Arundel — COUNTY NAME — 02 — COUNTY NO.

STATE SIGNATURE ___ INSERT S → (41)

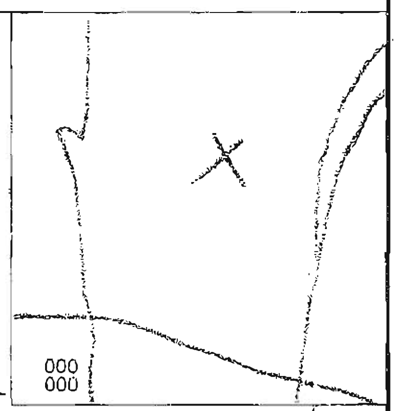
DATE ISSUED 06/22/07 (43 MM DD YY 48) — [signature] — CO SIGNATURE — 06/22/08 EXP. DATE

NORTH GRID 435 000 (50–55) EAST GRID 885 000 (57–63)

APPROXIMATE DEPTH OF WELL 70 FEET (24–28)

APPROXIMATE DIAMETER OF WELL 2 NEAREST INCH

SHOW MAJOR FEATURES OF BOX & LOCATE WELL WITH AN X →



SOURCES OF DRILLING WATER
1.
2.
3.

METHOD OF DRILLING (circle one)

BORED (or Augered)	JETTED	Jetted & DRIVEN
30 AIR-ROTary	AIR-PERcussion	ROTARY (Hydraulic Rotary)
37 CABLE	REVerse-ROTary	DRive-POINT

other ___

WRITE THE BOX NUMBER FROM THE MAP HERE

E 885

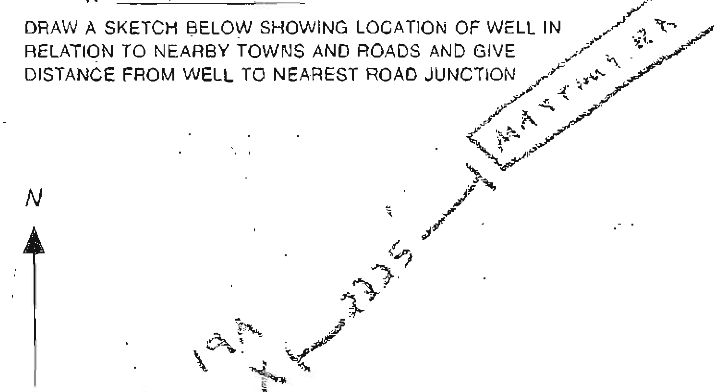
N 435

REPLACEMENT OR DEEPENED WELLS (CIRCLE APPROPRIATE BOX)

- N THIS WELL WILL NOT REPLACE AN EXISTING WELL
- Y THIS WELL WILL REPLACE A WELL THAT WILL BE ABANDONED AND SEALED
- 39 S THIS WELL WILL REPLACE A WELL THAT WILL BE USED AS A STANDBY-CONTACT LOCAL APPROVING AUTHORITY FOR POLICY ON STANDBY WELLS
- D THIS WELL WILL DEEPEN AN EXISTING WELL

PERMIT NUMBER OF WELL TO BE REPLACED OR DEEPENED (IF AVAILABLE) 41 __ __ - __ __ - __ __ __ __ 52

DRAW A SKETCH BELOW SHOWING LOCATION OF WELL IN RELATION TO NEARBY TOWNS AND ROADS AND GIVE DISTANCE FROM WELL TO NEAREST ROAD JUNCTION



Not to be filled in by driller (MDE OR COUNTY USE ONLY)

APPROP. PERMIT NUMBER _ _ _ _ _ _ G _ _ _

PERMIT No. AA-95-3052 (70 71 72 73 74 75 76 77 78 79)

SPECIAL CONDITIONS

NOTE – APPROVING AUTHORITIES SHOULD USE SEPARATE SHEET IF NEEDED

C 1 0561 (MDE USE ONLY)

1 2 3 6
(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

STATE OF MARYLAND WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

ST/CO USE ONLY
DATE Received MM DD YY 13

DATE WELL COMPLETED MM 7 DD 14 YY 07 (15–20)

Depth of Well 22 95 26 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-95-3052 (28–37)

OWNER Tolson Landfill (last name / first name)
STREET OR RFD 1457 Capital Raceway Rd. TOWN Crofton
SUBDIVISION Tolson Landfill SECTION TM36 LOT

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	check if water bearing
Topsoil	0	1	
Fine-Med tan sand	1	23	
Med-Coarse sand w/gravel	23	68	
Fine-Med Sand Red &White Clay	68	92	
Clay	92	95	

NUMBER OF UNSUCCESSFUL WELLS: 0

WELL HYDROFRACTURED yes Y no N

CIRCLE APPROPRIATE LETTER
- **A** A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
- **E** ELECTRIC LOG OBTAINED
- **P** TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS LIC. NO. M W D517

DRILLERS SIGNATURE
(MUST MATCH SIGNATURE ON APPLICATION)

LIC. NO. __ __ D __ __ __

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N 44

TYPE OF GROUTING MATERIAL (Circle one)
CEMENT CM BENTONITE CLAY BC 45 46
NO. OF BAGS 2 NO. OF POUNDS 128
GALLONS OF WATER 12
DEPTH OF GROUT SEAL (to nearest foot)
from 0 (48 TOP 52) ft. to 82 (54 BOTTOM 58) ft.
(enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below

ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL (60 61)	2 (63 64)	85 (66 70)

OTHER CASING (if used)

EACH CASING — diameter inch, depth (feet) from, to

SCREEN RECORD

screen type or open hole insert appropriate code below

ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C 2

DEPTH (nearest ft.)

EACH SCREEN	type	from	to
1	PL	85	95
2			
3			

SLOT SIZE 1 .020 2 ____ 3 ____

DIAMETER OF SCREEN 2" (NEAREST INCH) 56 60

GRAVEL PACK from 82 to 96
IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY
(NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W Q
70 TELESCOPE CASING, 72 LOG INDICATOR, 74 75 76 OTHER DATA

C 3

PUMPING TEST

HOURS PUMPED (nearest hour) 1
PUMPING RATE (gal. per min.) •
METHOD USED TO MEASURE PUMPING RATE 5 GAL.
WATER LEVEL (distance from land surface)
BEFORE PUMPING 62 ft.
WHEN PUMPING 82 ft.

TYPE OF PUMP USED (for test)
A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

PUMP INSTALLED

DRILLER INSTALLED PUMP (CIRCLE) (YES or NO) YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS.

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX 29.

CAPACITY: GALLONS PER MINUTE (to nearest gallon)

PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height)
+ above / − below LAND SURFACE 2 (nearest) foot)

LOCATION OF WELL ON LOT
SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND /OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

Test Well

DENV-CR00

OWNER

EMERGENCY/TEMP NO. IF ANY 0000-0706-2003

B 1 **2261** (1 2 3 6) SEQUENCE NO. (MDE USE ONLY)	STATE OF MARYLAND APPLICATION FOR PERMIT TO DRILL WELL please type	STATE PERMIT NUMBER AA - 95 - 3053 (70 79) fill in this form completely

Date Received (APA) [illegible] (8 MM DD YY 13)

OWNER INFORMATION

Tolson Landfill
(15 Last Name Owner First Name 34)

1457 Capitol Raceway Road
(36 Street or RFD 55)

Crofton MD 21114
(57 Town 70 State 72 Zip 76)

DRILLER INFORMATION

David B.Hartman MW D517
(Driller's Name 76 License No. 81)

A.C.Schultes of Maryland,Inc.
Firm Name

24 Old S.River RdEdgewater,MD21037
Address

[signature] 6/19/07
Signature Date

LOCATION OF WELL

B 3

AA
(8 COUNTY 21)

Tolson Landfill
(23 SUBDIVISION 42)

SECTION ____ (44 46) LOT ____ (48 50)

Crofton
(52 NEAREST TOWN 71)

MILES FROM TOWN (enter 0 if in town) 0 MI (73 76 77 78)

B 4

DIRECTION OF WELL FROM TOWN (CIRCLE BOX)

N, NE, E, SE, S, SW, W, NW — TOWN

Maytime Dr.
(11 NEAR WHAT ROAD 30)

ON WHICH SIDE OF ROAD (CIRCLE APPROPRIATE BOX) NORTH N, WEST W, EAST E, SOUTH S

TEST

1205 (34 37) DISTANCE FROM ROAD FT
ENTER FT OR MI (38 39)

TAX MAP 36 BLK: ____ PARCEL ____

B 2 WELL INFORMATION

APPROX. PUMPING RATE (GAL. PER MIN.) ____ (8 12)

AVERAGE DAILY QUANTITY NEEDED (GAL. PER DAY) ____ (14 20)

USE FOR WATER (CIRCLE APPROPRIATE BOX)

- D DOMESTIC POTABLE SUPPLY & RESIDENTIAL IRRIGATION
- F FARMING (LIVESTOCK WATERING & AGRICULTURAL IRRIGATION
- I INDUSTRIAL, COMMERICIAL, DEWATERING
- P PUBLIC WATER SUPPLY WELL
- T TEST, OBSERVATION, MONITORING
- G GEO-THERMAL

NOT TO BE FILLED IN BY DRILLER HEALTH DEPARTMENT APPROVAL

Anne Arundel 02
COUNTY NAME COUNTY NO.

STATE SIGNATURE ____ INSERT S → ____ 41

DATE ISSUED
06/22/07 Sara [signature] 06/22/08
(43 MM DD YY 48) CO SIGNATURE EXP. DATE

NORTH GRID 435 000 (50 55) EAST GRID 885 000 (57 63)

APPROXIMATE DEPTH OF WELL 160 FEET (24 28)

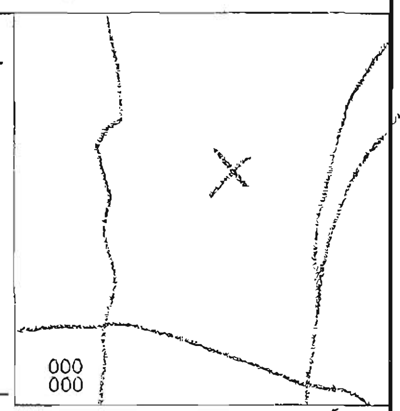
APPROXIMATE DIAMETER OF WELL 2 NEAREST INCH

METHOD OF DRILLING (circle one)

BORED (or Augered)	JETTED	Jetted & DRIVEN
30 AIR-ROTary	AIR-PERcussion	ROTARY (Hydraulic Rotary)
37 CABLE	REVerse-ROTary	DRive-POINT

other ____

SHOW MAJOR FEATURES OF BOX & LOCATE WELL WITH AN X →



SOURCES OF DRILLING WATER
1.
2.
3.

WRITE THE BOX NUMBER FROM THE MAP HERE

E 885

N 435

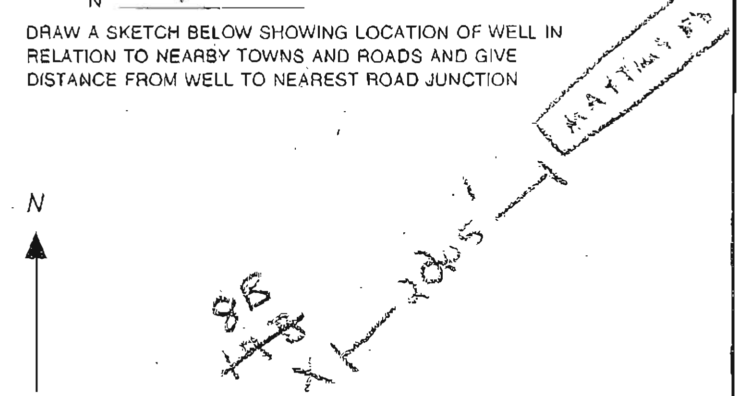
000
000

REPLACEMENT OR DEEPENED WELLS (CIRCLE APPROPRIATE BOX)

- N THIS WELL WILL NOT REPLACE AN EXISTING WELL
- Y THIS WELL WILL REPLACE A WELL THAT WILL BE ABANDONED AND SEALED
- 39 S THIS WELL WILL REPLACE A WELL THAT WILL BE USED AS A STANDBY-CONTACT LOCAL APPROVING AUTHORITY FOR POLICY ON STANDBY WELLS
- D THIS WELL WILL DEEPEN AN EXISTING WELL

PERMIT NUMBER OF WELL TO BE REPLACED OR DEEPENED (IF AVAILABLE) 41 __ __ - __ __ - __ __ __ __ 52

DRAW A SKETCH BELOW SHOWING LOCATION OF WELL IN RELATION TO NEARBY TOWNS AND ROADS AND GIVE DISTANCE FROM WELL TO NEAREST ROAD JUNCTION



Not to be filled in by driller (MDE OR COUNTY USE ONLY)

APPROP PERMIT NUMBER _ _ _ _ _ _G_ _ _

PERMIT No. AA-95-3053 (70 71 72 73 74 75 76 77 78 79)

SPECIAL CONDITIONS
NOTE - APPROVING AUTHORITIES SHOULD USE SEPARATE SHEET IF NEEDED.

C 1 0962 (MDE USE ONLY)

1 2 3 6
(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE TYPE

45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

ST/CO USE ONLY DATE Received (MM DD YY) 13	DATE WELL COMPLETED (MM DD YY) 15–20	Depth of Well 22–26 (TO NEAREST FOOT)	PERMIT NO. FROM "PERMIT TO DRILL WELL" 28–37
	7 20 97	165	AA-95-3052

OWNER [illegible] (last name) (first name)
STREET OR RFD 1457 Capital Raceway Rd. TOWN Crofton
SUBDIVISION [illegible] SECTION [illegible] LOT

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	check if water bearing
See DRillers Log			

NUMBER OF UNSUCCESSFUL WELLS: 0

WELL HYDROFRACTURED yes Y no N

CIRCLE APPROPRIATE LETTER
- A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
- E ELECTRIC LOG OBTAINED
- P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS LIC. NO. M D 517

DRILLERS SIGNATURE [signature]
MUST MATCH SIGNATURE ON APPLICATION)

LIC. NO. __ __ D __ __ __

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y 44 no N 44

TYPE OF GROUTING MATERIAL (Circle one)
CEMENT CM 45 46 BENTONITE CLAY BC 45 46

NO. OF BAGS 5 NO. OF POUNDS 70

GALLONS OF WATER 30

DEPTH OF GROUT SEAL (to nearest foot)
from 0 ft. to 124 ft. (48 TOP 52, 54 BOTTOM 58)
(enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below

ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE (60–61)	Nominal diameter top (main) casing (nearest inch) (63–64)	Total depth of main casing (nearest foot) (66–70)
PL	2	145

EACH CASING — OTHER CASING (if used)

diameter inch	depth (feet) from	to

SCREEN RECORD

screen type or open hole insert appropriate code below

ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C 2

EACH SCREEN — DEPTH (nearest ft.)

	type	from	to
1	PL	145	165
2			
3			

SLOT SIZE 1 .020 2 ___ 3 ___

DIAMETER OF SCREEN 2" (NEAREST INCH) 56 60

	from	to
GRAVEL PACK	127	165

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W Q
70 TELESCOPE CASING 72 LOG INDICATOR 74 75 76 OTHER DATA

PUMPING TEST

C 3

HOURS PUMPED (nearest hour) 1 (8 9)

PUMPING RATE (gal. per min.) 1 (11 15)

METHOD USED TO MEASURE PUMPING RATE 5 GAL.

WATER LEVEL (distance from land surface)
BEFORE PUMPING 94 ft. (17 20)
WHEN PUMPING 140 ft. (22 25)

TYPE OF PUMP USED (for test)
A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible (27)

PUMP INSTALLED

DRILLER INSTALLED PUMP (CIRCLE) (YES or NO) YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS.

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX 29.

CAPACITY: GALLONS PER MINUTE (to nearest gallon) 31 35

PUMP HORSE POWER 37 41

PUMP COLUMN LENGTH (nearest ft.) 43 47

CASING HEIGHT (circle appropriate box and enter casing height)
+ above LAND SURFACE
− below 2 (nearest foot) 50 51

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

Test

DENV-CR00 OWNER

Telephone 410-841-6710
Fax # 410-841-6711

A.C. SCHULTES OF MARYLAND, INC.
24 Old South River Road Edgewater, MD 21037

Driller's Log

Water Well Contractors

CUSTOMER: ERM JOB: H5118

ADDRESS: CROFTON DATE: 7/20/07

LOCATION: 1457 CAPITAL RACEWAY RD PERMIT NO. AA-95-3053

		FEET FROM GROUND SURFACE	WELL LOG
GROUND		0-10	SOIL W/BROWN SAND
	CASING	10-20	SAND W/MED GRAVEL W/WOOD
		20-30	FINE TO COARSE SAND W/LOTS OF WOOD
		30-40	COARSE SAND W/GRAVEL SOME CLAY
		40-60	FINE TO MED SAND W/GRAVEL & CLAY
		60-80	MED SAND W/RED CLAY
		80-100	RED & GRAY CLAY W/SILTY SAND
		100-120	FINE SAND W/HARD RED CLAY
		120-140	FINE TO MED SAND W/RED & GRAY CLAY
		140-165	GRAY CLAY W/FINE TO COARSE SAND
	145		
165 TOTAL DEPTH			
	SCREEN 20		

WELL NO. 8B	DIAMETER OF WELL 2"	DEPT. OF WELL 165'
HOURS PUMPED 2	SLOT SIZE 0.10	TYPE OF CASING PVC
CAPACITY GPM 1/2	DRILLING MACHINE NO. D1	LENGTH OF CASING 145
STATIC LEVEL 94.2'	DRILLER T.SCHULTES	DISTANCE TO TOP OF SCREEN 145
PUMPING LEVEL	GRAVEL 14 OF #2	TYPE SCREEN PVC
SPECIFIC CAPACITY	2 BAGS OF CEMENT	SIZE OF SCREEN 2"
PUMPED WITH	DATE WELL COMPLETED 7/20/07	OUTER CASING SIZE
DEPTH OF GROUT 121-0	DRILLER'S HELPER L.JACKSON	OUTER CASING DEPTH
DEPTH GRAVEL PACKED 165-121		

EMERGENCY/TEMP NO. IF ANY 0000 0700-2009?

B 1 2262 — SEQUENCE NO. (MDE USE ONLY)	**STATE OF MARYLAND** *APPLICATION FOR PERMIT TO DRILL WELL* please type	STATE PERMIT NUMBER AA-95-3054 ***fill in this form completely***

Date Received (APA) 6-20-07 MRC

OWNER INFORMATION

Tolson Landfill — Last Name / Owner / First Name

1457 Capitol Raceway Road — Street or RFD

Crofton — Town; MD — State; 21114 — Zip

DRILLER INFORMATION

David BG Hartman — Driller's Name; MW D 517 — License No.

A.C.Schultes of Maryland, Inc. — Firm Name

24 Old S.River Rd. Edgewater,MD21037 — Address

Signature: DGH — Date: 6/19/07

B 2 *WELL INFORMATION*

APPROX. PUMPING RATE (GAL. PER MIN.) ______

AVERAGE DAILY QUANTITY NEEDED (GAL. PER DAY) ______

LOCATION OF WELL B 3

AA — COUNTY

Tolson Landfill — SUBDIVISION

SECTION ______ LOT ______

Crofton — NEAREST TOWN

MILES FROM TOWN (enter 0 if in town) Ø M

B 4 DIRECTION OF WELL FROM TOWN (CIRCLE BOX): N, NE, E, SE, S, SW, W, NW — TOWN

Maytime DR — NEAR WHAT ROAD

ON WHICH SIDE OF ROAD (CIRCLE APPROPRIATE BOX) NORTH N, WEST W, 32, EAST E, SOUTH S

TEST

2100 — DISTANCE FROM ROAD; ENTER FT OR MI: FT

TAX MAP: 36 BLK: ______ PARCEL ______

USE FOR WATER (CIRCLE APPROPRIATE BOX)

- D DOMESTIC POTABLE SUPPLY & RESIDENTIAL IRRIGATION
- F FARMING (LIVESTOCK WATERING & AGRICULTURAL IRRIGATION
- I INDUSTRIAL, COMMERICIAL, DEWATERING
- P PUBLIC WATER SUPPLY WELL
- T TEST, OBSERVATION, MONITORING
- G GEO-THERMAL

NOT TO BE FILLED IN BY DRILLER
HEALTH DEPARTMENT APPROVAL

Anne Arundel — COUNTY NAME; 02 — COUNTY NO.

STATE SIGNATURE ______ INSERT S →

DATE ISSUED 06/22/07 — CO SIGNATURE Mara Trillone — EXP. DATE 06/22/08

NORTH GRID 435 000 EAST GRID 885 000

APPROXIMATE DEPTH OF WELL 70 FEET

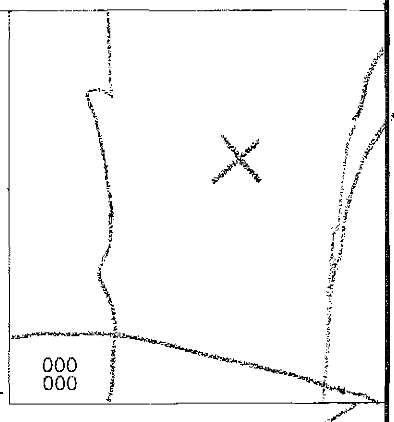
APPROXIMATE DIAMETER OF WELL 2 NEAREST INCH

METHOD OF DRILLING (circle one)

BORED (or Augered)	JETTED	Jetted & DRIVEN
AIR-ROTary	AIR-PERcussion	ROTARY (Hydraulic Rotary)
CABLE	REVerse-ROTary	DRive-POINT

other ______

SHOW MAJOR FEATURES OF BOX & LOCATE WELL WITH AN X →



SOURCES OF DRILLING WATER
1.
2.
3.

WRITE THE BOX NUMBER FROM THE MAP HERE

E 855

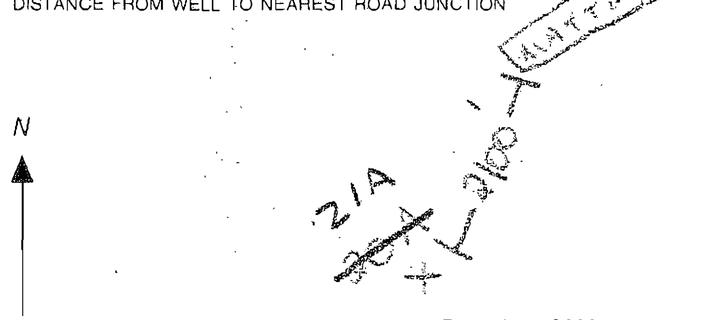
N 435

REPLACEMENT OR DEEPENED WELLS
(CIRCLE APPROPRIATE BOX)

- N THIS WELL WILL NOT REPLACE AN EXISTING WELL
- Y THIS WELL WILL REPLACE A WELL THAT WILL BE ABANDONED AND SEALED
- S THIS WELL WILL REPLACE A WELL THAT WILL BE USED AS A STANDBY-CONTACT LOCAL APPROVING AUTHORITY FOR POLICY ON STANDBY WELLS
- D THIS WELL WILL DEEPEN AN EXISTING WELL

PERMIT NUMBER OF WELL TO BE REPLACED OR DEEPENED (IF AVAILABLE) __ __ - __ __ - __ __ __ __

DRAW A SKETCH BELOW SHOWING LOCATION OF WELL IN RELATION TO NEARBY TOWNS AND ROADS AND GIVE DISTANCE FROM WELL TO NEAREST ROAD JUNCTION



Not to be filled in by driller (MDE OR COUNTY USE ONLY)

APPROP. PERMIT NUMBER __ __ __ __ __ G __ __

PERMIT No. AA-95-3054

SPECIAL CONDITIONS

NOTE: APPROVING AUTHORITIES SHOULD USE SEPARATE SHEET IF NEEDED

C 1 0953 | (MDE USE ONLY)

1 2 3 6
(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

STATE OF MARYLAND WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE TYPE

45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

ST/CO USE ONLY DATE Received (MM DD YY)	DATE WELL COMPLETED (MM DD YY)	Depth of Well (TO NEAREST FOOT)	PERMIT NO. FROM "PERMIT TO DRILL WELL"
13	7 9 07 (15–20)	50 (22–26)	AA-95-2054 (28–37)

OWNER Tolson Landfill (last name / first name)
STREET OR RFD 1457 Capital Raceway TOWN Crofton
SUBDIVISION Tolson Landfill SECTION [illegible]36 LOT

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	check if water bearing
Soil, Sand	0	10	
Sand, fine-Med w/trash	10	20	
Med to Fine sand w/some gravel	20	40	
Fine to Med Sand w/white Clay	40	62	

NUMBER OF UNSUCCESSFUL WELLS: 0

WELL HYDROFRACTURED yes Y no N

CIRCLE APPROPRIATE LETTER
- A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
- E ELECTRIC LOG OBTAINED
- P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS LIC. NO. M D 517

DRILLERS SIGNATURE
(MUST MATCH SIGNATURE ON APPLICATION)

LIC. NO. __ __ D __ __ __

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N (44)

TYPE OF GROUTING MATERIAL (Circle one)
CEMENT CM (45 46) BENTONITE CLAY BC (45 46)
NO. OF BAGS 1 NO. OF POUNDS 92
GALLONS OF WATER 6
DEPTH OF GROUT SEAL (to nearest foot)
from 0 ft. (48 TOP 52) to 32 ft. (54 BOTTOM 58)
(enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below

ST STEEL CO CONCRETE
PL PLASTIC OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL (60 61)	2 (63 64)	40 (66 70)

OTHER CASING (if used) — EACH CASING

	diameter inch	depth (feet) from	to

SCREEN RECORD

screen type or open hole insert appropriate code below

ST STEEL BR BRASS BRONZE HO OPEN HOLE
PL PLASTIC OT OTHER

C 2

DEPTH (nearest ft.) — EACH SCREEN

	type	from	to
1	PL (8 9)	40 (11 15)	50 (17 21)
2	(23 24)	(26 30)	(32 36)
3	(38 39)	(41 45)	(47 51)

SLOT SIZE 1 .020 2 ___ 3 ___

DIAMETER OF SCREEN 2" (56 60) (NEAREST INCH)

	from	to
GRAVEL PACK	32	62

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY
(NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W Q
70 72 74 75 76
TELESCOPE CASING LOG INDICATOR OTHER DATA

C 3

PUMPING TEST

HOURS PUMPED (nearest hour) 1 (8 9)
PUMPING RATE (gal. per min.) 1 (11 15)
METHOD USED TO MEASURE PUMPING RATE 5 Gal
WATER LEVEL (distance from land surface)
BEFORE PUMPING 41 ft. (17 20)
WHEN PUMPING 46 ft. (22 25)

TYPE OF PUMP USED (for test)
A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible (27)

PUMP INSTALLED

DRILLER INSTALLED PUMP (CIRCLE) (YES or NO) YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS.

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX 29.
CAPACITY: GALLONS PER MINUTE (to nearest gallon) (31 35)
PUMP HORSE POWER (37 41)
PUMP COLUMN LENGTH (nearest ft.) (43 47)
CASING HEIGHT (circle appropriate box and enter casing height)
+ above / − below LAND SURFACE (nearest foot) (49) (50 51)

LOCATION OF WELL ON LOT

SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND /OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

N

Test

OWNER

DENV-CR00

EMERGENCY/TEMP NO. IF ANY 0000 - ... - ...

B 1 2263 SEQUENCE NO. (MDE USE ONLY)

STATE OF MARYLAND
APPLICATION FOR PERMIT TO DRILL WELL

please type

STATE PERMIT NUMBER AA - 95 - 3055

fill in this form completely

Date Received (APA)

OWNER INFORMATION

Tolson Landfill
Last Name / Owner / First Name

1457 Capitol Raceway Rd
Street or RFD

Crofton MD 21114
Town / State / Zip

DRILLER INFORMATION

David B.Hartman M WD517
Driller's Name / License No.

A.C.Schultes of Maryland, Inc.
Firm Name

24 Old S.River Rd. Edgewater,MD21037
Address

Signature: D. Hartman Date: 6/14/06

B 3 LOCATION OF WELL

AA
COUNTY

Tolson Landfill
SUBDIVISION

SECTION ____ LOT ____

Crofton
NEAREST TOWN

MILES FROM TOWN (enter 0 if in town) 0 MI

B 4

DIRECTION OF WELL FROM TOWN (CIRCLE BOX): N, NE, E, SE, S, SW, W, NW, TOWN

Maytime Dr.
NEAR WHAT ROAD

ON WHICH SIDE OF ROAD (CIRCLE APPROPRIATE BOX): NORTH N, WEST W, 32, E EAST, S SOUTH

TEST

2005 DISTANCE FROM ROAD FT
ENTER FT OR MI

TAX MAP: 36 BLK: ____ PARCEL ____

B 2 WELL INFORMATION

APPROX. PUMPING RATE (GAL. PER MIN.) ____

AVERAGE DAILY QUANTITY NEEDED (GAL. PER DAY) ____

NOT TO BE FILLED IN BY DRILLER
HEALTH DEPARTMENT APPROVAL

Anne Arundel 02
COUNTY NAME / COUNTY NO.

STATE SIGNATURE ____ INSERT S →

DATE ISSUED 06/22/07 Sara Follone 06/22/08
CO SIGNATURE / EXP. DATE

NORTH GRID 435 000 EAST GRID 885 000

USE FOR WATER (CIRCLE APPROPRIATE BOX)

- D DOMESTIC POTABLE SUPPLY & RESIDENTIAL IRRIGATION
- F FARMING (LIVESTOCK WATERING & AGRICULTURAL IRRIGATION
- I INDUSTRIAL, COMMERICIAL, DEWATERING
- P PUBLIC WATER SUPPLY WELL
- T TEST, OBSERVATION, MONITORING
- G GEO-THERMAL

APPROXIMATE DEPTH OF WELL 160 FEET

APPROXIMATE DIAMETER OF WELL 2 NEAREST INCH

METHOD OF DRILLING (circle one)

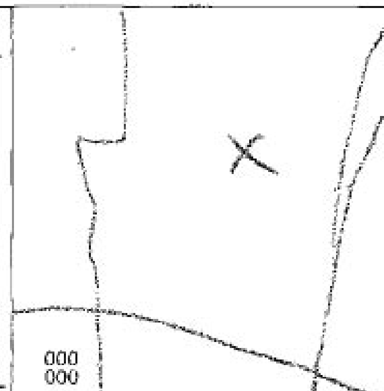
BORED (or Augered) · JETTED · Jetted & DRIVEN
AIR-ROTary · AIR-PERcussion · ROTARY (Hydraulic Rotary)
CABLE · REVerse-ROTary · DRive-POINT
other ____

SHOW MAJOR FEATURES OF BOX & LOCATE WELL WITH AN X

SOURCES OF DRILLING WATER
1.
2.
3.

WRITE THE BOX NUMBER FROM THE MAP HERE

E 885
N 435



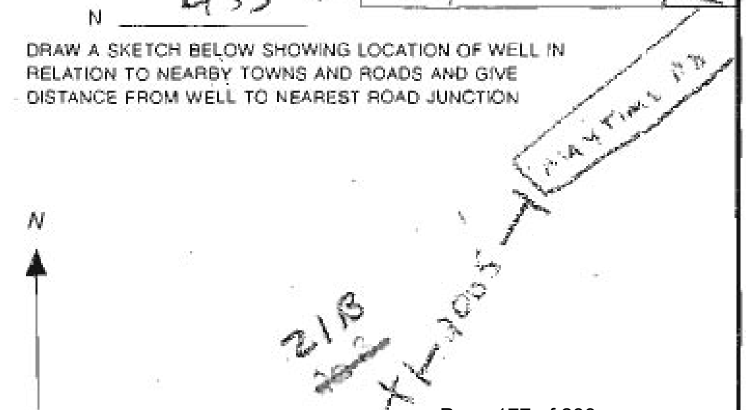
000
000

REPLACEMENT OR DEEPENED WELLS
(CIRCLE APPROPRIATE BOX)

- N THIS WELL WILL NOT REPLACE AN EXISTING WELL
- Y THIS WELL WILL REPLACE A WELL THAT WILL BE ABANDONED AND SEALED
- S THIS WELL WILL REPLACE A WELL THAT WILL BE USED AS A STANDBY-CONTACT LOCAL APPROVING AUTHORITY FOR POLICY ON STANDBY WELLS
- D THIS WELL WILL DEEPEN AN EXISTING WELL

PERMIT NUMBER OF WELL TO BE REPLACED OR DEEPENED (IF AVAILABLE) __ __ - __ __ - __ __ __ __

DRAW A SKETCH BELOW SHOWING LOCATION OF WELL IN RELATION TO NEARBY TOWNS AND ROADS AND GIVE DISTANCE FROM WELL TO NEAREST ROAD JUNCTION



Not to be filled in by driller (MDE OR COUNTY USE ONLY)

APPROP. PERMIT NUMBER _ _ _ _ _ _ G _ _ _

PERMIT No AA-95-3055

SPECIAL CONDITIONS

NOTE - APPROVING AUTHORITIES SHOULD USE SEPARATE SHEET IF NEEDED -

C 1 | 0964 (MDE USE ONLY)
1 2 3 6
(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE TYPE

THIS REPORT MUST BE SUBMITTED 45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

ST/CO USE ONLY
DATE Received MM DD YY ______ 13

DATE WELL COMPLETED MM 7 DD 13 YY 07 (15–20)

Depth of Well 22 128 26 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-95-3055 (28 29 30 31 32 33 34 35 36 37)

OWNER Folger Ira Hill (last name, first name)
STREET OR RFD 1457 Capitol Raceway TOWN Crofton
SUBDIVISION Folger Ira Hill SECTION ____ LOT ____

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	check if water bearing
See DRillers Log			

NUMBER OF UNSUCCESSFUL WELLS: 0

WELL HYDROFRACTURED yes Y no N

CIRCLE APPROPRIATE LETTER
- **A** A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
- **E** ELECTRIC LOG OBTAINED
- **P** TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS LIC. NO. M A D 517

DRILLERS SIGNATURE
(MUST MATCH SIGNATURE ON APPLICATION)

LIC. NO. __ __ D __ __ __

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N (44)

TYPE OF GROUTING MATERIAL (Circle one)
CEMENT C M (45 46) BENTONITE CLAY B C (45 46)
NO. OF BAGS 2 NO. OF POUNDS 188
GALLONS OF WATER 12
DEPTH OF GROUT SEAL (to nearest foot)
from 0 (48 TOP 52) ft. to 112 (54 BOTTOM 58) ft.
(enter 0 if from surface)

CASING RECORD
casing types insert appropriate code below

S T STEEL · C O CONCRETE · P L PLASTIC · O T OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)	Total depth of main casing (nearest foot)
PL (60 61)	2 (63 64)	118 (66 70)

OTHER CASING (if used)

EACH CASING	diameter inch	depth (feet) from	to

SCREEN RECORD
screen type or open hole — insert appropriate code below

S T STEEL · B R BRASS BRONZE · H O OPEN HOLE · P L PLASTIC · O T OTHER

C 2 (1 2)

DEPTH (nearest ft.)

EACH SCREEN	type	from	to
1	PL (8 9)	118 (11 15)	128 (17 21)
2	(23 24)	(26 30)	(32 36)
3	(38 39)	(41 45)	(47 51)

SLOT SIZE 1 .020 2 ____ 3 ____

DIAMETER OF SCREEN 2" (56 60) (NEAREST INCH)

GRAVEL PACK from 112 to 130
IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W Q
70 TELESCOPE CASING · 72 LOG INDICATOR · 74 75 76 OTHER DATA

C 3 (1 2)

PUMPING TEST
HOURS PUMPED (nearest hour) 1 (8 9)
PUMPING RATE (gal. per min.) 1 (11 15)
METHOD USED TO MEASURE PUMPING RATE 5 Gal
WATER LEVEL (distance from land surface)
BEFORE PUMPING 113 (17 20) ft.
WHEN PUMPING 120 (22 25) ft.

TYPE OF PUMP USED (for test)
- A air (27)
- P piston (27)
- T turbine (27)
- C centrifugal (27)
- R rotary (27)
- O other (describe below) (27)
- J jet (27)
- S submersible (27)

PUMP INSTALLED
DRILLER INSTALLED PUMP (CIRCLE) (YES or NO) YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS.

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX 29. ___ 29
CAPACITY: GALLONS PER MINUTE (to nearest gallon) (31 35)
PUMP HORSE POWER (37 41)
PUMP COLUMN LENGTH (nearest ft.) (43 47)

CASING HEIGHT (circle appropriate box and enter casing height)
+ above (49) LAND SURFACE
– below (49) 2 (50 51) (nearest) foot)

LOCATION OF WELL ON LOT
SHOW PERMANENT STRUCTURE SUCH AS BUILDING, SEPTIC TANKS, AND /OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)

N

Test 21B

DENV-CR00 OWNER

Telephone 410-841-6710
Fax # 410-841-6711

A.C. SCHULTES OF MARYLAND, INC.

24 Old South River Road Edgewater, MD 21037

Driller's Log

Water Well Contractors

CUSTOMER: ERM JOB: H5118

ADDRESS: CROFTON DATE: 7/13/07

LOCATION: 1457 CAPITAL RACEWAY RD PERMIT NO. AA-95-3055

		FEET FROM GROUND SURFACE	WELL LOG
GROUND		0-10	FINE TO MED SAND W/SILTY CLAY
	CASING	10-20	MED TO COARSE SAND W/SILTY CLAY
		20-40	FINE TO MED SAND W/CLAY
		40-70	MED TO COARSE SAND W/GRAVEL, WHITE CLAY
			AND RED CLAY
		70-90	MED SAND W/COARSE GRAVEL AND MULTI
			COLORED CLAY
		90-100	RED AND WHITE CLAY W/BLACK FINE SAND
		100-120	RED CLAY W/MED TO FINE SAND
		120-130	FINE TO COARSE SAND
	118		
128 TOTAL DEPTH			
	SCREEN		
	10		

WELL NO, 21B	DIAMETER OF WELL 2"	DEPT. OF WELL 128'
HOURS PUMPED	SLOT SIZE 0.10	TYPE OF CASING PVC
CAPACITY GPM 1/2	DRILLING MACHINE NO. D1	LENGTH OF CASING 118
STATIC LEVEL 113'	DRILLER T. SCHULTES	DISTANCE TO TOP OF SCREEN 118'
PUMPING LEVEL	GRAVEL #2 6 BAGS	TYPE SCREEN PVC
SPECIFIC CAPACITY	2 BAGS OF CEMENT	SIZE OF SCREEN 2"
PUMPED WITH	DATE WELL COMPLETED 7/13/07	OUTER CASING SIZE
DEPTH OF GROUT 112-0	DRILLER'S HELPER L. JACKSON	OUTER CASING DEPTH
DEPTH GRAVEL PACKED 130-112		

C1 54452

SEQUENCE NO. (MDE USE ONLY)

(THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

STATE OF MARYLAND
WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY
PLEASE TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

ST/CO USE ONLY DATE Received MM DD YY

DATE WELL COMPLETED MM 3 DD 15 YY 19

Depth of Well 25 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-18-0104

OWNER Tolson & Associates LLC

WELL SITE ADDRESS Francis Station Road TOWN Gambrills

SUBDIVISION SECTION LOT

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	check if water bearing
Brown f/c Sand	0	12	
Brown Sand & Silt	12	17	
Brown f/c Sand	17	22	✓
Gray Silt	22	27	✓
Gray silty Sand	27	32	✓
Gray clay	32	36	✓

NUMBER OF UNSUCCESSFUL WELLS: 0

WELL HYDROFRACTURED yes Y no N (N circled)

CIRCLE APPROPRIATE LETTER
- A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
- E ELECTRIC LOG OBTAINED
- P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS LIC. NO. MGD027

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

LIC. NO. JGD067

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y (circled) no N

TYPE OF GROUTING MATERIAL (Circle one)

CEMENT CM BENTONITE CLAY BC

NO. OF BAGS 3 NO. OF POUNDS 150

GALLONS OF WATER 16

DEPTH OF GROUT SEAL (to nearest foot) from 0 ft. TOP to 13 ft. BOTTOM (enter 0 if from surface)

CASING RECORD

casing types insert appropriate code below

ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)!	Total depth of main casing (nearest foot)
PL	2	15

OTHER CASING (if used) diameter inch depth (feet) from to

SCREEN RECORD

screen type or open hole insert appropriate code below

ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C2 DEPTH (nearest ft.)

EACH SCREEN 1 PL 15 25

SLOT SIZE 1 0.010 2 3

DIAMETER OF SCREEN 2 (NEAREST INCH)

GRAVEL PACK from 13 to 25

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER) T (E.R.O.S.) W Q

TELESCOPE CASING LOG INDICATOR OTHER DATA

C3 PUMPING TEST

N/A

HOURS PUMPED (nearest hour)

PUMPING RATE (gal. per min.)

METHOD USED TO MEASURE PUMPING RATE

WATER LEVEL (distance from land surface)

BEFORE PUMPING ft.

WHEN PUMPING ft.

TYPE OF PUMP USED (for test): A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

PUMP INSTALLED

DRILLER INSTALLED PUMP (CIRCLE) (YES or NO) YES NO (NO circled)

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS.

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX 29.

CAPACITY: GALLONS PER MINUTE (to nearest gallon)

PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height) + above (circled) / − below LAND SURFACE 3 (nearest) foot)

LATITUDE 39.045652
LONGITUDE 76.707960
(DEFAULT COORD. WGS 84)

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MDE/WMA/PER.071 OWNER

TEST MW 37A

C 1 54451

SEQUENCE NO. (MDE USE ONLY)

1 2 3 6 (THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

ST/CO USE ONLY
DATE Received MM DD YY 8 13

DATE WELL COMPLETED MM 3 DD 18 YY 19 (15–20)

Depth of Well 22 30 26 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-18-0105 (28–37)

OWNER Tolson & Associates LLC (last name / first name)

WELL SITE ADDRESS Francis Station Road TOWN Gambrills

SUBDIVISION ______ SECTION ______ LOT ______

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	check if water bearing
Brown Fm Sand	0	2	
Brown Sand + Silt	2	28	✓
Brown sand and Gravel with clay	28	31	✓

NUMBER OF UNSUCCESSFUL WELLS: 0

WELL HYDROFRACTURED yes Y no N (N circled)

CIRCLE APPROPRIATE LETTER
- A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
- E ELECTRIC LOG OBTAINED
- P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS LIC. NO. MGD027

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

LIC. NO. JGD667

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N (Y circled) 44

TYPE OF GROUTING MATERIAL (Circle one)
CEMENT CM (circled) 45 46 BENTONITE CLAY BC 45 46

NO. OF BAGS 3.5 NO. OF POUNDS 330

GALLONS OF WATER 20

DEPTH OF GROUT SEAL (to nearest foot)
from 0 ft. to 18 ft. (48 TOP 52, 54 BOTTOM 58)
(enter 0 if from surface)

CASING RECORD
casing types insert appropriate code below
ST STEEL CO CONCRETE PL PLASTIC OT OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)!	Total depth of main casing (nearest foot)
PL (60 61)	2 (63 64)	20 (66 70)

OTHER CASING (if used) — EACH CASING: diameter inch / depth (feet) from / to

SCREEN RECORD
screen type or open hole insert appropriate code below
ST STEEL BR BRASS BRONZE HO OPEN HOLE PL PLASTIC OT OTHER

C 2 DEPTH (nearest ft.)

EACH SCREEN	type	from	to
1	PL (8 9)	20 (11 15)	30 (17 21)
2	(23 24)	(26 30)	(32 36)
3	(38 39)	(41 45)	(47 51)

SLOT SIZE 1 0.010 2 ____ 3 ____

DIAMETER OF SCREEN 2 (NEAREST INCH) 56 60

GRAVEL PACK from 18 to 30
IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T 70 TELESCOPE CASING; (E.R.O.S.) 72 LOG INDICATOR; W Q 74 75 76 OTHER DATA

C 3

PUMPING TEST
HOURS PUMPED (nearest hour) N/A 8 9

PUMPING RATE (gal. per min.) — 11 15

METHOD USED TO MEASURE PUMPING RATE —

WATER LEVEL (distance from land surface)
BEFORE PUMPING — ft. 17 20
WHEN PUMPING — ft. 22 25

TYPE OF PUMP USED (for test)
A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible (27)

PUMP INSTALLED
DRILLER INSTALLED PUMP (CIRCLE) (YES or NO) YES NO (NO circled)

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS.

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX 29. —

CAPACITY: GALLONS PER MINUTE (to nearest gallon) — 31 35

PUMP HORSE POWER — 37 41

PUMP COLUMN LENGTH (nearest ft.) — 43 47

CASING HEIGHT (circle appropriate box and enter casing height)
+ above / − below LAND SURFACE 3 (nearest foot) 49 50 51

LATITUDE 39.046773
LONGITUDE 76.706899
(DEFAULT COORD. WGS 84)

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MDE/WMA/PER.071 OWNER

TEST - MW 36A

C 1 54447 SEQUENCE NO. (MDE USE ONLY)
1 2 3 6 (THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

ST/CO USE ONLY DATE Received MM DD YY 8 13

DATE WELL COMPLETED MM DD YY 3 13 19 (15–20)

Depth of Well 22 95 26 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-18-0106 (28–37)

OWNER Tolson & Associates LLC (last name / first name)
WELL SITE ADDRESS Francis Station Road TOWN Gambrills
SUBDIVISION ______ SECTION ______ LOT ______

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	check if water bearing
Brown Sand & clay	0	2	
Brown/red silt and clay	2	8	
Brown fine Sand	8	18	
Brown sand and silt	18	38	
Gray Sand and silt	38	48	
Brown fine Sand	48	58	
Brown Sand & Gravel	58	82	
Lght brown Sand + Silt	82	92	✓
Brown Sand & Gravel	92	96	✓

NUMBER OF UNSUCCESSFUL WELLS: 0

WELL HYDROFRACTURED yes Y no N (circled: N)

CIRCLE APPROPRIATE LETTER
A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
E ELECTRIC LOG OBTAINED
P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS LIC. NO. M G D 627

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

LIC. NO. J G D 067

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N (44)
TYPE OF GROUTING MATERIAL (Circle one) CEMENT CM (circled) BENTONITE CLAY BC (45 46)
NO. OF BAGS 18 NO. OF POUNDS 1690
GALLONS OF WATER 100
DEPTH OF GROUT SEAL (to nearest foot) from 0 ft. (TOP 48–52) to 83 ft. (BOTTOM 54–58)
(enter 0 if from surface)

CASING RECORD
casing types insert appropriate code below: ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE (60 61)	Nominal diameter top (main) casing (nearest inch)! (63 64)	Total depth of main casing (nearest foot) (66–70)
PL	2	85

OTHER CASING (if used) EACH CASING — diameter inch, depth (feet) from, to

SCREEN RECORD
screen type or open hole insert appropriate code below: ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C 2 — DEPTH (nearest ft.)

EACH SCREEN	Type	From	To
1 (8 9 / 11–15 / 17–21)	PL	85	95
2 (23 24 / 26–30 / 32–36)			
3 (38 39 / 41–45 / 47–51)			

SLOT SIZE 1 0.010 2 ____ 3 ____
DIAMETER OF SCREEN 2 (NEAREST INCH) (56–60)

GRAVEL PACK from 83 to 95
IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W Q
70 TELESCOPE CASING — 72 LOG INDICATOR — 74 75 76 OTHER DATA

C 3 PUMPING TEST
HOURS PUMPED (nearest hour) N/A
PUMPING RATE (gal. per min.) /
METHOD USED TO MEASURE PUMPING RATE /
WATER LEVEL (distance from land surface)
BEFORE PUMPING / ft.
WHEN PUMPING / ft.
TYPE OF PUMP USED (for test): A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

PUMP INSTALLED
DRILLER INSTALLED PUMP (CIRCLE) (YES or NO) YES NO (circled: NO)
IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS.
TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX 29. /
CAPACITY: GALLONS PER MINUTE (to nearest gallon) /
PUMP HORSE POWER /
PUMP COLUMN LENGTH (nearest ft.) /
CASING HEIGHT (circle appropriate box and enter casing height) + above / − below LAND SURFACE 3 (nearest foot)

LATITUDE 39.046460
LONGITUDE 76.701228
(DEFAULT COORD. WGS 84)

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MDE/WMA/PER.071 OWNER TEST - MW 33A

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE TYPE

C 1 54448 — SEQUENCE NO. (MDE USE ONLY)
1 2 3 6 (THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

ST/CO USE ONLY — DATE Received MM DD YY (8–13)

DATE WELL COMPLETED MM DD YY: 3 12 19 (15–20)

Depth of Well (22–26): 45 (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL" (28–37): AA-18-0107

OWNER: Telsen & Associates LLC (last name / first name)

WELL SITE ADDRESS: Francis Station Roads — TOWN: Gambrills

SUBDIVISION: — SECTION: — LOT:

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	check if water bearing
Brown f/m Sand	0	17	
Gravel	17	23	✓
Brown Sand + Gravel	23	28	✓
Gray Silt	28	33	✓
Gray/Brown Silty Sand	33	38	✓
Brown f/m Sand + Gravel	38	43	✓
Brown f/m Sand	43	46	✓

NUMBER OF UNSUCCESSFUL WELLS: 0

WELL HYDROFRACTURED — yes Y / no N

CIRCLE APPROPRIATE LETTER
- **A** A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
- **E** ELECTRIC LOG OBTAINED
- **P** TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS LIC. NO. MGD 627

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

LIC. NO. JGD 667

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box) — yes Y (44) / no N (44)

TYPE OF GROUTING MATERIAL (Circle one): CEMENT CM (45 46) — BENTONITE CLAY BC (45 46)

NO. OF BAGS 7 — NO. OF POUNDS 660

GALLONS OF WATER 40

DEPTH OF GROUT SEAL (to nearest foot) from 0 ft. (48 TOP 52) to 33 ft. (54 BOTTOM 58) (enter 0 if from surface)

CASING RECORD
casing types insert appropriate code below: ST STEEL — CO CONCRETE — PL PLASTIC — OT OTHER

MAIN CASING TYPE (60 61)	Nominal diameter top (main) casing (nearest inch)! (63 64)	Total depth of main casing (nearest foot) (66 70)
PL	2	35

OTHER CASING (if used) — EACH CASING: diameter inch / depth (feet) from / to

SCREEN RECORD
screen type or open hole insert appropriate code below: ST STEEL — BR BRASS BRONZE — HO OPEN HOLE — PL PLASTIC — OT OTHER

C 2 — DEPTH (nearest ft.)

EACH SCREEN	Type (8 9)	From (11–15)	To (17–21)
1	PL	35	45
2			
3			

SLOT SIZE 1 .010 2 ___ 3 ___

DIAMETER OF SCREEN (56–60): 2 (NEAREST INCH)

GRAVEL PACK from 33 to 45

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER): T (70) TELESCOPE CASING — (E.R.O.S.) (72) LOG INDICATOR — W Q (74 75 76) OTHER DATA

C 3 PUMPING TEST
HOURS PUMPED (nearest hour) (8 9): N/A

PUMPING RATE (gal. per min.) (11–15): —

METHOD USED TO MEASURE PUMPING RATE: —

WATER LEVEL (distance from land surface)

BEFORE PUMPING (17–20): — ft.

WHEN PUMPING (22–25): — ft.

TYPE OF PUMP USED (for test) (27): A air — P piston — T turbine — C centrifugal — R rotary — O other (describe below) — J jet — S submersible

PUMP INSTALLED
DRILLER INSTALLED PUMP (CIRCLE) (YES or NO): YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS.

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX 29: —

CAPACITY: GALLONS PER MINUTE (to nearest gallon) (31–35): —

PUMP HORSE POWER (37–41): —

PUMP COLUMN LENGTH (nearest ft.) (43–47): —

CASING HEIGHT (circle appropriate box and enter casing height) + above / − below LAND SURFACE (49): 3 (nearest) foot (50 51)

LATITUDE 39.043496

LONGITUDE 76.699487

(DEFAULT COORD. WGS 84)

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MDE/WMA/PER.071 — OWNER — TEST-MW32A

C 1 54449 SEQUENCE NO. (MDE USE ONLY)

1 2 3 6 (THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

ST/CO USE ONLY DATE Received MM DD YY 8 13

DATE WELL COMPLETED MM 3 DD 12 YY 19 (15–20)

Depth of Well 35 (TO NEAREST FOOT) (22–26)

PERMIT NO. FROM "PERMIT TO DRILL WELL" AA-18-0108 (28–37)

OWNER Tolson & Associates LLC (last name / first name)

WELL SITE ADDRESS Francis Station Roads TOWN Gambrills

SUBDIVISION ______ SECTION ______ LOT ______

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	check if water bearing
Brown Gravel	0	2	
Brown f/m Sand	2	36	✓

NUMBER OF UNSUCCESSFUL WELLS: 0

WELL HYDROFRACTURED yes Y no N

CIRCLE APPROPRIATE LETTER
- A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
- E ELECTRIC LOG OBTAINED
- P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS LIC. NO. M G D 627

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

LIC. NO. — G D 627

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y (44) no N (44)

TYPE OF GROUTING MATERIAL (Circle one)

CEMENT C M (45 46) BENTONITE CLAY B C (45 46)

NO. OF BAGS 4.5 NO. OF POUNDS 225

GALLONS OF WATER 25

DEPTH OF GROUT SEAL (to nearest foot) from 0 ft. (48 TOP 52) to 23 ft. (54 BOTTOM 58)

(enter 0 if from surface)

CASING RECORD
casing types insert appropriate code below

S T STEEL; C O CONCRETE; P L PLASTIC; O T OTHER

MAIN CASING TYPE	Nominal diameter top (main) casing (nearest inch)!	Total depth of main casing (nearest foot)
PL (60 61)	2 (63 64)	25 (66 70)

EACH CASING — OTHER CASING (if used): diameter inch; depth (feet) from, to

SCREEN RECORD
screen type or open hole insert appropriate code below

S T STEEL; B R BRASS BRONZE; H O OPEN HOLE; P L PLASTIC; O T OTHER

C 2 (1 2)

EACH SCREEN — DEPTH (nearest ft.)

	Type	From	To
1	PL (8 9)	25 (11 15)	35 (17 21)
2	(23 24)	(26 30)	(32 36)
3	(38 39)	(41 45)	(47 51)

SLOT SIZE 1 .010 2 ____ 3 ____

DIAMETER OF SCREEN 2 (NEAREST INCH) (56 60)

	from	to
GRAVEL PACK	23	35

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68 ____

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)

T (70) TELESCOPE CASING; (E.R.O.S.) (72) LOG INDICATOR; W Q (74 75 76) OTHER DATA

C 3 (1 2)

PUMPING TEST
HOURS PUMPED (nearest hour) N/A (8 9)

PUMPING RATE (gal. per min.) — (11 15)

METHOD USED TO MEASURE PUMPING RATE —

WATER LEVEL (distance from land surface)

BEFORE PUMPING — ft. (17 20)

WHEN PUMPING — ft. (22 25)

TYPE OF PUMP USED (for test)
A air; P piston; T turbine; C centrifugal; R rotary; O other (describe below); J jet; S submersible (27)

PUMP INSTALLED
DRILLER INSTALLED PUMP (CIRCLE) (YES or NO) YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS.

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX 29. —

CAPACITY: GALLONS PER MINUTE (to nearest gallon) — (31 35)

PUMP HORSE POWER — (37 41)

PUMP COLUMN LENGTH (nearest ft.) — (43 47)

CASING HEIGHT (circle appropriate box and enter casing height)
+ above (49) LAND SURFACE
– below (49) 3 (nearest foot) (50 51)

LATITUDE 39.047585
LONGITUDE 76.704917
(DEFAULT COORD. WGS 84)

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MDE/WMA/PER.071 OWNER TEST MW 35A

C 1 54450 SEQUENCE NO. (MDE USE ONLY)

1 2 3 6 (THIS NUMBER IS TO BE PUNCHED IN COLS. 3-6 ON ALL CARDS)

STATE OF MARYLAND
WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE TYPE

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED.

COUNTY NUMBER 02

ST/CO USE ONLY
DATE Received MM DD YY (8–13)

DATE WELL COMPLETED MM DD YY: 11 19 (15–20)

Depth of Well: 30 (22–26) (TO NEAREST FOOT)

PERMIT NO. FROM "PERMIT TO DRILL WELL": AA-18-0109 (28–37)

OWNER Tucker and Associates LLC (last name / first name)

WELL SITE ADDRESS 1451 Capital Raceway Road (Frakes Station) TOWN Gambrills

SUBDIVISION ______ SECTION ______ LOT ______

WELL LOG
Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	check if water bearing
Brown f/m Sand w/ trace clay	0	16	
Brown silty sand	16	21	✓
Brown f/m Sand	21	26	✓
Light Brown silt and sand	26	31	✓

NUMBER OF UNSUCCESSFUL WELLS: 0

WELL HYDROFRACTURED yes Y no N

CIRCLE APPROPRIATE LETTER
- A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED
- E ELECTRIC LOG OBTAINED
- P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 "WELL CONSTRUCTION" AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE ABOVE CAPTIONED PERMIT, AND THAT THE INFORMATION PRESENTED HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE.

DRILLERS LIC. NO. M G D 0 2 7

DRILLERS SIGNATURE (MUST MATCH SIGNATURE ON APPLICATION)

LIC. NO. J G D 0 6 7

Melinda Nyman

SITE SUPERVISOR (sign. of driller or journeyman responsible for sitework if different from permittee)

GROUTING RECORD
WELL HAS BEEN GROUTED (Circle Appropriate Box) yes Y no N (44)

TYPE OF GROUTING MATERIAL (Circle one)
CEMENT CM (45 46) BENTONITE CLAY BC (45 46)

NO. OF BAGS ______ NO. OF POUNDS ______

GALLONS OF WATER 15

DEPTH OF GROUT SEAL (to nearest foot) from 0 ft. (48 TOP 52) to 18 ft. (54 BOTTOM 58) (enter 0 if from surface)

CASING RECORD
casing types insert appropriate code below: ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE (60 61)	Nominal diameter top (main) casing (nearest inch)! (63 64)	Total depth of main casing (nearest foot) (66 70)
PL	2	20

OTHER CASING (if used) — EACH CASING: diameter inch ______ depth (feet) from ______ to ______

SCREEN RECORD
screen type or open hole insert appropriate code below: ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C 2 — DEPTH (nearest ft.)

EACH SCREEN	Type	from	to
1 (8 9 / 11 15 / 17 21)	PL	20	30
2 (23 24 / 26 30 / 32 36)			
3 (38 39 / 41 45 / 47 51)			

SLOT SIZE 1 .010 2 ______ 3 ______

DIAMETER OF SCREEN 2 (56 60) (NEAREST INCH)

GRAVEL PACK from 18 to 30

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

MDE USE ONLY (NOT TO BE FILLED IN BY DRILLER)
T (E.R.O.S.) W Q
70 TELESCOPE CASING; 72 LOG INDICATOR; 74 75 76 OTHER DATA

C 3

PUMPING TEST
HOURS PUMPED (nearest hour) N/A (8 9)

PUMPING RATE (gal. per min.) ______ (11–15)

METHOD USED TO MEASURE PUMPING RATE ______

WATER LEVEL (distance from land surface)

BEFORE PUMPING ______ ft. (17–20)

WHEN PUMPING ______ ft. (22–25)

TYPE OF PUMP USED (for test) (27): A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, S submersible

PUMP INSTALLED
DRILLER INSTALLED PUMP (CIRCLE) (YES or NO) YES NO

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS.

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX 29. ______

CAPACITY: GALLONS PER MINUTE (to nearest gallon) ______ (31–35)

PUMP HORSE POWER ______ (37–41)

PUMP COLUMN LENGTH (nearest ft.) ______ (43–47)

CASING HEIGHT (circle appropriate box and enter casing height)
+ above (49) LAND SURFACE
− below (49) 3 (50 51) (nearest foot)

LATITUDE 39.048579
LONGITUDE 76.703769
(DEFAULT COORD. WGS 84)

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MDE/WMA/PER.071 OWNER TEST-MW 34A

ATTACHMENT 4

Laboratory Soil Testing Results [Geosyntec, 2019]

HILLIS-CARNES
ENGINEERING ASSOCIATES
300 South Pennell Road, Suite 410
Media, PA 19063
P (484) 434-1000 F (484) 581-2020

LETTER OF TRANSMITTAL

May 22, 2019

Geosyntec Consultants
10211 Wincopin Circle, Floor 4

Columbia, MD 21044

RE: Geosyntec-Tolson LF

HCEA Project No.: P19036

Location: NA, PA

We are enclosing:

__X__ Materials Engineering Division Reports

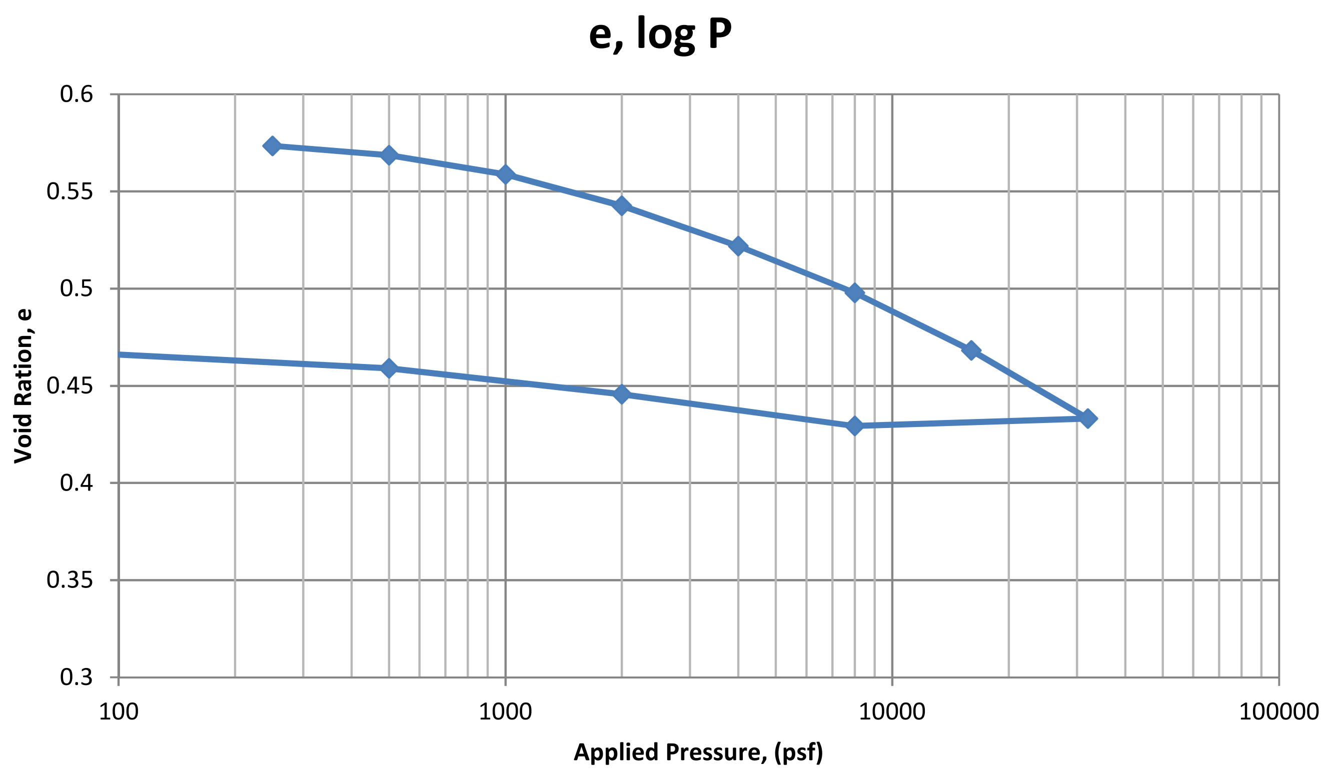
_____ Materials Laboratory Reports

CC: Geosyntec Consultants - Mark Bauer

ENCL:

Lab Test Results	5/22/2019
Lab Test Results	5/22/2019
Lab Test Results	5/22/2019

Consolidation Test Report



Material Description	USCS	AASHTO
Clayey SAND	SC	A-2-4(0)

LL	25
PI	9
Sg	2.71

	Init	Final
Dry Density (pcf)	107.1	114.8
Moisture	0.175	0.175
Saturation	0.817	1.000
Void Ratio	0.576	0.472

Pc (psf)	Cc
2310	0.12

Preparation:

Shelby tube extraction

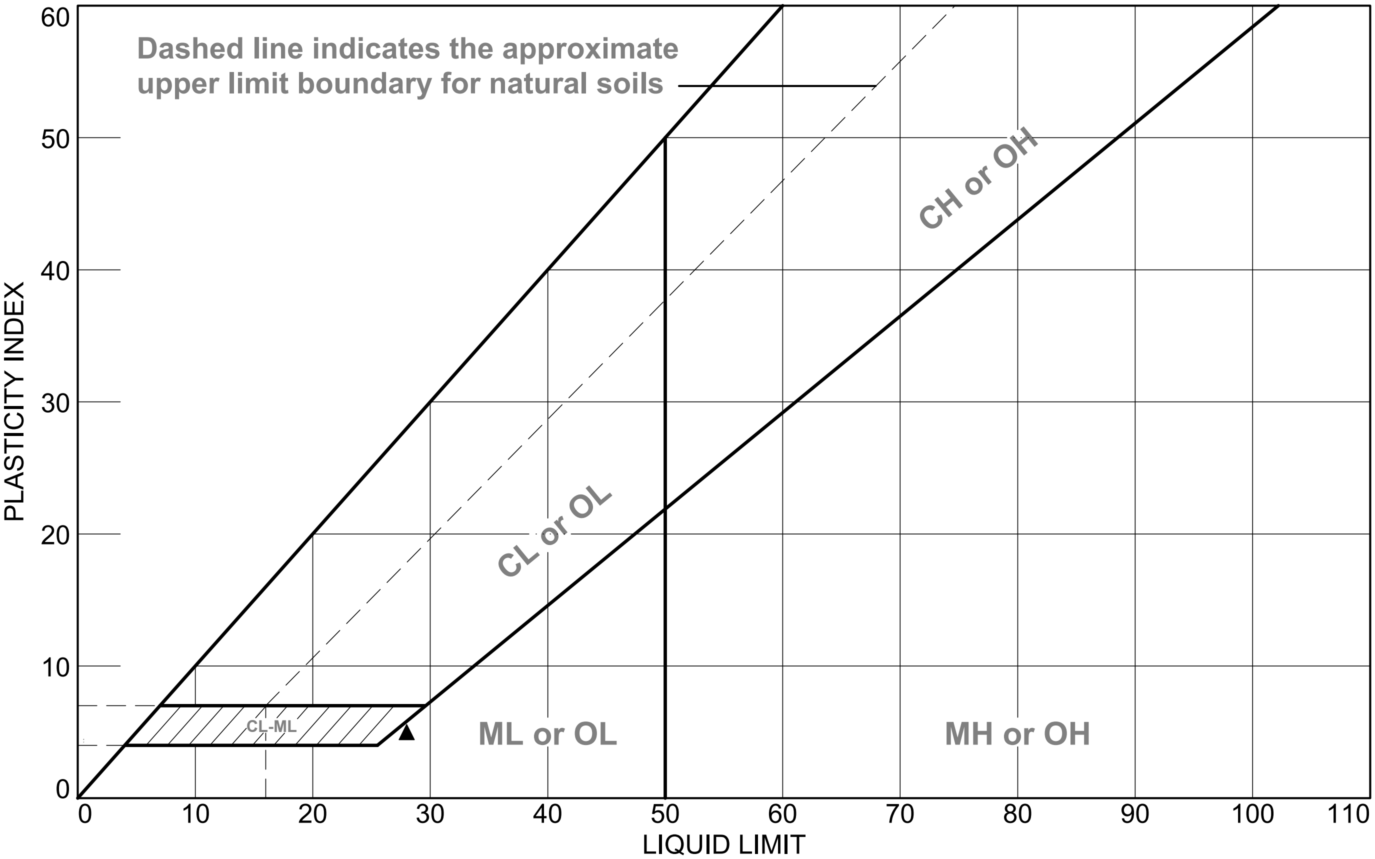
Notes:

Proj. No. P19036 Client: Geosyntec Consultants
Project: Tolson Rubble Landfill Phase 2
Sample: B117
Depth: 54-56'

Hillis-Carnes Engineering Associates

Media, Pennsylvania

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LIQUIDITY INDEX	USCS
●	B117		34'	5.9	NP	NV	NP		SW
■	B117		9'	3.8	NP	NV	NP		SP
▲	B117		49'	19.6	23	28	5	-0.7	
◆	B117		47'	17.9	NP	NV	NP		SP

HILLIS-CARNES ENGINEERING ASSOCIATES

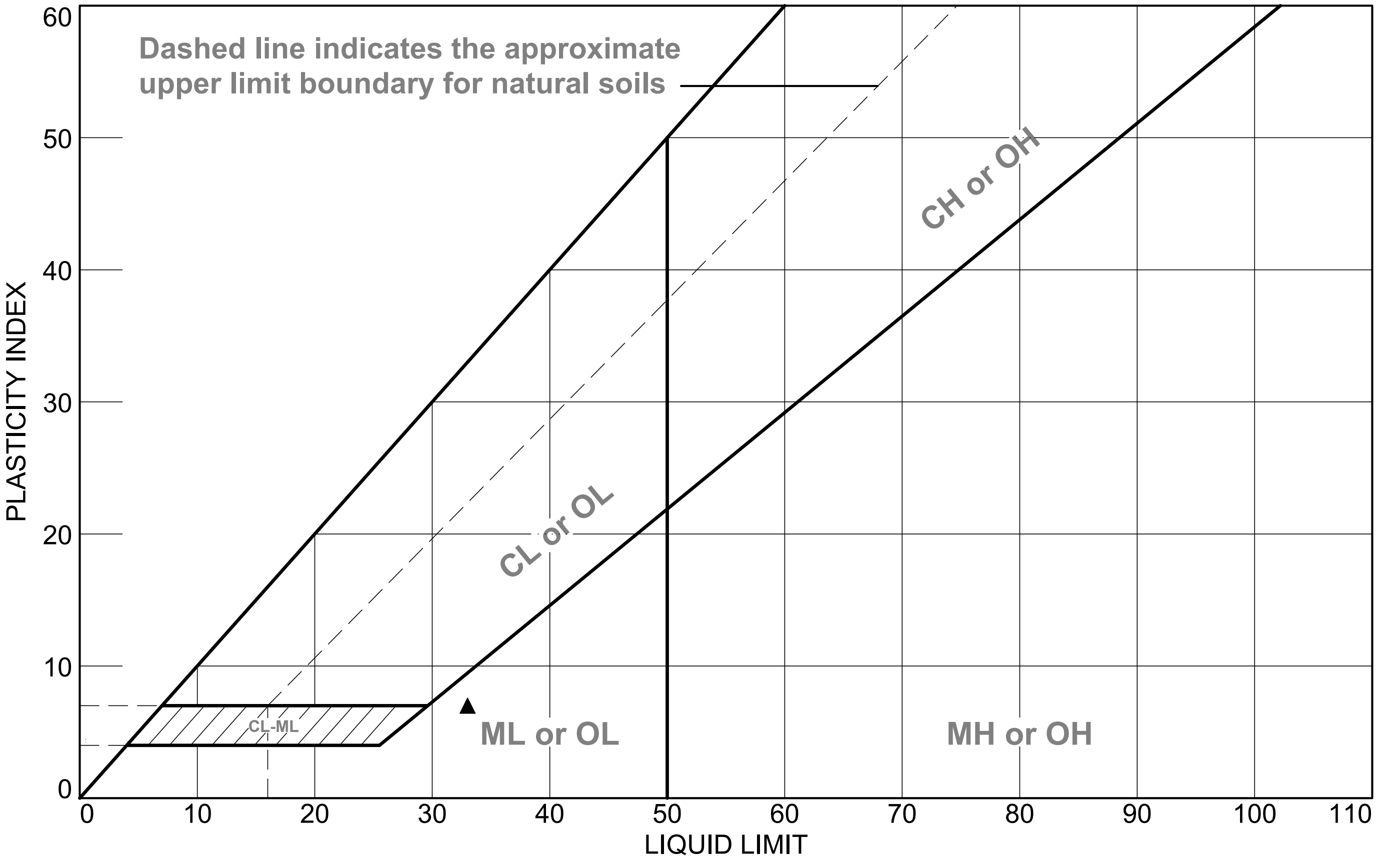
Philadelphia, Pennsylvania

Client: Geosyntec
Project: Tolson Rubble Landfill

Project No.:

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT

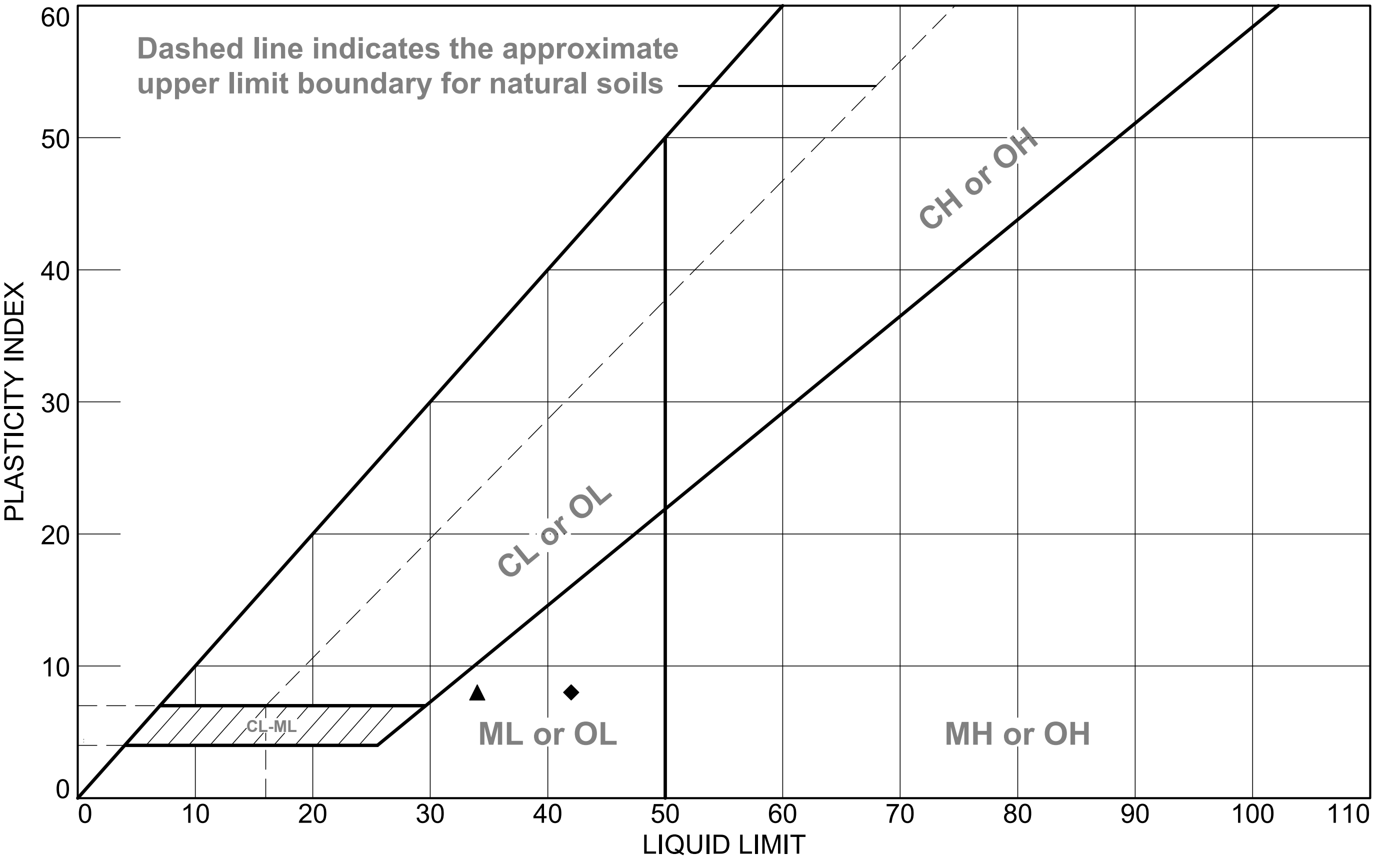


SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LIQUIDITY INDEX	USCS
●	B118		44'	15.5	NP	NV	NP		SP
■	B118		24'	12.0	NP	18	NP		
▲	B118		79'	14.6	26	33	7	-1.6	
◆	B118		9'	15.8	NP	30	NP		

HILLIS-CARNES ENGINEERING ASSOCIATES Philadelphia, Pennsylvania	**Client:** Geosyntec **Project:** Tolson Rubble Landfill **Project No.:** **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT

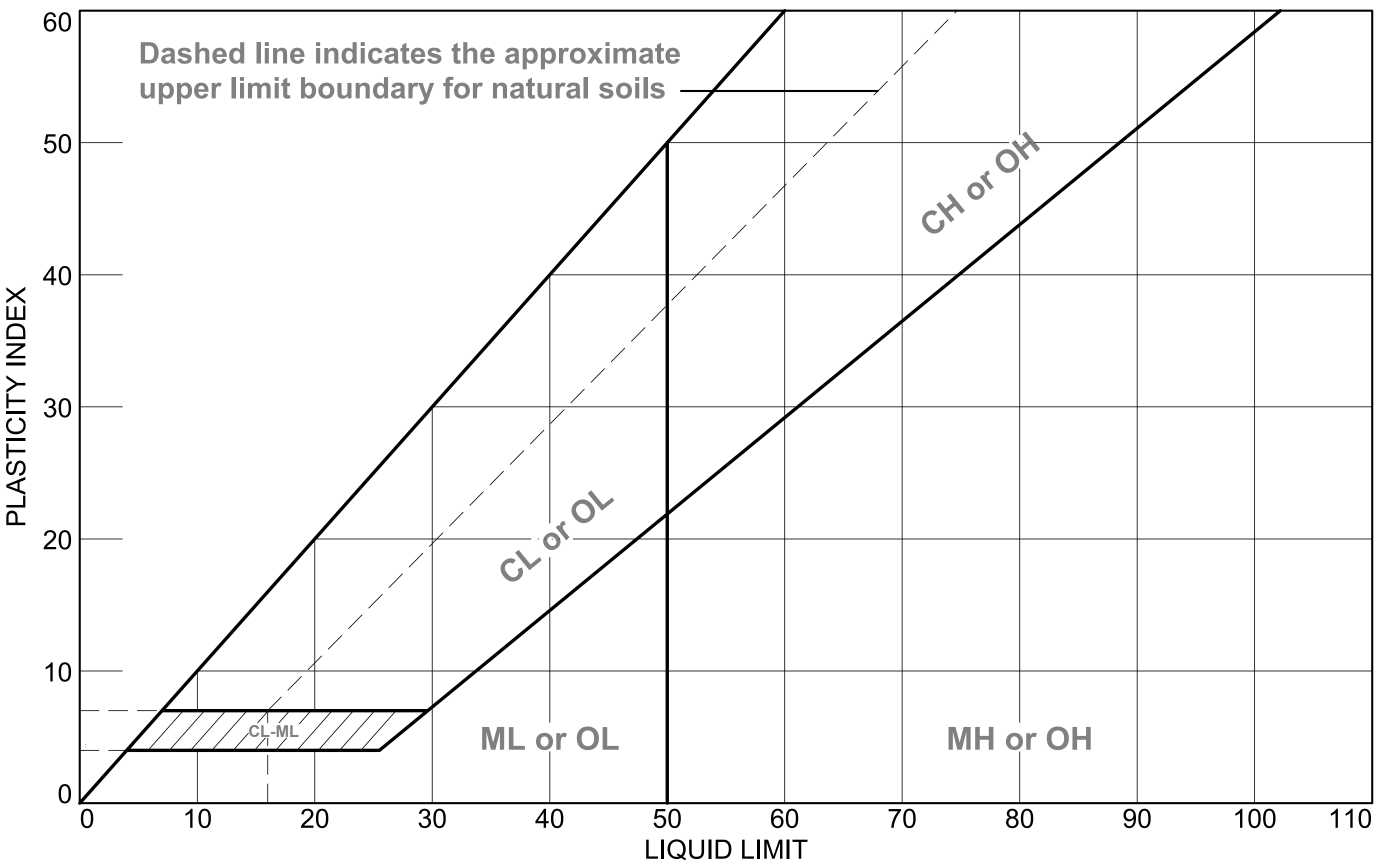


SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LIQUIDITY INDEX	USCS
●	B119		20'	9.0	NP	NV	NP		SW-SM
■	B119		89'	18.7	NP	NV	NP		SP
▲	B119		99'	15.1	26	34	8	-1.4	
◆	B119		54'	26.7	34	42	8	-0.9	

HILLIS-CARNES ENGINEERING ASSOCIATES **Philadelphia, Pennsylvania**	**Client:** Geosyntec **Project:** Tolson Rubble Landfill **Project No.:** **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LIQUIDITY INDEX	USCS
●	MW-32A		19'	4.0	NP	NV	NP		SP
■	MW-32A		34'	20.6	NP	18	NP		

HILLIS-CARNES ENGINEERING ASSOCIATES

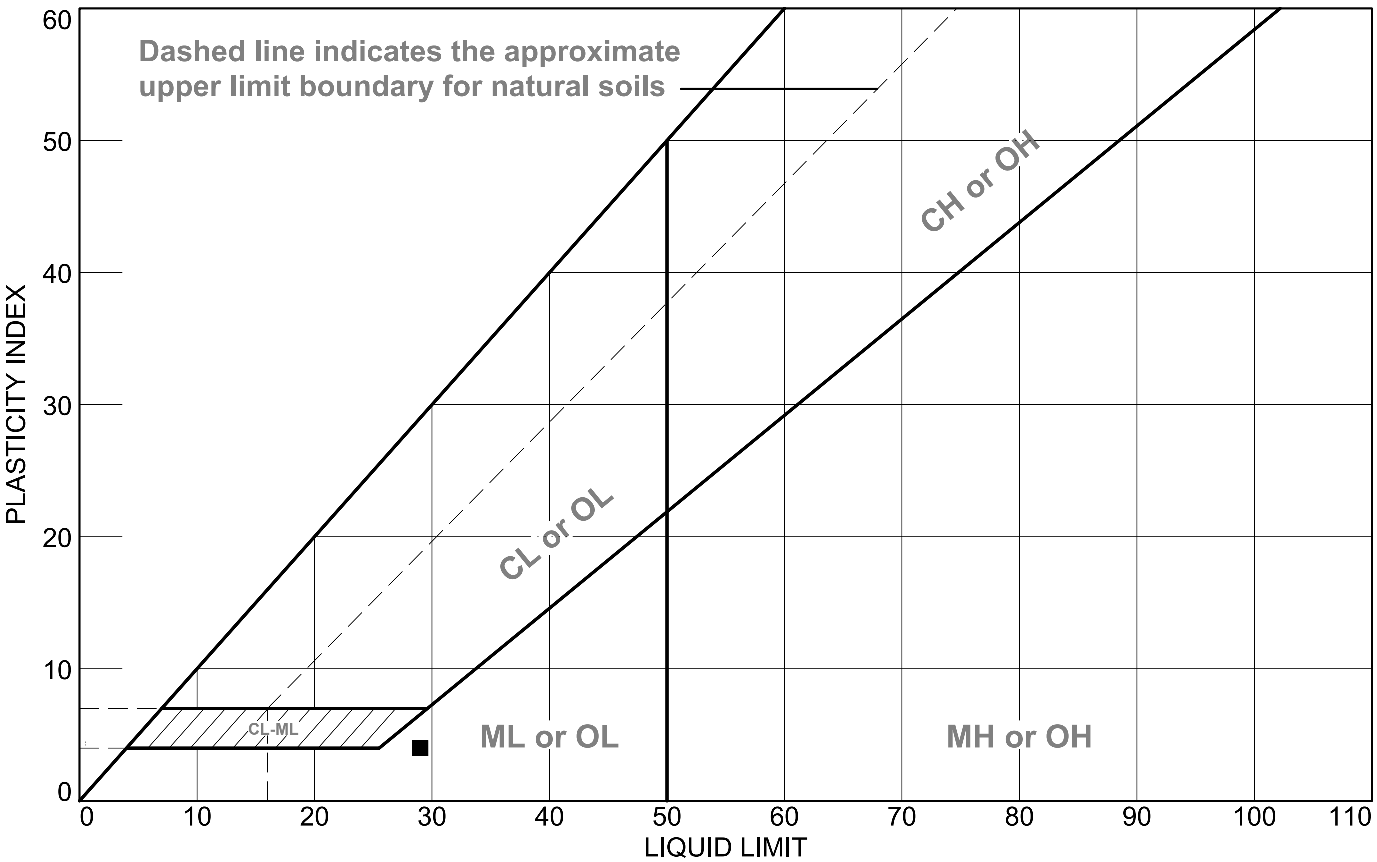
Philadelphia, Pennsylvania

Client: Geosyntec

Project: Tolson Rubble Landfill

Project No.: **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT

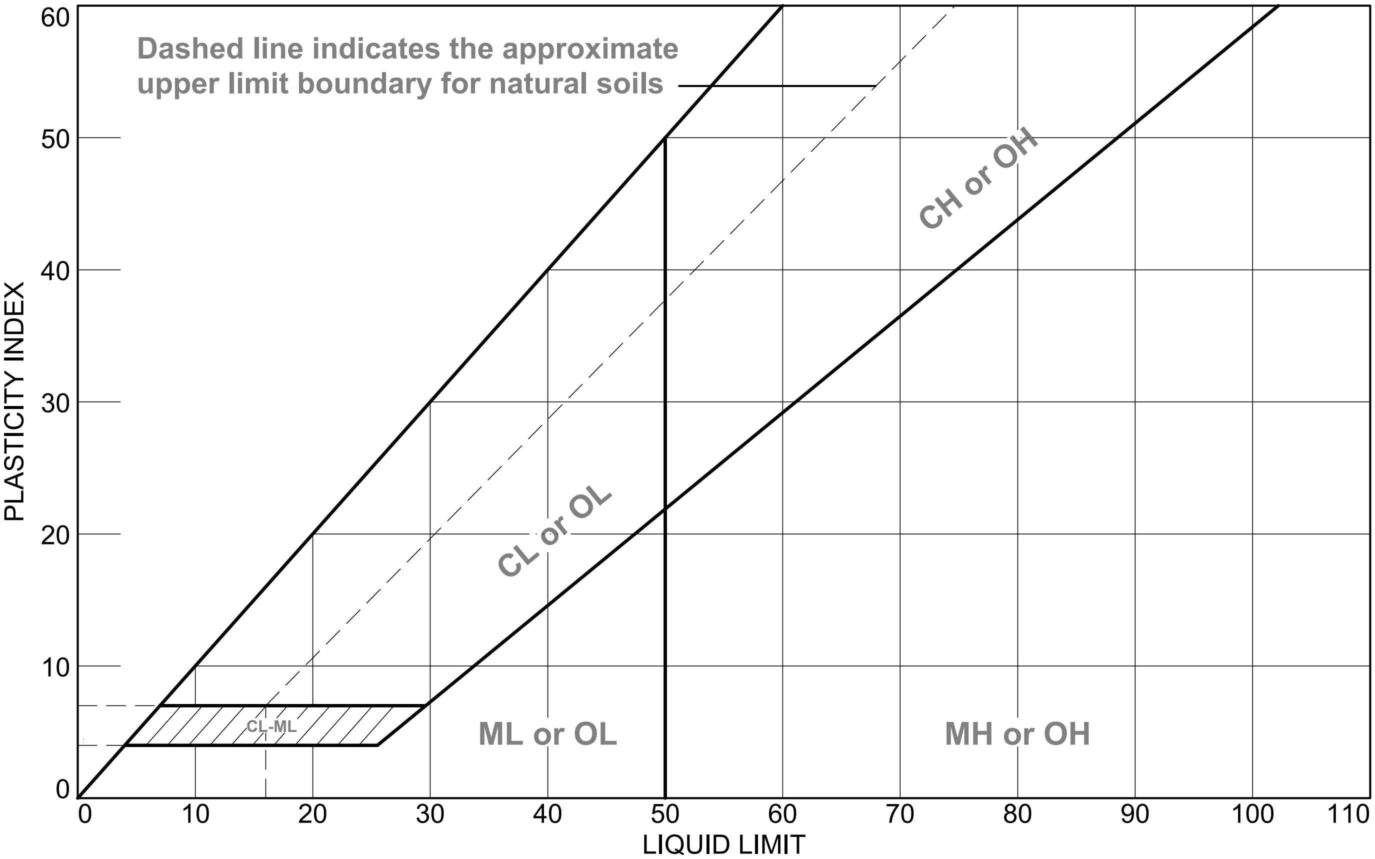


SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LIQUIDITY INDEX	USCS
●	MW-33A		14'	12.2	NP	NV	NP		SP-SM
■	MW-33A		44'	26.0	25	29	4	0.2	

HILLIS-CARNES ENGINEERING ASSOCIATES **Philadelphia, Pennsylvania**	**Client:** Geosyntec **Project:** Tolson Rubble Landfill **Project No.:** **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT

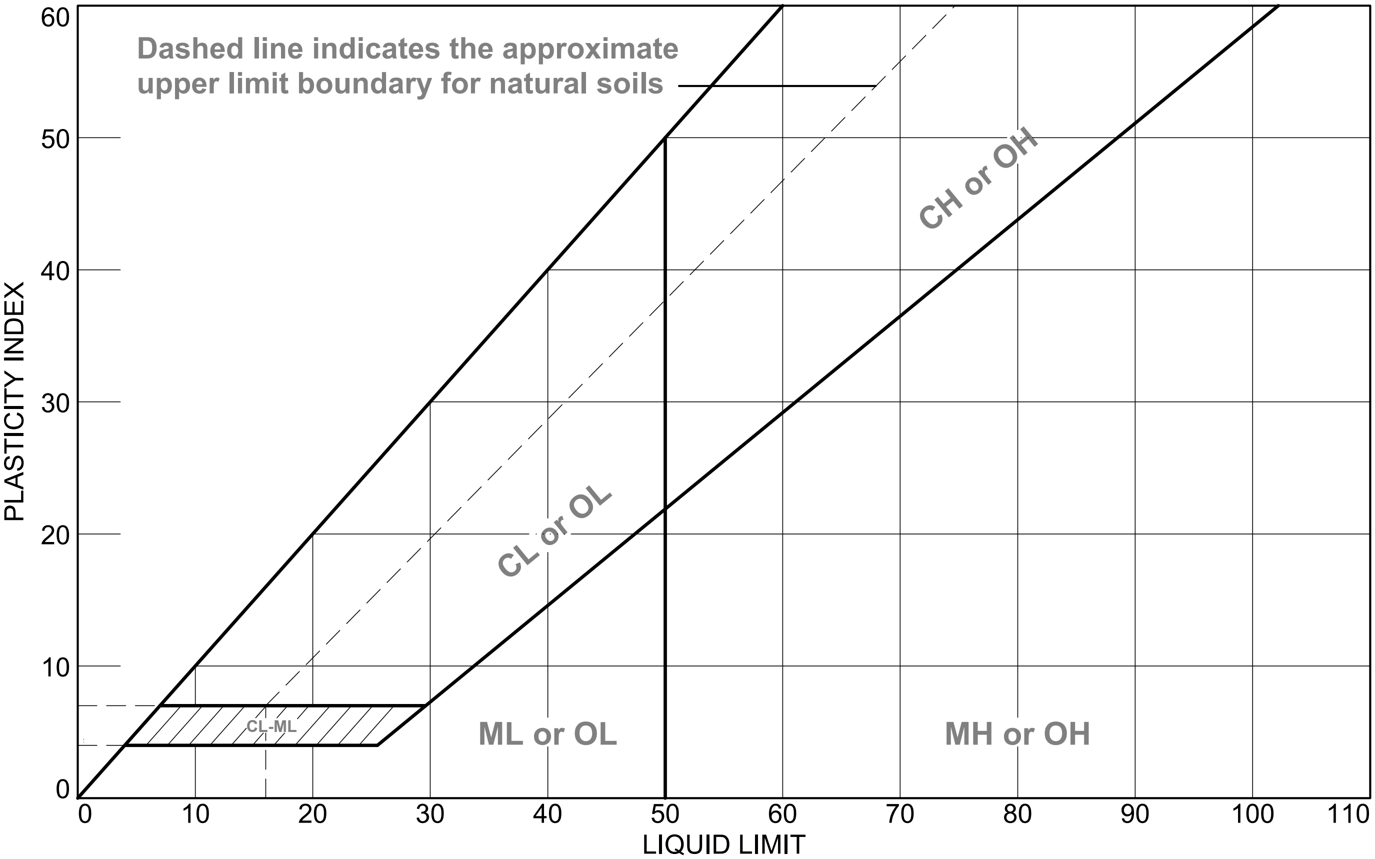


SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LIQUIDITY INDEX	USCS
●	MW-34A		14'	15.8	NP	NV	NP		SP
■	MW-34A		29'	19.1	NP	22	NP		

HILLIS-CARNES ENGINEERING ASSOCIATES **Philadelphia, Pennsylvania**	**Client:** Geosyntec **Project:** Tolson Rubble Landfill **Project No.:** **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LIQUIDITY INDEX	USCS
●	MW-35A		14'	18.1	NP	NV	NP		SP
■	MW-35A		19'	23.7	NP	NV	NP		SP

HILLIS-CARNES ENGINEERING ASSOCIATES

Philadelphia, Pennsylvania

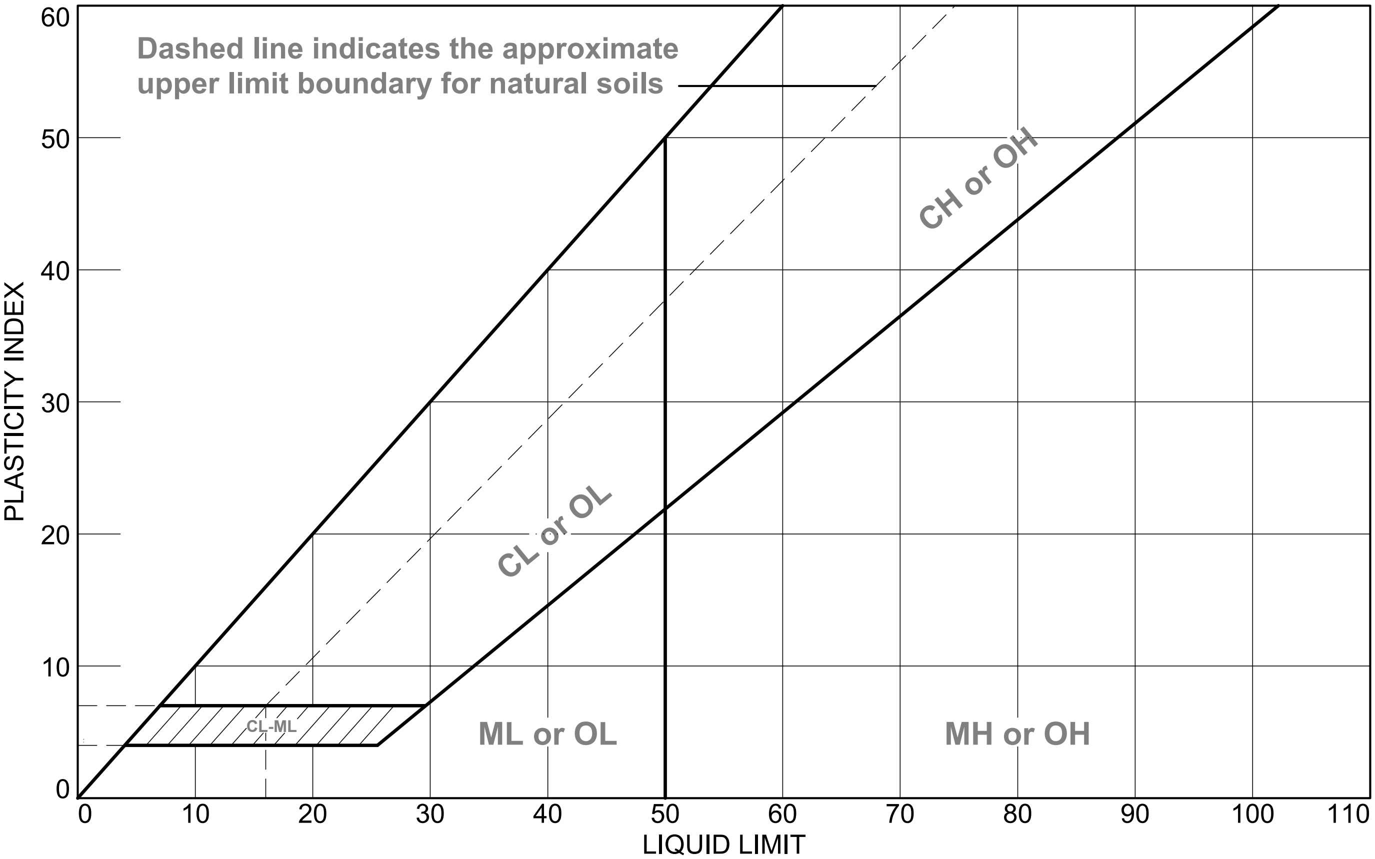
Client: Geosyntec

Project: Tolson Rubble Landfill

Project No.:

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT

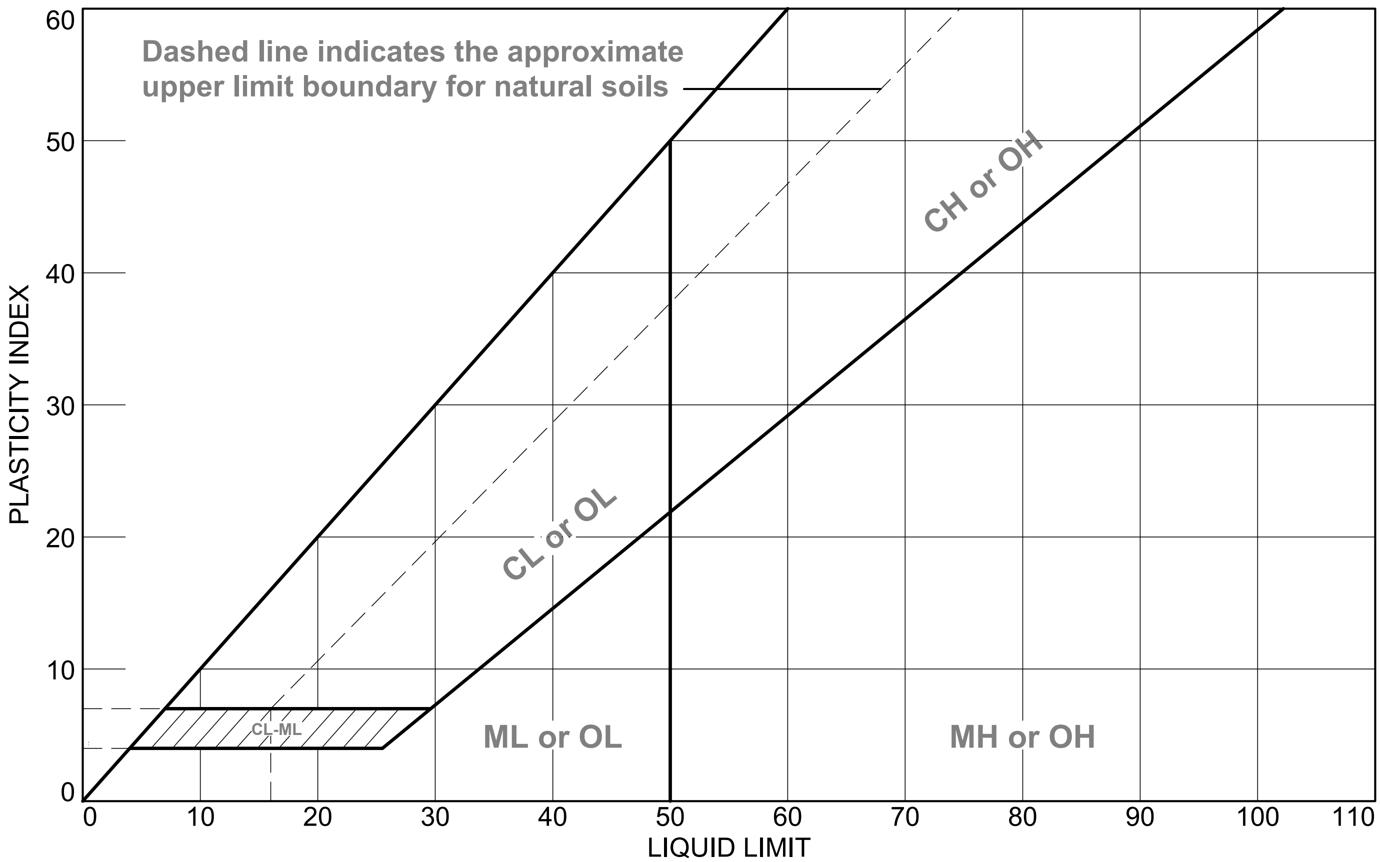


SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LIQUIDITY INDEX	USCS
●	MW-36A		9'	19.9	NP	NV	NP		SP
■	MW-36A		19'	19.7	NP	NV	NP		SP

HILLIS-CARNES ENGINEERING ASSOCIATES **Philadelphia, Pennsylvania**	**Client:** Geosyntec **Project:** Tolson Rubble Landfill **Project No.:** **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LIQUIDITY INDEX	USCS
●	MW-37A		14'	18.0	NP	NV	NP		SP
■	MW-37A		19'	22.3	NP	NV	NP		

HILLIS-CARNES ENGINEERING ASSOCIATES

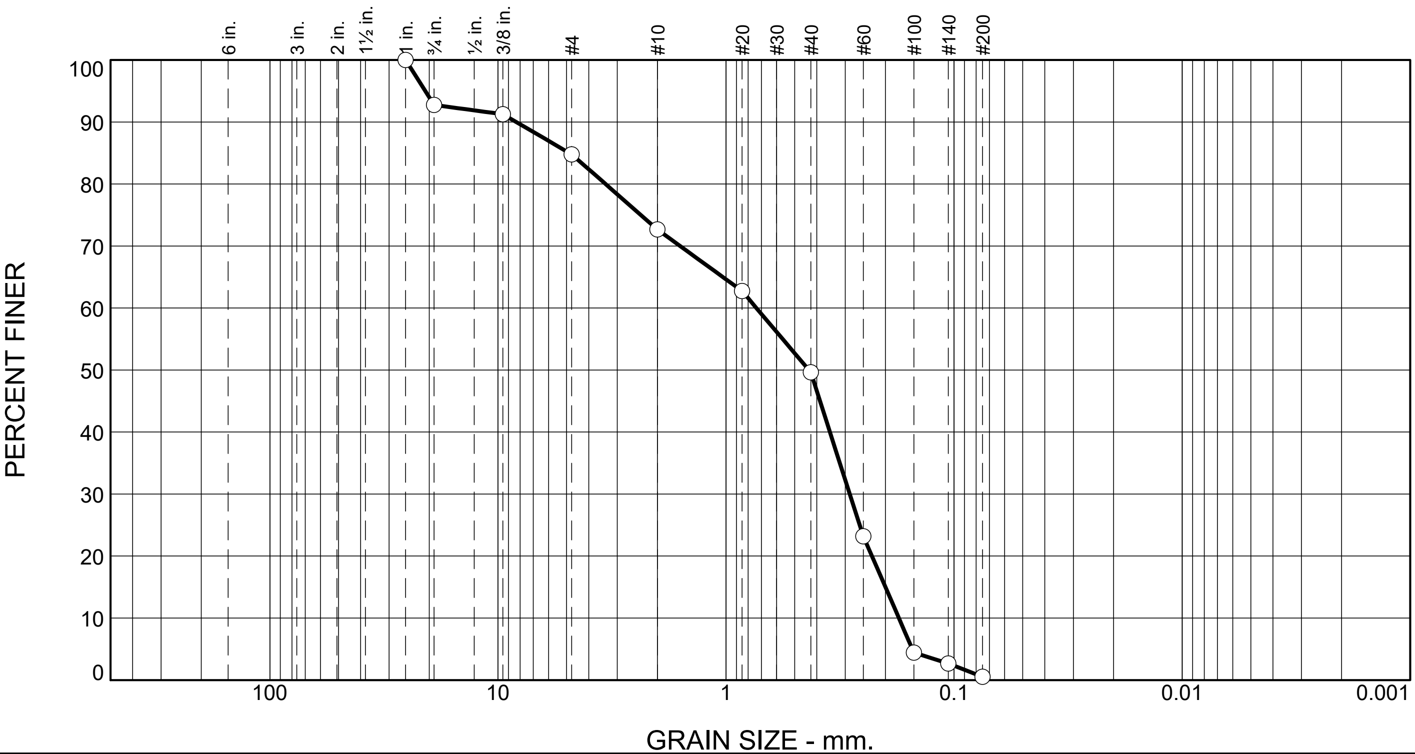
Philadelphia, Pennsylvania

Client: Geosyntec
Project: Tolson Rubble Landfill

Project No.:

Figure

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	7.2	8.0	12.1	23.1	49.1	0.5	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1	100.0		
.75	92.8		
.375	91.3		
#4	84.8		
#10	72.7		
#20	62.7		
#40	49.6		
#60	23.2		
#100	4.4		
#140	2.7		
#200	0.5		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 8.3200 D_{85}= 4.8592 D_{60}= 0.7355
D_{50}= 0.4333 D_{30}= 0.2866 D_{15}= 0.2001
D_{10}= 0.1746 C_u= 4.21 C_c= 0.64

Remarks

Date Received: ____________ **Date Tested:** ____________

Tested By: ____________

Checked By: ____________

Title: ____________

Source of Sample: B117 **Depth:** 9' **Date Sampled:**

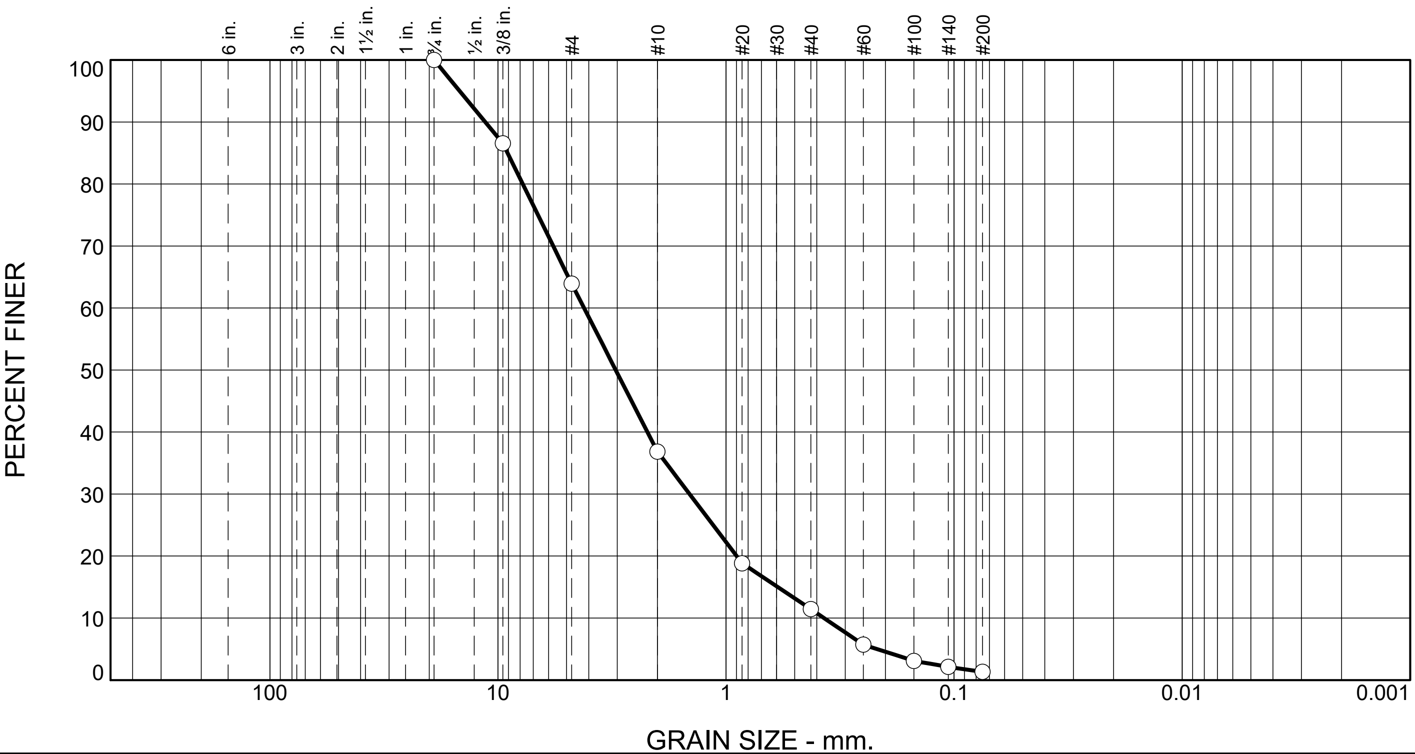
HILLIS-CARNES ENGINEERING ASSOCIATES

Philadelphia, Pennsylvania

Client: Geosyntec
Project: Tolson Rubble Landfill

Project No: **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	36.1	27.1	25.4	10.1	1.3	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.75	100.0		
.375	86.6		
#4	63.9		
#10	36.8		
#20	18.8		
#40	11.4		
#60	5.7		
#100	3.1		
#140	2.1		
#200	1.3		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SW **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 11.3673 D_{85}= 9.0751 D_{60}= 4.1909
D_{50}= 3.0447 D_{30}= 1.4446 D_{15}= 0.5934
D_{10}= 0.3721 C_u= 11.26 C_c= 1.34

Remarks

Date Received: ____________ **Date Tested:** ____________
Tested By: ____________
Checked By: ____________
Title: ____________

Source of Sample: B117 **Depth:** 34' **Date Sampled:**

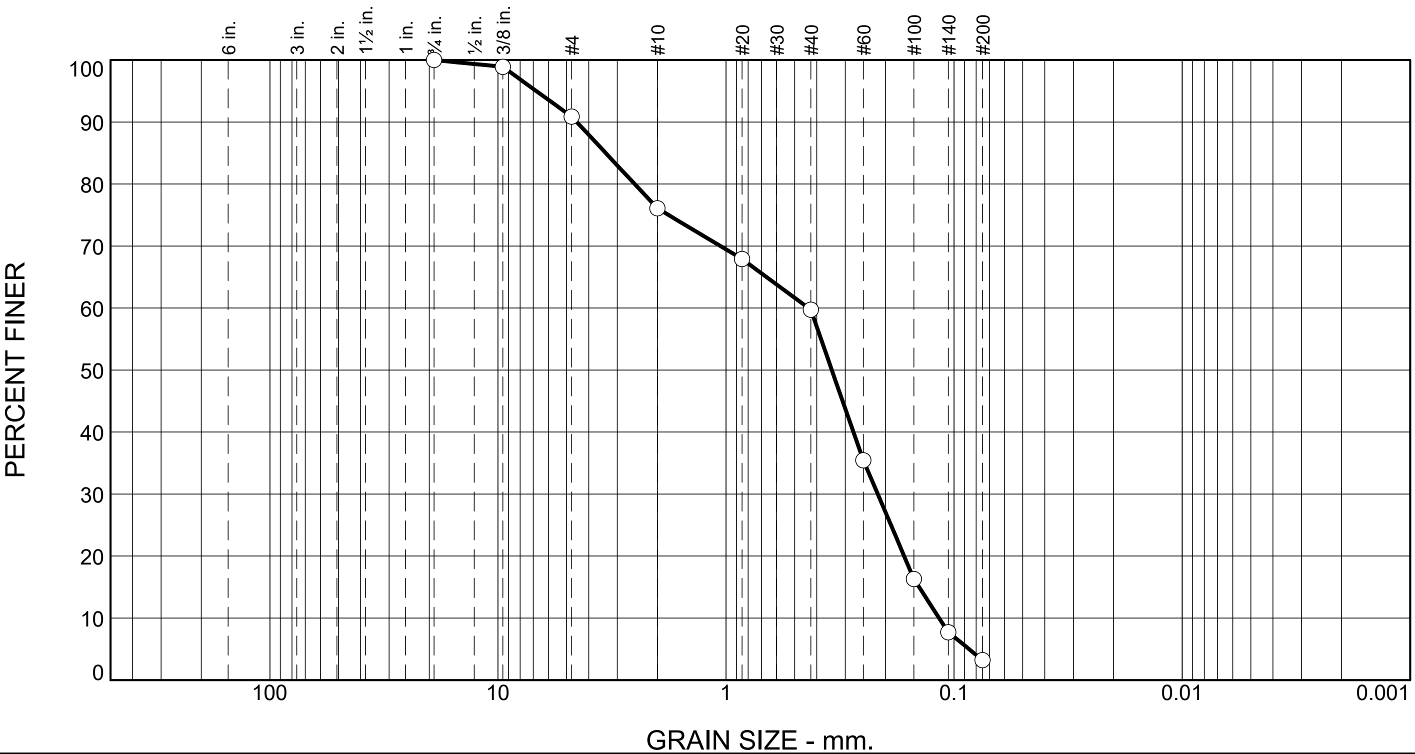
HILLIS-CARNES ENGINEERING ASSOCIATES

Philadelphia, Pennsylvania

Client: Geosyntec
Project: Tolson Rubble Landfill

Project No: **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	9.1	14.8	16.4	56.5	3.2	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.75	100.0		
.375	98.9		
#4	90.9		
#10	76.1		
#20	67.9		
#40	59.7		
#60	35.4		
#100	16.3		
#140	7.7		
#200	3.2		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP **AASHTO (M 145)=** A-3

Coefficients

D_{90}= 4.5149 D_{85}= 3.3690 D_{60}= 0.4353
D_{50}= 0.3437 D_{30}= 0.2162 D_{15}= 0.1423
D_{10}= 0.1163 C_u= 3.74 C_c= 0.92

Remarks

Date Received: **Date Tested:**

Tested By:

Checked By:

Title:

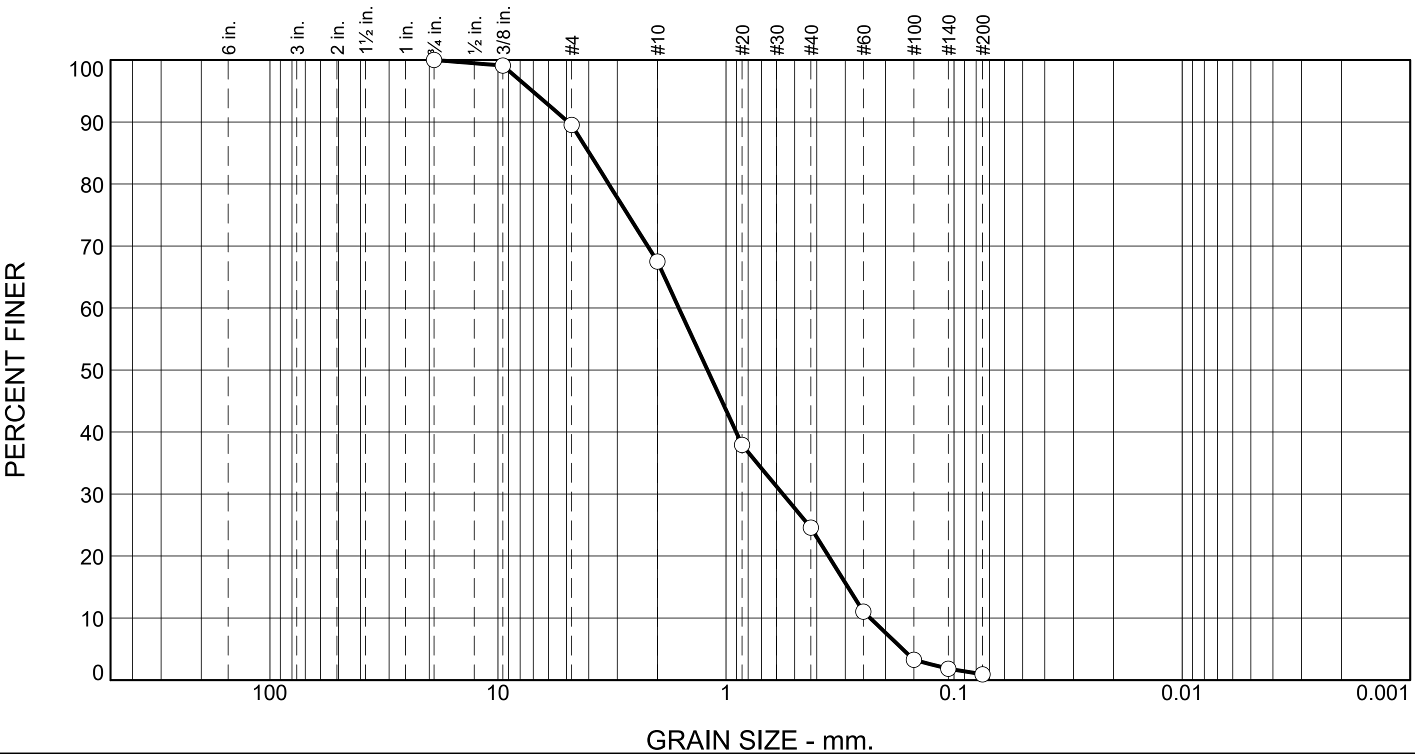
Source of Sample: B117 **Depth:** 47' **Date Sampled:**

HILLIS-CARNES ENGINEERING ASSOCIATES

Philadelphia, Pennsylvania

Client: Geosyntec
Project: Tolson Rubble Landfill
Project No: **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	10.5	22.0	42.9	23.7	0.9	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.75	100.0		
.375	99.1		
#4	89.5		
#10	67.5		
#20	37.9		
#40	24.6		
#60	11.0		
#100	3.3		
#140	1.8		
#200	0.9		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 4.9146 D_{85}= 3.9762 D_{60}= 1.6102
D_{50}= 1.2056 D_{30}= 0.5633 D_{15}= 0.2920
D_{10}= 0.2335 C_u= 6.90 C_c= 0.84

Remarks

Date Received: ____________ **Date Tested:** ____________

Tested By: ____________

Checked By: ____________

Title: ____________

Source of Sample: B118 **Depth:** 44' **Date Sampled:**

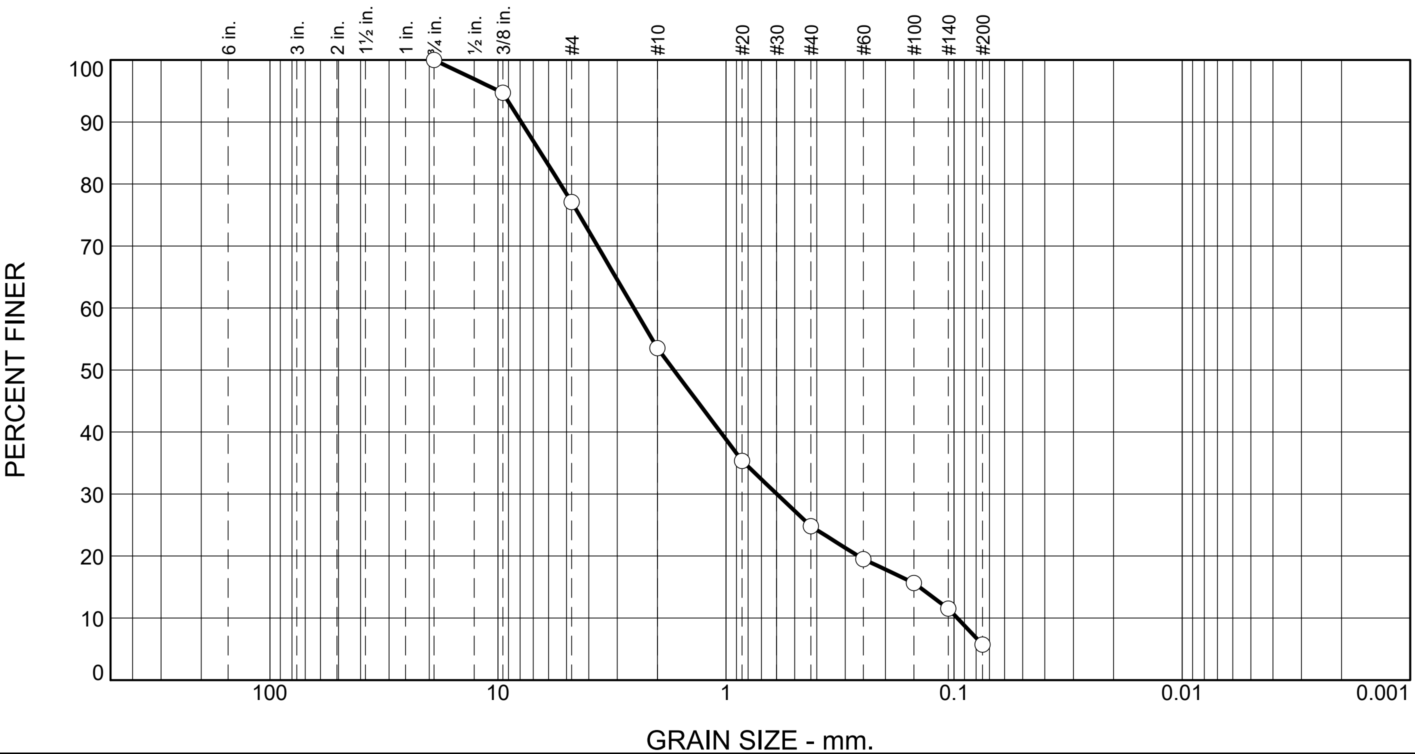
HILLIS-CARNES ENGINEERING ASSOCIATES

Philadelphia, Pennsylvania

Client: Geosyntec
Project: Tolson Rubble Landfill

Project No: **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	22.9	23.6	28.7	19.1	5.7	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.75	100.0		
.375	94.7		
#4	77.1		
#10	53.5		
#20	35.3		
#40	24.8		
#60	19.5		
#100	15.7		
#140	11.5		
#200	5.7		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SW-SM **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 7.9041 D_{85}= 6.4881 D_{60}= 2.5355
D_{50}= 1.6935 D_{30}= 0.5980 D_{15}= 0.1419
D_{10}= 0.0968 C_u= 26.19 C_c= 1.46

Remarks

Date Received: ______ **Date Tested:** ______

Tested By: ______

Checked By: ______

Title: ______

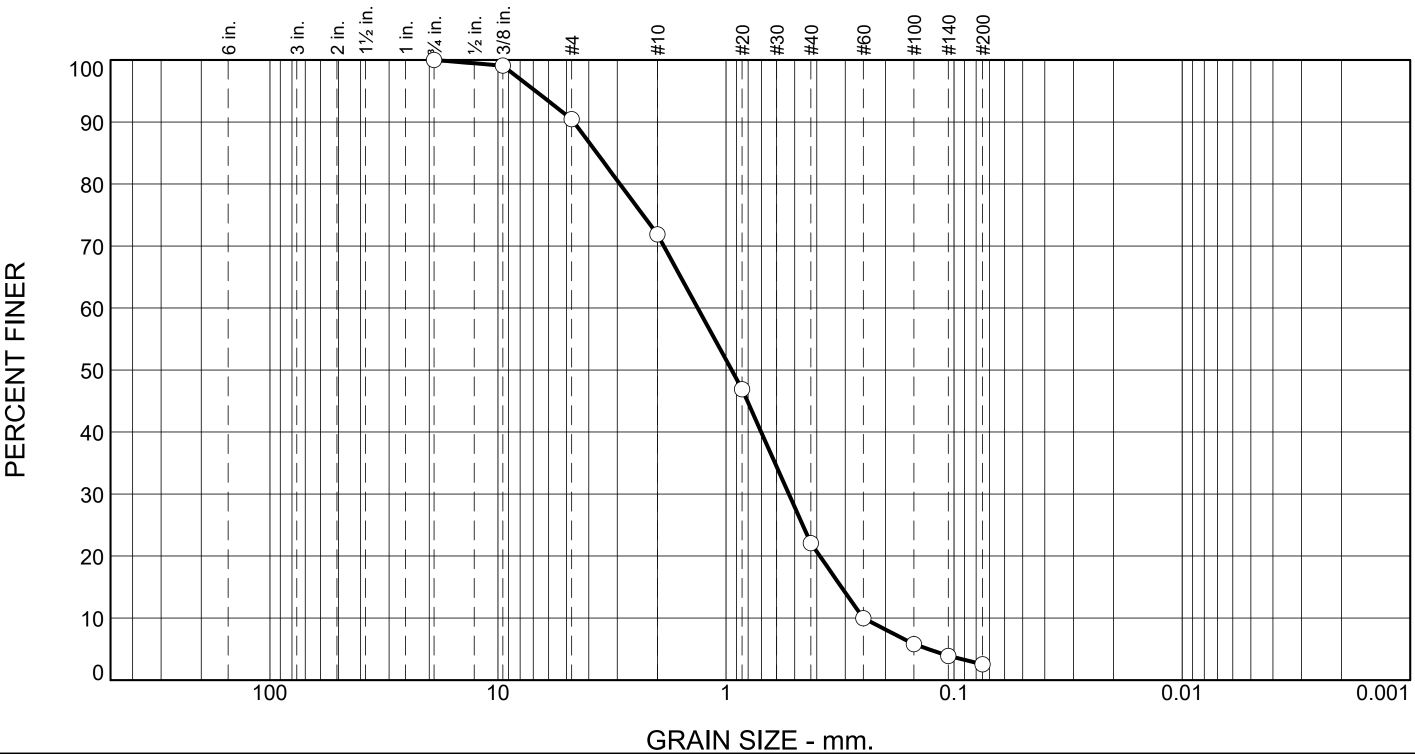
Source of Sample: B119 **Depth:** 20' **Date Sampled:**

HILLIS-CARNES ENGINEERING ASSOCIATES

Philadelphia, Pennsylvania

Client: Geosyntec
Project: Tolson Rubble Landfill
Project No: **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	9.5	18.6	49.8	19.5	2.6	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.75	100.0		
.375	99.1		
#4	90.5		
#10	71.9		
#20	46.9		
#40	22.1		
#60	10.0		
#100	5.8		
#140	3.9		
#200	2.6		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 4.6498 D_{85}= 3.6835 D_{60}= 1.3311
D_{50}= 0.9452 D_{30}= 0.5303 D_{15}= 0.3117
D_{10}= 0.2503 C_u= 5.32 C_c= 0.84

Remarks

Date Received: ____________ **Date Tested:** ____________

Tested By: ______________________

Checked By: ______________________

Title: ______________________

Source of Sample: B119 **Depth:** 89' **Date Sampled:**

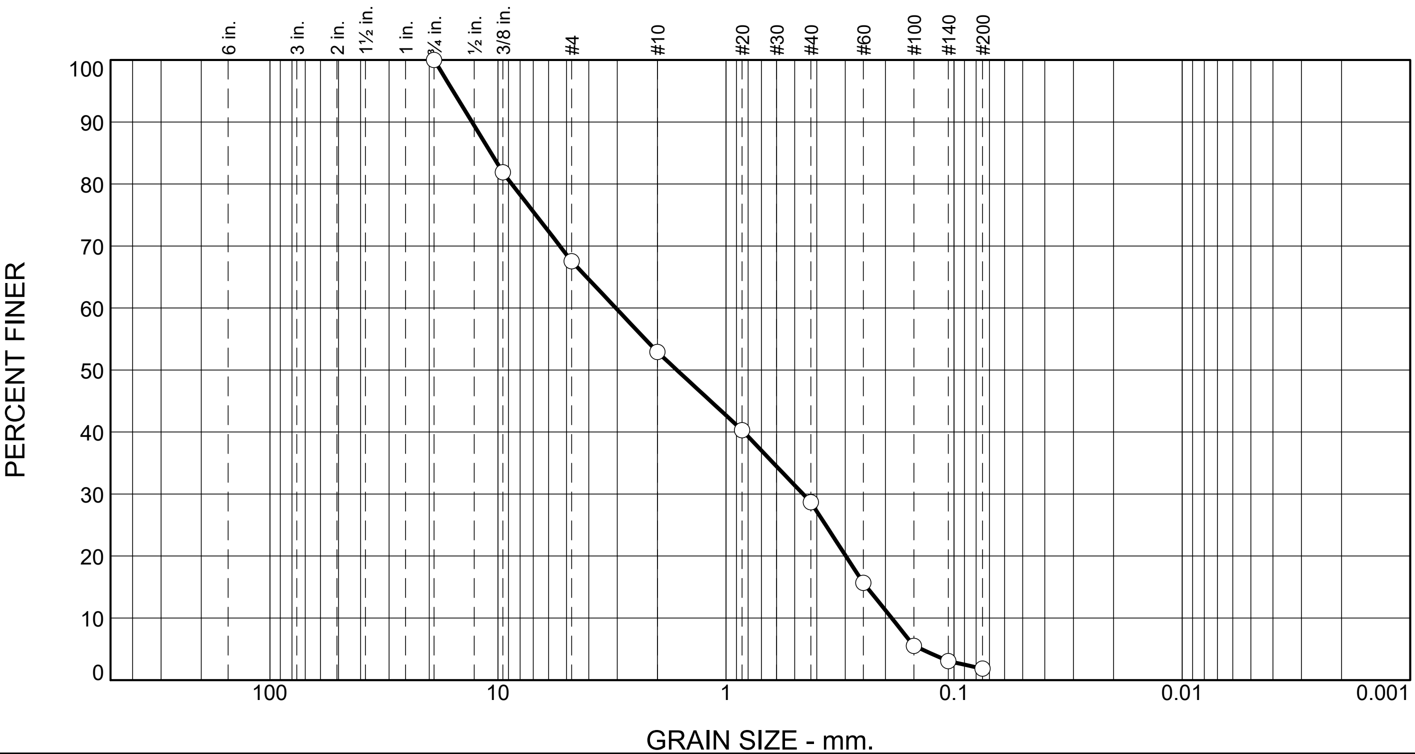
HILLIS-CARNES ENGINEERING ASSOCIATES

Philadelphia, Pennsylvania

Client: Geosyntec
Project: Tolson Rubble Landfill

Project No: **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	32.5	14.6	24.2	26.9	1.8	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.75	100.0		
.375	81.9		
#4	67.5		
#10	52.9		
#20	40.3		
#40	28.7		
#60	15.7		
#100	5.5		
#140	3.1		
#200	1.8		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 12.9944 D_{85}= 10.7322 D_{60}= 3.0411
D_{50}= 1.6418 D_{30}= 0.4596 D_{15}= 0.2416
D_{10}= 0.1879 C_u= 16.19 C_c= 0.37

Remarks

Date Received: ____________ **Date Tested:** ____________

Tested By: ____________

Checked By: ____________

Title: ____________

Source of Sample: MW-32A **Depth:** 19' **Date Sampled:**

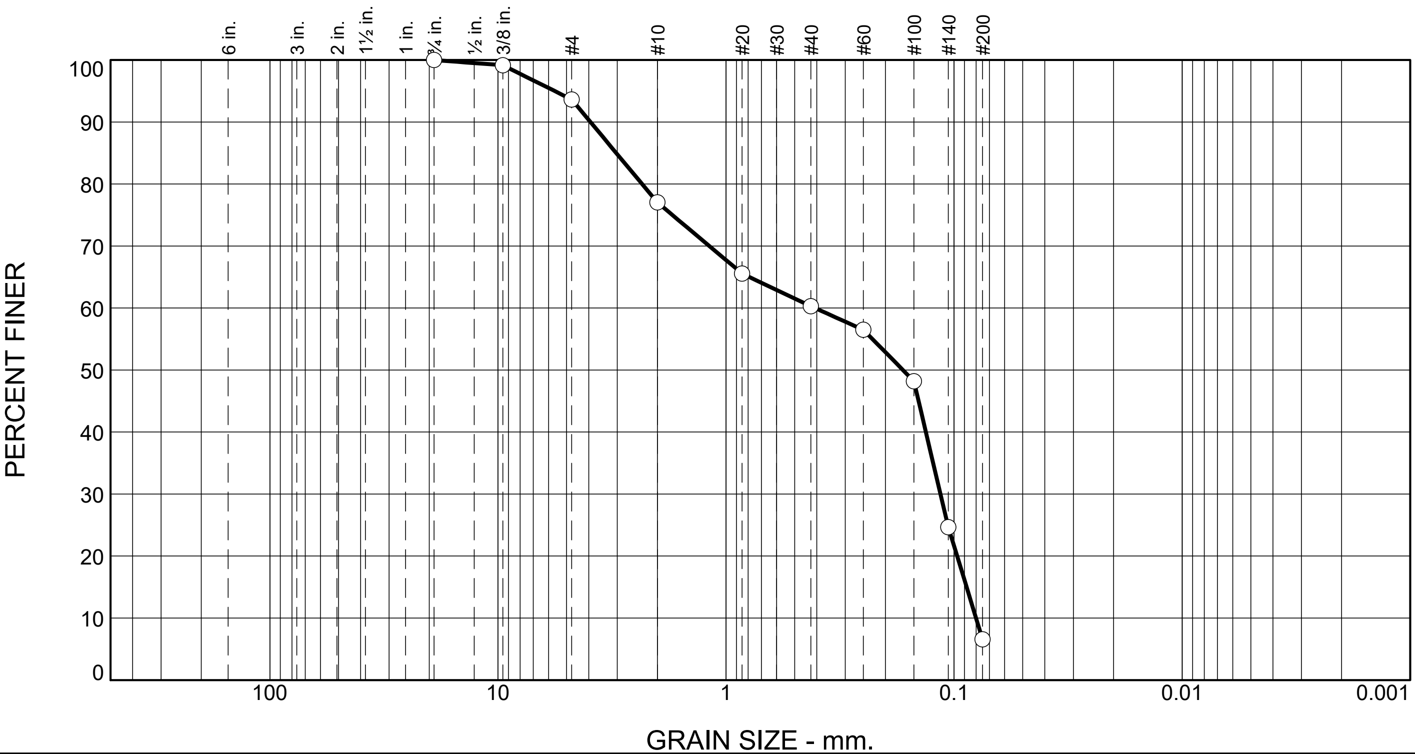
HILLIS-CARNES ENGINEERING ASSOCIATES

Philadelphia, Pennsylvania

Client: Geosyntec
Project: Tolson Rubble Landfill

Project No: **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.4	16.6	16.7	53.7	6.6	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.75	100.0		
.375	99.2		
#4	93.6		
#10	77.0		
#20	65.6		
#40	60.3		
#60	56.5		
#100	48.2		
#140	24.6		
#200	6.6		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP-SM **AASHTO (M 145)=** A-3

Coefficients

D_{90}= 3.9295 D_{85}= 3.0278 D_{60}= 0.4079
D_{50}= 0.1677 D_{30}= 0.1147 D_{15}= 0.0881
D_{10}= 0.0801 C_u= 5.09 C_c= 0.40

Remarks

Date Received: ______ **Date Tested:** ______

Tested By: ______

Checked By: ______

Title: ______

Source of Sample: MW-33A **Depth:** 14' **Date Sampled:**

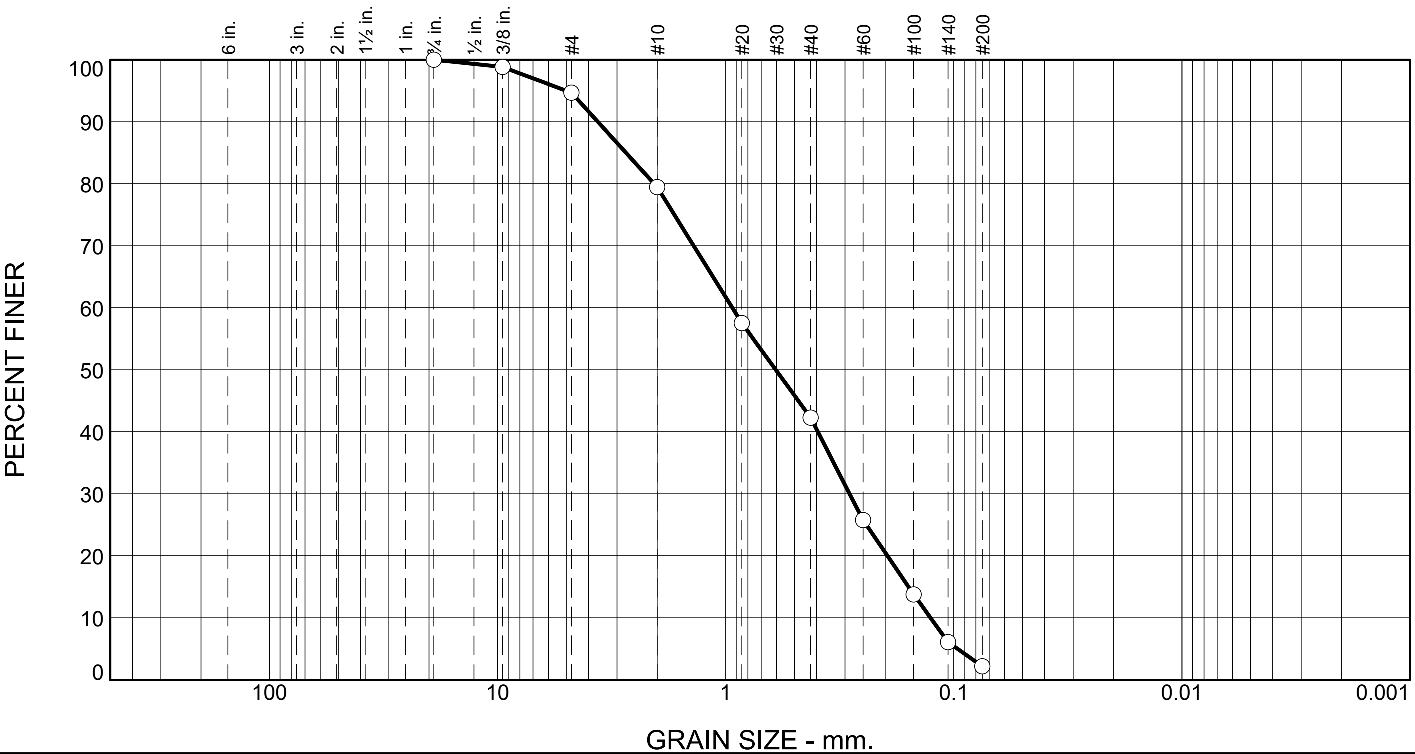
HILLIS-CARNES ENGINEERING ASSOCIATES

Philadelphia, Pennsylvania

Client: Geosyntec
Project: Tolson Rubble Landfill

Project No: **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	5.3	15.2	37.2	40.1	2.2	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.75	100.0		
.375	98.8		
#4	94.7		
#10	79.5		
#20	57.5		
#40	42.3		
#60	25.8		
#100	13.8		
#140	6.1		
#200	2.2		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 3.6385 D_{85}= 2.7384 D_{60}= 0.9363
D_{50}= 0.6037 D_{30}= 0.2865 D_{15}= 0.1580
D_{10}= 0.1265 C_u= 7.40 C_c= 0.69

Remarks

Date Received: ____________ **Date Tested:** ____________

Tested By: ____________

Checked By: ____________

Title: ____________

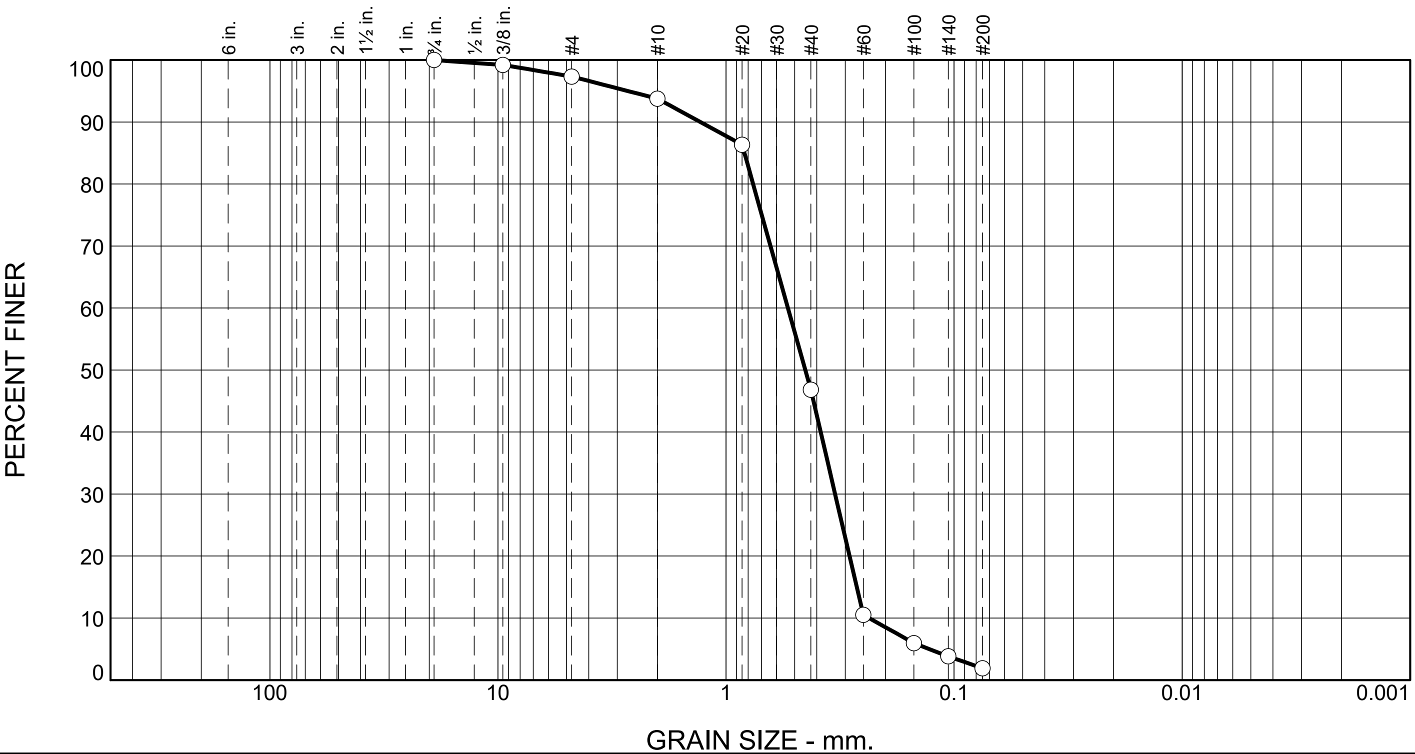
Source of Sample: MW-34A **Depth:** 14' **Date Sampled:**

HILLIS-CARNES ENGINEERING ASSOCIATES

Philadelphia, Pennsylvania

Client: Geosyntec
Project: Tolson Rubble Landfill
Project No: **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.7	3.5	47.0	44.9	1.9	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.75	100.0		
.375	99.2		
#4	97.3		
#10	93.8		
#20	86.3		
#40	46.8		
#60	10.5		
#100	6.0		
#140	3.8		
#200	1.9		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 1.2957 D_{85}= 0.8302 D_{60}= 0.5355
D_{50}= 0.4493 D_{30}= 0.3324 D_{15}= 0.2670
D_{10}= 0.2361 C_u= 2.27 C_c= 0.87

Remarks

Date Received: ______ **Date Tested:** ______

Tested By: ______

Checked By: ______

Title: ______

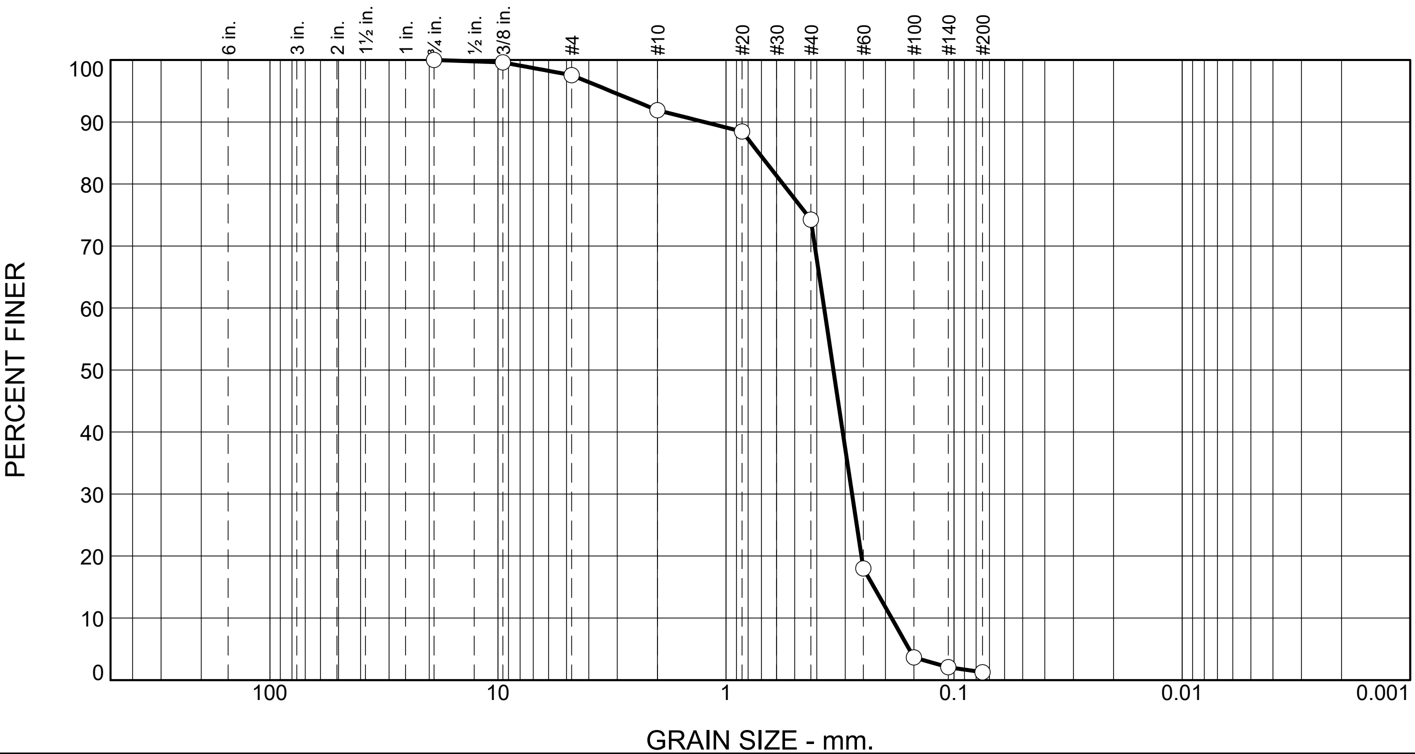
Source of Sample: MW-35A **Depth:** 14' **Date Sampled:**

HILLIS-CARNES ENGINEERING ASSOCIATES

Philadelphia, Pennsylvania

Client: Geosyntec
Project: Tolson Rubble Landfill
Project No: **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.4	5.7	17.6	73.0	1.3	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.75	100.0		
.375	99.6		
#4	97.6		
#10	91.9		
#20	88.5		
#40	74.3		
#60	18.0		
#100	3.6		
#140	2.1		
#200	1.3		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP **AASHTO (M 145)=** A-3

Coefficients

D_{90}= 1.2450 D_{85}= 0.7177 D_{60}= 0.3715
D_{50}= 0.3381 D_{30}= 0.2800 D_{15}= 0.2247
D_{10}= 0.1881 C_u= 1.98 C_c= 1.12

Remarks

Date Received: ________ **Date Tested:** ________

Tested By: ________

Checked By: ________

Title: ________

Source of Sample: MW-35A **Depth:** 19' **Date Sampled:**

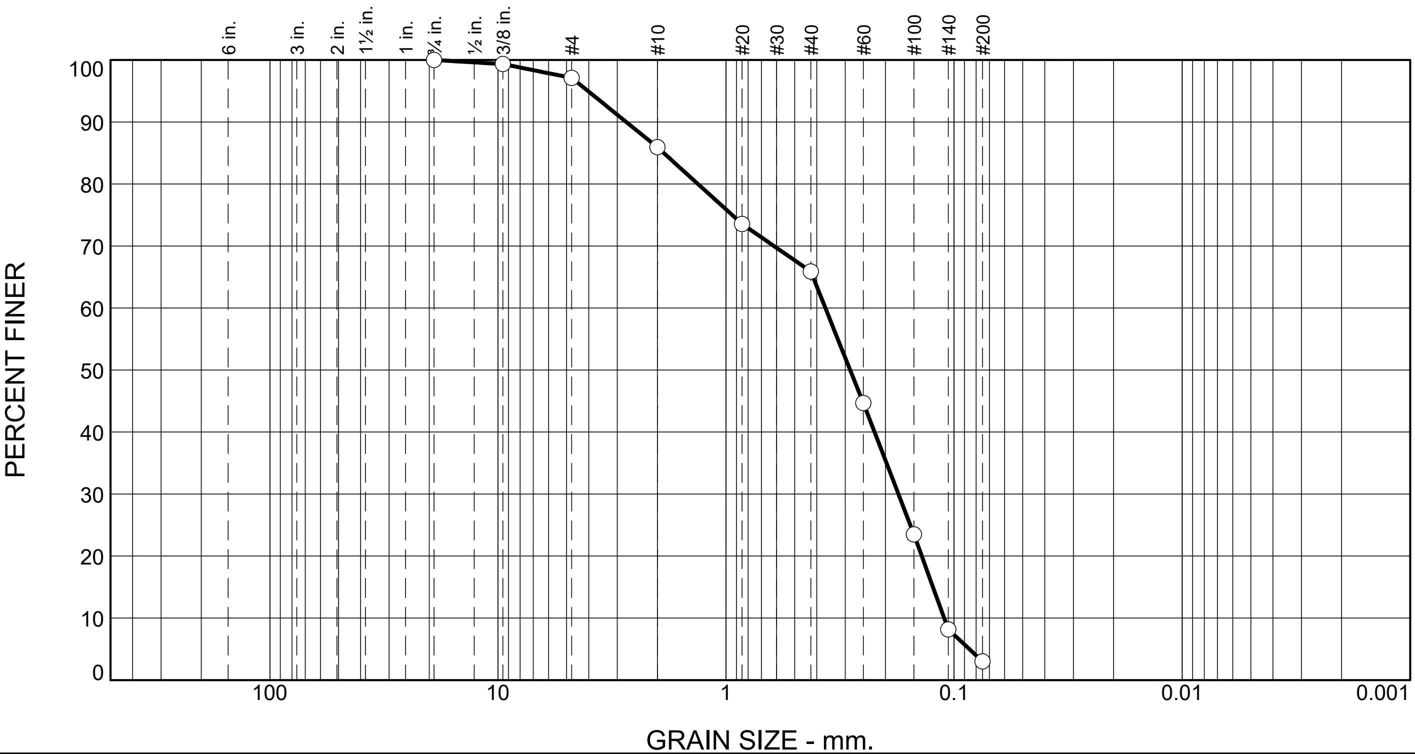
HILLIS-CARNES ENGINEERING ASSOCIATES

Philadelphia, Pennsylvania

Client: Geosyntec
Project: Tolson Rubble Landfill

Project No: **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.9	11.2	20.0	62.9	3.0	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.75	100.0		
.375	99.4		
#4	97.1		
#10	85.9		
#20	73.6		
#40	65.9		
#60	44.7		
#100	23.5		
#140	8.2		
#200	3.0		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP **AASHTO (M 145)=** A-3

Coefficients

D_{90}= 2.7385 D_{85}= 1.8747 D_{60}= 0.3667
D_{50}= 0.2855 D_{30}= 0.1755 D_{15}= 0.1237
D_{10}= 0.1105 C_u= 3.32 C_c= 0.76

Remarks

Date Received: ____________ **Date Tested:** ____________

Tested By: ______________________

Checked By: ______________________

Title: ______________________

Source of Sample: MW-36A **Depth:** 9' **Date Sampled:**

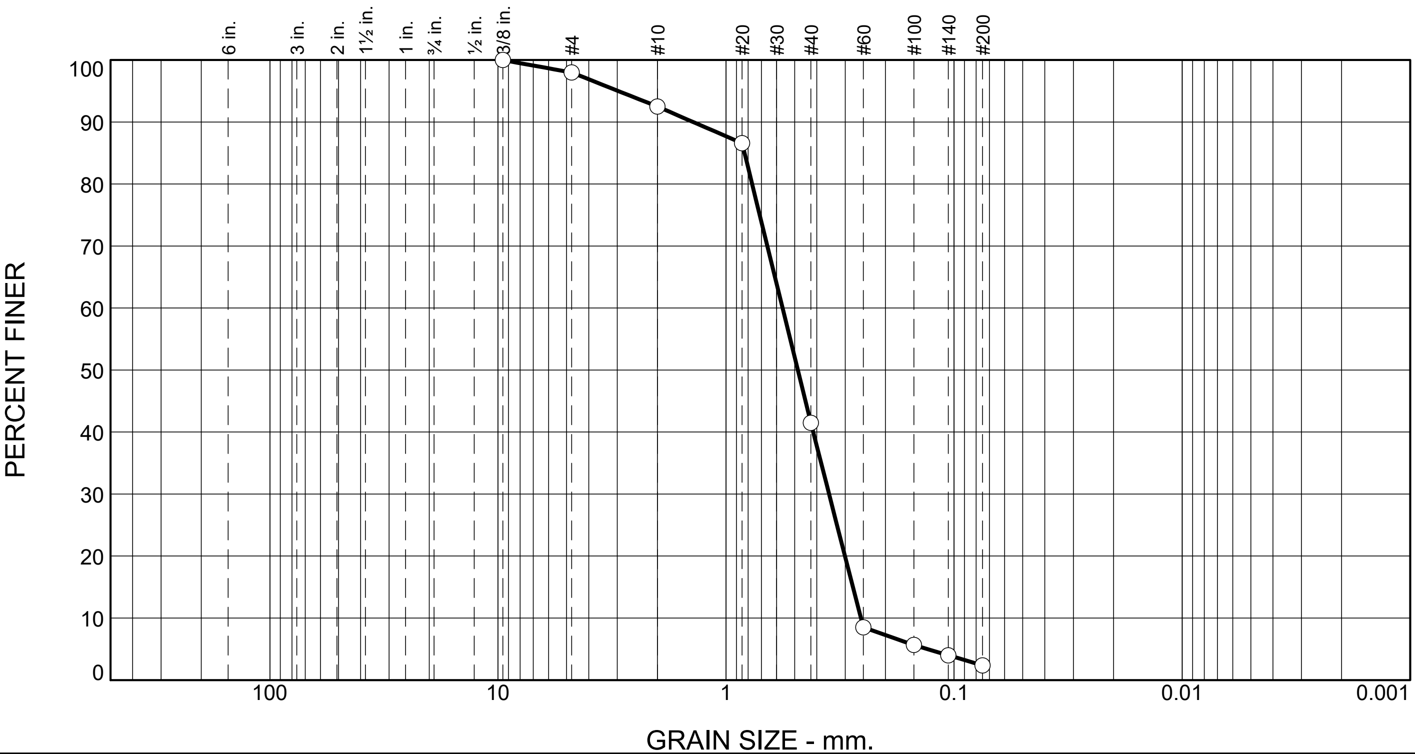
HILLIS-CARNES ENGINEERING ASSOCIATES

Philadelphia, Pennsylvania

Client: Geosyntec
Project: Tolson Rubble Landfill

Project No: **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.0	5.5	51.0	39.1	2.4	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.375	100.0		
#4	98.0		
#10	92.5		
#20	86.6		
#40	41.5		
#60	8.5		
#100	5.7		
#140	4.0		
#200	2.4		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 1.3933 D_{85}= 0.8296 D_{60}= 0.5649
D_{50}= 0.4844 D_{30}= 0.3533 D_{15}= 0.2776
D_{10}= 0.2561 C_u= 2.21 C_c= 0.86

Remarks

Date Received: ____________ **Date Tested:** ____________

Tested By: ____________

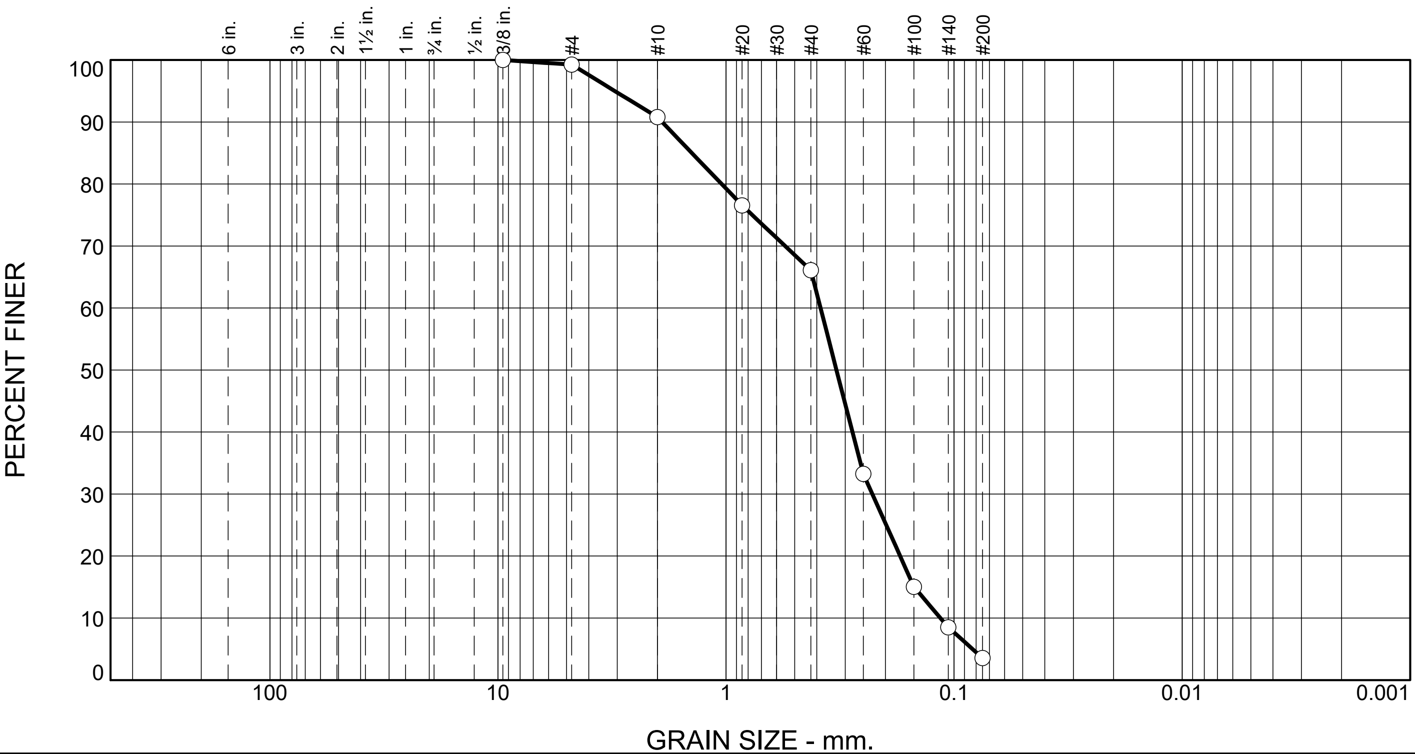
Checked By: ____________

Title: ____________

Source of Sample: MW-36A **Depth:** 19' **Date Sampled:**

HILLIS-CARNES ENGINEERING ASSOCIATES Philadelphia, Pennsylvania	**Client:** Geosyntec **Project:** Tolson Rubble Landfill **Project No:** **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.7	8.5	24.7	62.6	3.5	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.375	100.0		
#4	99.3		
#10	90.8		
#20	76.6		
#40	66.1		
#60	33.2		
#100	15.0		
#140	8.5		
#200	3.5		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SP **AASHTO (M 145)=** A-3

Coefficients

D_{90}= 1.9067 D_{85}= 1.4116 D_{60}= 0.3852
D_{50}= 0.3277 D_{30}= 0.2283 D_{15}= 0.1498
D_{10}= 0.1148 C_u= 3.35 C_c= 1.18

Remarks

Date Received: ____________ **Date Tested:** ____________

Tested By: ____________

Checked By: ____________

Title: ____________

Source of Sample: MW-37A **Depth:** 14' **Date Sampled:**

HILLIS-CARNES ENGINEERING ASSOCIATES

Philadelphia, Pennsylvania

Client: Geosyntec
Project: Tolson Rubble Landfill

Project No: **Figure**

ATTACHMENT 5

Interface Shear Laboratory Results

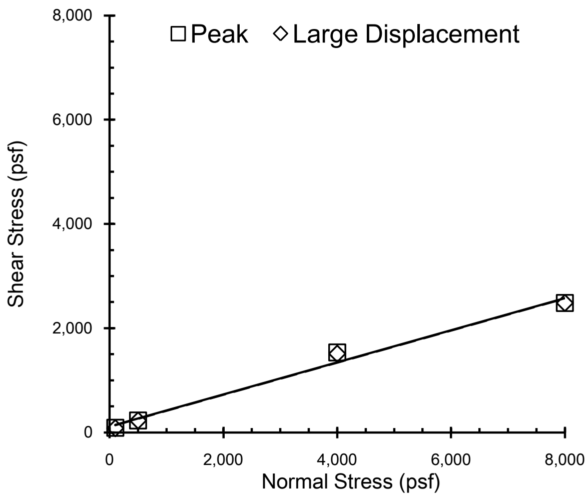
Shear Strength of Soil-Geosynthetic Interface by Direct Shear (ASTM D5321)

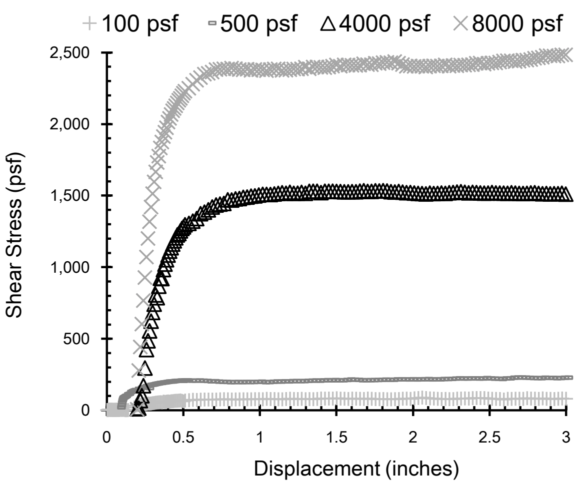
Client: Geosyntec Consultants — TRI Log #: 39571-1

Project: Midshore 2 Landfill — Richard S. Lacey, P.E. 1/10/2019

Analysis & Quality Review/Date

Select Clay vs.
Agru 60 mil HDPE MSGM (G18D002463) - shiny side up





Test Results, Linear Regression			
Mohr-Coulomb Parameters		Peak	Large Displacement
Friction Angle	Degrees	17.1	17.1
Y-intercept or Adhesion	psf	116	107
Minimum Secant Angle	Degrees	17.2	17.2

Note - Large Displacement Values Reported for 3.0 inches of Displacement

Test Conditions		
Upper Box	Select Clay ω = 17.4 % γ_d = 102.9 pcf	
Lower Box	Agru 60 mil HDPE MSGM (G18D002463) - shiny side up	
Conditioning	Wet - Loading applied and Interface flooded for a minimum of 24 hours prior to shear.	
Shearing Rate	inches/minute	0.04

Test Notes

Shearing occurred at the interface at all stresses.

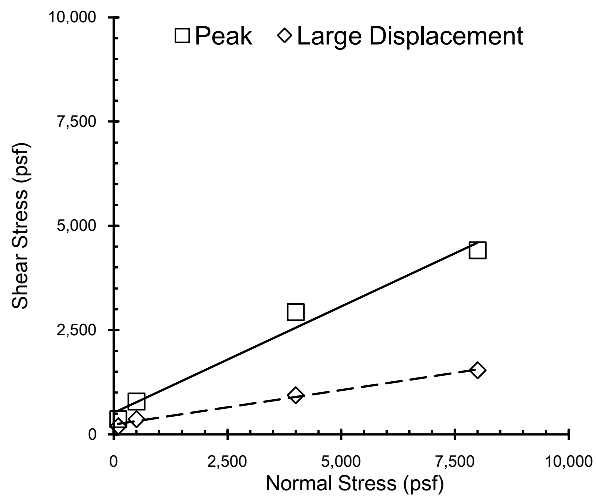
Specimen No.		-	1	2	3	4
Normal Stress		psf	100	500	4,000	8,000
Box Edge Dimension		in	12	12	12	12
Equivalent Bearing Slide Resist. Correction		psf	9	13	46	84
Peak	Shear Stress	psf	89	230	1,535	2,484
	Secant Angle	deg.	41.8	24.7	21.0	17.2
Large Displacement	Shear Stress	psf	81	229	1,511	2,484
	Secant Angle	deg.	39.0	24.6	20.7	17.2
Asperity Height, Avg. of 5 Meas.		mils	34	34	34	32

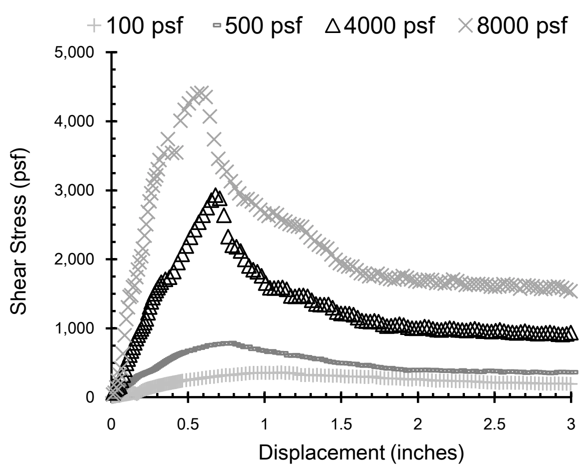
Shear Strength of Geosynthetic-Geosynthetic Interface by Direct Shear (ASTM D5321)

Client:	Geosyntec Consultants	TRI Log #:	39571-2
Project:	Midshore 2 Landfill	Jeffrey A. Kuhn, Ph.D., P.E.,	3/4/2019

Analysis & Quality Review/Date

Skaps DSGC TN 450-2-8(85301010106) vs.
Agru 60 mil HDPE MSGM (G18D002463) - Dull side up





Test Results, Linear Regression			
Mohr-Coulomb Parameters		Peak	Large Displacement
Friction Angle	Degrees	27.0	9.4
Y-intercept or Adhesion	psf	515	237
Minimum Secant Angle	Degrees	28.9	10.9

Note - Large Displacement Values Reported for 3.0 inches of Displacement

Test Conditions		
Upper Box	Skaps DSGC TN 450-2-8(85301010106)	
Lower Box	Agru 60 mil HDPE MSGM (G18D002463) - Dull side up	
Conditioning	Wet - Loading applied and Interface flooded for a minimum of 1 hour prior to shear.	
Shearing Rate	inches/minute	0.04

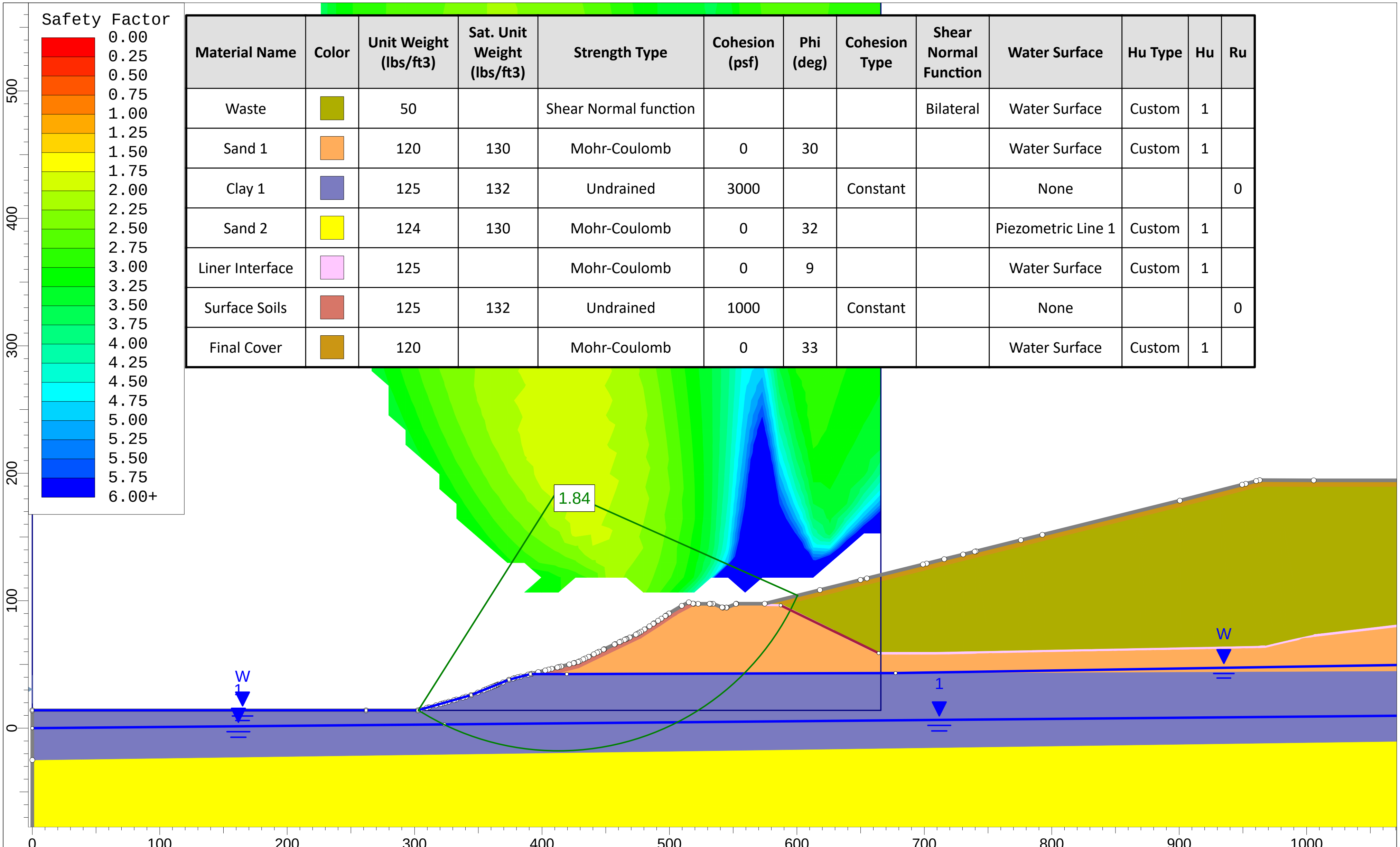
Test Notes

Shearing occurred at the interface at all stresses.

Specimen No.		-	1	2	3	4
Normal Stress		psf	100	500	4,000	8,000
Box Edge Dimension		in	12	12	12	12
Equivalent Bearing Slide Resist. Correction		psf	9	13	46	84
Peak	Shear Stress	psf	361	786	2,930	4,412
	Secant Angle	deg.	74.5	57.6	36.2	28.9
Large Displacement	Shear Stress	psf	193	363	937	1,536
	Secant Angle	deg.	62.6	36.0	13.2	10.9
Asperity Height, Avg. of 5 Meas.		mils	34	35	42	40

ATTACHMENT 6

SLIDE Output



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Shear Normal Function	Water Surface	Hu Type	Hu	Ru
Waste		50		Shear Normal function				Bilateral	Water Surface	Custom	1	
Sand 1		120	130	Mohr-Coulomb	0	30			Water Surface	Custom	1	
Clay 1		125	132	Undrained	3000		Constant		None			0
Sand 2		124	130	Mohr-Coulomb	0	32			Piezometric Line 1	Custom	1	
Liner Interface		125		Mohr-Coulomb	0	9			Water Surface	Custom	1	
Surface Soils		125	132	Undrained	1000		Constant		None			0
Final Cover		120		Mohr-Coulomb	0	33			Water Surface	Custom	1	

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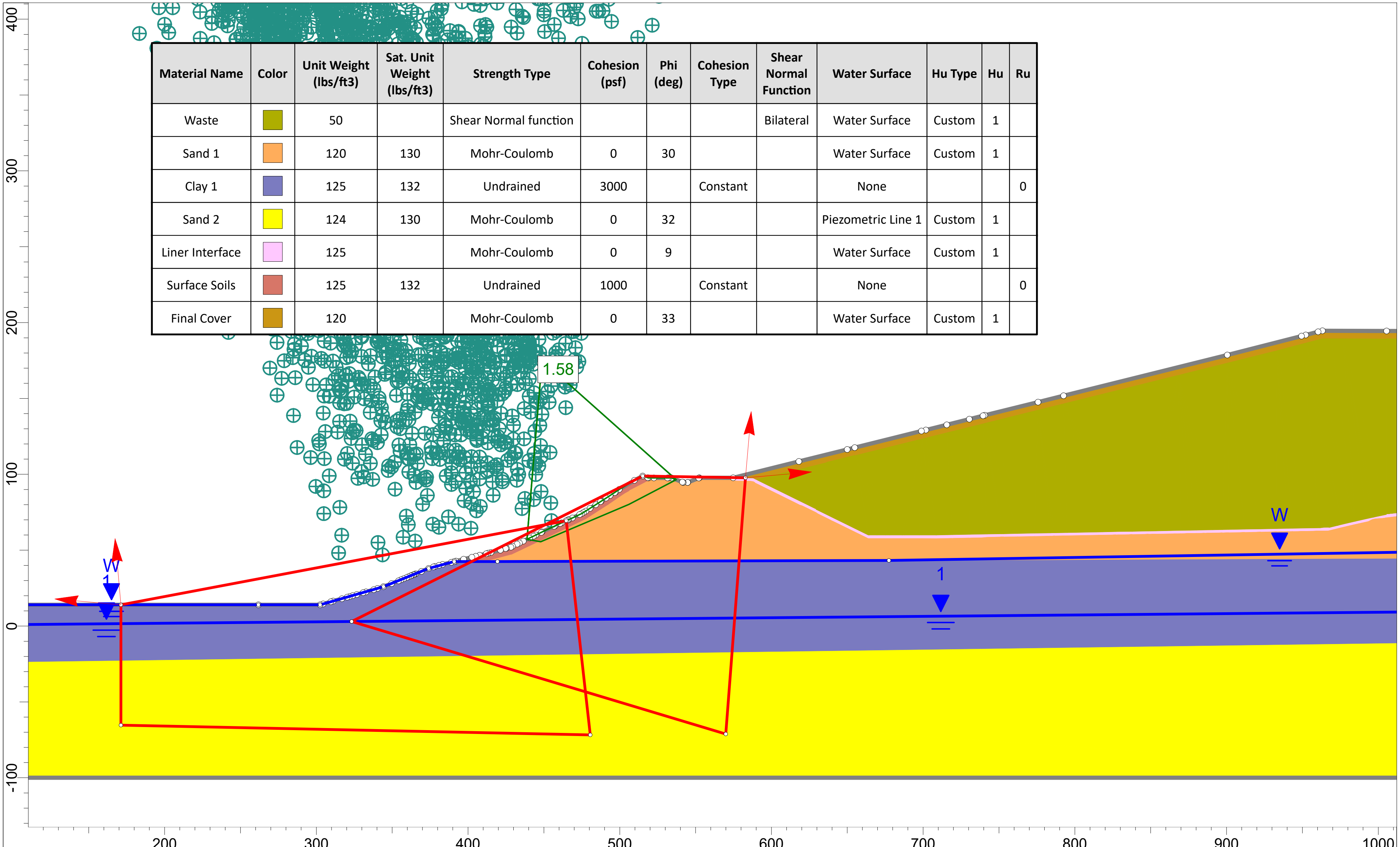
SLIDEINTERPRET 8.032

Project	SLIDE - An Interactive Slope Stability Program
Analysis Description	
Drawn By	*Scale* 1:1250
Company	
Date 2/19/2020, 10:36:05 AM	*File Name* AA_undrained_circular.slim

Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Shear Normal Function	Water Surface	Hu Type	Hu	Ru
Waste		50		Shear Normal function				Bilateral	Water Surface	Custom	1	
Sand 1		120	130	Mohr-Coulomb	0	30			Water Surface	Custom	1	
Clay 1		125	132	Undrained	3000		Constant		None			0
Sand 2		124	130	Mohr-Coulomb	0	32			Piezometric Line 1	Custom	1	
Liner Interface		125		Mohr-Coulomb	0	9			Water Surface	Custom	1	
Surface Soils		125	132	Undrained	1000		Constant		None			0
Final Cover		120		Mohr-Coulomb	0	33			Water Surface	Custom	1	



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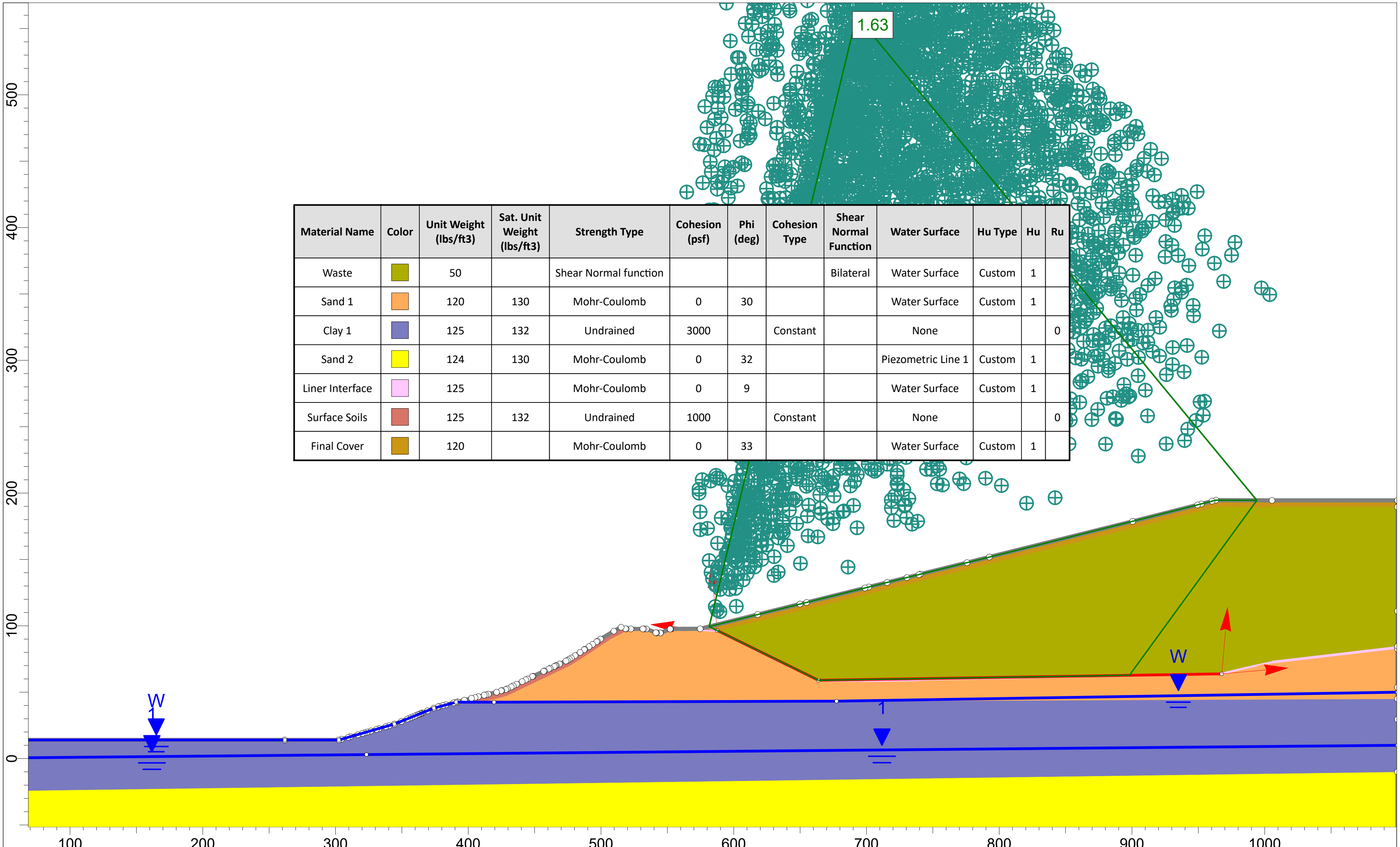
SLIDEINTERPRET 8.032

Project	SLIDE - An Interactive Slope Stability Program
Analysis Description	
Drawn By	
Scale	1:1050
Company	
Date	2/19/2020, 10:36:05 AM
File Name	AA_undrained_noncircular.slim



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Shear Normal Function	Water Surface	Hu Type	Hu	Ru
Waste		50		Shear Normal function				Bilateral	Water Surface	Custom	1	
Sand 1		120	130	Mohr-Coulomb	0	30			Water Surface	Custom	1	
Clay 1		125	132	Undrained	3000		Constant		None			0
Sand 2		124	130	Mohr-Coulomb	0	32			Piezometric Line 1	Custom	1	
Liner Interface		125		Mohr-Coulomb	0	9			Water Surface	Custom	1	
Surface Soils		125	132	Undrained	1000		Constant		None			0
Final Cover		120		Mohr-Coulomb	0	33			Water Surface	Custom	1	

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SLIDEINTERPRET 8.032

Project	SLIDE - An Interactive Slope Stability Program
Analysis Description	
Drawn By	
Scale	1:1200
Company	
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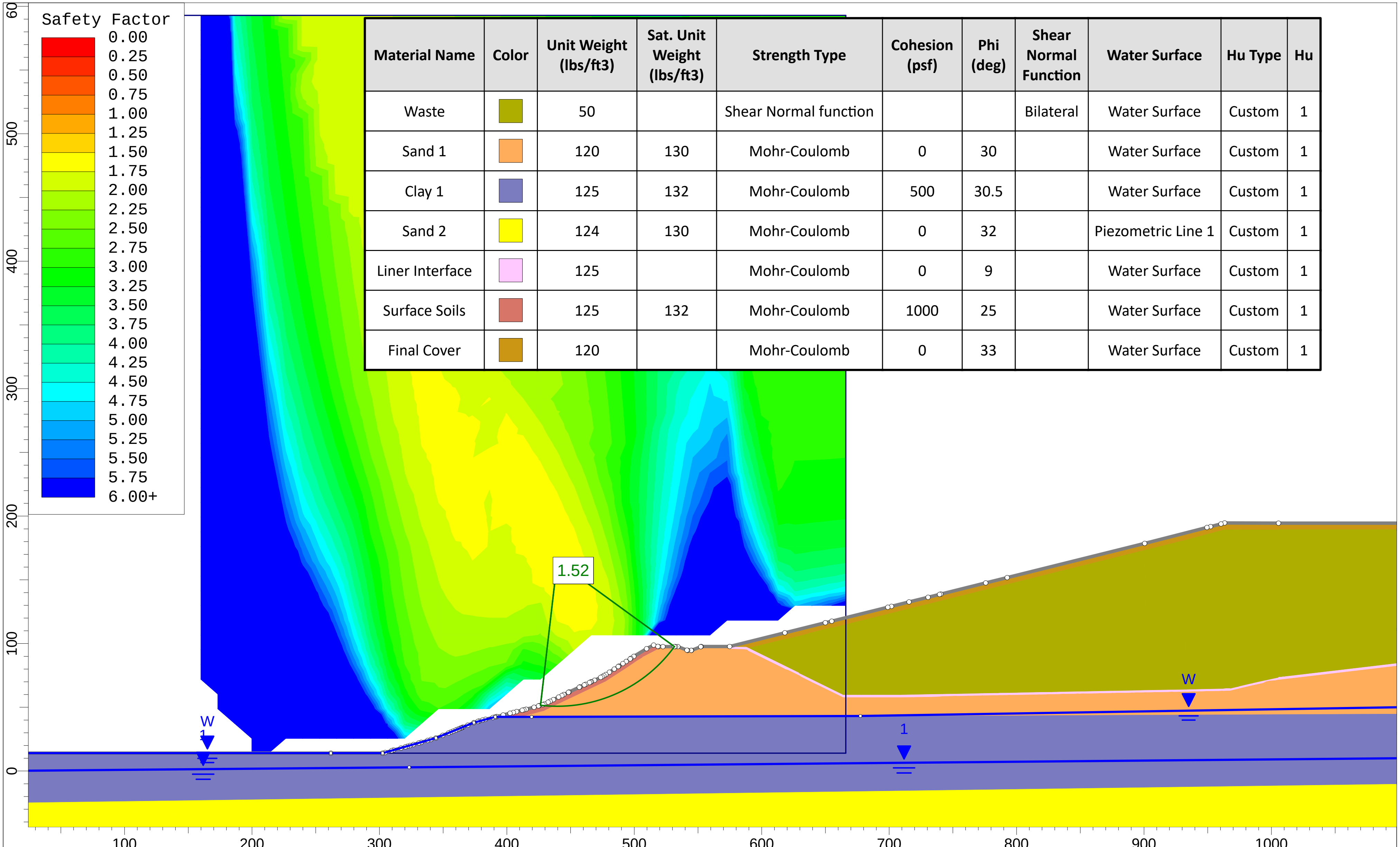
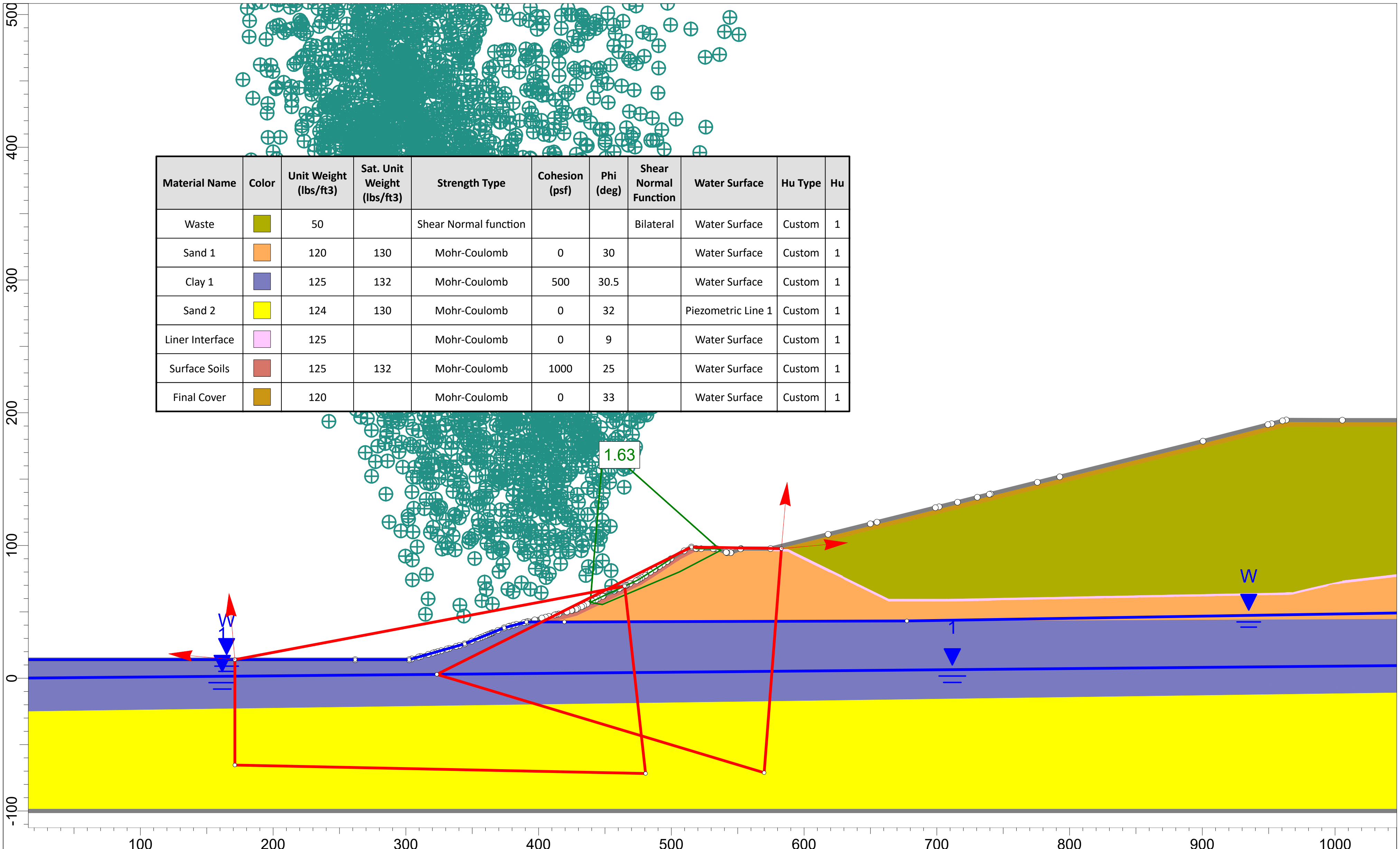


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Hu Type	Hu
Waste		50		Shear Normal function			Bilateral	Water Surface	Custom	1
Sand 1		120	130	Mohr-Coulomb	0	30		Water Surface	Custom	1
Clay 1		125	132	Mohr-Coulomb	500	30.5		Water Surface	Custom	1
Sand 2		124	130	Mohr-Coulomb	0	32		Piezometric Line 1	Custom	1
Liner Interface		125		Mohr-Coulomb	0	9		Water Surface	Custom	1
Surface Soils		125	132	Mohr-Coulomb	1000	25		Water Surface	Custom	1
Final Cover		120		Mohr-Coulomb	0	33		Water Surface	Custom	1

Project	SLIDE - An Interactive Slope Stability Program
Analysis Description	
Drawn By	
Scale	1:1250
Company	
Date	2/19/2020, 10:36:05 AM
File Name	AA_drained_circular2.slim

SLIDEINTERPRET 8.032



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Hu Type	Hu
Waste		50		Shear Normal function			Bilateral	Water Surface	Custom	1
Sand 1		120	130	Mohr-Coulomb	0	30		Water Surface	Custom	1
Clay 1		125	132	Mohr-Coulomb	500	30.5		Water Surface	Custom	1
Sand 2		124	130	Mohr-Coulomb	0	32		Piezometric Line 1	Custom	1
Liner Interface		125		Mohr-Coulomb	0	9		Water Surface	Custom	1
Surface Soils		125	132	Mohr-Coulomb	1000	25		Water Surface	Custom	1
Final Cover		120		Mohr-Coulomb	0	33		Water Surface	Custom	1

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Project

SLIDE - An Interactive Slope Stability Program

Analysis Description

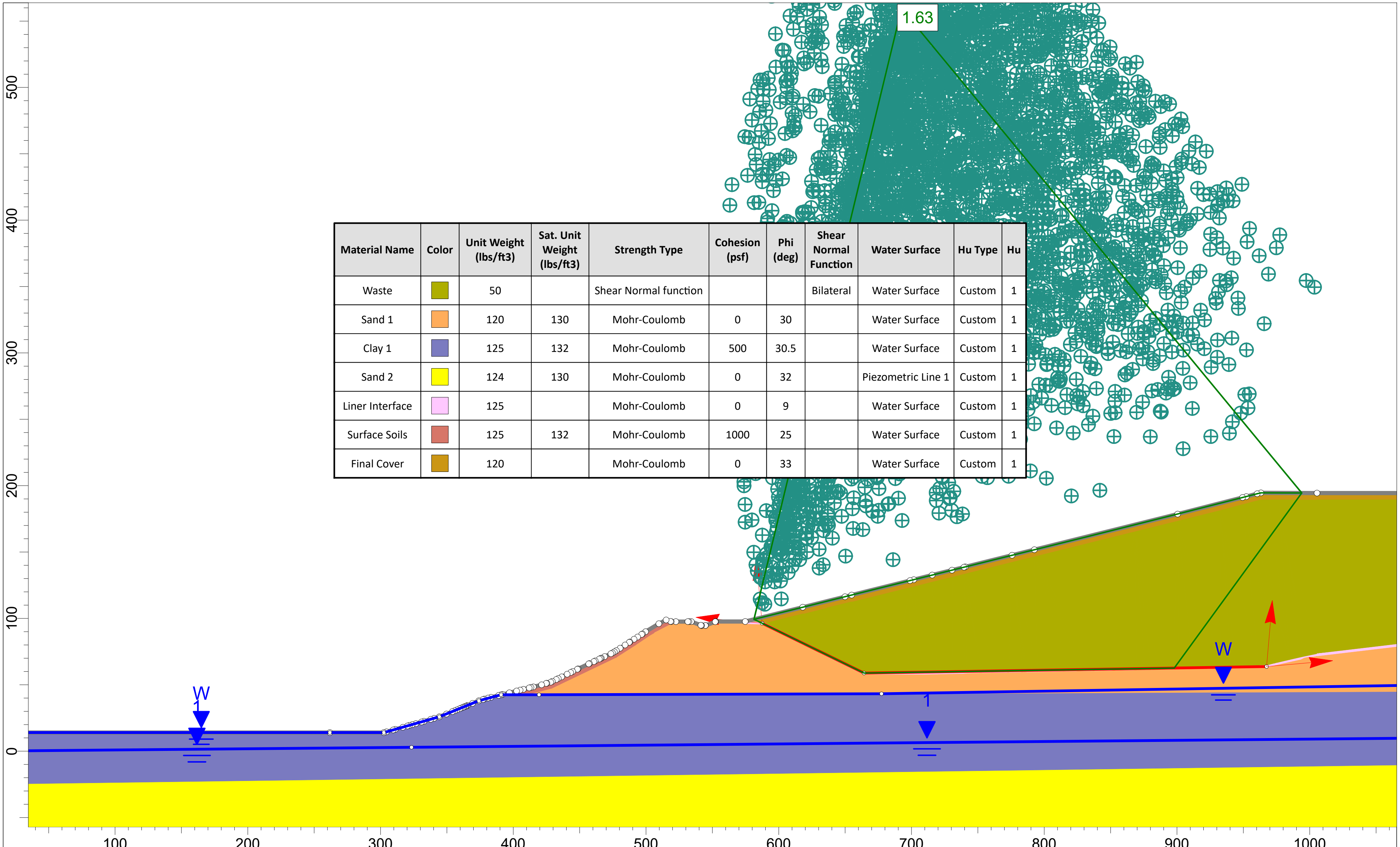
Drawn By

Scale 1:1200

Company

Date 2/19/2020, 10:36:05 AM

File Name AA_drained_noncircular.slim



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Hu Type	Hu
Waste		50		Shear Normal function			Bilateral	Water Surface	Custom	1
Sand 1		120	130	Mohr-Coulomb	0	30		Water Surface	Custom	1
Clay 1		125	132	Mohr-Coulomb	500	30.5		Water Surface	Custom	1
Sand 2		124	130	Mohr-Coulomb	0	32		Piezometric Line 1	Custom	1
Liner Interface		125		Mohr-Coulomb	0	9		Water Surface	Custom	1
Surface Soils		125	132	Mohr-Coulomb	1000	25		Water Surface	Custom	1
Final Cover		120		Mohr-Coulomb	0	33		Water Surface	Custom	1

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Project SLIDE - An Interactive Slope Stability Program

Analysis Description

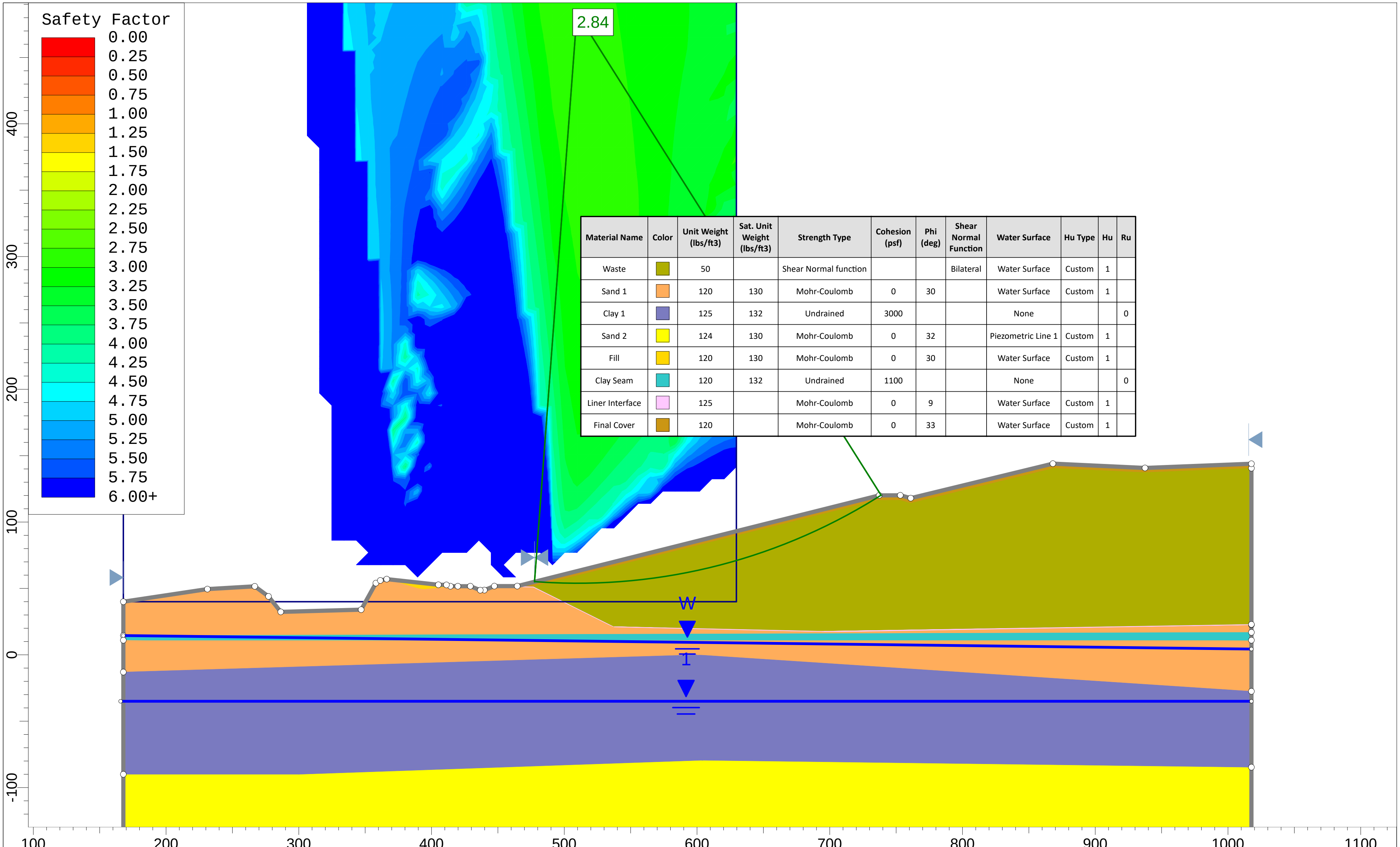
Drawn By

Scale 1:1200

Company

Date 2/19/2020, 10:36:05 AM

File Name AA_drained_liner.slim



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Hu Type	Hu	Ru
Waste		50		Shear Normal function			Bilateral	Water Surface	Custom	1	
Sand 1		120	130	Mohr-Coulomb	0	30		Water Surface	Custom	1	
Clay 1		125	132	Undrained	3000			None			0
Sand 2		124	130	Mohr-Coulomb	0	32		Piezometric Line 1	Custom	1	
Fill		120	130	Mohr-Coulomb	0	30		Water Surface	Custom	1	
Clay Seam		120	132	Undrained	1100			None			0
Liner Interface		125		Mohr-Coulomb	0	9		Water Surface	Custom	1	
Final Cover		120		Mohr-Coulomb	0	33		Water Surface	Custom	1	

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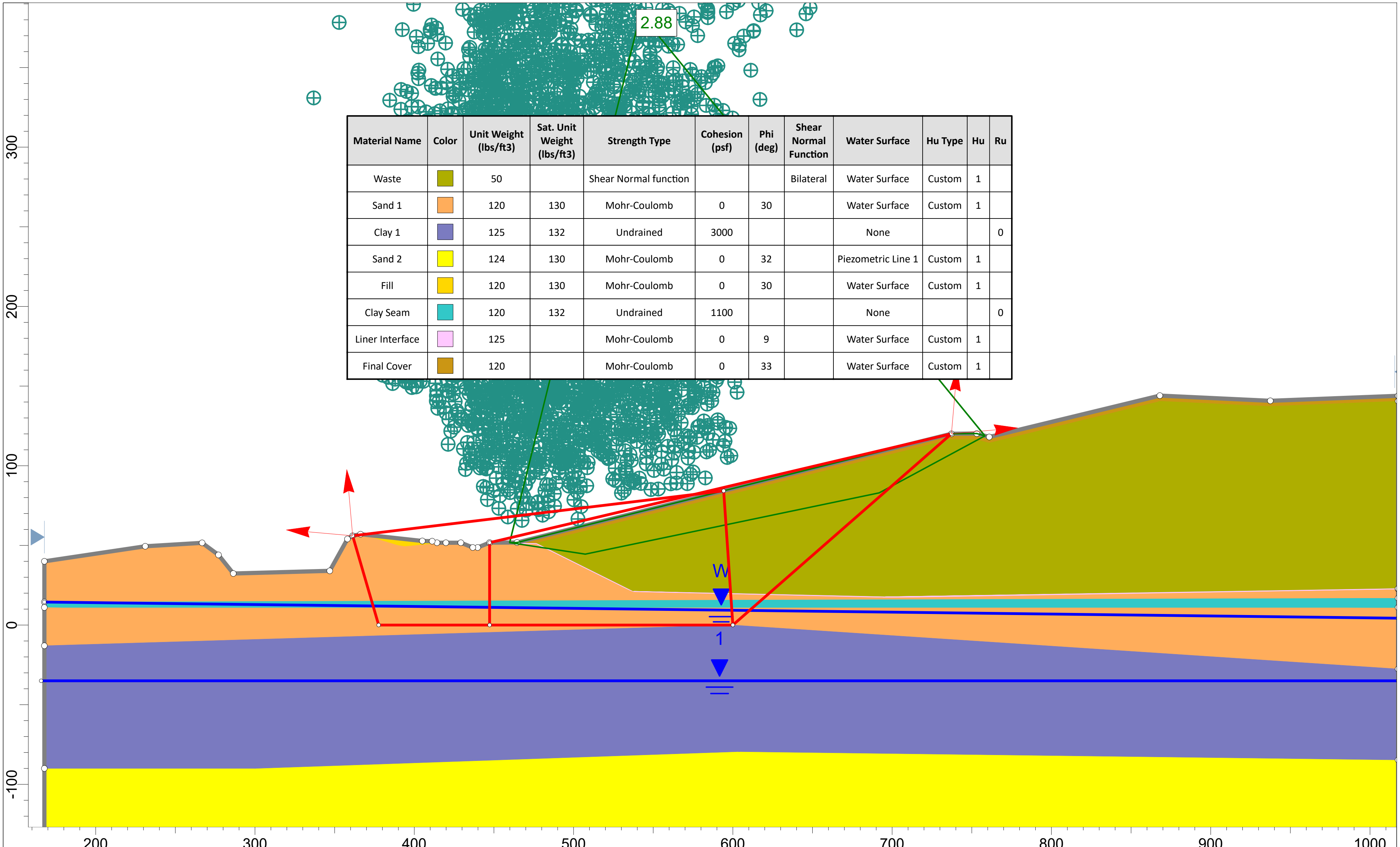
SLIDEINTERPRET 8.032

Project	SLIDE - An Interactive Slope Stability Program
Analysis Description	
Drawn By	*Scale* 1:1200
Company	
Date 2/19/2020, 10:36:05 AM	*File Name* BB_undrained_circular_V2.slim



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Hu Type	Hu	Ru
Waste		50		Shear Normal function			Bilateral	Water Surface	Custom	1	
Sand 1		120	130	Mohr-Coulomb	0	30		Water Surface	Custom	1	
Clay 1		125	132	Undrained	3000			None			0
Sand 2		124	130	Mohr-Coulomb	0	32		Piezometric Line 1	Custom	1	
Fill		120	130	Mohr-Coulomb	0	30		Water Surface	Custom	1	
Clay Seam		120	132	Undrained	1100			None			0
Liner Interface		125		Mohr-Coulomb	0	9		Water Surface	Custom	1	
Final Cover		120		Mohr-Coulomb	0	33		Water Surface	Custom	1	

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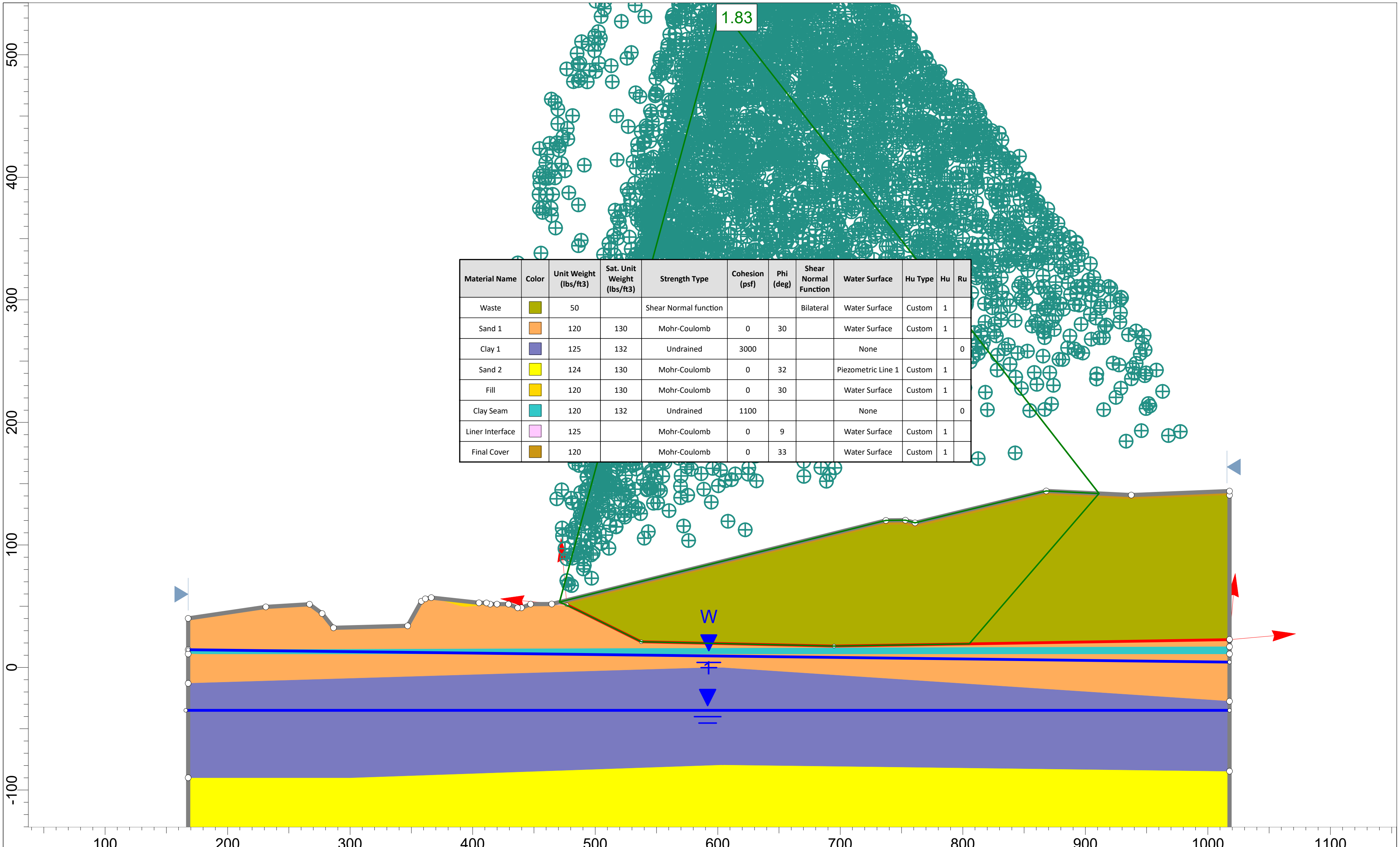
SLIDEINTERPRET 8.032

Project	SLIDE - An Interactive Slope Stability Program
Analysis Description	
Drawn By	*Scale* 1:1000
Company	
Date 2/19/2020, 10:36:05 AM	*File Name* BB_undrained_noncircular_V2.slim



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Hu Type	Hu	Ru
Waste		50		Shear Normal function			Bilateral	Water Surface	Custom	1	
Sand 1		120	130	Mohr-Coulomb	0	30		Water Surface	Custom	1	
Clay 1		125	132	Undrained	3000			None			0
Sand 2		124	130	Mohr-Coulomb	0	32		Piezometric Line 1	Custom	1	
Fill		120	130	Mohr-Coulomb	0	30		Water Surface	Custom	1	
Clay Seam		120	132	Undrained	1100			None			0
Liner Interface		125		Mohr-Coulomb	0	9		Water Surface	Custom	1	
Final Cover		120		Mohr-Coulomb	0	33		Water Surface	Custom	1	

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Project	SLIDE - An Interactive Slope Stability Program
Analysis Description	
Drawn By	
Scale	1:1300
Company	
Date	2/19/2020, 10:36:05 AM
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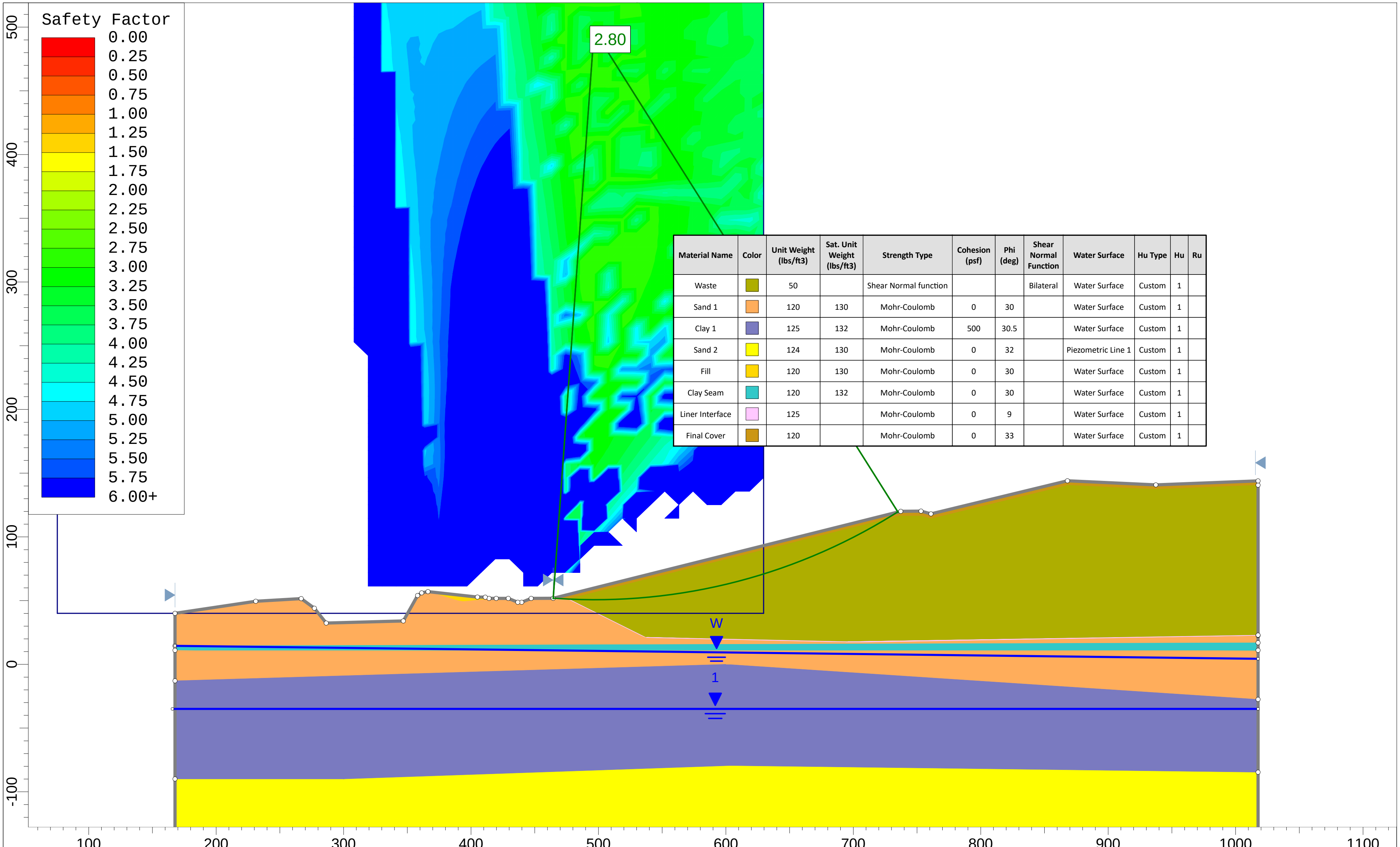

Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Hu Type	Hu	Ru
Waste		50		Shear Normal function			Bilateral	Water Surface	Custom	1	
Sand 1		120	130	Mohr-Coulomb	0	30		Water Surface	Custom	1	
Clay 1		125	132	Mohr-Coulomb	500	30.5		Water Surface	Custom	1	
Sand 2		124	130	Mohr-Coulomb	0	32		Piezometric Line 1	Custom	1	
Fill		120	130	Mohr-Coulomb	0	30		Water Surface	Custom	1	
Clay Seam		120	132	Mohr-Coulomb	0	30		Water Surface	Custom	1	
Liner Interface		125		Mohr-Coulomb	0	9		Water Surface	Custom	1	
Final Cover		120		Mohr-Coulomb	0	33		Water Surface	Custom	1	

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SLIDEINTERPRET 8.032

Project	SLIDE - An Interactive Slope Stability Program
Analysis Description	
Drawn By	
Scale	1:1250
Company	
Date	2/19/2020, 10:36:05 AM
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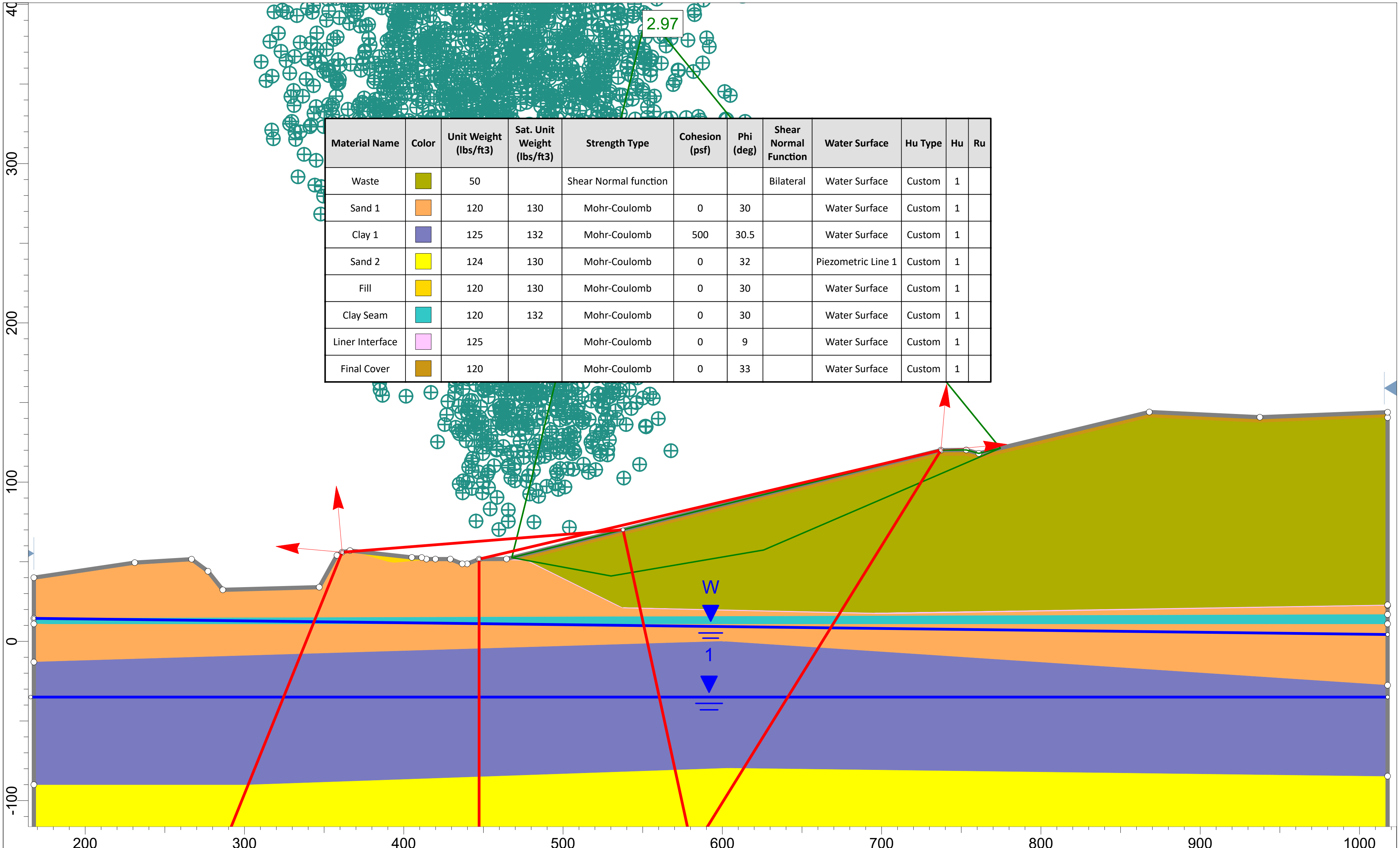
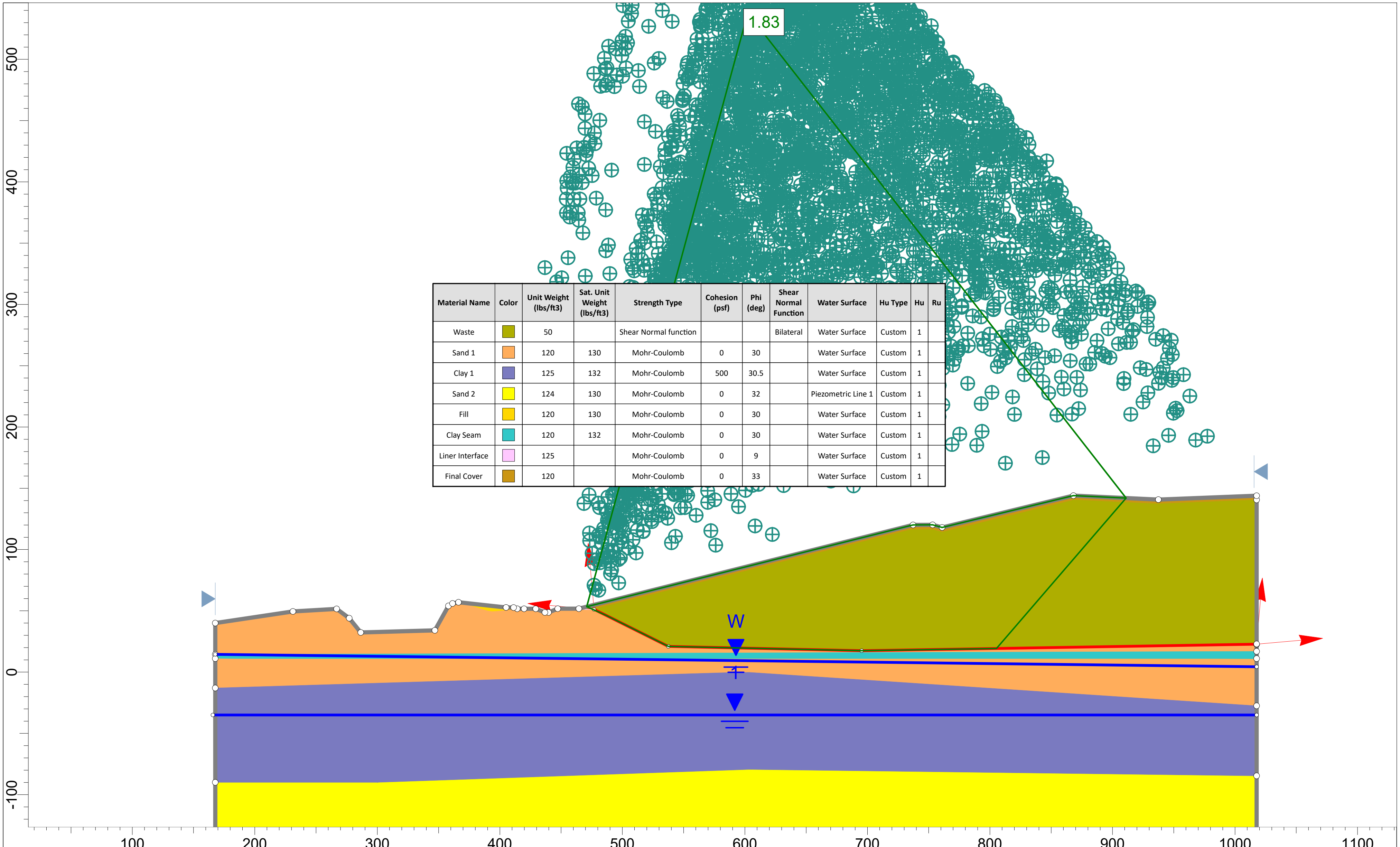


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Hu Type	Hu	Ru
Waste		50		Shear Normal function			Bilateral	Water Surface	Custom	1	
Sand 1		120	130	Mohr-Coulomb	0	30		Water Surface	Custom	1	
Clay 1		125	132	Mohr-Coulomb	500	30.5		Water Surface	Custom	1	
Sand 2		124	130	Mohr-Coulomb	0	32		Piezometric Line 1	Custom	1	
Fill		120	130	Mohr-Coulomb	0	30		Water Surface	Custom	1	
Clay Seam		120	132	Mohr-Coulomb	0	30		Water Surface	Custom	1	
Liner Interface		125		Mohr-Coulomb	0	9		Water Surface	Custom	1	
Final Cover		120		Mohr-Coulomb	0	33		Water Surface	Custom	1	

rocscience	*Project* SLIDE - An Interactive Slope Stability Program		
	Analysis Description		
	Drawn By	*Scale* 1:1000	*Company*
SLIDEINTERPRET 8.032	*Date* 2/19/2020, 10:36:05 AM		*File Name* BB_drained_noncircular_V2.slim



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Hu Type	Hu	Ru
Waste		50		Shear Normal function			Bilateral	Water Surface	Custom	1	
Sand 1		120	130	Mohr-Coulomb	0	30		Water Surface	Custom	1	
Clay 1		125	132	Mohr-Coulomb	500	30.5		Water Surface	Custom	1	
Sand 2		124	130	Mohr-Coulomb	0	32		Piezometric Line 1	Custom	1	
Fill		120	130	Mohr-Coulomb	0	30		Water Surface	Custom	1	
Clay Seam		120	132	Mohr-Coulomb	0	30		Water Surface	Custom	1	
Liner Interface		125		Mohr-Coulomb	0	9		Water Surface	Custom	1	
Final Cover		120		Mohr-Coulomb	0	33		Water Surface	Custom	1	

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SLIDEINTERPRET 8.032

Project	SLIDE - An Interactive Slope Stability Program
Analysis Description	
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Company	
Date	2/19/2020, 10:36:05 AM
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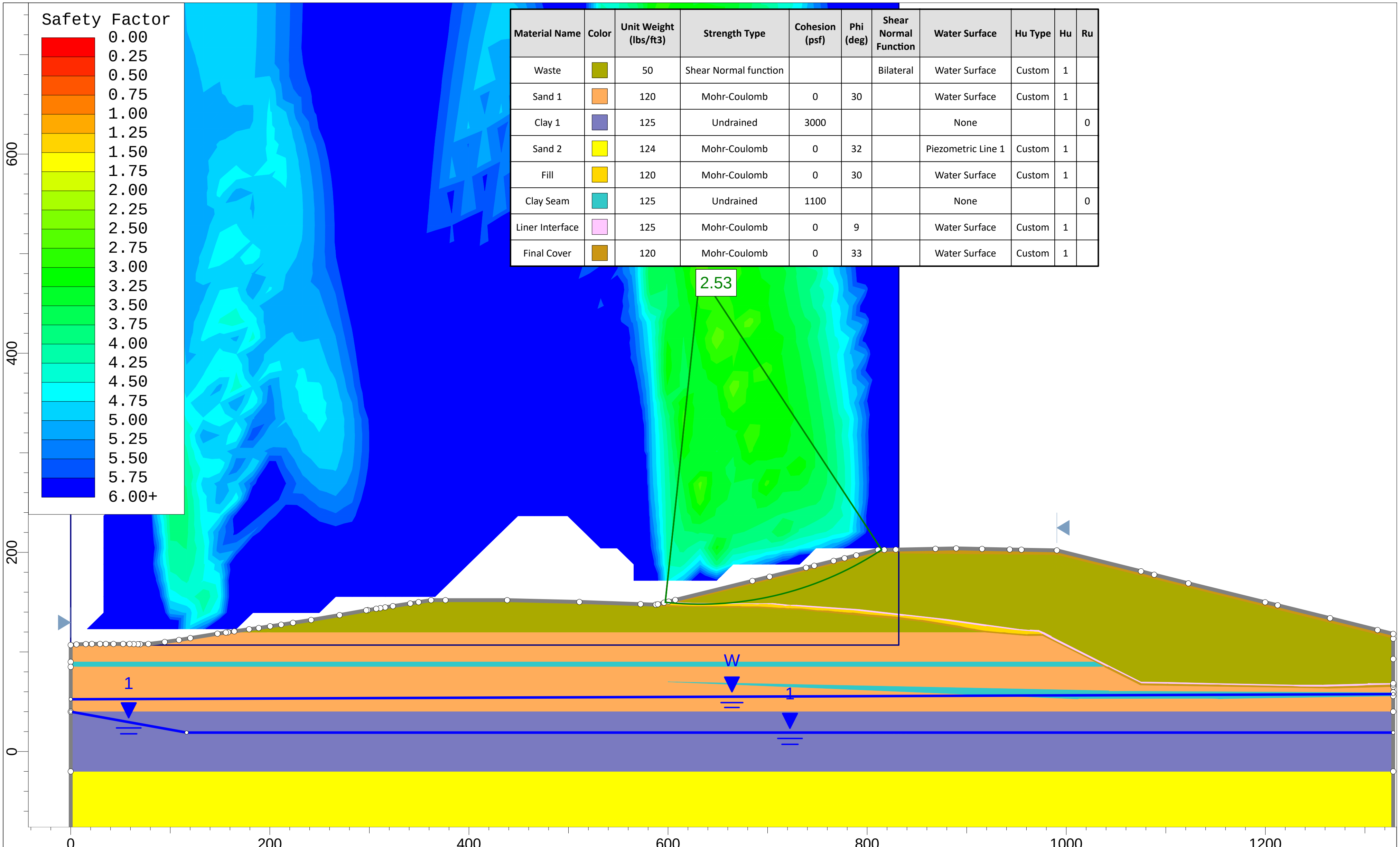

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Hu Type	Hu	Ru
Waste		50	Shear Normal function			Bilateral	Water Surface	Custom	1	
Sand 1		120	Mohr-Coulomb	0	30		Water Surface	Custom	1	
Clay 1		125	Undrained	3000			None			0
Sand 2		124	Mohr-Coulomb	0	32		Piezometric Line 1	Custom	1	
Fill		120	Mohr-Coulomb	0	30		Water Surface	Custom	1	
Clay Seam		125	Undrained	1100			None			0
Liner Interface		125	Mohr-Coulomb	0	9		Water Surface	Custom	1	
Final Cover		120	Mohr-Coulomb	0	33		Water Surface	Custom	1	

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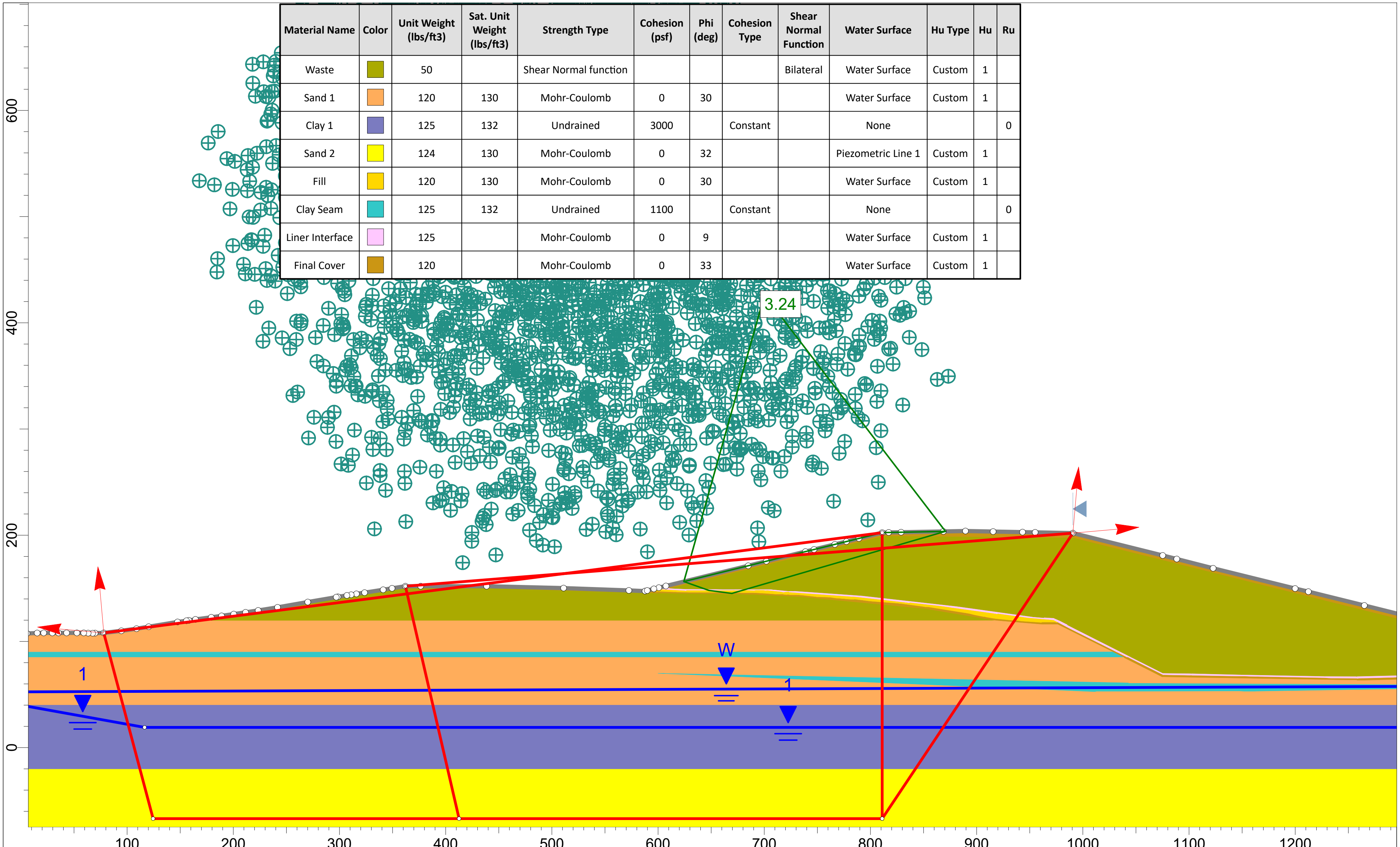
SLIDEINTERPRET 8.032

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description			
Drawn By		*Scale* 1:1600	*Company*
Date 2/19/2020, 3:16:18 PM		*File Name* CC_undrained_circular.slim	

Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Shear Normal Function	Water Surface	Hu Type	Hu	Ru
Waste		50		Shear Normal function				Bilateral	Water Surface	Custom	1	
Sand 1		120	130	Mohr-Coulomb	0	30			Water Surface	Custom	1	
Clay 1		125	132	Undrained	3000		Constant		None			0
Sand 2		124	130	Mohr-Coulomb	0	32			Piezometric Line 1	Custom	1	
Fill		120	130	Mohr-Coulomb	0	30			Water Surface	Custom	1	
Clay Seam		125	132	Undrained	1100		Constant		None			0
Liner Interface		125		Mohr-Coulomb	0	9			Water Surface	Custom	1	
Final Cover		120		Mohr-Coulomb	0	33			Water Surface	Custom	1	



SLIDEINTERPRET 8.032

Project: SLIDE - An Interactive Slope Stability Program

Analysis Description

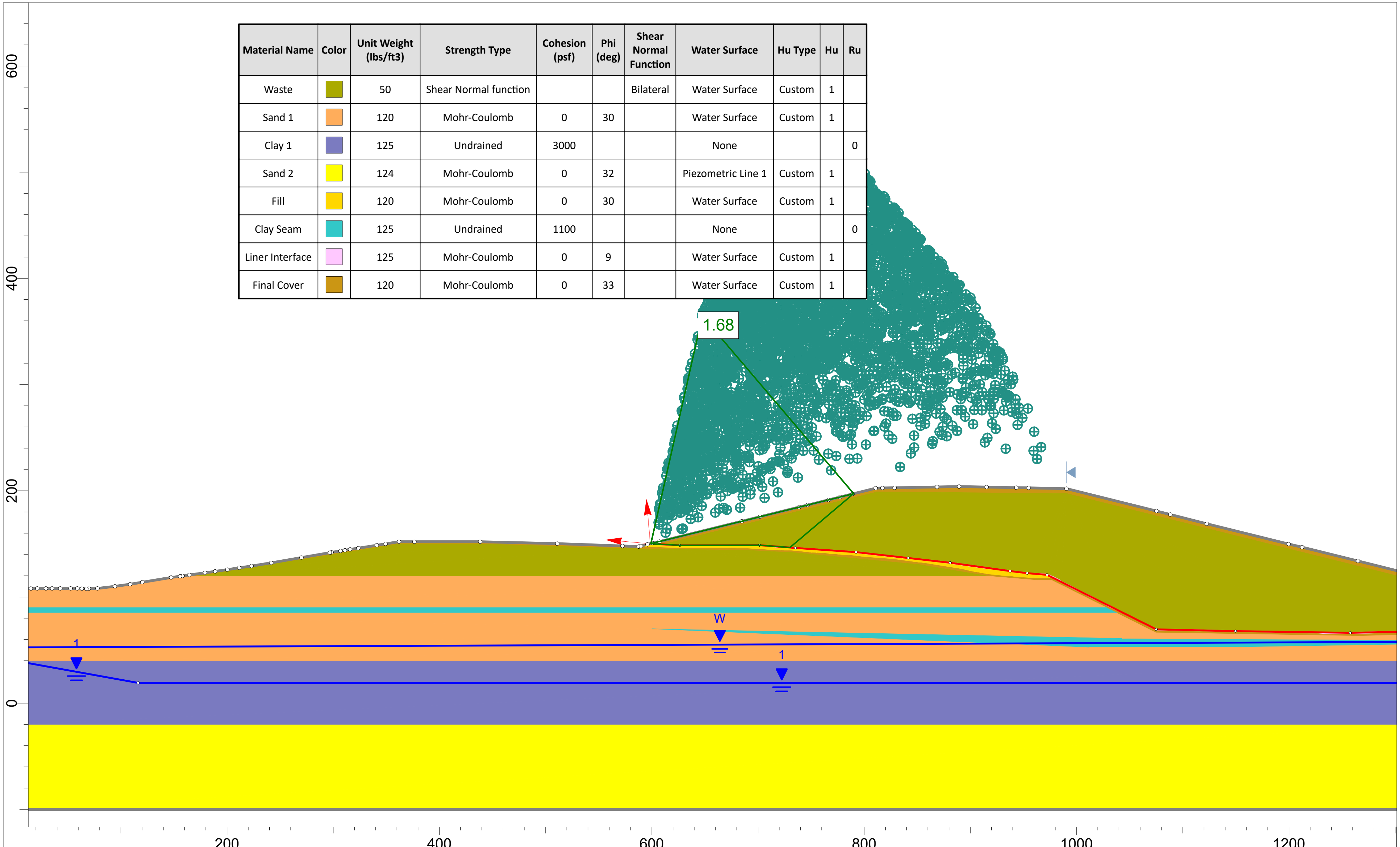
Drawn By

Scale: 1:1500

Company

Date: 2/19/2020, 3:16:18 PM

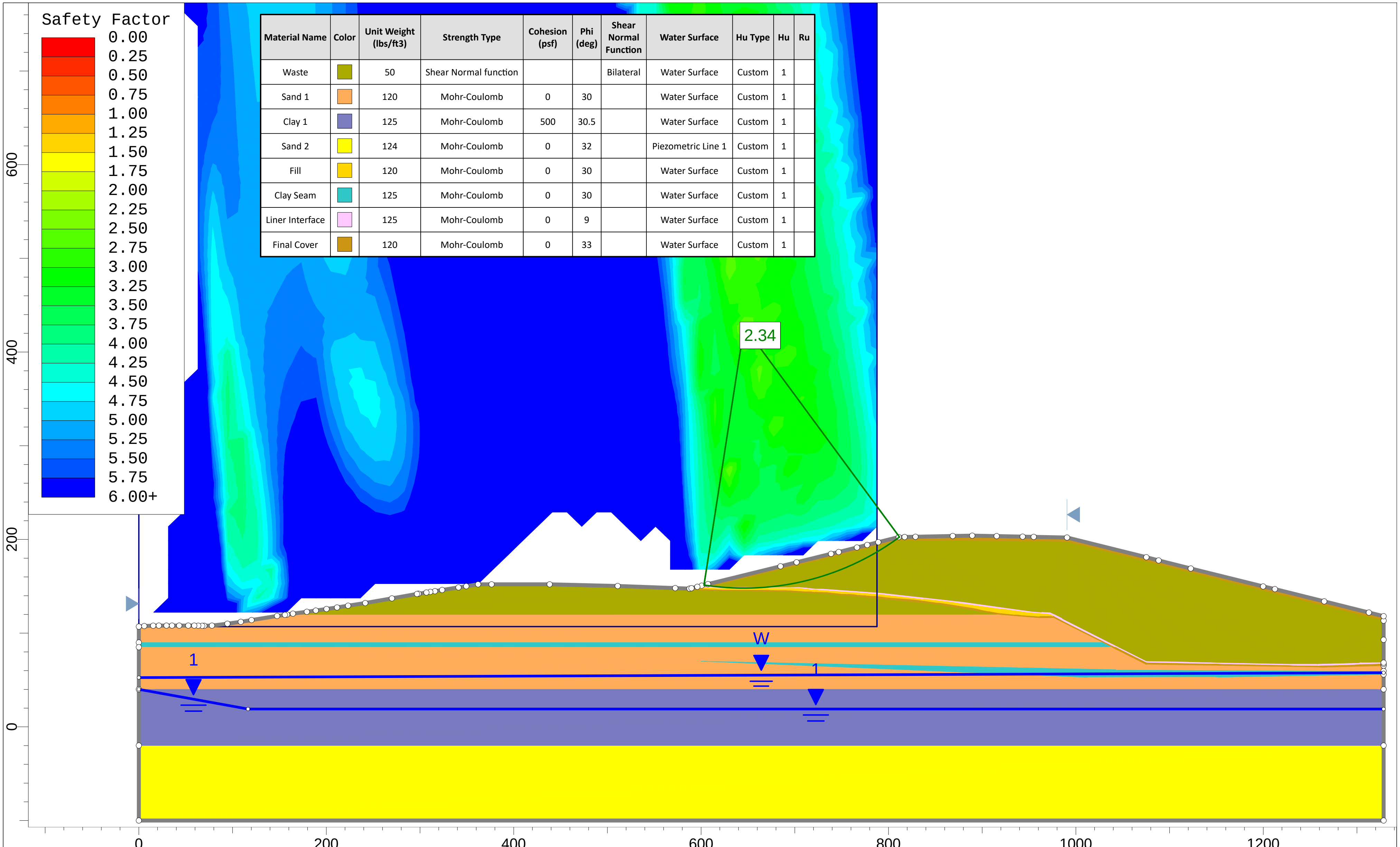
File Name: CC_undrained_noncircular.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Hu Type	Hu	Ru
Waste		50	Shear Normal function			Bilateral	Water Surface	Custom	1	
Sand 1		120	Mohr-Coulomb	0	30		Water Surface	Custom	1	
Clay 1		125	Undrained	3000			None			0
Sand 2		124	Mohr-Coulomb	0	32		Piezometric Line 1	Custom	1	
Fill		120	Mohr-Coulomb	0	30		Water Surface	Custom	1	
Clay Seam		125	Undrained	1100			None			0
Liner Interface		125	Mohr-Coulomb	0	9		Water Surface	Custom	1	
Final Cover		120	Mohr-Coulomb	0	33		Water Surface	Custom	1	

Project	SLIDE - An Interactive Slope Stability Program
Analysis Description	
Drawn By	
Scale	1:1500
Company	
Date	2/19/2020, 3:16:18 PM
File Name	CC_undrained_liner.slim

SLIDEINTERPRET 8.032



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Hu Type	Hu	Ru
Waste		50	Shear Normal function			Bilateral	Water Surface	Custom	1	
Sand 1		120	Mohr-Coulomb	0	30		Water Surface	Custom	1	
Clay 1		125	Mohr-Coulomb	500	30.5		Water Surface	Custom	1	
Sand 2		124	Mohr-Coulomb	0	32		Piezometric Line 1	Custom	1	
Fill		120	Mohr-Coulomb	0	30		Water Surface	Custom	1	
Clay Seam		125	Mohr-Coulomb	0	30		Water Surface	Custom	1	
Liner Interface		125	Mohr-Coulomb	0	9		Water Surface	Custom	1	
Final Cover		120	Mohr-Coulomb	0	33		Water Surface	Custom	1	

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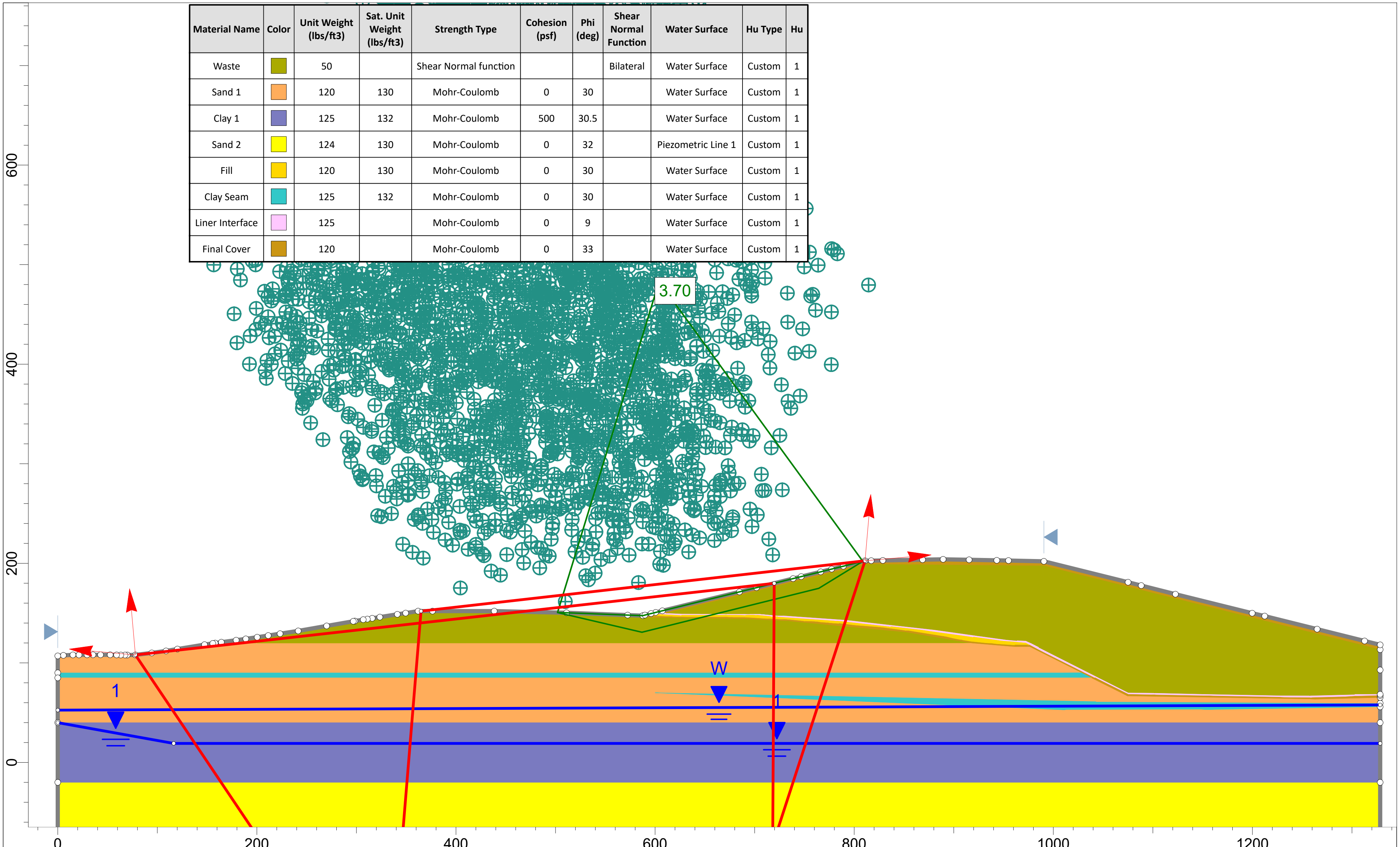
SLIDEINTERPRET 8.032

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description			
Drawn By		*Scale* 1:1700	*Company*
Date 2/19/2020, 3:16:18 PM		*File Name* CC_drained_circular.slim	

Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Hu Type	Hu
Waste		50		Shear Normal function			Bilateral	Water Surface	Custom	1
Sand 1		120	130	Mohr-Coulomb	0	30		Water Surface	Custom	1
Clay 1		125	132	Mohr-Coulomb	500	30.5		Water Surface	Custom	1
Sand 2		124	130	Mohr-Coulomb	0	32		Piezometric Line 1	Custom	1
Fill		120	130	Mohr-Coulomb	0	30		Water Surface	Custom	1
Clay Seam		125	132	Mohr-Coulomb	0	30		Water Surface	Custom	1
Liner Interface		125		Mohr-Coulomb	0	9		Water Surface	Custom	1
Final Cover		120		Mohr-Coulomb	0	33		Water Surface	Custom	1

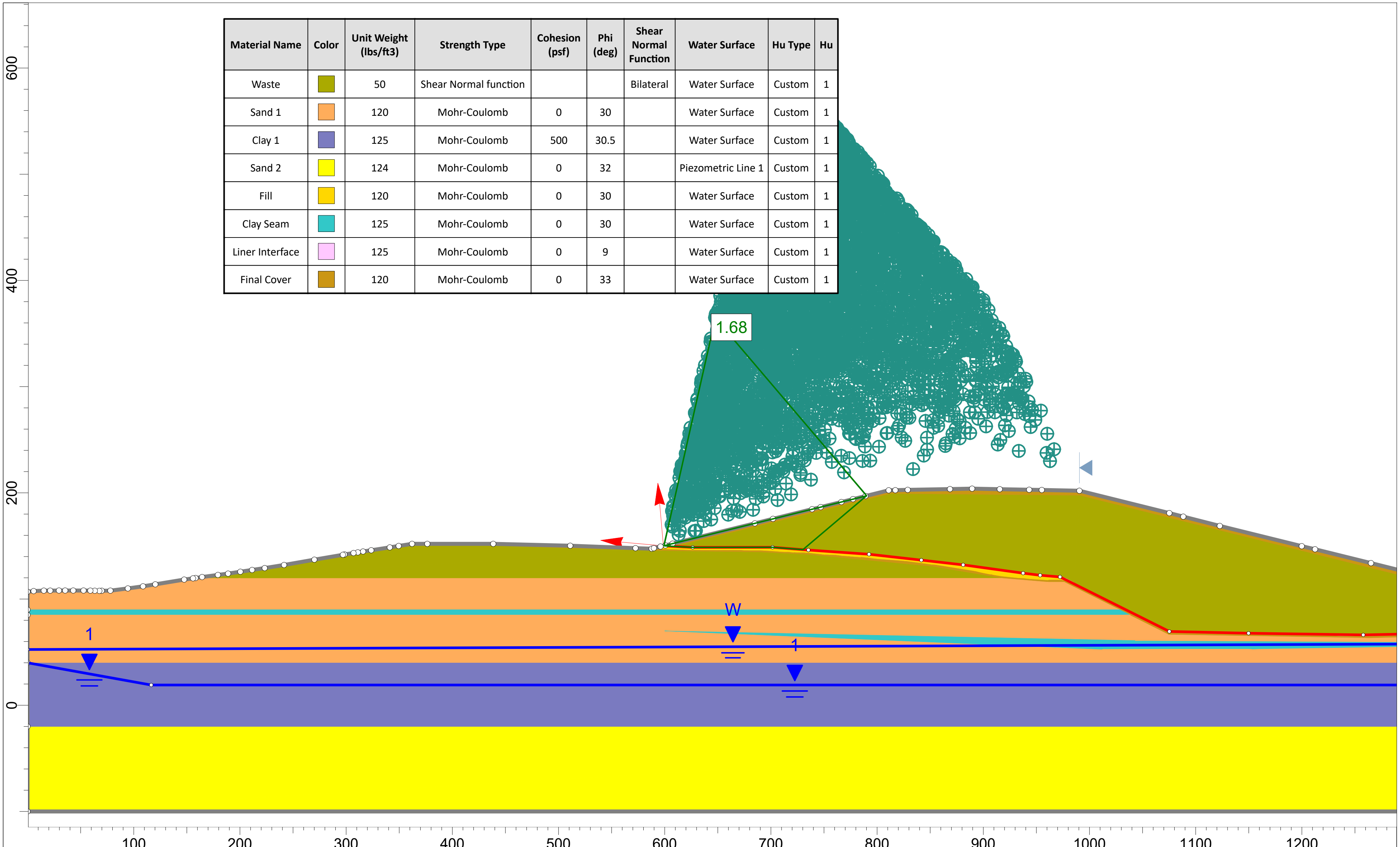


rocscience

SLIDEINTERPRET 8.032

Project	SLIDE - An Interactive Slope Stability Program
Analysis Description	
Drawn By	
Scale	1:1600
Company	
Date	2/19/2020, 3:16:18 PM
File Name	CC_drained_noncircular.slim

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Hu Type	Hu
Waste		50	Shear Normal function			Bilateral	Water Surface	Custom	1
Sand 1		120	Mohr-Coulomb	0	30		Water Surface	Custom	1
Clay 1		125	Mohr-Coulomb	500	30.5		Water Surface	Custom	1
Sand 2		124	Mohr-Coulomb	0	32		Piezometric Line 1	Custom	1
Fill		120	Mohr-Coulomb	0	30		Water Surface	Custom	1
Clay Seam		125	Mohr-Coulomb	0	30		Water Surface	Custom	1
Liner Interface		125	Mohr-Coulomb	0	9		Water Surface	Custom	1
Final Cover		120	Mohr-Coulomb	0	33		Water Surface	Custom	1



rocscience

SLIDEINTERPRET 8.032

Project

SLIDE - An Interactive Slope Stability Program

Analysis Description

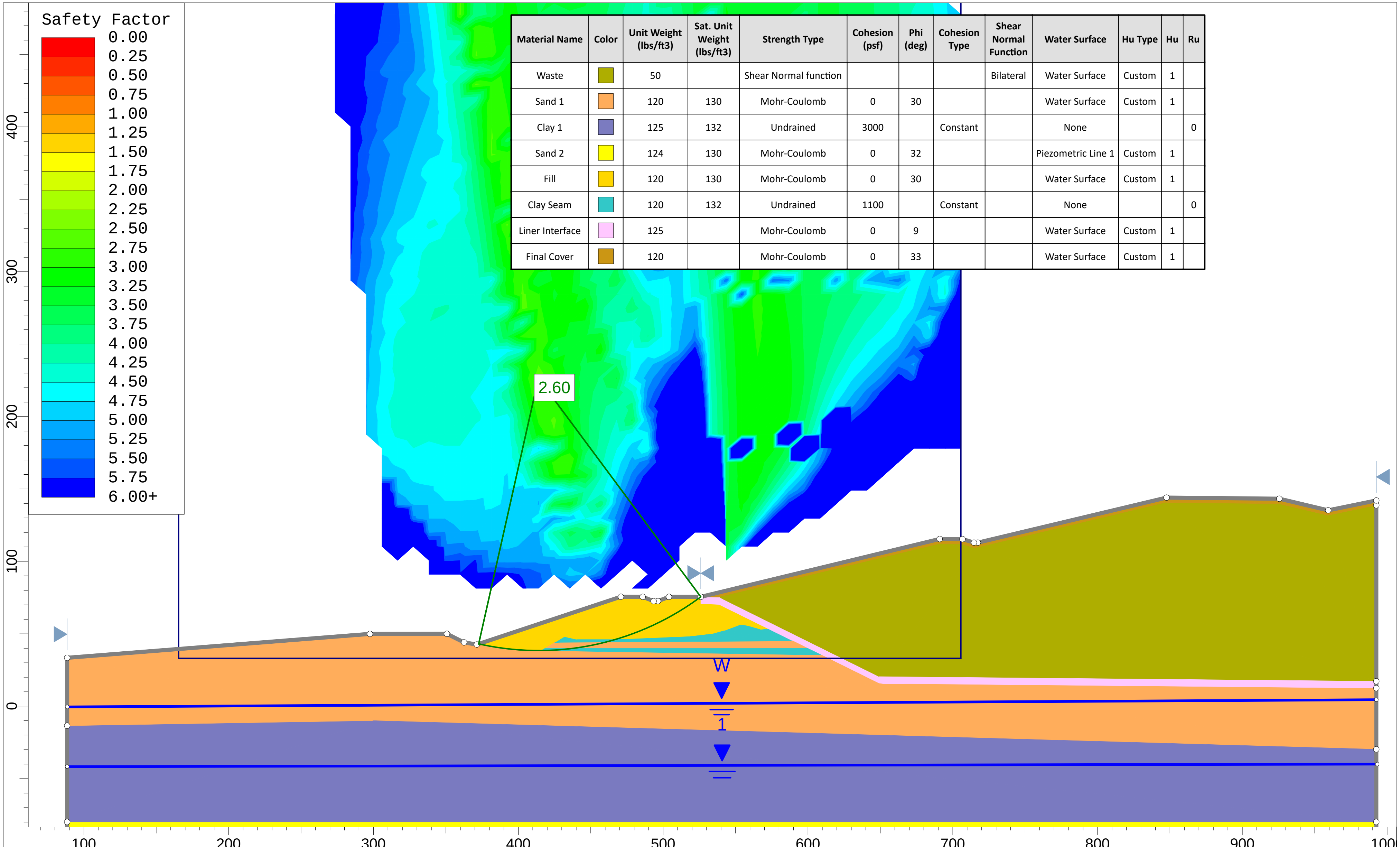
Drawn By

Scale 1:1500

Company

Date 2/19/2020, 3:16:18 PM

File Name CC_drained_liner.slim



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Shear Normal Function	Water Surface	Hu Type	Hu	Ru
Waste		50		Shear Normal function				Bilateral	Water Surface	Custom	1	
Sand 1		120	130	Mohr-Coulomb	0	30			Water Surface	Custom	1	
Clay 1		125	132	Undrained	3000		Constant		None			0
Sand 2		124	130	Mohr-Coulomb	0	32			Piezometric Line 1	Custom	1	
Fill		120	130	Mohr-Coulomb	0	30			Water Surface	Custom	1	
Clay Seam		120	132	Undrained	1100		Constant		None			0
Liner Interface		125		Mohr-Coulomb	0	9			Water Surface	Custom	1	
Final Cover		120		Mohr-Coulomb	0	33			Water Surface	Custom	1	

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SLIDEINTERPRET 8.032

Project

SLIDE - An Interactive Slope Stability Program

Analysis Description

Drawn By

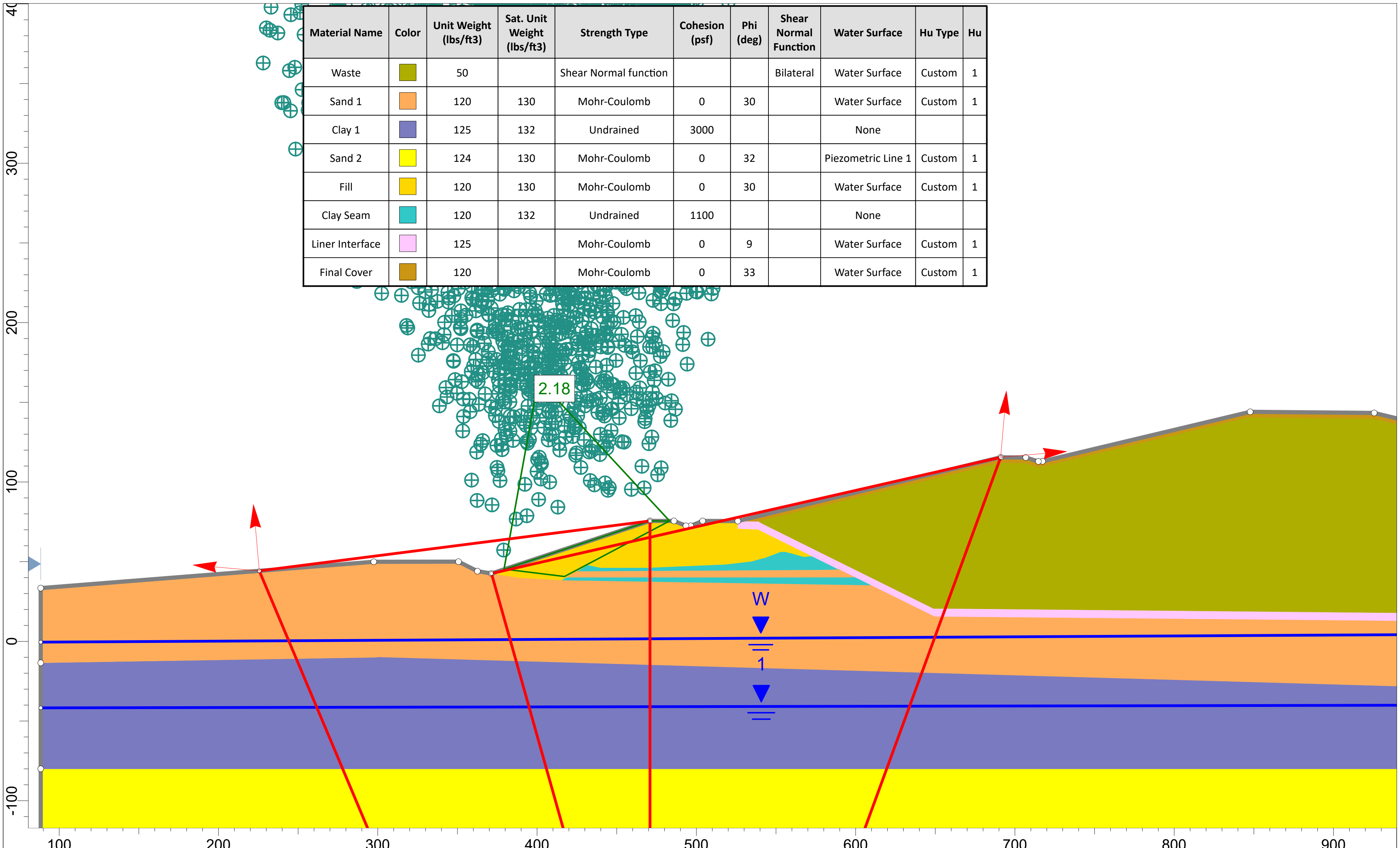
Scale 1:1100

Company

Date 2/19/2020, 10:36:05 AM

File Name DD_undrained_circular.slim

Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Hu Type	Hu
Waste		50		Shear Normal function			Bilateral	Water Surface	Custom	1
Sand 1		120	130	Mohr-Coulomb	0	30		Water Surface	Custom	1
Clay 1		125	132	Undrained	3000			None		
Sand 2		124	130	Mohr-Coulomb	0	32		Piezometric Line 1	Custom	1
Fill		120	130	Mohr-Coulomb	0	30		Water Surface	Custom	1
Clay Seam		120	132	Undrained	1100			None		
Liner Interface		125		Mohr-Coulomb	0	9		Water Surface	Custom	1
Final Cover		120		Mohr-Coulomb	0	33		Water Surface	Custom	1



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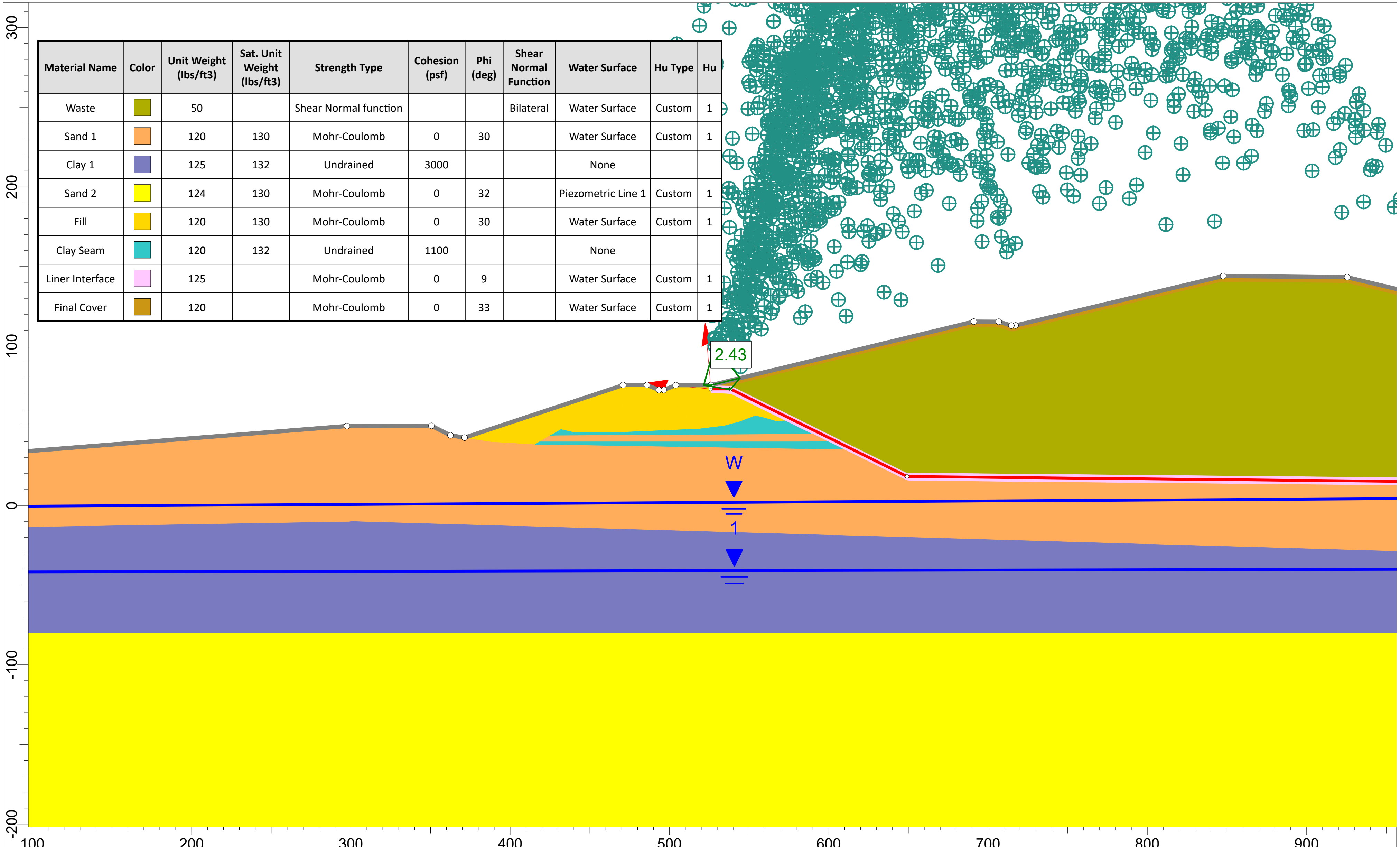
SLIDEINTERPRET 8.032

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description			
Drawn By		*Scale* 1:1000	*Company*
Date 2/19/2020, 10:36:05 AM		*File Name* DD_undrained_noncircular.slim	



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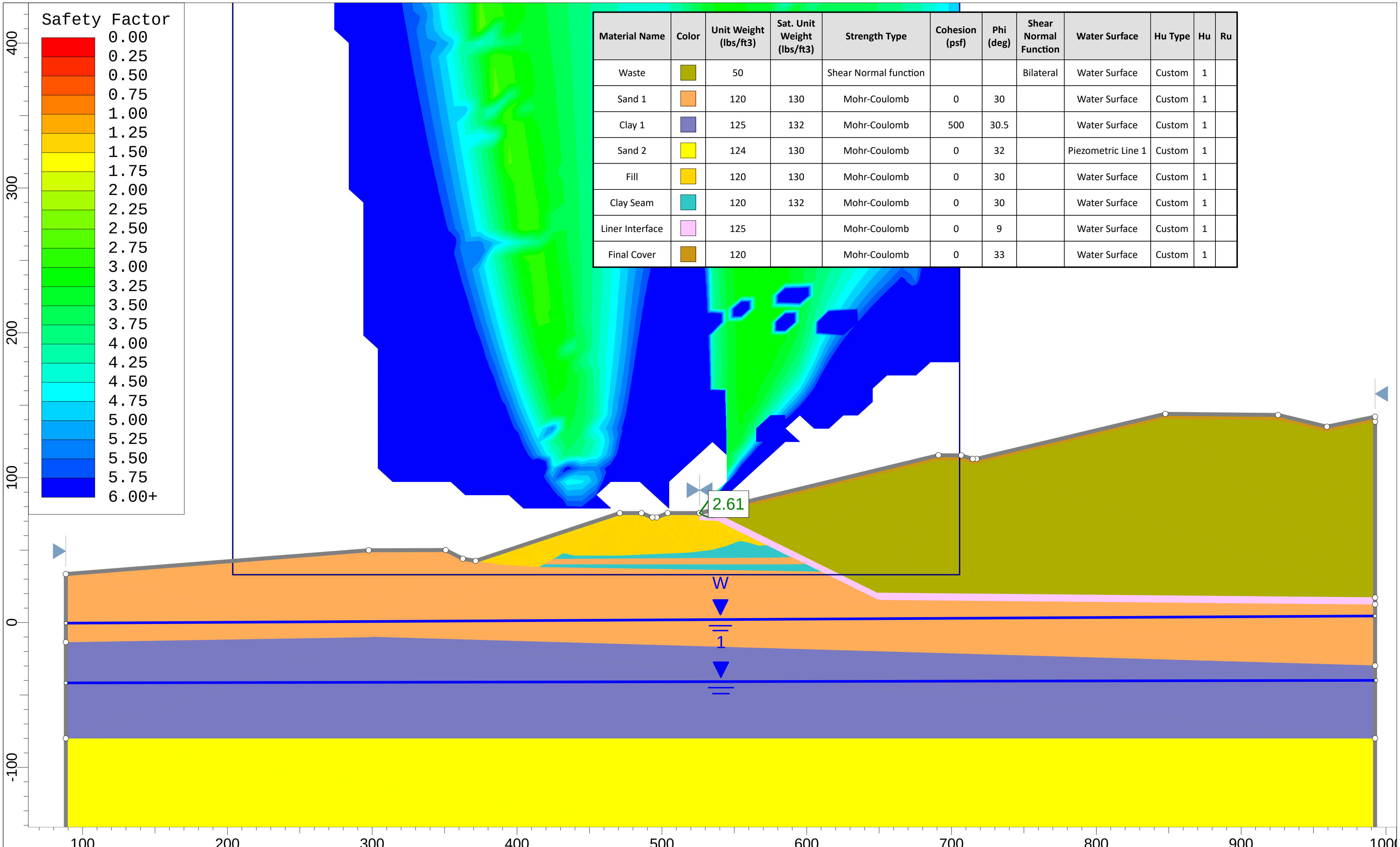
Waste		50		Shear Normal function			Bilateral	Water Surface	Custom	1
Sand 1		120	130	Mohr-Coulomb	0	30		Water Surface	Custom	1
Clay 1		125	132	Undrained	3000			None		
Sand 2		124	130	Mohr-Coulomb	0	32		Piezometric Line 1	Custom	1
Fill		120	130	Mohr-Coulomb	0	30		Water Surface	Custom	1
Clay Seam		120	132	Undrained	1100			None		
Liner Interface		125		Mohr-Coulomb	0	9		Water Surface	Custom	1
Final Cover		120		Mohr-Coulomb	0	33		Water Surface	Custom	1

rocscience

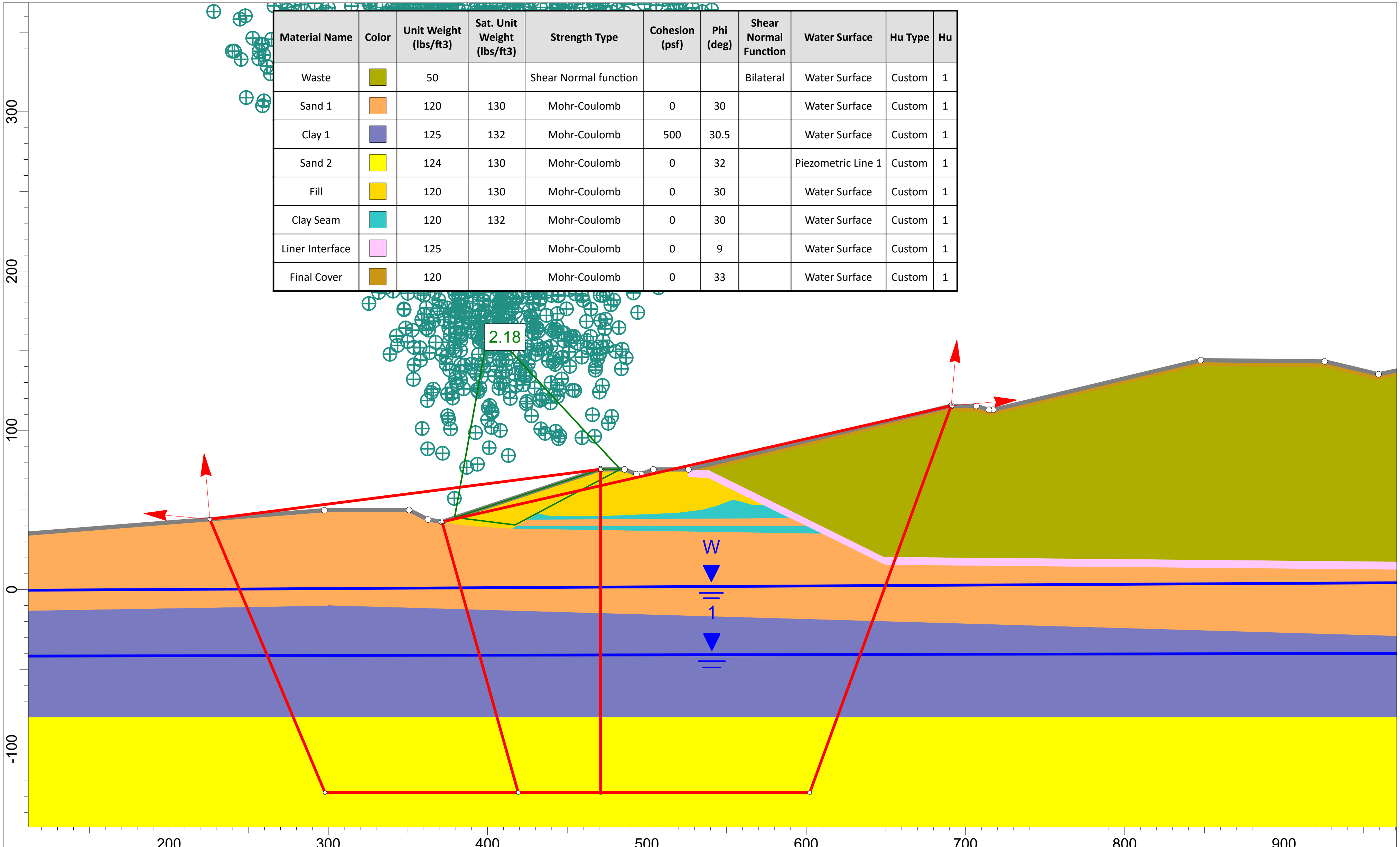
SLIDEINTERPRET 8.032

Project	SLIDE - An Interactive Slope Stability Program
Analysis Description	
Drawn By	
Scale	1:1000
Company	
Date	2/19/2020, 10:36:05 AM
File Name	DD_undrained_liner.slim



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Hu Type	Hu	Ru
Waste		50		Shear Normal function			Bilateral	Water Surface	Custom	1	
Sand 1		120	130	Mohr-Coulomb	0	30		Water Surface	Custom	1	
Clay 1		125	132	Mohr-Coulomb	500	30.5		Water Surface	Custom	1	
Sand 2		124	130	Mohr-Coulomb	0	32		Piezometric Line 1	Custom	1	
Fill		120	130	Mohr-Coulomb	0	30		Water Surface	Custom	1	
Clay Seam		120	132	Mohr-Coulomb	0	30		Water Surface	Custom	1	
Liner Interface		125		Mohr-Coulomb	0	9		Water Surface	Custom	1	
Final Cover		120		Mohr-Coulomb	0	33		Water Surface	Custom	1	

rocscience SLIDEINTERPRET 8.032	*Project* SLIDE - An Interactive Slope Stability Program		
	Analysis Description		
	Drawn By	*Scale* 1:1100	*Company*
	Date 2/19/2020, 10:36:05 AM		*File Name* DD_drained_circular.slim



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Waste		50		Shear Normal function			Bilateral	Water Surface	Custom	1
Sand 1		120	130	Mohr-Coulomb	0	30		Water Surface	Custom	1
Clay 1		125	132	Mohr-Coulomb	500	30.5		Water Surface	Custom	1
Sand 2		124	130	Mohr-Coulomb	0	32		Piezometric Line 1	Custom	1
Fill		120	130	Mohr-Coulomb	0	30		Water Surface	Custom	1
Clay Seam		120	132	Mohr-Coulomb	0	30		Water Surface	Custom	1
Liner Interface		125		Mohr-Coulomb	0	9		Water Surface	Custom	1
Final Cover		120		Mohr-Coulomb	0	33		Water Surface	Custom	1

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SLIDEINTERPRET 8.032

Project

SLIDE - An Interactive Slope Stability Program

Analysis Description

Drawn By

Scale 1:1000

Company

Date 2/19/2020, 10:36:05 AM

File Name DD_drained_noncircular.slim

Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Hu Type	Hu
Waste		50		Shear Normal function			Bilateral	Water Surface	Custom	1
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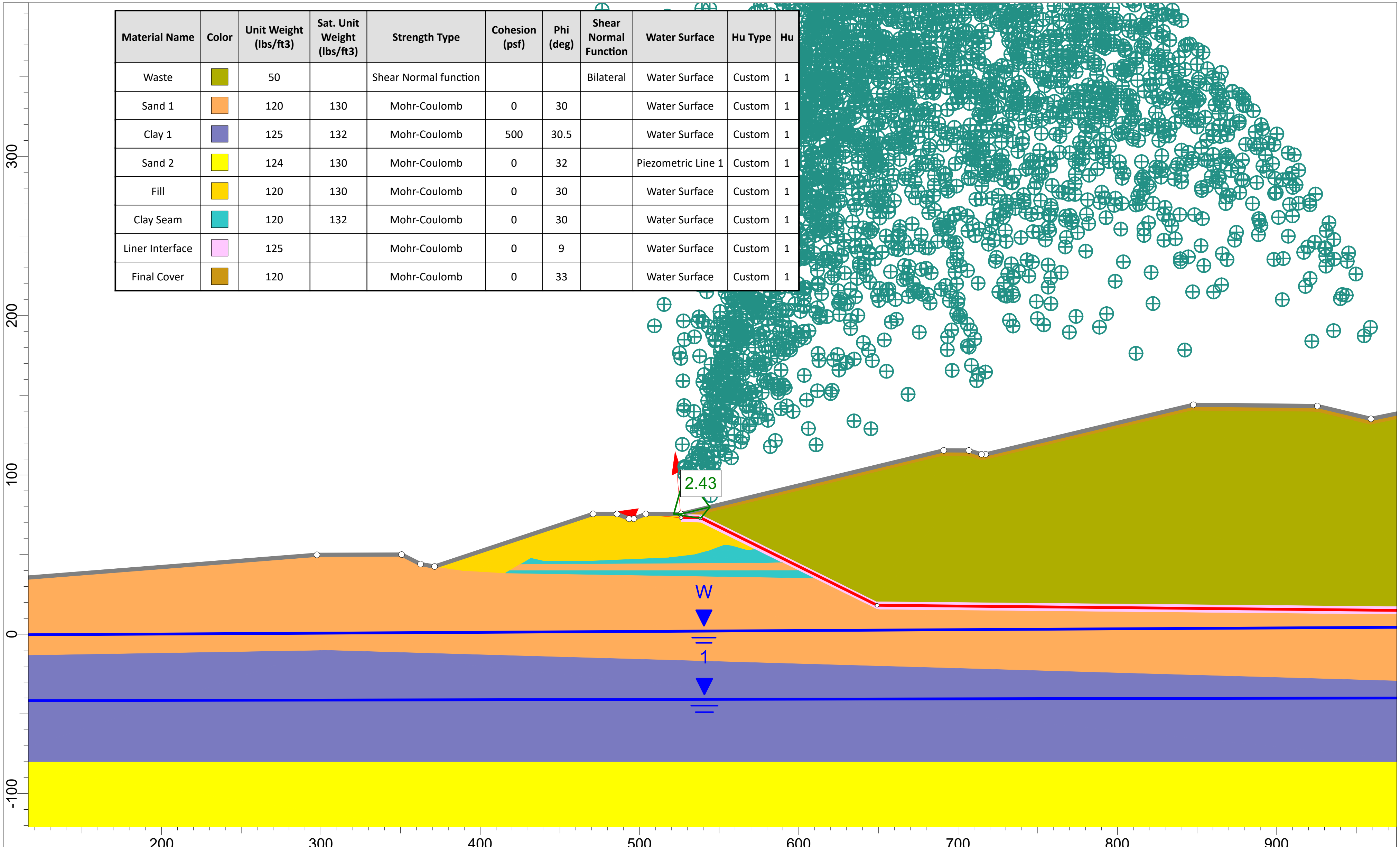
Clay 1		125	132	Mohr-Coulomb	500	30.5		Water Surface	Custom	1
Sand 2		124	130	Mohr-Coulomb	0	32		Piezometric Line 1	Custom	1
Fill		120	130	Mohr-Coulomb	0	30		Water Surface	Custom	1
Clay Seam		120	132	Mohr-Coulomb	0	30		Water Surface	Custom	1
Liner Interface		125		Mohr-Coulomb	0	9		Water Surface	Custom	1
Final Cover		120		Mohr-Coulomb	0	33		Water Surface	Custom	1



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SLIDEINTERPRET 8.032

Project SLIDE - An Interactive Slope Stability Program

Analysis Description

Drawn By

Scale 1:1000

Company

Date 2/19/2020, 10:36:05 AM

File Name DD_drained_liner.slim

Appendix G: Stormwater Management System

Geosyntec
consultants

Appendix G.1: Stormwater Routing Analyses

Geosyntec consultants

COMPUTATION COVER SHEET

Client: Tolson & Associates **Project:** TRL Vertical Expansion **Project #:** ME1606 **Phase #:** 3

TITLE OF COMPUTATIONS: STORMWATER ROUTING ANALYSES

COMPUTATIONS BY: Signature ______ July 21, 2020 DATE

Printed Name and Title: Helena Harris, Staff Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY: (Peer Reviewer) Signature ______ August 3, 2020 DATE

Printed Name and Title: William M. Steier, P.E., Principal

COMPUTATIONS CHECKED BY: Signature ______ August 3, 2020 DATE

Printed Name and Title: William M. Steier, P.E., Principal

COMPUTATIONS BACKCHECKED BY: (Originator) Signature ______ August 4, 2020 DATE

Printed Name and Title: Simone Smith, P.E., Senior Engineer

APPROVED BY: (PM or Designate) Signature C.H. Pendleton August 4, 2020 DATE

Printed Name and Title: Carrie H. Pendleton, P.E., Principal

APPROVAL NOTES: ______

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

STORMWATER ROUTING ANALYSIS
TOLSON LANDFILL SWM DESIGN

PURPOSE

The purpose of this calculation package is to develop a post-development watershed stormwater routing analysis for the proposed expansion of Tolson Rubble Landfill (TRL) in Crofton, Maryland. These analyses are integral to estimating the peak discharge associated with the post-development subcatchment areas of the site. In turn, the peak discharge is a design input for each of the stormwater management features for the project, including: (i) cover terraces; (ii) perimeter drainage channels; (iii) sediment traps and (iv) the stormwater retention basin. Post-development analyses were performed for the discharge outlets at the stormwater management basin.

METHOD

Watershed analyses in this calculation package were performed using "*HydroCAD® Stormwater Modeling System*," version 10.00-18 [Applied Microcomputer Systems, 2016] (HydroCAD®). HydroCAD® routes stormwater runoff through the defined modeling using the procedures described in the documents, "*Urban Hydrology for Small Watersheds, Technical Release 55*," [USDA-SCS, 1986] and "*Computer Program for Project Formulation Hydrology, Technical Release 20*," [USDA –SCS, 1982].

CALCULATION PARAMETERS

The following section summarizes the selection of the various hydrologic parameters used for the watershed analysis.

- **Design Rainfall Depth and Distribution:** Based on information provided by NOAA Atlas 14, Volume 2, Version 3, a 24-hour duration SCS Type II rainfall distribution of the following magnitudes are considered in the hydrologic analyses (see Attachment 1):

Return Period (years)	Rainfall Depth (in.)
1	2.65
2	3.2
5	4.12
10	4.93
25	6.17
100	8.51

- **Hydrologic Soil Groups:**

  Post-Development: It is assumed that the soil used to construct the final cover system will come from a combination of onsite and offsite sources. In general, the final cover soil is anticipated to exhibit characteristics of Hydrologic Soils Group C or D.

- **Curve Number (CN):**

  Post-Development: For the final cover system, a CN of 80 is used, the values recommended by SCS for hydrologic soil group D for "open spaces in good condition (grass cover > 75%)." A summary of runoff CN values provided by SCS [SCS, 1986] are provided in Attachment 2.

- **Time of Concentration T_c:** The T_c value represents the total time for stormwater runoff to travel from the hydraulically most distant point of a watershed or drainage area, to the POI. Factors affecting T_c include surface roughness, channel shape and flow patterns, and slope. The calculation of T_c includes analysis of three different types of stormwater runoff flow:

  - **sheet flow** – flow over plane surfaces, which is limited to a maximum length of 100 ft.;
  - **shallow concentrated flow** – after 100 ft., sheet flow will begin to concentrate, but not necessarily defined in a specific channel; and
  - **open channel flow** – flow that is confined to a defined channel.

  The T_c value for a drainage area is the sum of the individual various travel time (T_t) values of the above flow types. The equations for calculating the T_t are presented below:

  - **sheet flow:** $$T_t = \frac{0.007\,(nL)^{0.8}}{(P_2)^{0.5}\,s^{0.4}}$$
  - **shallow concentrated flow:** $$T_t = \frac{L}{3{,}600\,V}$$
  - **open channel flow:** $$T_t = \frac{nL}{3{,}600\,(1.49)\,R^{2/3}\,S^{1/2}}$$

  where:
  T_t = travel time (hours)
  n = Manning's roughness coefficient (dimensionless)
  L = length of flow (ft)
  P_2 = rainfall from a 2-year, 24-hour storm (in)
  S = Bed or surface slope in the flow direction (ft/ft)

V = velocity (ft/sec)
R = hydraulic radius (ft)

HydroCAD® gives typical values for n. For calculating sheet flow under post-development conditions, n was chosen as 0.15, corresponding to short grass. This value was chosen because the surface of TRL is expected to be vegetated following closure. For calculating open channel flow (i.e. flow through a cover terrace) in the post-development condition, n was chosen as 0.04, the value recommended for channels lined with soil stabilization matting and flow greater than six inches [MDE, 2011].

USDA-SCS [1986] provides a graphical solution for T_t for shallow concentrated flow over "paved" and "unpaved areas." Alternatively, the "*National Engineering Handbook, Section 4 Hydrology (NEH-4)*," [SCS, 1985] provides the following equation for V:

$$V = K_v \sqrt{s}$$

Where K_v is a velocity factor based on various surface conditions (i.e., paved, unpaved, grassed waterway, short grass pasture) and s is the slope of the land surface. HydroCAD® provides a table of velocity factors (K_v), which are used to calculate V in the above equation.

Under post-development conditions, K_v is chosen as 7.0 ft/sec (corresponding to "short grass or pasture"). The computations for T_c and T_t are completed in the HydroCAD® model.

- **Catchment Drainage Areas:**

  Post-Development: The post-closure drainage areas are presented as Figure 1. Unique subcatchment and basin identification numbers used for modeling the post-development conditions are included in this figure. This plan presents boundaries of the landfill drainage areas. In general, subcatchment drainage areas of the final cover system are defined by the locations of cover terraces, downchutes, perimeter channels, and the receiving stormwater management basins. Drainage lengths and slopes for the HydroCAD® analysis were estimated by hand using the post-development topography shown in Figure 1.

RESULTS

The results of the HydroCAD® analysis for the post-development condition during the 25-yr, 24-hr design storm are presented in Attachment 3. These results will be used to verify the geometry and select appropriate erosion resistant lining for each of the stormwater management conveyance features.

REFERENCES

HydroCAD Software Solutions LLC, "*HydroCAD® Stormwater Modeling System*", Version 10.00, Chocorua, New Hampshire 2016.

Maryland Department of the Environment and Center for Watershed Protection, *"2000 Maryland Stormwater Design Manual Volumes I and II*", Revised 2009.

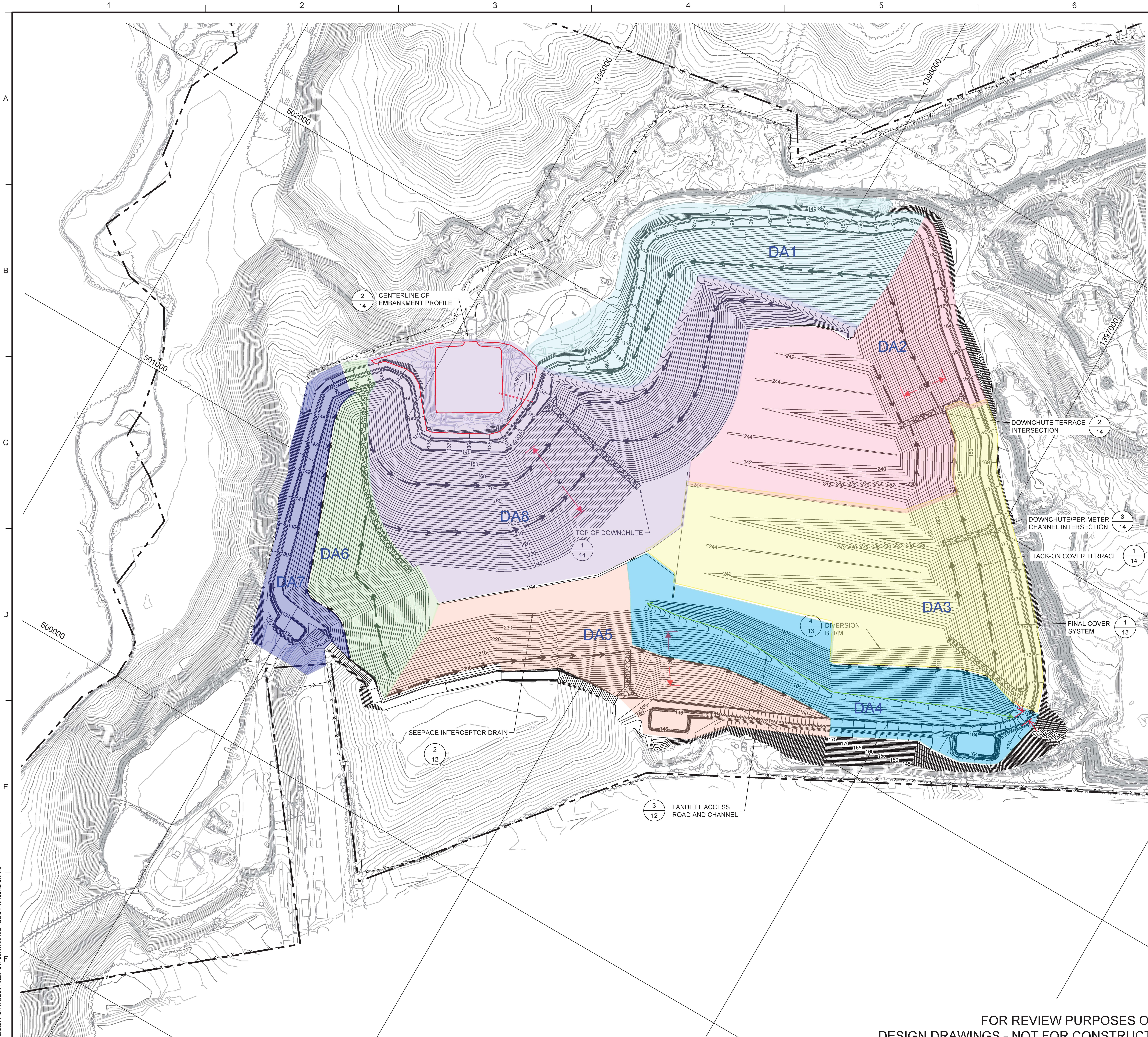
Maryland Department of the Environment, "*Maryland Standards and Specifications for Soil Erosion and Sediment Contr*ol", 2011.

United States Department of Agriculture, Natural Resources Conservation Service, *"Part 630 Hydrology - National Engineering Handbook"*, Washington D.C., 2015.

United States Department of Agriculture, Soil Conservation Service, "*Computer Program for Project Formulation Hydrology, Technical Release 20*", Washington D.C., 1982.

United States Department of Agriculture, Soil Conservation Service, "*Urban Hydrology for Small Watersheds, Technical Release 55*", 2nd ed., Washington, D.C., 1986.

FIGURES



0 160 320
SCALE IN FEET

LEGEND

- EXISTING CONTOURS (FEET, MSL)
- EXISTING TREE LINE
- EXISTING FENCE
- EXISTING ELECTRIC POLES
- EXISTING ELECTRIC LINE
- EXISTING UNDERGROUND ELECTRIC LINE
- EXISTING ROAD
- PROPOSED CONTOUR GRADE (FEET, MSL)
- PROPERTY BOUNDARY
- PROPOSED DRAINAGE TERRACE
- PROPOSED DOWNCHUTE

NOTES:

1. CONTOURS SHOWN REPRESENT TOP OF FINAL COVER GRADE.

FOR REVIEW PURPOSES ONLY
DESIGN DRAWINGS - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DRN	APP

Geosyntec consultants
10211 WINCOPIN CIRCLE, FLOOR 4
COLUMBIA, MARYLAND 21044
PHONE: (410) 381-4333

TOLSON AND ASSOCIATES, LLC
24024 FREDERICK ROAD
CLARKSBURG, MARYLAND 20871

TITLE: FINAL COVER GRADING AND STORMWATER MANAGEMENT SYSTEM

PROJECT: **VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL**

SITE: **TOLSON RUBBLE LANDFILL**

DRAFT

SIGNATURE

DATE

DESIGN BY:	SS	DATE:	JULY 2020
DRAWN BY:	ANA	PROJECT NO.:	ME1606
CHECKED BY:	SS	FILE:	ME1606-012
REVIEWED BY:	---	DRAWING NO.:	
APPROVED BY:	CHP	11 OF 18	

ATTACHMENT 1

Design Storms [NOAA, 2006]

NOAA Atlas 14, Volume 2, Version 3
Location name: Odenton, Maryland, USA*
Latitude: 39.0447°, Longitude: -76.7041°
Elevation: 117.86 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.347 (0.315-0.382)	0.415 (0.376-0.457)	0.494 (0.447-0.544)	0.551 (0.498-0.608)	0.623 (0.559-0.687)	0.677 (0.605-0.747)	0.730 (0.649-0.808)	0.780 (0.689-0.867)	0.842 (0.736-0.943)	0.891 (0.773-1.00)
10-min	0.554 (0.503-0.610)	0.664 (0.602-0.730)	0.791 (0.717-0.872)	0.882 (0.797-0.972)	0.994 (0.892-1.10)	1.08 (0.963-1.19)	1.16 (1.03-1.28)	1.24 (1.09-1.37)	1.33 (1.16-1.49)	1.40 (1.22-1.58)
15-min	0.693 (0.629-0.763)	0.834 (0.756-0.918)	1.00 (0.906-1.10)	1.12 (1.01-1.23)	1.26 (1.13-1.39)	1.37 (1.22-1.51)	1.47 (1.30-1.62)	1.56 (1.38-1.73)	1.68 (1.47-1.88)	1.76 (1.53-1.98)
30-min	0.950 (0.862-1.05)	1.15 (1.05-1.27)	1.42 (1.29-1.57)	1.62 (1.46-1.78)	1.87 (1.67-2.06)	2.06 (1.84-2.27)	2.25 (2.00-2.48)	2.43 (2.15-2.70)	2.67 (2.33-2.99)	2.85 (2.47-3.21)
60-min	1.18 (1.08-1.30)	1.45 (1.31-1.59)	1.82 (1.65-2.01)	2.10 (1.90-2.32)	2.48 (2.23-2.74)	2.79 (2.49-3.08)	3.09 (2.75-3.42)	3.40 (3.01-3.79)	3.83 (3.35-4.29)	4.16 (3.61-4.69)
2-hr	1.40 (1.27-1.55)	1.71 (1.55-1.88)	2.16 (1.96-2.38)	2.51 (2.27-2.77)	3.01 (2.70-3.31)	3.41 (3.05-3.75)	3.83 (3.40-4.22)	4.26 (3.76-4.72)	4.88 (4.25-5.45)	5.38 (4.64-6.04)
3-hr	1.52 (1.38-1.67)	1.84 (1.67-2.04)	2.34 (2.12-2.58)	2.73 (2.46-3.01)	3.28 (2.94-3.62)	3.74 (3.33-4.13)	4.22 (3.73-4.67)	4.74 (4.14-5.26)	5.47 (4.72-6.11)	6.07 (5.17-6.83)
6-hr	1.87 (1.71-2.07)	2.27 (2.06-2.50)	2.86 (2.60-3.16)	3.35 (3.03-3.70)	4.08 (3.65-4.50)	4.70 (4.16-5.19)	5.36 (4.71-5.95)	6.09 (5.29-6.77)	7.15 (6.10-8.03)	8.05 (6.77-9.10)
12-hr	2.27 (2.05-2.55)	2.75 (2.48-3.09)	3.49 (3.14-3.92)	4.13 (3.69-4.64)	5.11 (4.51-5.73)	5.97 (5.22-6.69)	6.93 (5.98-7.79)	8.00 (6.80-9.02)	9.63 (8.00-10.9)	11.0 (9.01-12.6)
24-hr	2.65 (2.41-2.94)	3.20 (2.92-3.55)	4.12 (3.75-4.57)	4.93 (4.46-5.45)	6.17 (5.54-6.78)	7.27 (6.47-7.96)	8.51 (7.51-9.30)	9.92 (8.65-10.8)	12.1 (10.4-13.1)	14.0 (11.8-15.2)
2-day	3.07 (2.79-3.39)	3.71 (3.38-4.11)	4.77 (4.33-5.27)	5.67 (5.13-6.26)	7.04 (6.33-7.74)	8.23 (7.35-9.03)	9.56 (8.47-10.5)	11.0 (9.68-12.1)	13.3 (11.5-14.5)	15.2 (13.0-16.7)
3-day	3.23 (2.94-3.56)	3.91 (3.57-4.32)	5.01 (4.56-5.53)	5.96 (5.41-6.56)	7.38 (6.65-8.09)	8.61 (7.72-9.43)	9.99 (8.88-10.9)	11.5 (10.2-12.6)	13.8 (12.0-15.1)	15.8 (13.6-17.3)
4-day	3.39 (3.10-3.74)	4.10 (3.76-4.53)	5.25 (4.80-5.78)	6.24 (5.68-6.85)	7.72 (6.98-8.45)	9.00 (8.09-9.83)	10.4 (9.29-11.4)	12.0 (10.6-13.1)	14.4 (12.6-15.7)	16.5 (14.2-18.0)
7-day	3.94 (3.61-4.32)	4.74 (4.35-5.21)	5.99 (5.49-6.57)	7.07 (6.45-7.73)	8.67 (7.86-9.46)	10.0 (9.06-10.9)	11.6 (10.4-12.6)	13.3 (11.8-14.4)	15.8 (13.8-17.2)	17.9 (15.5-19.5)
10-day	4.48 (4.13-4.89)	5.39 (4.97-5.87)	6.73 (6.19-7.32)	7.84 (7.20-8.53)	9.47 (8.65-10.3)	10.8 (9.85-11.7)	12.3 (11.1-13.3)	13.9 (12.5-15.1)	16.2 (14.4-17.6)	18.2 (16.0-19.7)
20-day	6.05 (5.62-6.52)	7.19 (6.69-7.75)	8.70 (8.07-9.36)	9.91 (9.19-10.7)	11.6 (10.7-12.5)	13.0 (11.9-13.9)	14.4 (13.2-15.5)	15.9 (14.5-17.1)	17.9 (16.2-19.3)	19.6 (17.6-21.1)
30-day	7.47 (6.97-8.01)	8.84 (8.25-9.48)	10.5 (9.81-11.3)	11.9 (11.1-12.7)	13.7 (12.7-14.7)	15.2 (14.1-16.3)	16.7 (15.4-17.9)	18.2 (16.8-19.5)	20.4 (18.5-21.8)	22.0 (19.9-23.6)
45-day	9.40 (8.83-10.0)	11.1 (10.4-11.8)	13.0 (12.2-13.8)	14.4 (13.5-15.3)	16.3 (15.3-17.3)	17.7 (16.6-18.9)	19.2 (17.9-20.4)	20.6 (19.1-21.9)	22.4 (20.7-23.9)	23.7 (21.8-25.3)
60-day	11.2 (10.5-11.9)	13.2 (12.4-13.9)	15.2 (14.3-16.1)	16.8 (15.8-17.7)	18.8 (17.6-19.9)	20.2 (19.0-21.4)	21.7 (20.3-22.9)	23.0 (21.5-24.4)	24.7 (23.0-26.3)	26.0 (24.1-27.6)

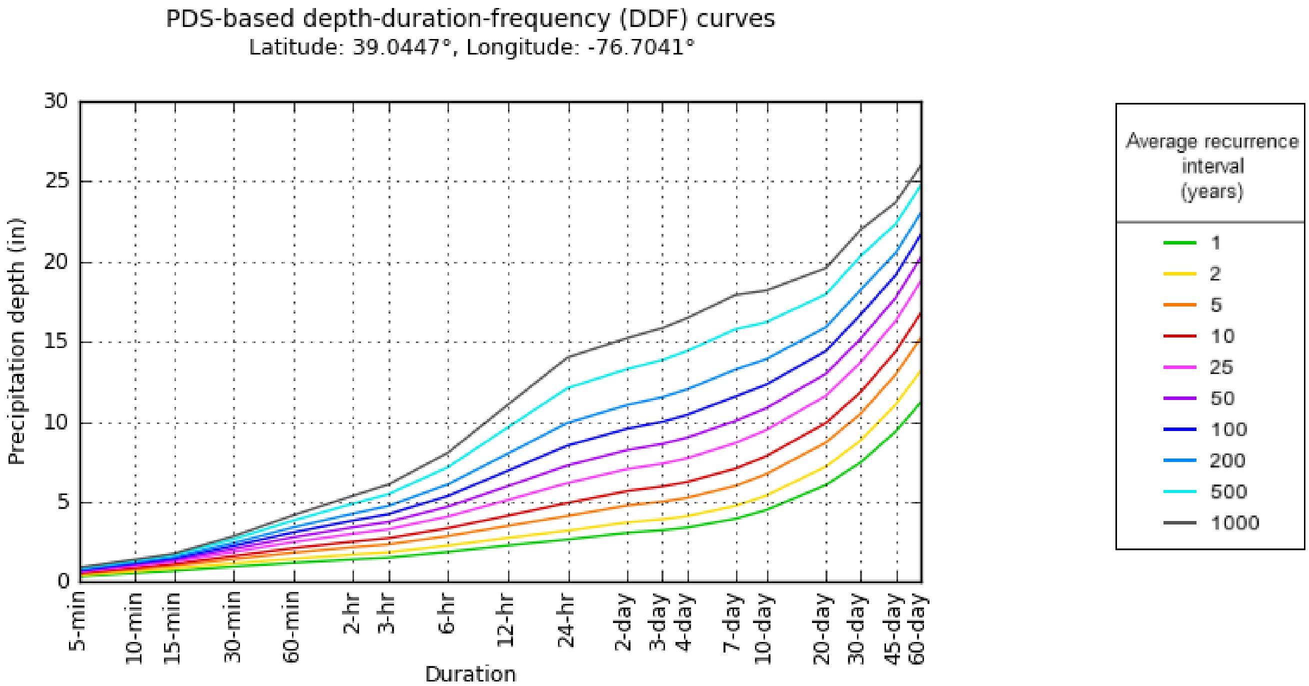
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

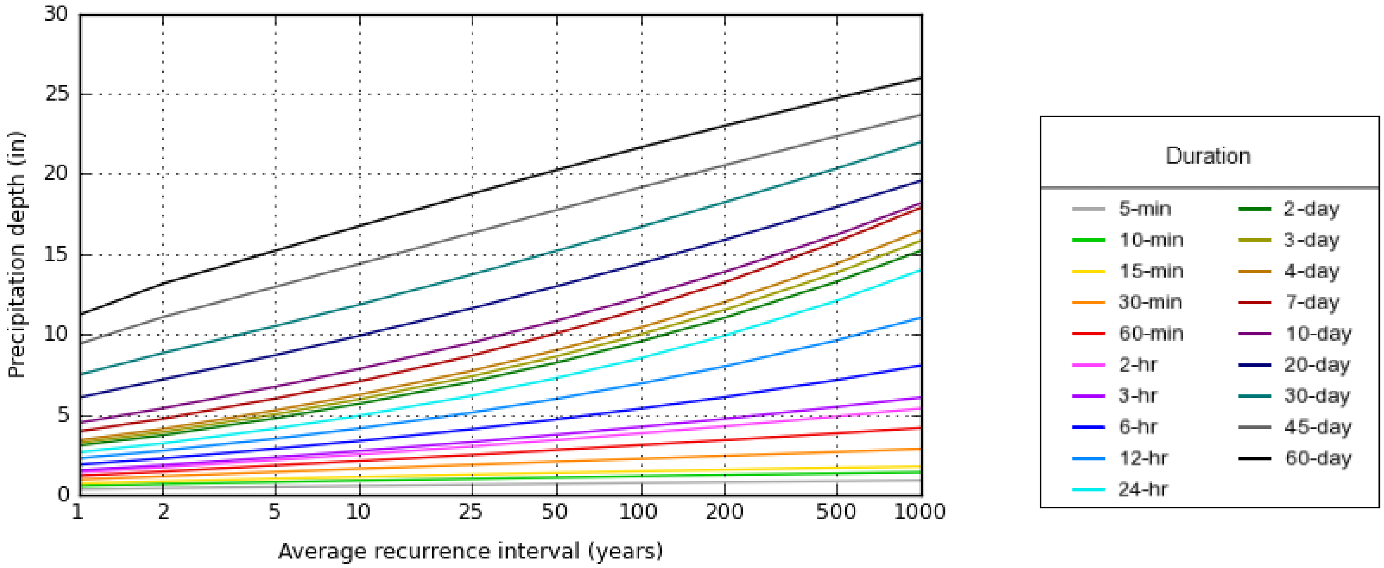
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical



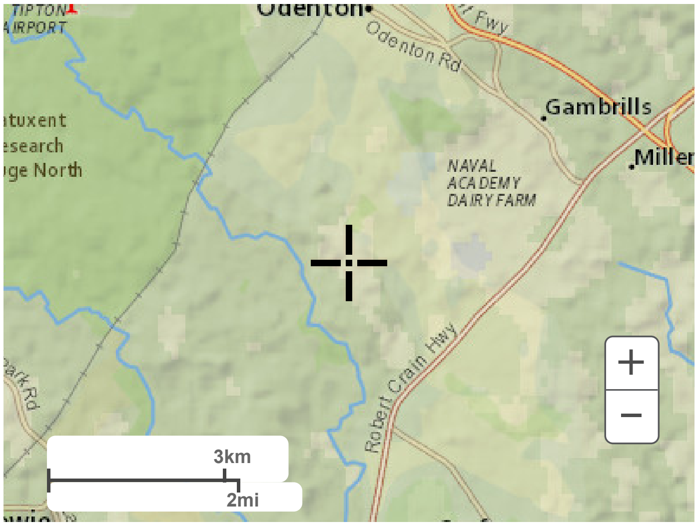


NOAA Atlas 14, Volume 2, Version 3 Created (GMT): Thu Jan 23 22:34:26 2020

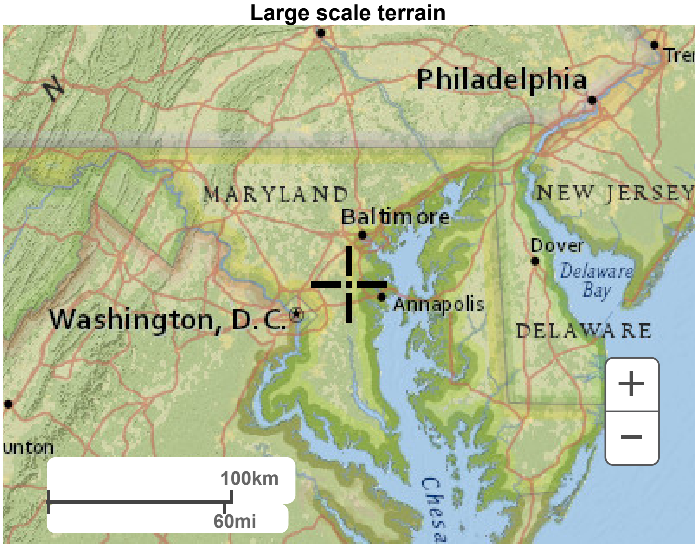
Back to Top

Maps & aerials

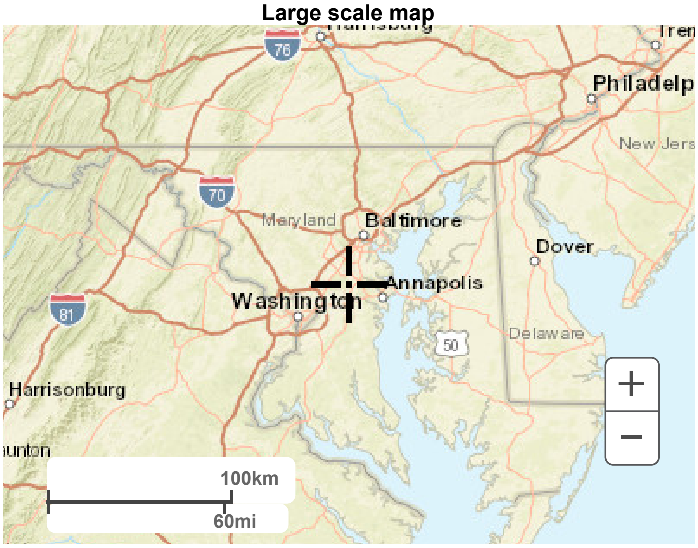
Small scale terrain



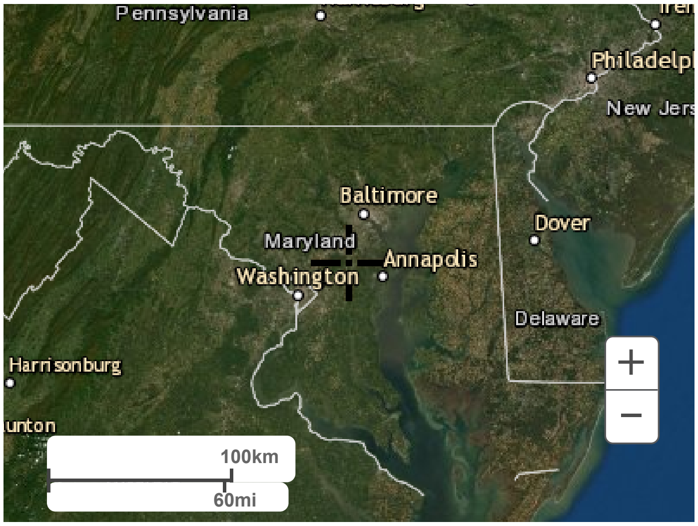
Large scale terrain



Large scale map



Large scale aerial



[Back to Top]

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ATTACHMENT 2

CN Values from USDA-SCS (1986)

Table 2-2a Runoff curve numbers for urban areas [1/]

Cover description: Cover type and hydrologic condition	Average percent impervious area [2/]	Curve numbers for hydrologic soil group: A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3/]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4/]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5/]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

1 Average runoff condition, and $I_a = 0.2S$.
2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.
3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.
4 Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.
5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

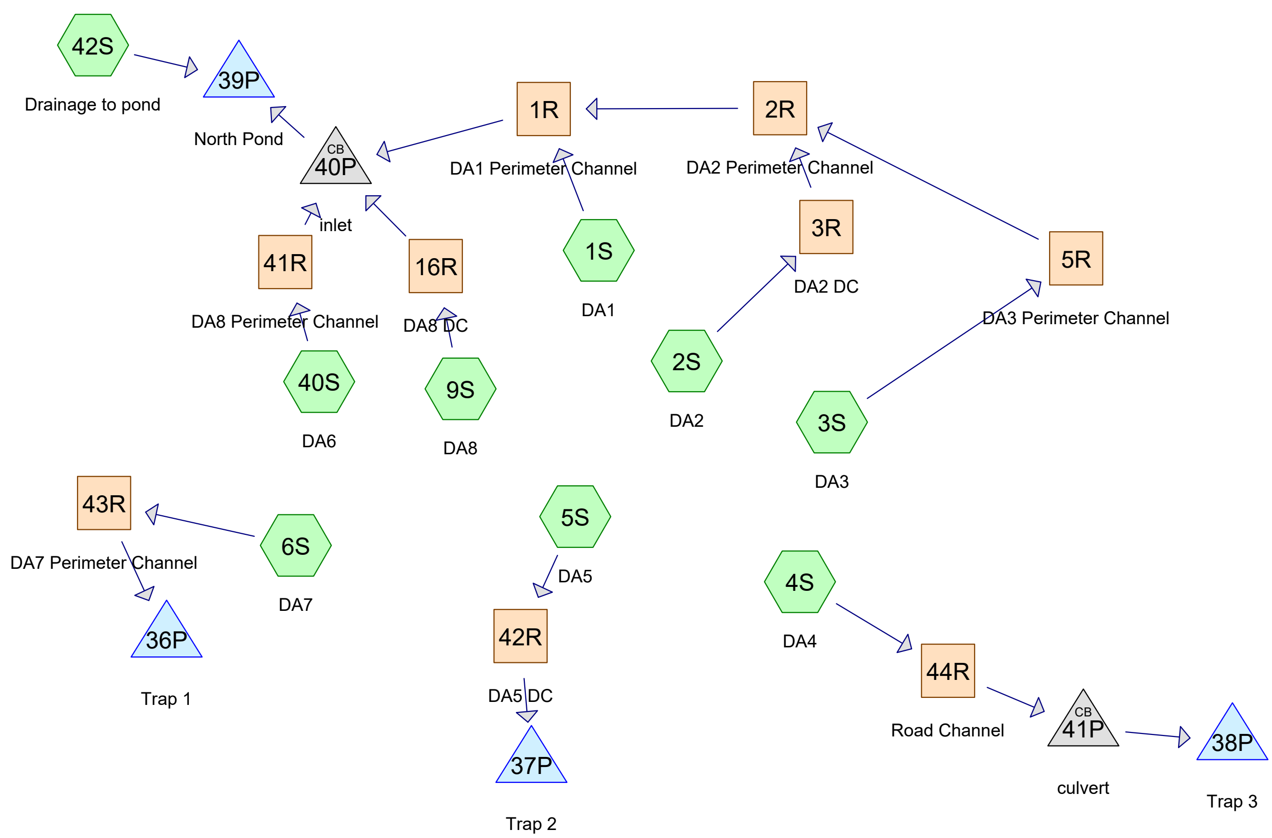
Table 2-2c Runoff curve numbers for other agricultural lands [1/]

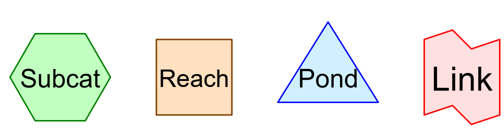
Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. [2/]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. [3/]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 [4/]	48	65	73
Woods—grass combination (orchard or tree farm). [5/]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. [6/]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 [4/]	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

1 Average runoff condition, and $I_a = 0.2S$.
2 *Poor:* <50%) ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.
3 *Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.
4 Actual curve number is less than 30; use CN = 30 for runoff computations.
5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.
6 *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

ATTACHMENT 3

HydroCAD® Output, Post-Development Condition





Routing Diagram for 2020_08.03 Tolson Sediment Traps
Prepared by SCCM, Printed 8/3/2020
HydroCAD® 10.00-21 s/n 00663 © 2018 HydroCAD Software Solutions LLC

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: DA1 Runoff Area=10.500 ac 0.00% Impervious Runoff Depth>3.66"
Flow Length=1,183' Tc=7.3 min CN=80 Runoff=67.74 cfs 3.204 af

Subcatchment 2S: DA2 Runoff Area=13.450 ac 0.00% Impervious Runoff Depth>3.65"
Flow Length=689' Tc=13.5 min CN=80 Runoff=70.82 cfs 4.096 af

Subcatchment 3S: DA3 Runoff Area=15.880 ac 0.00% Impervious Runoff Depth>3.65"
Flow Length=1,224' Tc=21.1 min CN=80 Runoff=66.83 cfs 4.824 af

Subcatchment 4S: DA4 Runoff Area=8.790 ac 0.00% Impervious Runoff Depth>3.66"
Flow Length=1,518' Slope=0.0400 '/' Tc=4.3 min CN=80 Runoff=62.58 cfs 2.684 af

Subcatchment 5S: DA5 Runoff Area=8.460 ac 0.00% Impervious Runoff Depth>3.66"
Flow Length=1,006' Tc=7.3 min CN=80 Runoff=54.58 cfs 2.581 af

Subcatchment 6S: DA7 Runoff Area=4.050 ac 0.00% Impervious Runoff Depth>3.67"
Flow Length=137' Slope=0.2500 '/' Tc=3.8 min CN=80 Runoff=29.33 cfs 1.237 af

Subcatchment 9S: DA8 Runoff Area=18.380 ac 0.00% Impervious Runoff Depth>3.66"
Flow Length=846' Tc=11.5 min CN=80 Runoff=102.94 cfs 5.600 af

Subcatchment 40S: DA6 Runoff Area=5.470 ac 0.00% Impervious Runoff Depth>3.66"
Flow Length=1,178' Tc=7.9 min CN=80 Runoff=34.66 cfs 1.669 af

Subcatchment 42S: Drainage to pond Runoff Area=2.790 ac 45.52% Impervious Runoff Depth>4.49"
Tc=6.0 min CN=88 Runoff=21.57 cfs 1.044 af

Reach 1R: DA1 Perimeter Channel Avg. Flow Depth=2.47' Max Vel=5.49 fps Inflow=128.09 cfs 12.067 af
n=0.040 L=1,767.0' S=0.0141 '/' Capacity=277.04 cfs Outflow=123.81 cfs 11.979 af

Reach 2R: DA2 Perimeter Channel Avg. Flow Depth=2.31' Max Vel=5.68 fps Inflow=119.70 cfs 8.904 af
n=0.040 L=1,108.5' S=0.0162 '/' Capacity=207.75 cfs Outflow=115.20 cfs 8.863 af

Reach 3R: DA2 DC Avg. Flow Depth=0.38' Max Vel=12.51 fps Inflow=70.82 cfs 4.096 af
n=0.030 L=99.0' S=0.2500 '/' Capacity=646.63 cfs Outflow=70.52 cfs 4.094 af

Reach 5R: DA3 Perimeter Channel Avg. Flow Depth=1.53' Max Vel=6.32 fps Inflow=66.83 cfs 4.824 af
n=0.040 L=720.0' S=0.0319 '/' Capacity=291.39 cfs Outflow=65.30 cfs 4.810 af

Reach 16R: DA8 DC Avg. Flow Depth=0.37' Max Vel=12.50 fps Inflow=102.94 cfs 5.600 af
n=0.030 L=240.0' S=0.2500 '/' Capacity=983.48 cfs Outflow=102.00 cfs 5.596 af

Reach 41R: DA8 Perimeter Channel Avg. Flow Depth=1.31' Max Vel=3.72 fps Inflow=34.66 cfs 1.669 af
n=0.040 L=914.0' S=0.0131 '/' Capacity=186.81 cfs Outflow=29.99 cfs 1.657 af

Reach 42R: DA5 DC Avg. Flow Depth=0.32' Max Vel=11.26 fps Inflow=54.58 cfs 2.581 af
n=0.030 L=157.5' S=0.2500 '/' Capacity=646.59 cfs Outflow=54.02 cfs 2.580 af

Reach 43R: DA7 Perimeter Channel Avg. Flow Depth=1.29' Max Vel=2.99 fps Inflow=29.33 cfs 1.237 af
n=0.040 L=922.5' S=0.0087 '/' Capacity=151.82 cfs Outflow=23.19 cfs 1.226 af

Reach 44R: Road Channel Avg. Flow Depth=1.41' Max Vel=5.74 fps Inflow=62.58 cfs 2.684 af
n=0.050 L=1,371.0' S=0.0481 '/' Capacity=200.63 cfs Outflow=52.55 cfs 2.668 af

Pond 36P: Trap 1 Peak Elev=137.49' Storage=0.479 af Inflow=23.19 cfs 1.226 af
Outflow=18.79 cfs 0.822 af

Pond 37P: Trap 2 Peak Elev=151.52' Storage=1.055 af Inflow=54.02 cfs 2.580 af
Outflow=47.58 cfs 1.661 af

Pond 38P: Trap 3 Peak Elev=167.09' Storage=1.821 af Inflow=52.55 cfs 2.668 af
Outflow=3.24 cfs 0.902 af

Pond 39P: North Pond Peak Elev=123.36' Storage=6.257 af Inflow=213.77 cfs 20.277 af
Outflow=183.58 cfs 16.670 af

Pond 40P: inlet Peak Elev=130.59' Inflow=206.43 cfs 19.233 af
48.0" Round Culvert x 3.00 n=0.012 L=125.0' S=0.0100 '/' Outflow=206.43 cfs 19.233 af

Pond 41P: culvert Peak Elev=176.11' Inflow=52.55 cfs 2.668 af
36.0" Round Culvert x 2.00 n=0.011 L=40.0' S=0.1000 '/' Outflow=52.55 cfs 2.668 af

Summary for Subcatchment 1S: DA1

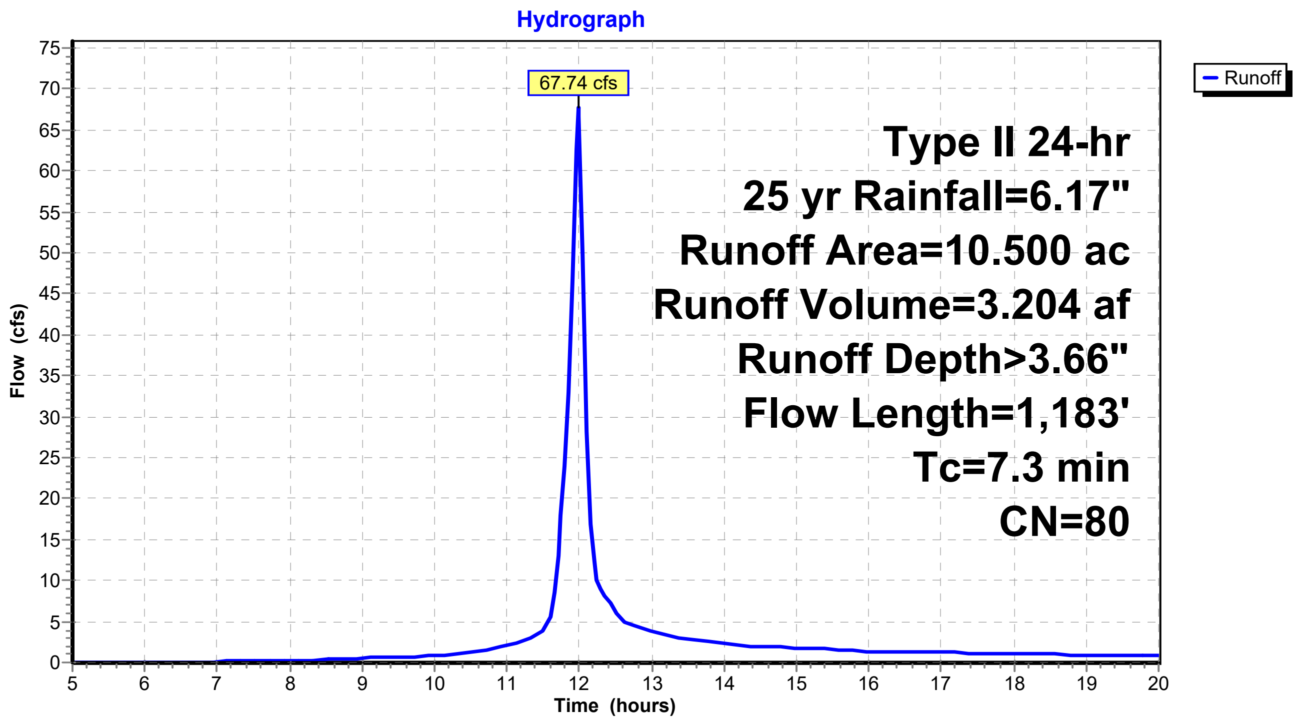
Runoff = 67.74 cfs @ 11.98 hrs, Volume= 3.204 af, Depth> 3.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 yr Rainfall=6.17"

	Area (ac)	CN	Description
*	10.500	80	
	10.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	100	0.2500	0.47		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.4	79	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
3.3	1,004	0.0300	5.11	34.49	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=1.50' Z= 2.0 & 4.0 '/' Top.W=9.00' n= 0.040
7.3	1,183	Total			

Subcatchment 1S: DA1



Summary for Subcatchment 2S: DA2

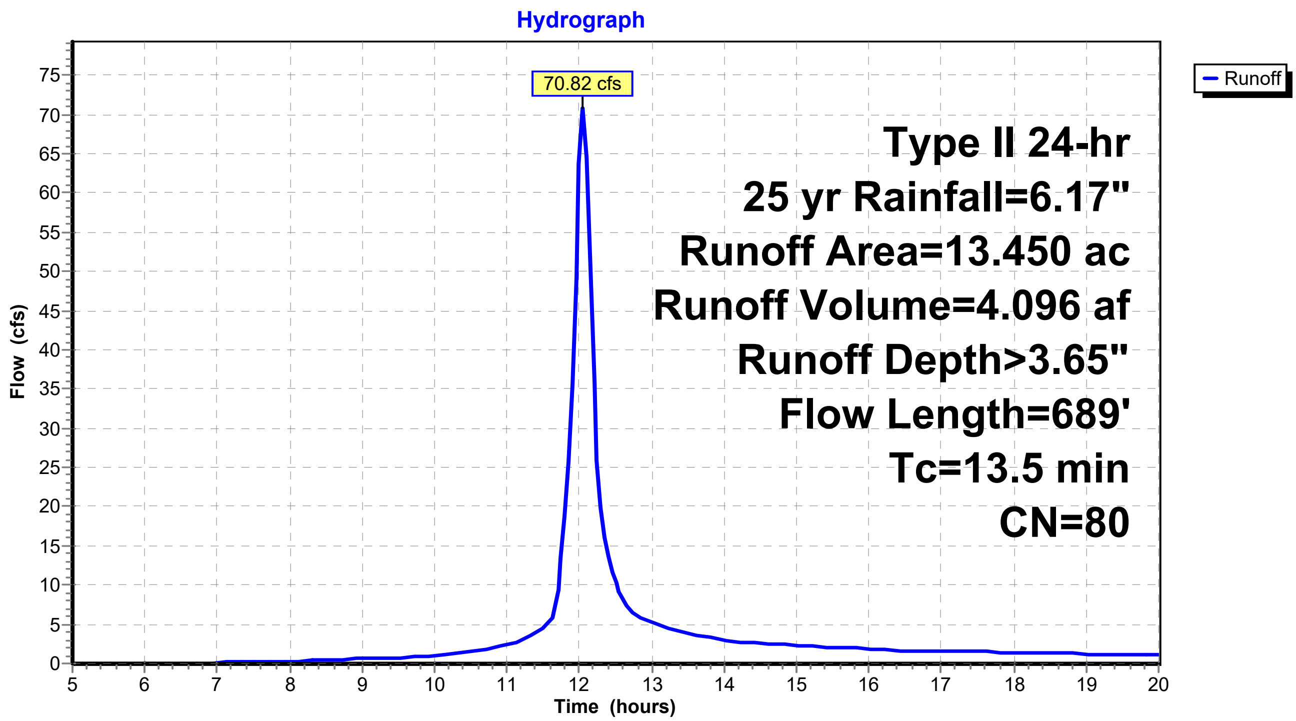
Runoff = 70.82 cfs @ 12.05 hrs, Volume= 4.096 af, Depth> 3.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 yr Rainfall=6.17"

	Area (ac)	CN	Description
*	13.450	80	
	13.450		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0300	0.20		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
4.4	321	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	134	0.2500	7.50		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.5	134	0.0200	4.17	28.16	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=1.50' Z= 2.0 & 4.0 '/' Top.W=9.00' n= 0.040
13.5	689	Total			

Subcatchment 2S: DA2



Summary for Subcatchment 3S: DA3

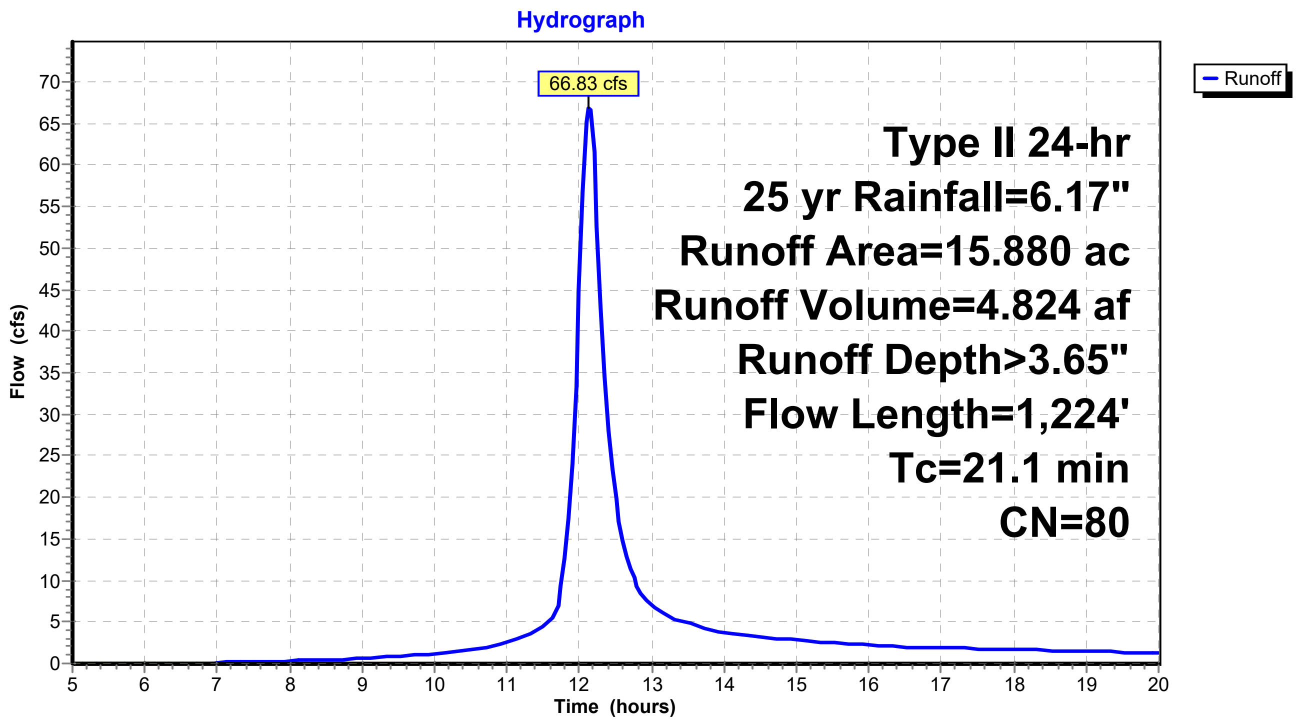
Runoff = 66.83 cfs @ 12.14 hrs, Volume= 4.824 af, Depth> 3.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 yr Rainfall=6.17"

	Area (ac)	CN	Description
*	15.880	80	
	15.880		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0300	0.20		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
11.6	842	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	77	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.8	205	0.0200	4.17	28.16	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=1.50' Z= 4.0 & 2.0 '/' Top.W=9.00' n= 0.040
21.1	1,224	Total			

Subcatchment 3S: DA3



Summary for Subcatchment 4S: DA4

[49] Hint: Tc<2dt may require smaller dt

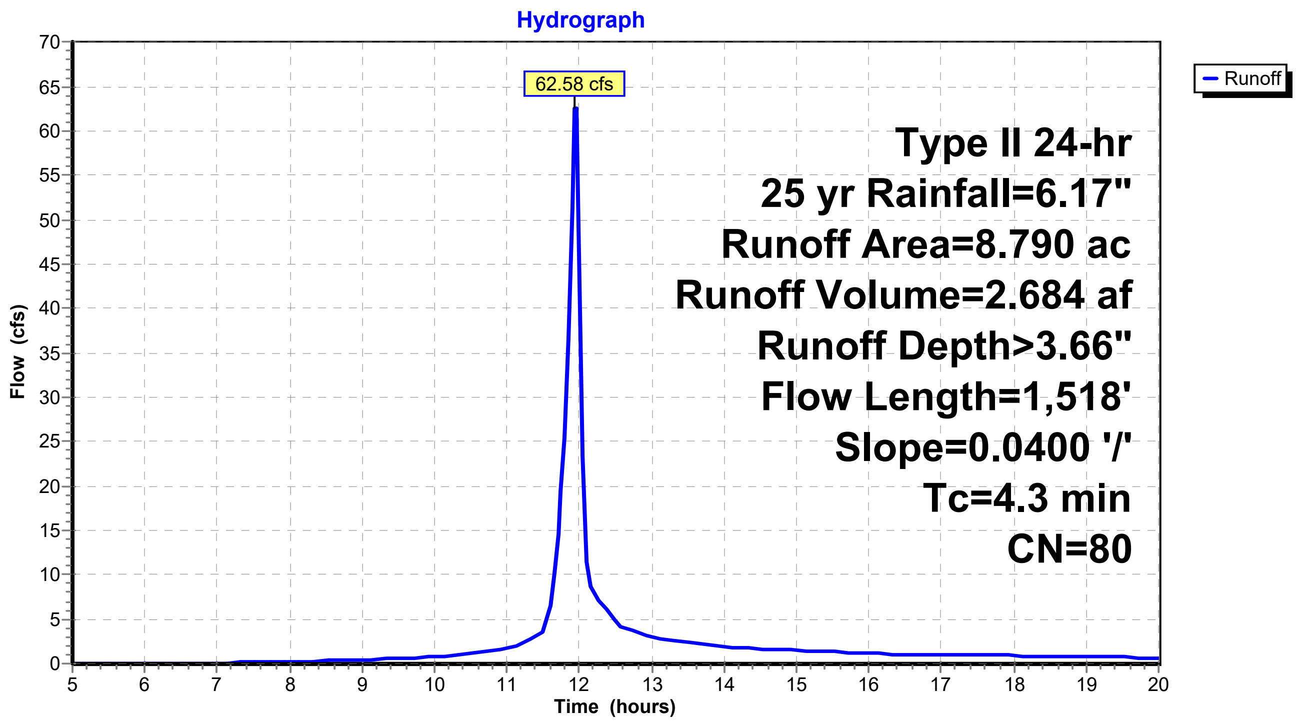
Runoff = 62.58 cfs @ 11.95 hrs, Volume= 2.684 af, Depth> 3.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 yr Rainfall=6.17"

	Area (ac)	CN	Description
*	8.790	80	
	8.790		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	1,518	0.0400	5.90	39.83	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=1.50' Z= 2.0 & 4.0 '/' Top.W=9.00' n= 0.040

Subcatchment 4S: DA4



Summary for Subcatchment 5S: DA5

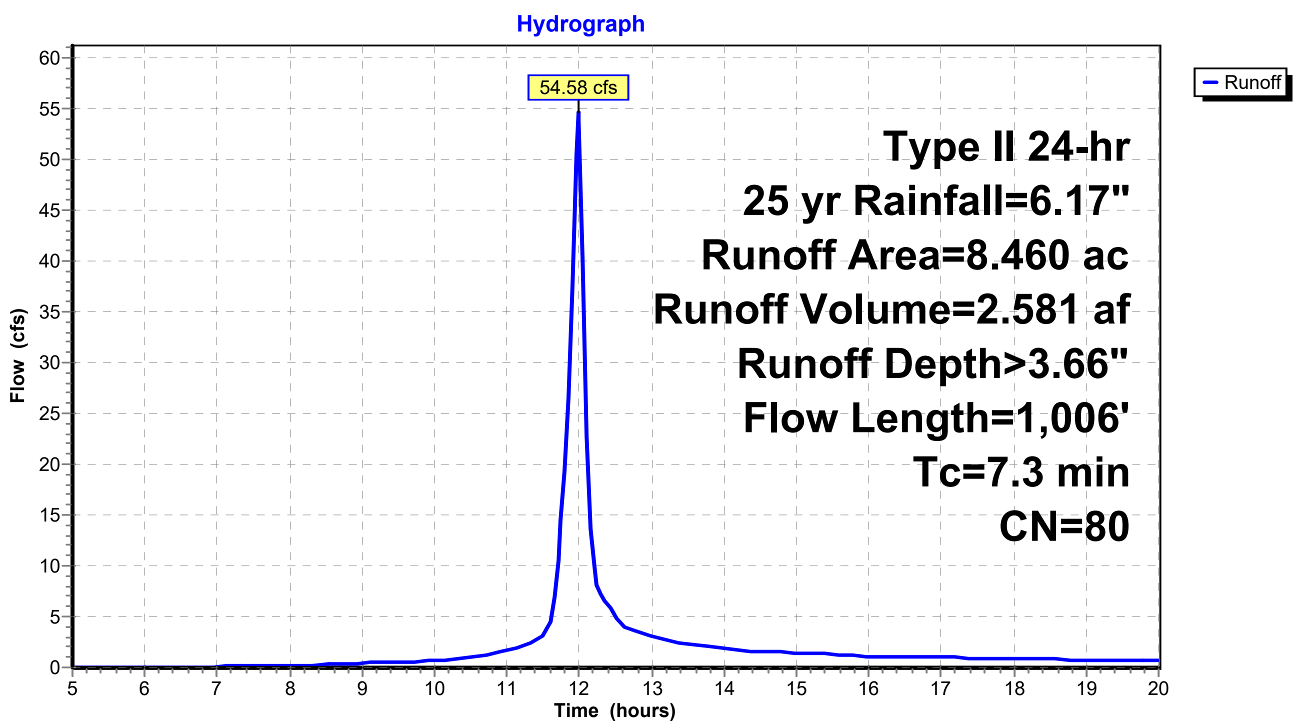
Runoff = 54.58 cfs @ 11.98 hrs, Volume= 2.581 af, Depth> 3.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 yr Rainfall=6.17"

	Area (ac)	CN	Description
*	8.460	80	
	8.460		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	100	0.2500	0.47		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.9	193	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.8	713	0.0200	4.17	28.16	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=1.50' Z= 4.0 & 2.0 '/' Top.W=9.00' n= 0.040
7.3	1,006	Total			

Subcatchment 5S: DA5



Summary for Subcatchment 6S: DA7

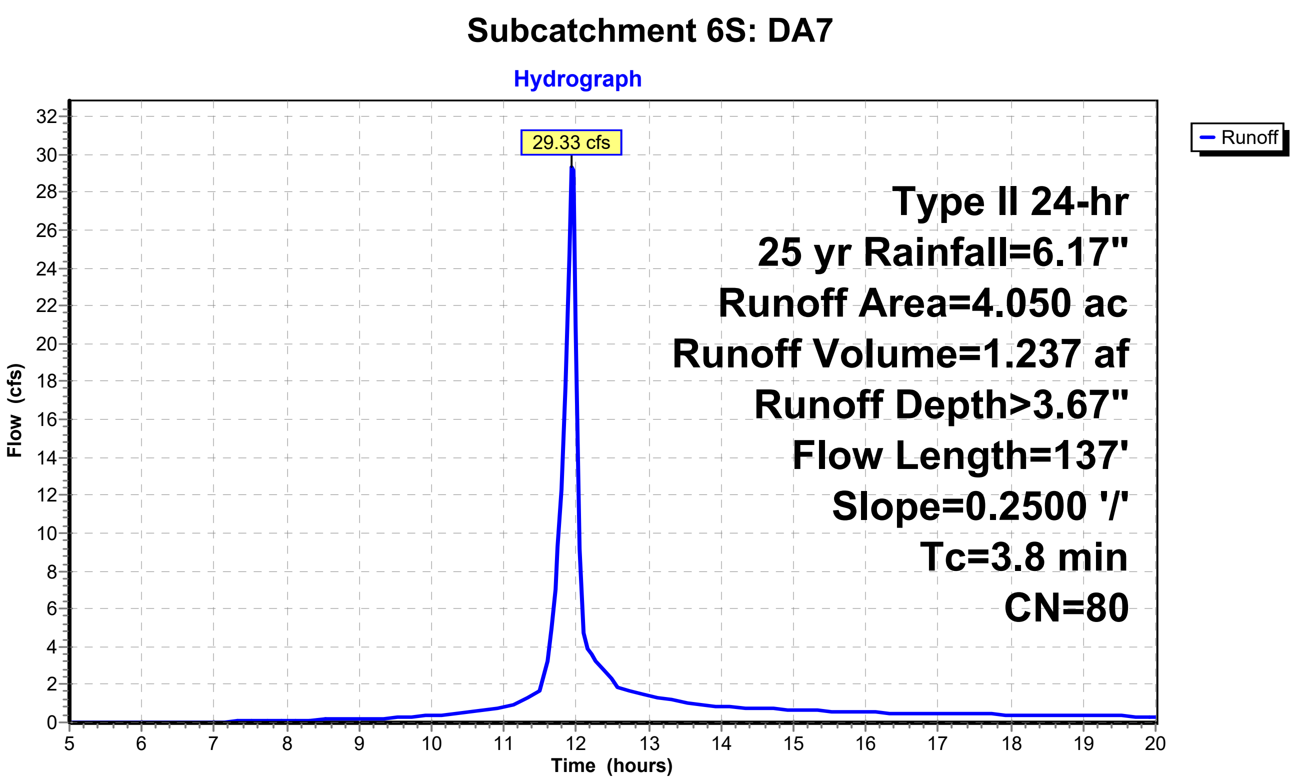
[49] Hint: Tc<2dt may require smaller dt

Runoff = 29.33 cfs @ 11.94 hrs, Volume= 1.237 af, Depth> 3.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 yr Rainfall=6.17"

	Area (ac)	CN	Description
*	4.050	80	
	4.050		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	100	0.2500	0.47		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.2	37	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
3.8	137	Total			



Summary for Subcatchment 9S: DA8

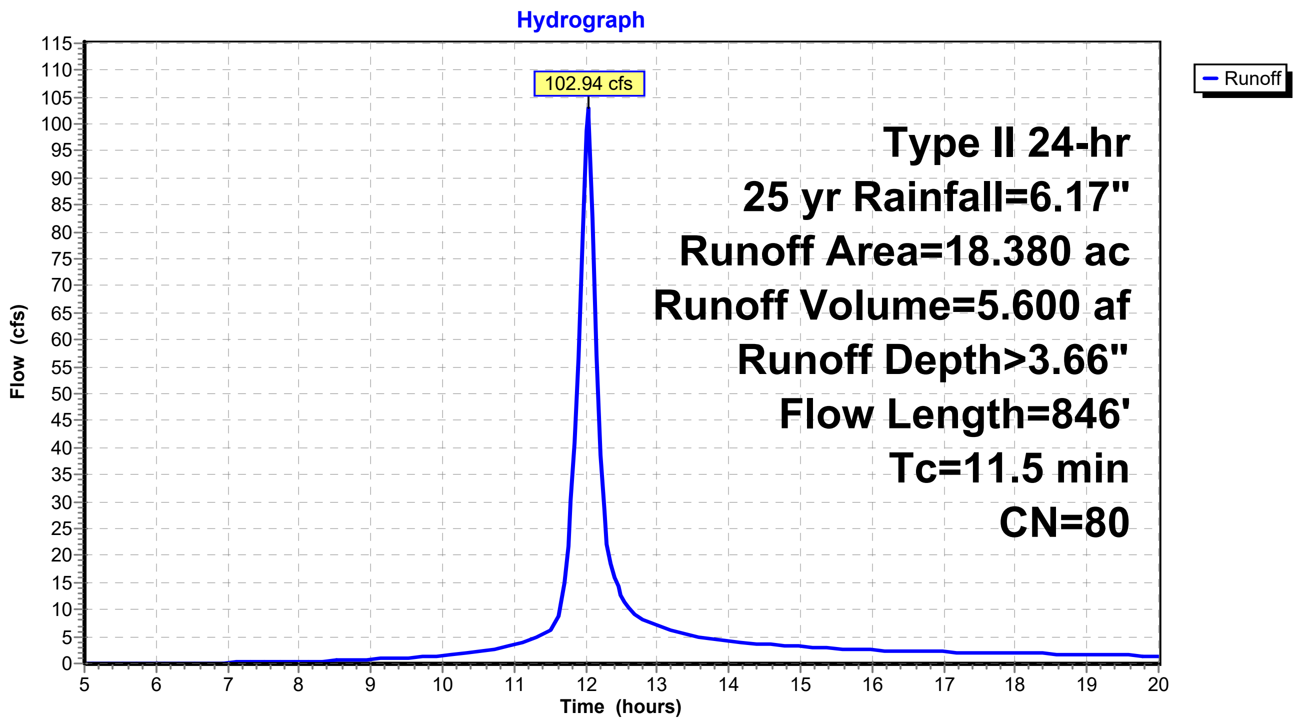
Runoff = 102.94 cfs @ 12.03 hrs, Volume= 5.600 af, Depth> 3.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 yr Rainfall=6.17"

	Area (ac)	CN	Description
*	18.380	80	
	18.380		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0300	0.20		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.3	23	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	111	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.4	612	0.0200	4.17	28.16	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=1.50' Z= 4.0 & 2.0 '/' Top.W=9.00' n= 0.040
11.5	846	Total			

Subcatchment 9S: DA8



Summary for Subcatchment 40S: DA6

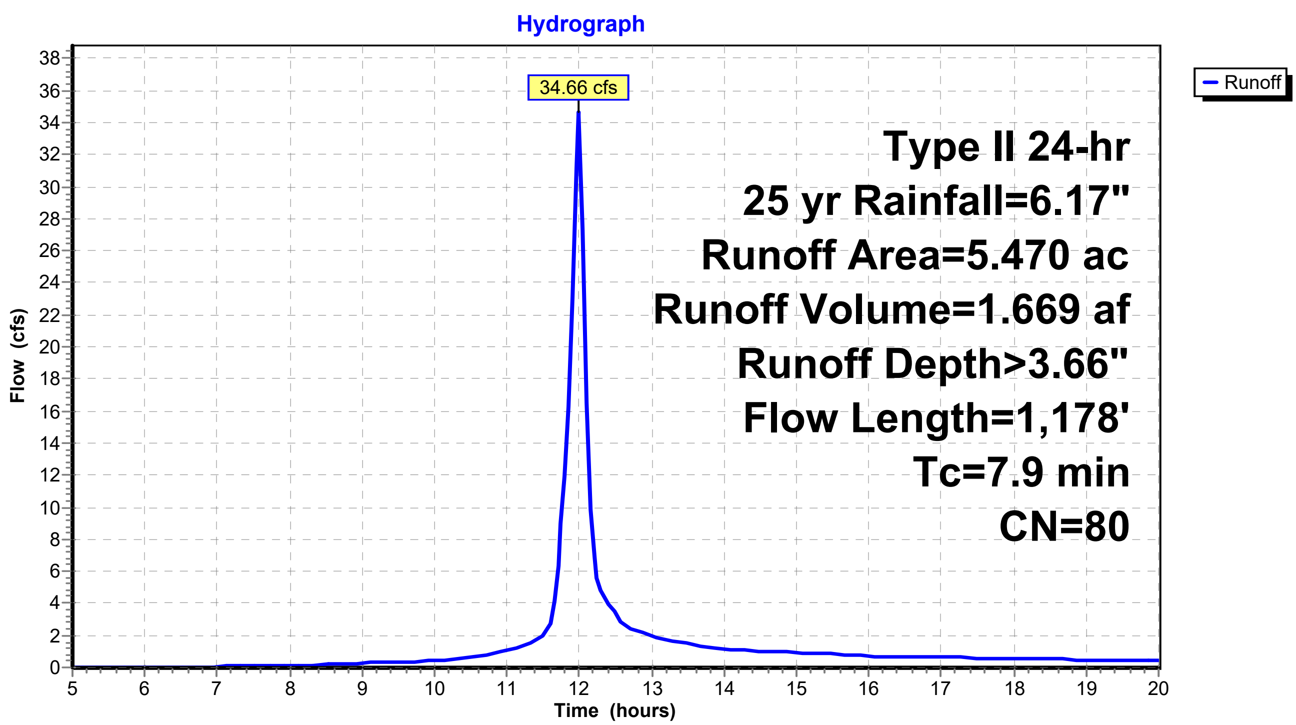
Runoff = 34.66 cfs @ 11.99 hrs, Volume= 1.669 af, Depth> 3.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 yr Rainfall=6.17"

	Area (ac)	CN	Description
*	5.470	80	
	5.470		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	100	0.2500	0.47		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.1	29	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
4.2	1,049	0.0200	4.17	28.16	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=1.50' Z= 4.0 & 2.0 '/' Top.W=9.00' n= 0.040
7.9	1,178	Total			

Subcatchment 40S: DA6



Summary for Subcatchment 42S: Drainage to pond

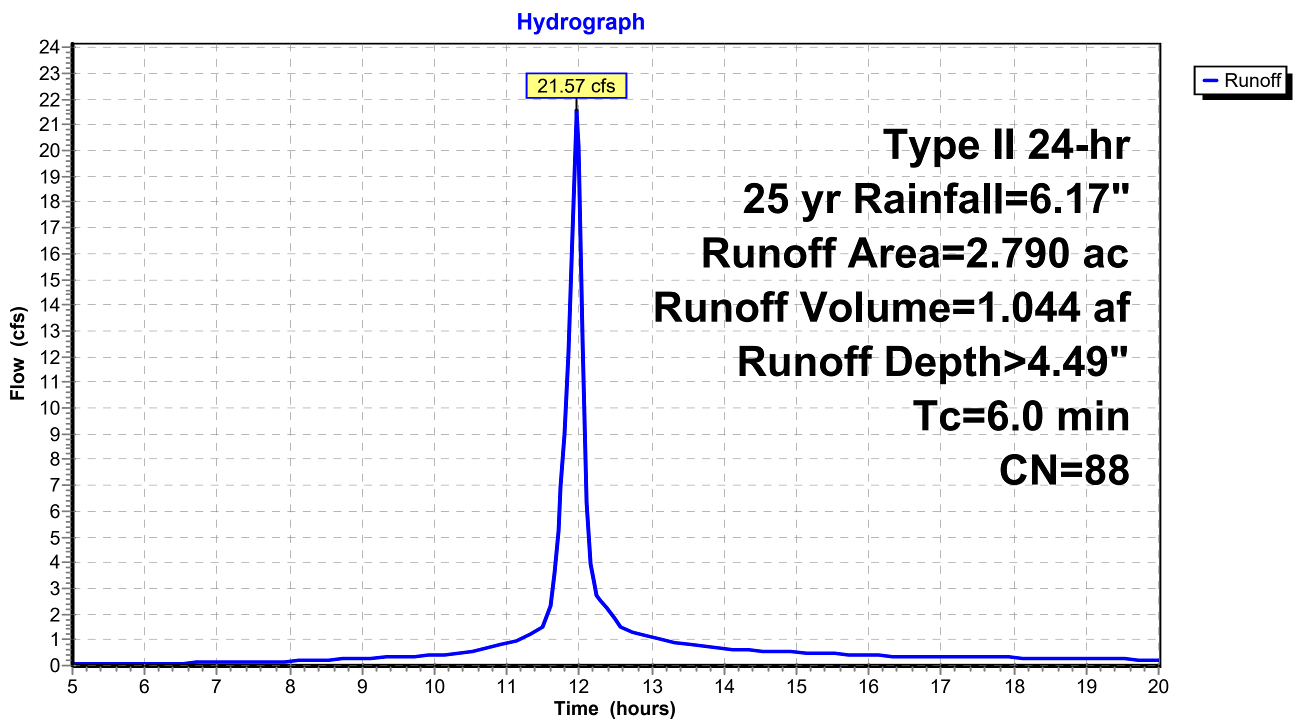
Runoff = 21.57 cfs @ 11.96 hrs, Volume= 1.044 af, Depth> 4.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25 yr Rainfall=6.17"

	Area (ac)	CN	Description
*	1.270	98	Water
	1.520	80	
	2.790	88	Weighted Average
	1.520		54.48% Pervious Area
	1.270		45.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 42S: Drainage to pond



Summary for Reach 1R: DA1 Perimeter Channel

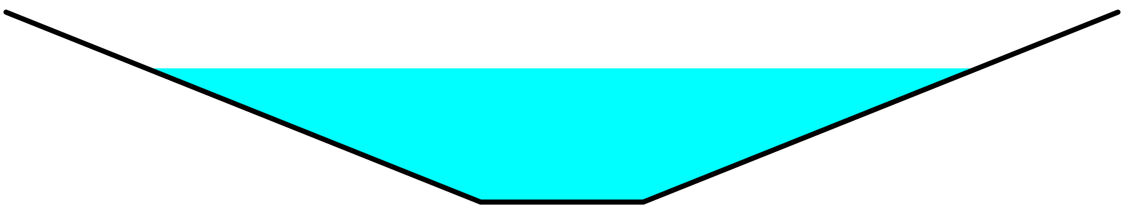
[62] Hint: Exceeded Reach 2R OUTLET depth by 0.51' @ 12.45 hrs

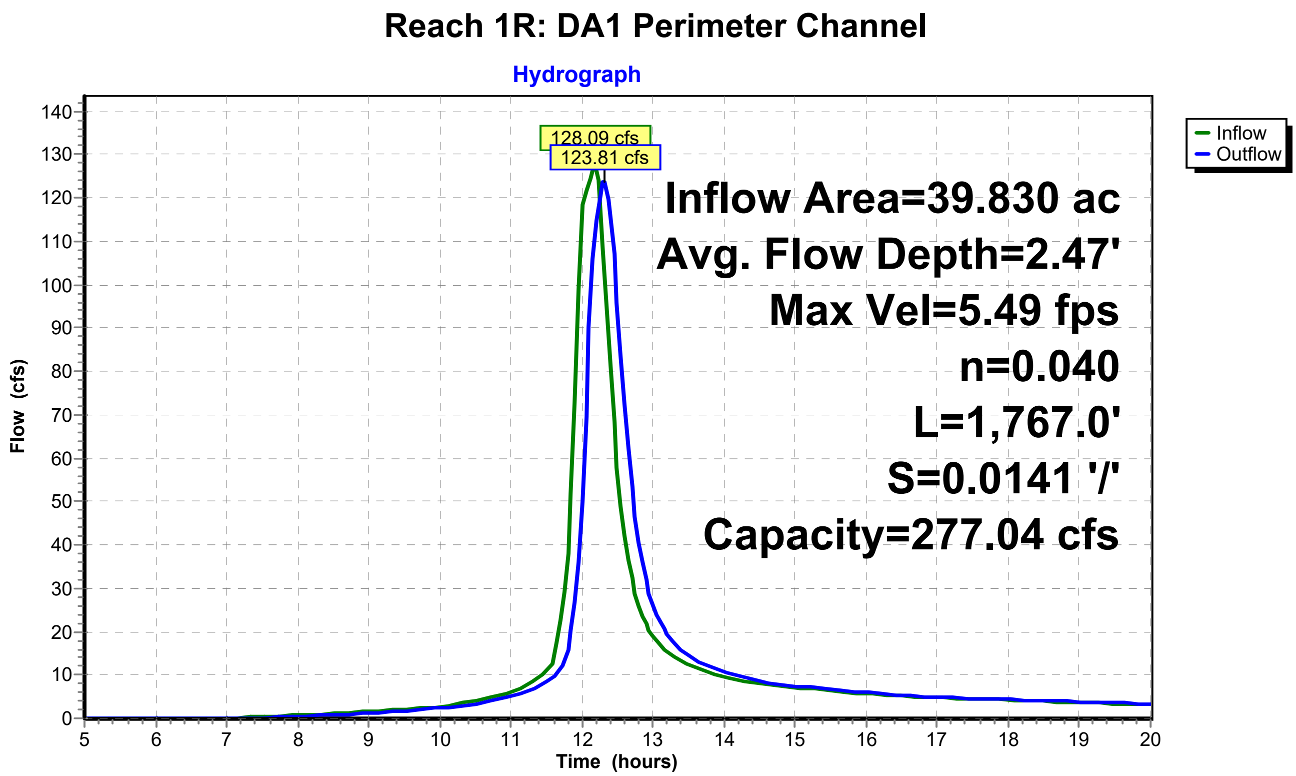
Inflow Area = 39.830 ac, 0.00% Impervious, Inflow Depth > 3.64" for 25 yr event
Inflow = 128.09 cfs @ 12.18 hrs, Volume= 12.067 af
Outflow = 123.81 cfs @ 12.31 hrs, Volume= 11.979 af, Atten= 3%, Lag= 8.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.49 fps, Min. Travel Time= 5.4 min
Avg. Velocity = 2.25 fps, Avg. Travel Time= 13.1 min

Peak Storage= 39,949 cf @ 12.23 hrs
Average Depth at Peak Storage= 2.47'
Bank-Full Depth= 3.50' Flow Area= 41.1 sf, Capacity= 277.04 cfs

3.00' x 3.50' deep channel, n= 0.040
Side Slope Z-value= 2.5 '/' Top Width= 20.50'
Length= 1,767.0' Slope= 0.0141 '/'
Inlet Invert= 155.00', Outlet Invert= 130.00'





Summary for Reach 2R: DA2 Perimeter Channel

[62] Hint: Exceeded Reach 3R OUTLET depth by 2.01' @ 12.20 hrs
[62] Hint: Exceeded Reach 5R OUTLET depth by 0.80' @ 12.10 hrs

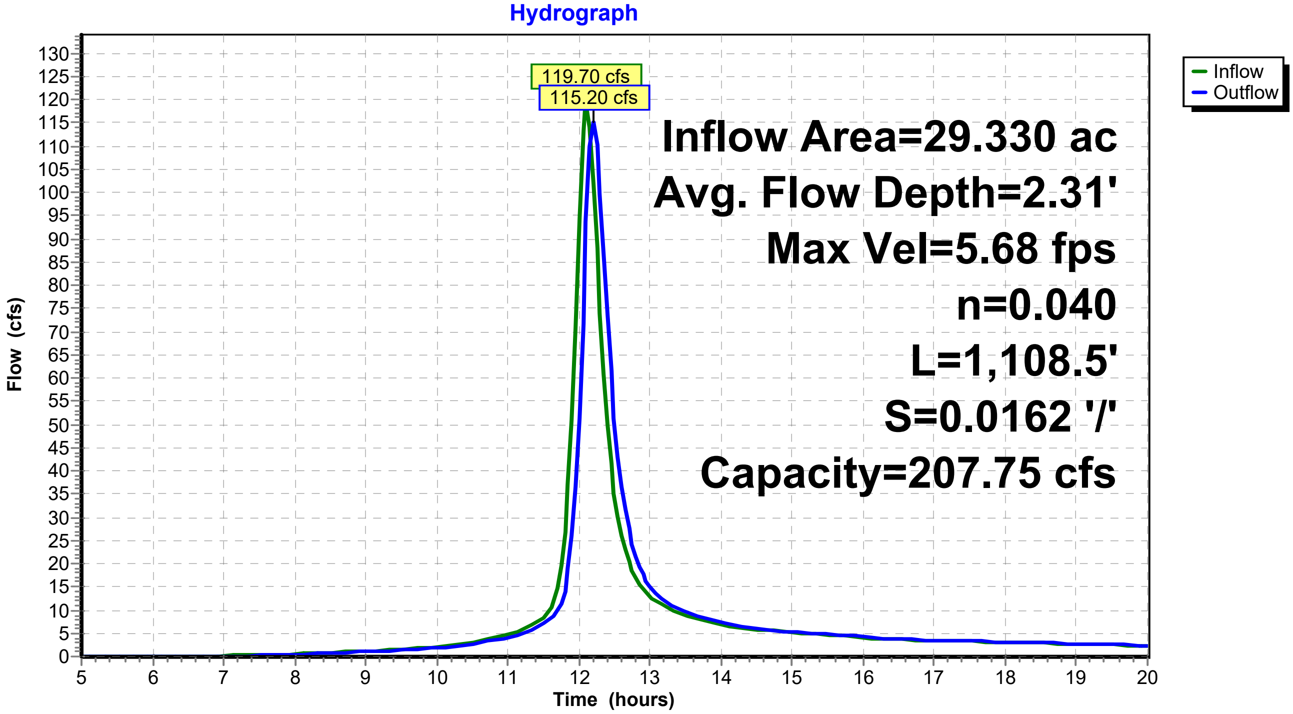
Inflow Area = 29.330 ac, 0.00% Impervious, Inflow Depth > 3.64" for 25 yr event
Inflow = 119.70 cfs @ 12.10 hrs, Volume= 8.904 af
Outflow = 115.20 cfs @ 12.20 hrs, Volume= 8.863 af, Atten= 4%, Lag= 6.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.68 fps, Min. Travel Time= 3.3 min
Avg. Velocity = 2.17 fps, Avg. Travel Time= 8.5 min

Peak Storage= 22,546 cf @ 12.15 hrs
Average Depth at Peak Storage= 2.31'
Bank-Full Depth= 3.00' Flow Area= 31.5 sf, Capacity= 207.75 cfs

3.00' x 3.00' deep channel, n= 0.040
Side Slope Z-value= 2.5 '/' Top Width= 18.00'
Length= 1,108.5' Slope= 0.0162 '/'
Inlet Invert= 173.00', Outlet Invert= 155.00'

Reach 2R: DA2 Perimeter Channel



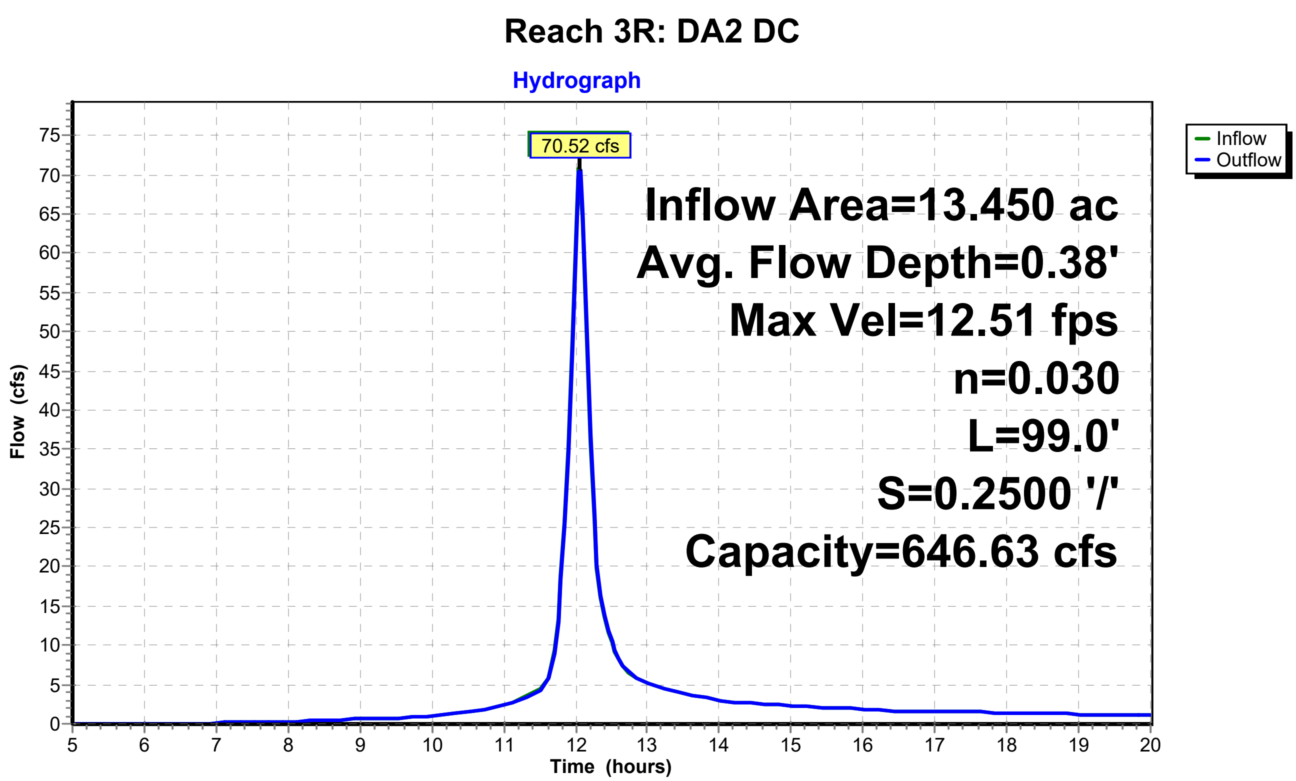
Summary for Reach 3R: DA2 DC

Inflow Area = 13.450 ac, 0.00% Impervious, Inflow Depth > 3.65" for 25 yr event
Inflow = 70.82 cfs @ 12.05 hrs, Volume= 4.096 af
Outflow = 70.52 cfs @ 12.06 hrs, Volume= 4.094 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 12.51 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.09 fps, Avg. Travel Time= 0.5 min

Peak Storage= 560 cf @ 12.05 hrs
Average Depth at Peak Storage= 0.38'
Bank-Full Depth= 1.50' Flow Area= 22.5 sf, Capacity= 646.63 cfs

15.00' x 1.50' deep channel, n= 0.030
Length= 99.0' Slope= 0.2500 '/'
Inlet Invert= 197.75', Outlet Invert= 173.00'



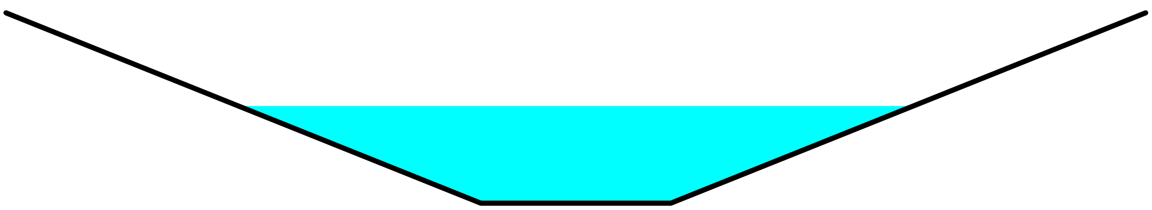
Summary for Reach 5R: DA3 Perimeter Channel

Inflow Area = 15.880 ac, 0.00% Impervious, Inflow Depth > 3.65" for 25 yr event
Inflow = 66.83 cfs @ 12.14 hrs, Volume= 4.824 af
Outflow = 65.30 cfs @ 12.19 hrs, Volume= 4.810 af, Atten= 2%, Lag= 3.5 min

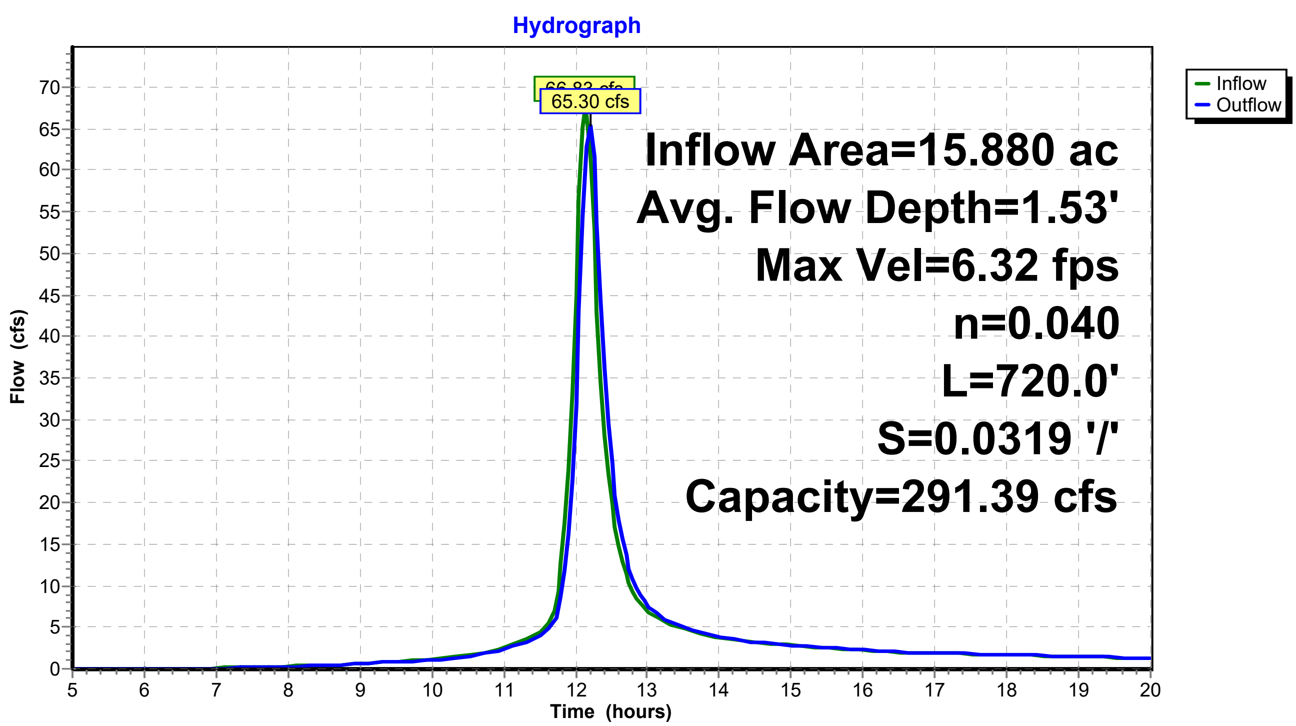
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.32 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 2.29 fps, Avg. Travel Time= 5.2 min

Peak Storage= 7,528 cf @ 12.16 hrs
Average Depth at Peak Storage= 1.53'
Bank-Full Depth= 3.00' Flow Area= 31.5 sf, Capacity= 291.39 cfs

3.00' x 3.00' deep channel, n= 0.040
Side Slope Z-value= 2.5 '/' Top Width= 18.00'
Length= 720.0' Slope= 0.0319 '/'
Inlet Invert= 196.00', Outlet Invert= 173.00'



Reach 5R: DA3 Perimeter Channel



Summary for Reach 16R: DA8 DC

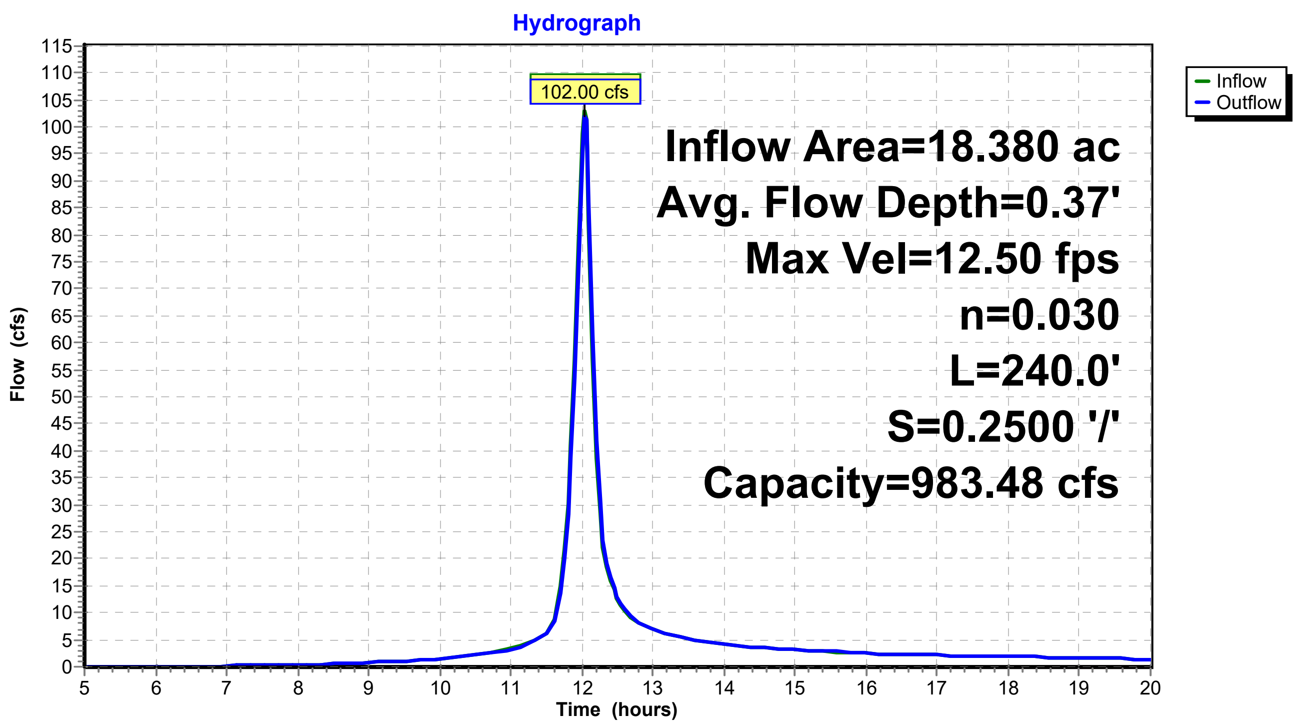
Inflow Area = 18.380 ac, 0.00% Impervious, Inflow Depth > 3.66" for 25 yr event
Inflow = 102.94 cfs @ 12.03 hrs, Volume= 5.600 af
Outflow = 102.00 cfs @ 12.04 hrs, Volume= 5.596 af, Atten= 1%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 12.50 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.01 fps, Avg. Travel Time= 1.3 min

Peak Storage= 1,970 cf @ 12.03 hrs
Average Depth at Peak Storage= 0.37'
Bank-Full Depth= 1.50' Flow Area= 33.0 sf, Capacity= 983.48 cfs

22.00' x 1.50' deep channel, n= 0.030
Length= 240.0' Slope= 0.2500 '/'
Inlet Invert= 190.00', Outlet Invert= 130.00'

Reach 16R: DA8 DC



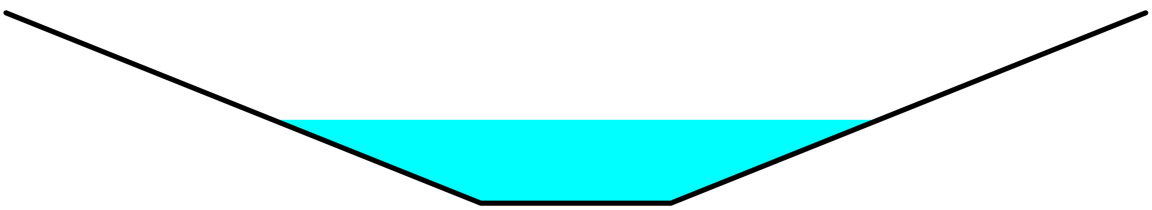
Summary for Reach 41R: DA8 Perimeter Channel

Inflow Area = 5.470 ac, 0.00% Impervious, Inflow Depth > 3.66" for 25 yr event
Inflow = 34.66 cfs @ 11.99 hrs, Volume= 1.669 af
Outflow = 29.99 cfs @ 12.10 hrs, Volume= 1.657 af, Atten= 13%, Lag= 6.5 min

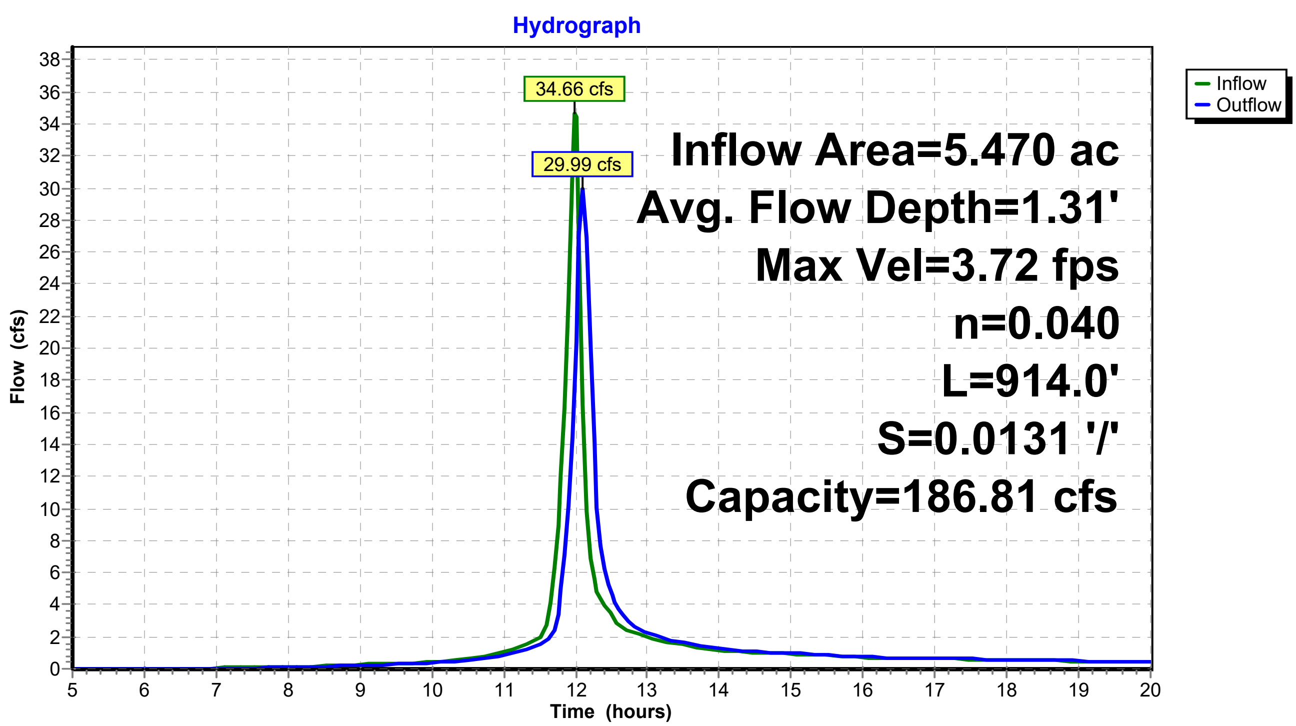
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.72 fps, Min. Travel Time= 4.1 min
Avg. Velocity = 1.19 fps, Avg. Travel Time= 12.8 min

Peak Storage= 7,545 cf @ 12.03 hrs
Average Depth at Peak Storage= 1.31'
Bank-Full Depth= 3.00' Flow Area= 31.5 sf, Capacity= 186.81 cfs

3.00' x 3.00' deep channel, n= 0.040
Side Slope Z-value= 2.5 '/' Top Width= 18.00'
Length= 914.0' Slope= 0.0131 '/'
Inlet Invert= 142.00', Outlet Invert= 130.00'



Reach 41R: DA8 Perimeter Channel



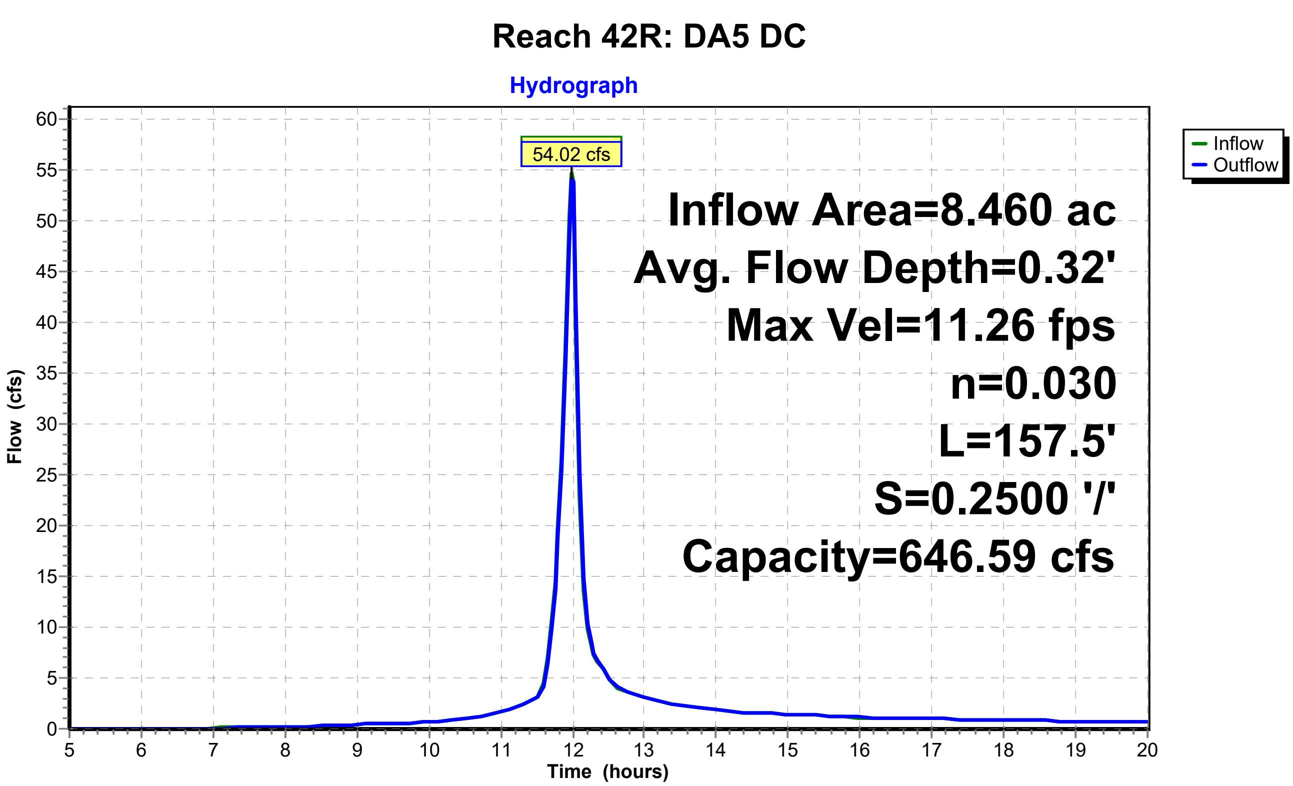
Summary for Reach 42R: DA5 DC

Inflow Area = 8.460 ac, 0.00% Impervious, Inflow Depth > 3.66" for 25 yr event
Inflow = 54.58 cfs @ 11.98 hrs, Volume= 2.581 af
Outflow = 54.02 cfs @ 11.99 hrs, Volume= 2.580 af, Atten= 1%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 11.26 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.62 fps, Avg. Travel Time= 1.0 min

Peak Storage= 760 cf @ 11.99 hrs
Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 1.50' Flow Area= 22.5 sf, Capacity= 646.59 cfs

15.00' x 1.50' deep channel, n= 0.030
Length= 157.5' Slope= 0.2500 '/'
Inlet Invert= 198.00', Outlet Invert= 158.63'



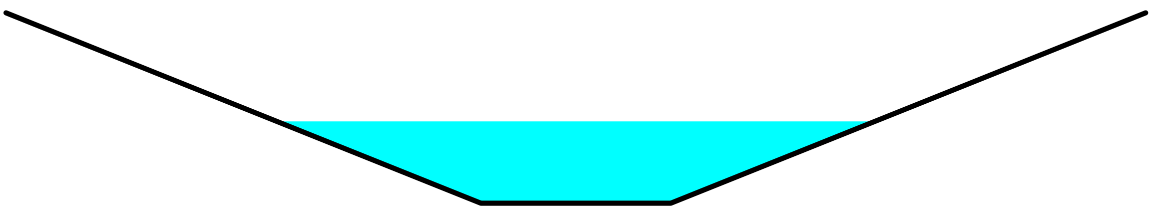
Summary for Reach 43R: DA7 Perimeter Channel

Inflow Area = 4.050 ac, 0.00% Impervious, Inflow Depth > 3.67" for 25 yr event
Inflow = 29.33 cfs @ 11.94 hrs, Volume= 1.237 af
Outflow = 23.19 cfs @ 12.07 hrs, Volume= 1.226 af, Atten= 21%, Lag= 7.8 min

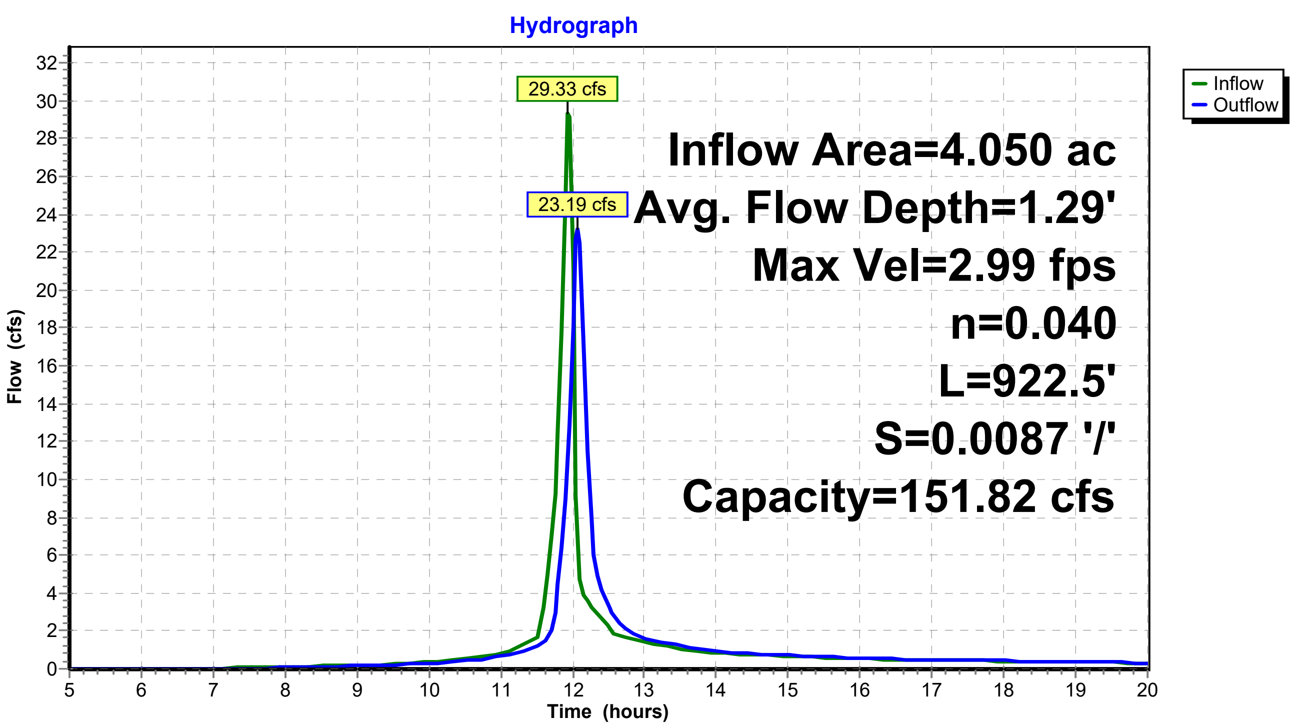
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.99 fps, Min. Travel Time= 5.1 min
Avg. Velocity = 0.94 fps, Avg. Travel Time= 16.4 min

Peak Storage= 7,404 cf @ 11.99 hrs
Average Depth at Peak Storage= 1.29'
Bank-Full Depth= 3.00' Flow Area= 31.5 sf, Capacity= 151.82 cfs

3.00' x 3.00' deep channel, n= 0.040
Side Slope Z-value= 2.5 '/' Top Width= 18.00'
Length= 922.5' Slope= 0.0087 '/'
Inlet Invert= 142.00', Outlet Invert= 134.00'



Reach 43R: DA7 Perimeter Channel



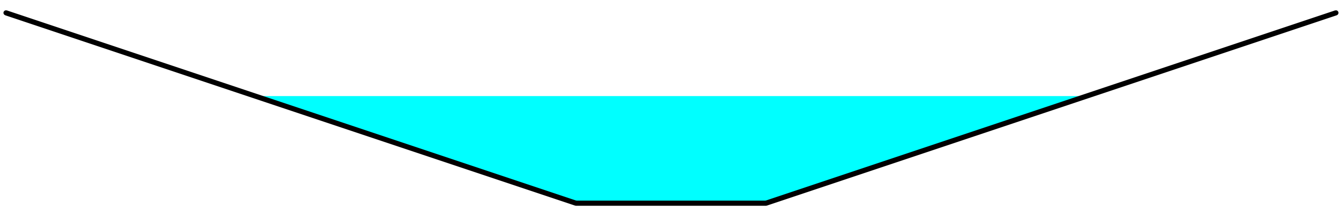
Summary for Reach 44R: Road Channel

Inflow Area = 8.790 ac, 0.00% Impervious, Inflow Depth > 3.66" for 25 yr event
Inflow = 62.58 cfs @ 11.95 hrs, Volume= 2.684 af
Outflow = 52.55 cfs @ 12.05 hrs, Volume= 2.668 af, Atten= 16%, Lag= 6.2 min

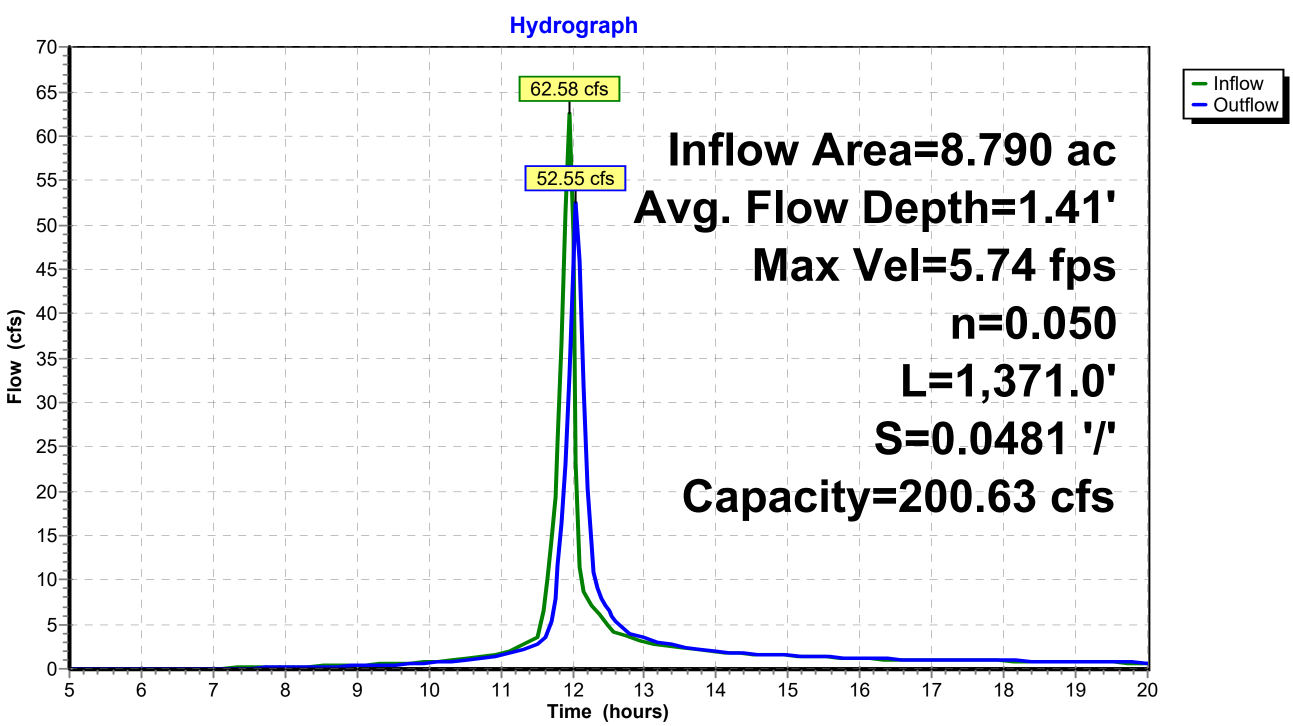
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.74 fps, Min. Travel Time= 4.0 min
Avg. Velocity = 1.88 fps, Avg. Travel Time= 12.1 min

Peak Storage= 12,943 cf @ 11.99 hrs
Average Depth at Peak Storage= 1.41'
Bank-Full Depth= 2.50' Flow Area= 25.0 sf, Capacity= 200.63 cfs

2.50' x 2.50' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 17.50'
Length= 1,371.0' Slope= 0.0481 '/'
Inlet Invert= 242.00', Outlet Invert= 176.00'



Reach 44R: Road Channel



Summary for Pond 36P: Trap 1

[62] Hint: Exceeded Reach 43R OUTLET depth by 2.91' @ 19.95 hrs

Inflow Area =	4.050 ac,	0.00% Impervious, Inflow Depth > 3.63"	for 25 yr event	
Inflow =	23.19 cfs @	12.07 hrs, Volume=	1.226 af	
Outflow =	18.79 cfs @	12.15 hrs, Volume=	0.822 af,	Atten= 19%, Lag= 4.9 min
Primary =	18.79 cfs @	12.15 hrs, Volume=	0.822 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 137.49' @ 12.15 hrs Surf.Area= 0.000 ac Storage= 0.479 af

Plug-Flow detention time= 116.0 min calculated for 0.822 af (67% of inflow)
Center-of-Mass det. time= 48.1 min (830.0 - 782.0)

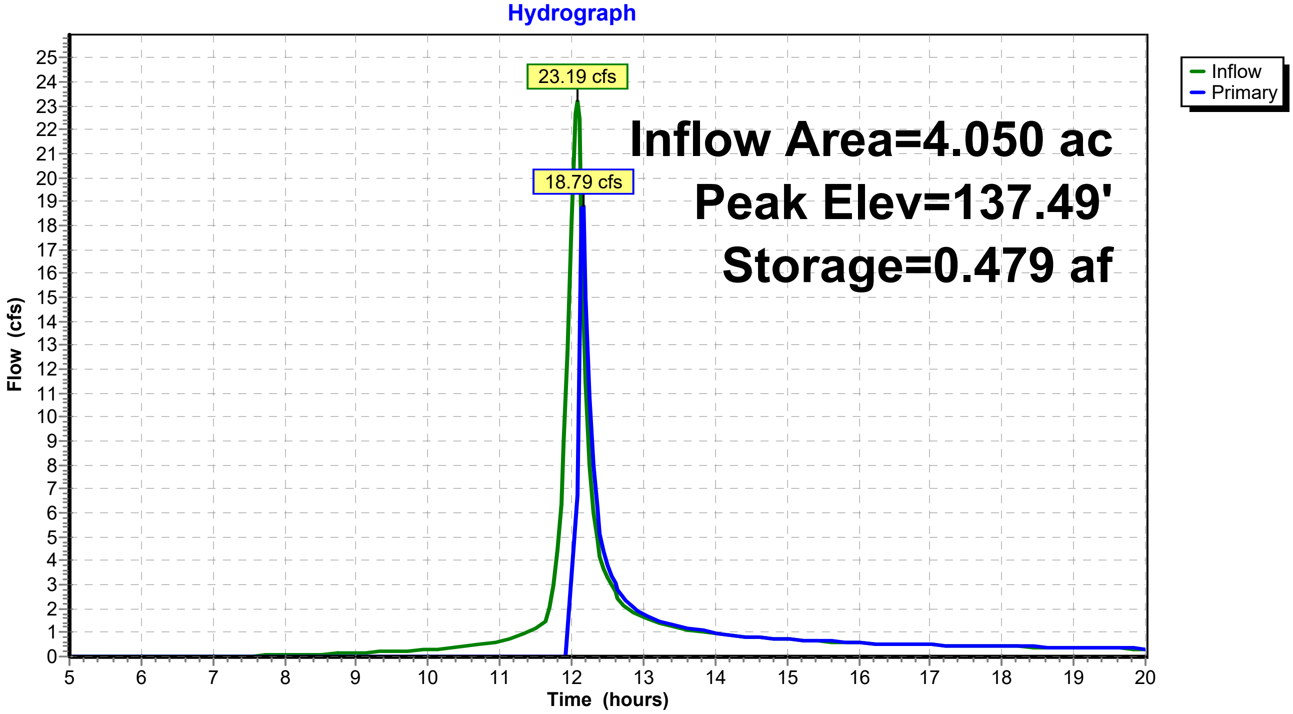
Volume	Invert	Avail.Storage	Storage Description
#1	134.00'	0.562 af	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (acre-feet)
134.00	0.000
136.00	0.253
137.00	0.400
138.00	0.562

Device	Routing	Invert	Outlet Devices
#1	Primary	137.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.00 Width (feet) 16.00 20.00

Primary OutFlow Max=18.42 cfs @ 12.15 hrs HW=137.48' (Free Discharge)
└─**1=Custom Weir/Orifice** (Weir Controls 18.42 cfs @ 2.25 fps)

Pond 36P: Trap 1



Summary for Pond 37P: Trap 2

Inflow Area = 8.460 ac, 0.00% Impervious, Inflow Depth > 3.66" for 25 yr event
Inflow = 54.02 cfs @ 11.99 hrs, Volume= 2.580 af
Outflow = 47.58 cfs @ 12.06 hrs, Volume= 1.661 af, Atten= 12%, Lag= 3.9 min
Primary = 47.58 cfs @ 12.06 hrs, Volume= 1.661 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 151.52' @ 12.06 hrs Surf.Area= 0.000 ac Storage= 1.055 af

Plug-Flow detention time= 121.1 min calculated for 1.656 af (64% of inflow)
Center-of-Mass det. time= 52.1 min (825.7 - 773.7)

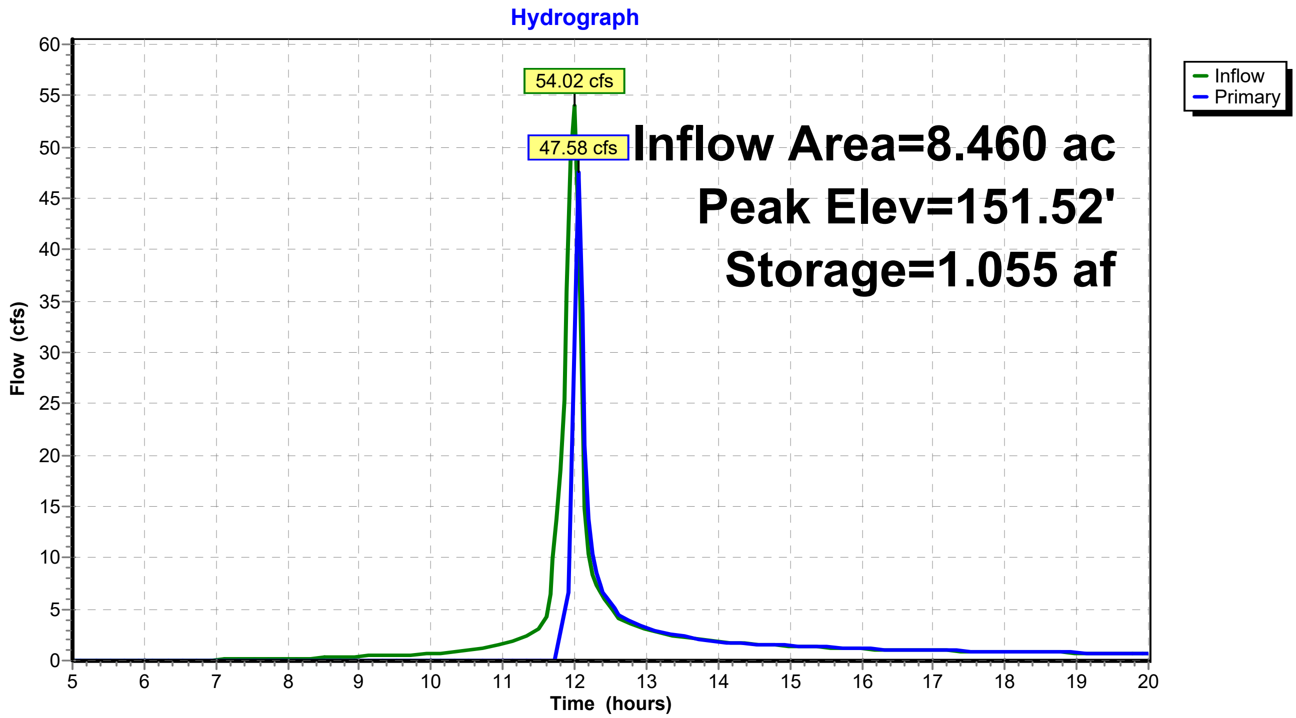
Volume	Invert	Avail.Storage	Storage Description
#1	147.00'	1.187 af	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (acre-feet)
147.00	0.000
148.00	0.201
150.00	0.656
151.00	0.912
152.00	1.187

Device	Routing	Invert	Outlet Devices
#1	Primary	151.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.00 Width (feet) 38.00 42.00

Primary OutFlow Max=45.81 cfs @ 12.06 hrs HW=151.51' (Free Discharge)
└─**1=Custom Weir/Orifice** (Weir Controls 45.81 cfs @ 2.32 fps)

Pond 37P: Trap 2



Summary for Pond 38P: Trap 3

Inflow Area = 8.790 ac, 0.00% Impervious, Inflow Depth > 3.64" for 25 yr event
Inflow = 52.55 cfs @ 12.05 hrs, Volume= 2.668 af
Outflow = 3.24 cfs @ 13.09 hrs, Volume= 0.902 af, Atten= 94%, Lag= 62.1 min
Primary = 3.24 cfs @ 13.09 hrs, Volume= 0.902 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 167.09' @ 13.09 hrs Surf.Area= 0.936 ac Storage= 1.821 af

Plug-Flow detention time= 233.4 min calculated for 0.899 af (34% of inflow)
Center-of-Mass det. time= 145.2 min (924.8 - 779.6)

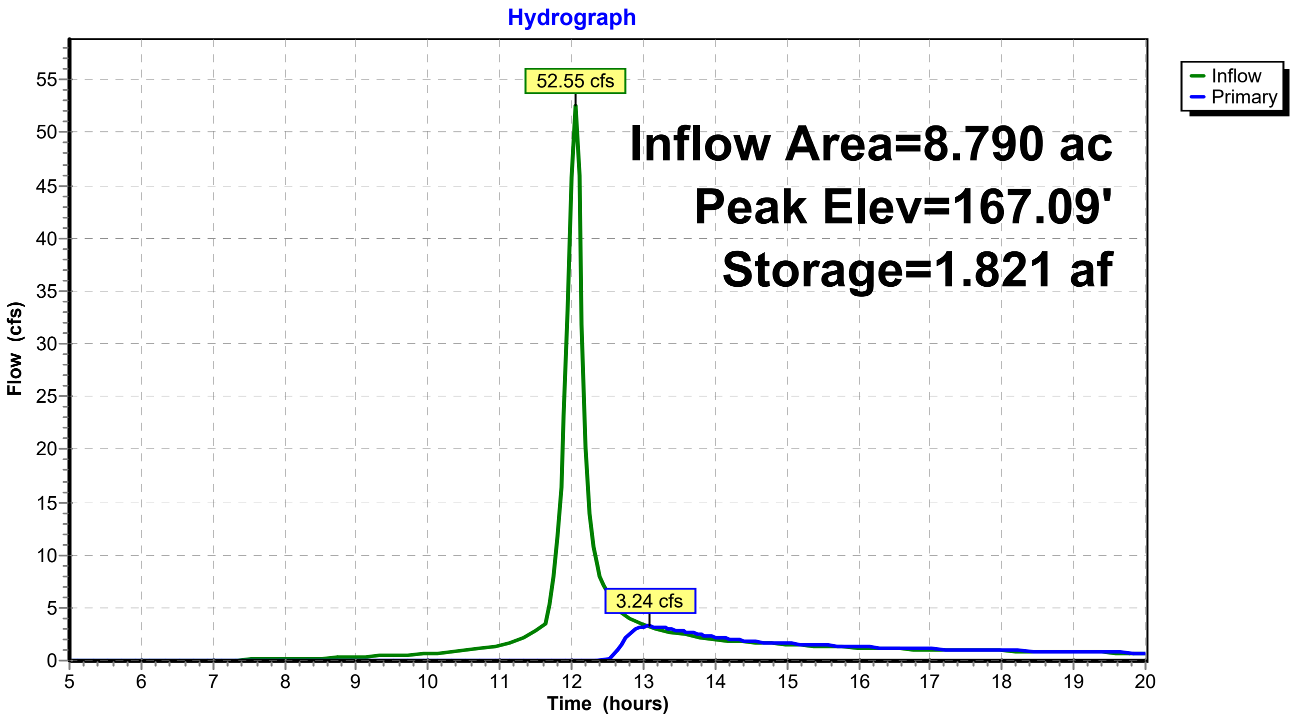
Volume	Invert	Avail.Storage	Storage Description
#1	163.00'	2.791 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
163.00	0.000	0.000	0.000
164.00	0.201	0.100	0.100
166.00	0.656	0.857	0.957
167.00	0.912	0.784	1.741
168.00	1.187	1.049	2.791

Device	Routing	Invert	Outlet Devices
#1	Primary	167.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.00 Width (feet) 38.00 42.00

Primary OutFlow Max=3.15 cfs @ 13.09 hrs HW=167.09' (Free Discharge)
↑—**1=Custom Weir/Orifice** (Weir Controls 3.15 cfs @ 0.96 fps)

Pond 38P: Trap 3



Summary for Pond 39P: North Pond

Inflow Area = 66.470 ac, 1.91% Impervious, Inflow Depth > 3.66" for 25 yr event
Inflow = 213.77 cfs @ 12.08 hrs, Volume= 20.277 af
Outflow = 183.58 cfs @ 12.20 hrs, Volume= 16.670 af, Atten= 14%, Lag= 7.2 min
Primary = 183.58 cfs @ 12.20 hrs, Volume= 16.670 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 119.00' Surf.Area= 1.158 ac Storage= 1.155 af
Peak Elev= 123.36' @ 12.20 hrs Surf.Area= 1.185 ac Storage= 6.257 af (5.103 af above start)

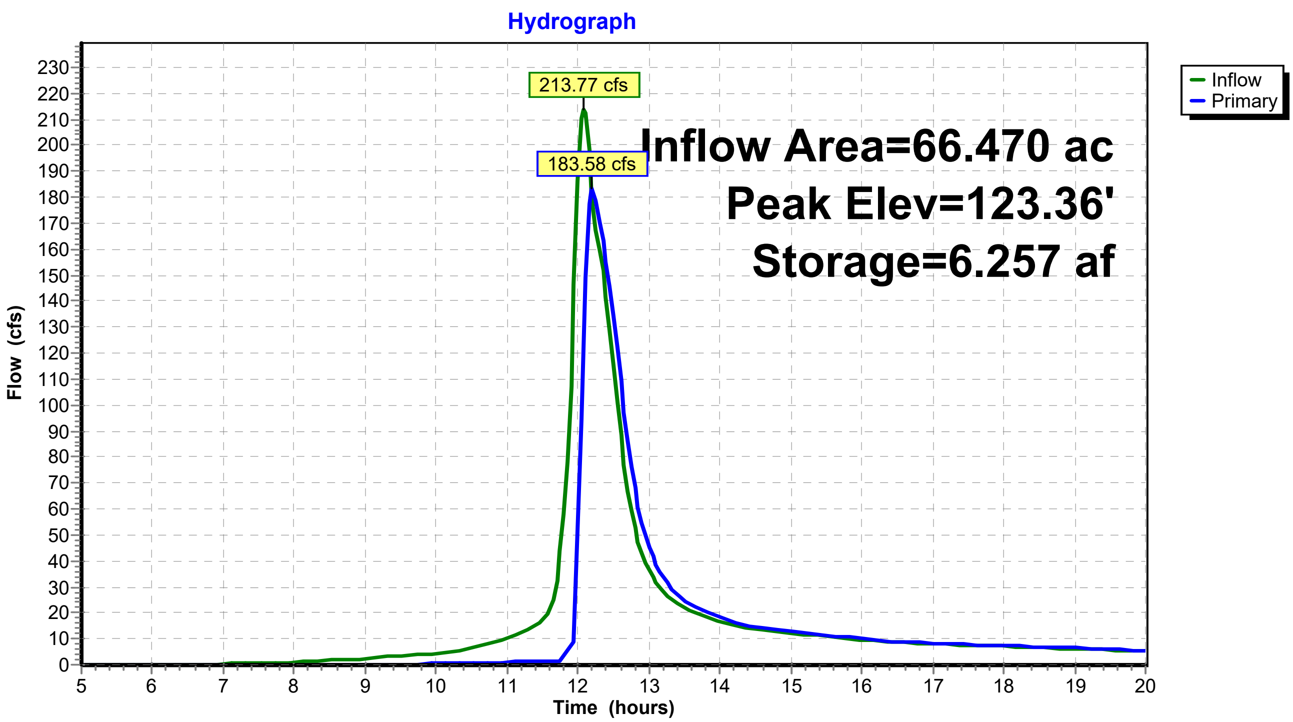
Plug-Flow detention time= 97.8 min calculated for 15.515 af (77% of inflow)
Center-of-Mass det. time= 31.6 min (819.5 - 787.9)

Volume	Invert	Avail.Storage	Storage Description
#1	118.00'	10.618 af	**226.00'W x 222.00'L x 9.00'H Prismatoid Z=0.3**

Device	Routing	Invert	Outlet Devices
#1	Primary	122.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 4.00 5.00 6.00 6.00 7.00 8.00 Width (feet) 35.00 35.00 35.00 41.00 42.00 43.00
#2	Primary	119.00'	**7.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=183.27 cfs @ 12.20 hrs HW=123.35' (Free Discharge)
└─**1=Custom Weir/Orifice** (Weir Controls 180.68 cfs @ 3.81 fps)
└─**2=Orifice/Grate** (Orifice Controls 2.59 cfs @ 9.71 fps)

Pond 39P: North Pond



Summary for Pond 40P: inlet

[61] Hint: Exceeded Reach 1R outlet invert by 0.59' @ 12.10 hrs
[62] Hint: Exceeded Reach 16R OUTLET depth by 0.26' @ 12.10 hrs
[61] Hint: Exceeded Reach 41R outlet invert by 0.59' @ 12.10 hrs

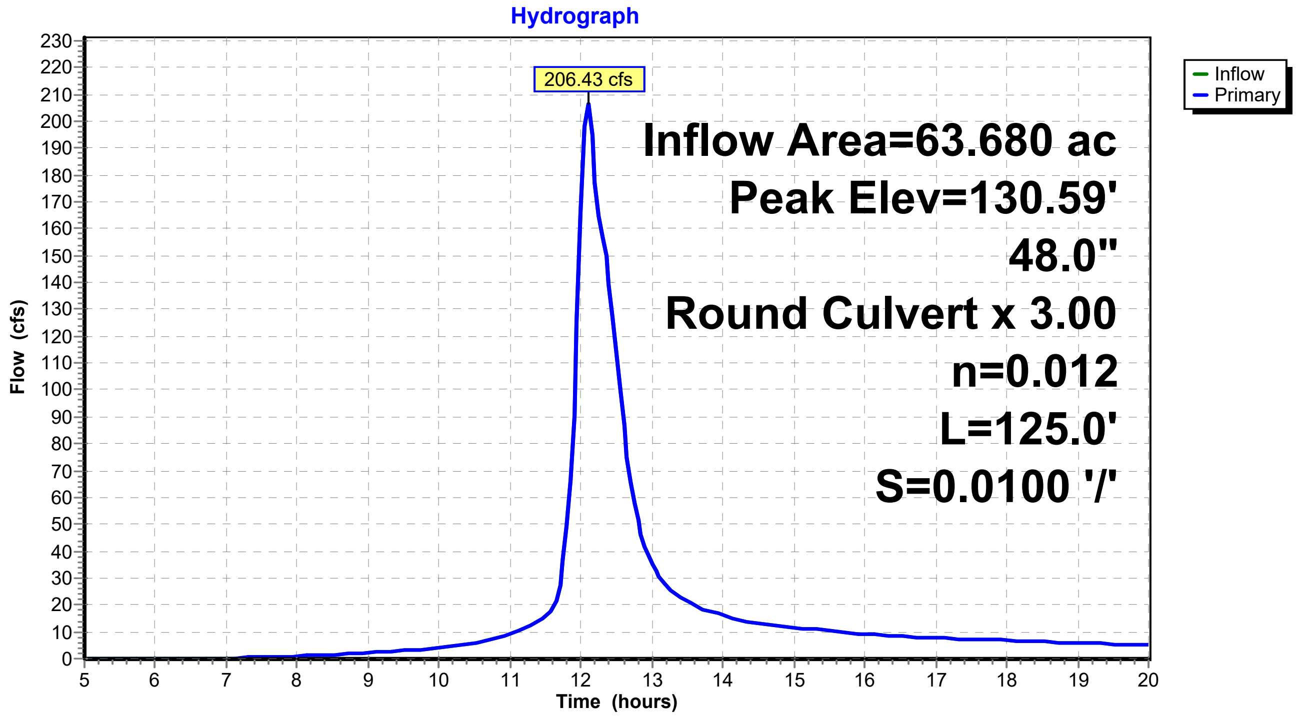
Inflow Area = 63.680 ac, 0.00% Impervious, Inflow Depth > 3.62" for 25 yr event
Inflow = 206.43 cfs @ 12.10 hrs, Volume= 19.233 af
Outflow = 206.43 cfs @ 12.10 hrs, Volume= 19.233 af, Atten= 0%, Lag= 0.0 min
Primary = 206.43 cfs @ 12.10 hrs, Volume= 19.233 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 130.59' @ 12.10 hrs
Flood Elev= 135.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	127.25'	**48.0" Round Culvert X 3.00** L= 125.0' Ke= 0.500 Inlet / Outlet Invert= 127.25' / 126.00' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 12.57 sf

Primary OutFlow Max=205.67 cfs @ 12.10 hrs HW=130.58' (Free Discharge)
↑**1=Culvert** (Barrel Controls 205.67 cfs @ 8.30 fps)

Pond 40P: inlet



Summary for Pond 41P: culvert

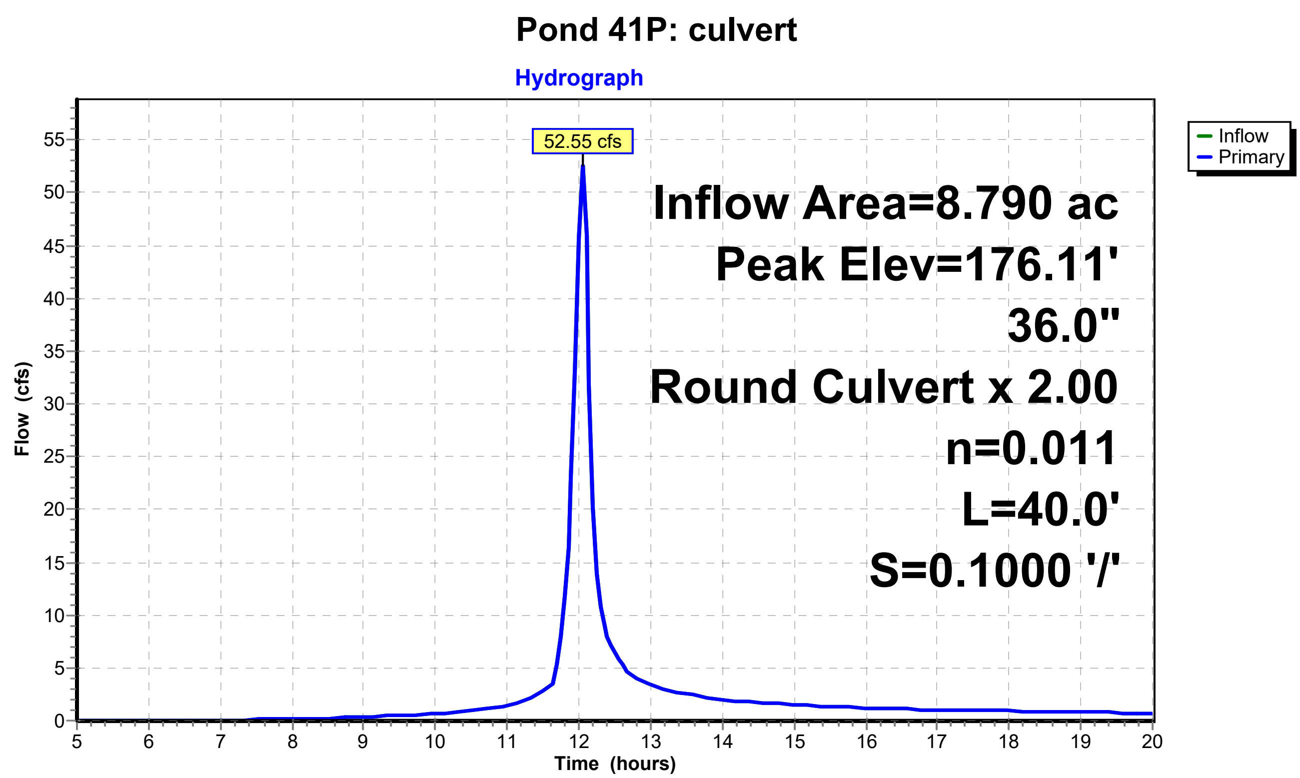
[61] Hint: Exceeded Reach 44R outlet invert by 0.11' @ 12.05 hrs

Inflow Area = 8.790 ac, 0.00% Impervious, Inflow Depth > 3.64" for 25 yr event
Inflow = 52.55 cfs @ 12.05 hrs, Volume= 2.668 af
Outflow = 52.55 cfs @ 12.05 hrs, Volume= 2.668 af, Atten= 0%, Lag= 0.0 min
Primary = 52.55 cfs @ 12.05 hrs, Volume= 2.668 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 176.11' @ 12.05 hrs
Flood Elev= 177.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	174.00'	**36.0" Round Culvert X 2.00** L= 40.0' Ke= 0.500 Inlet / Outlet Invert= 174.00' / 170.00' S= 0.1000 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 7.07 sf

Primary OutFlow Max=52.49 cfs @ 12.05 hrs HW=176.11' (Free Discharge)
1=Culvert (Inlet Controls 52.49 cfs @ 4.94 fps)



Appendix G.2: Conveyance Features

Geosyntec consultants

COMPUTATION COVER SHEET

Client: Tolson & Associates **Project:** TRL Vertical Expansion **Project #:** ME1606 **Phase #:** 03

TITLE OF COMPUTATIONS: STORMWATER CONVEYANCE FEATURES DESIGN

COMPUTATIONS BY:

Signature ______ July 21, 2020
DATE

Printed Name and Title: Helena Harris, Staff Professional

ASSUMPTIONS AND PROCEDURES CHECKED BY: (Peer Reviewer)

Signature ______ August 3, 2020
DATE

Printed Name and Title: William M. Steier, P.E., Principal

COMPUTATIONS CHECKED BY:

Signature ______ August 3, 2020
DATE

Printed Name and Title: William M. Steier, P.E., Principal

COMPUTATIONS BACKCHECKED BY: (Originator)

Signature ______ August 4, 2020
DATE

Printed Name and Title: Simone Smith, P.E., Senior Engineer

APPROVED BY: (PM or Designate)

Signature ______ August 4, 2020
DATE

Printed Name and Title: Carrie H. Pendleton, P.E., Principal

APPROVAL NOTES:

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

STORMWATER CONVEYANCE FEATURES DESIGN
TOLSON RUBBLE LANDFILL SWM DESIGN

PURPOSE

The purpose of this calculation package is to verify that the proposed geometry of the various stormwater management features of the proposed expansion of Tolson Rubble Landfill (TRL) final cover system are adequately sized to convey the design discharge at non-erosive velocities. The stormwater management features evaluated include: (i) downchutes; (ii) cover access road channel; (iii) perimeter drainage channels, and (iv) stormwater basin inlet culverts. Each of these features is designed to convey and withstand the erosive forces from the peak discharge associated with the 25-year, 24-hour design storm.

METHOD

The post-development peak discharge values for the 25-year, 24-hour design storms for the various stormwater management features are provided in Appendix G.1. The peak discharge values were calculated using *HydroCAD® Stormwater Modeling System*," version 10.00-18 [Applied Microcomputer Systems, 2016] (HydroCAD®).

The final cover system downchutes, cover access road channel, and perimeter drainage channels are designed with trapezoidal cross sections. Culverts are designed with a circular cross section. Calculations of discharge rates, flow velocities and flow depths (for each type of conveyance feature) are based on Manning's Equation [Chow, 1959] expressed as:

$$Q = \frac{1.49}{n} AR^{2/3} S^{1/2} \tag{1}$$

where: Q = discharge (ft^3/sec);
n = Manning's roughness coefficient (dimensionless);
A = area of cross-section of flow (ft^2);
R = hydraulic radius = $\frac{A}{P}$;
P = wetted perimeter (ft.); and
S = longitudinal slope of the channel (ft/ft).

The velocity (V) of the flow in a channel may be calculated as follows:

$$V = \frac{Q}{A} \tag{2}$$

The erosive force in the channels is related to the tractive stresses imposed by the force of the flowing water. The tractive force in the channel at normal flow depth was calculated using the following equation [Chow, 1959].

$$\tau = \gamma RS \tag{3}$$

where: τ = tractive stress (lb/ft^2);
γ = unit weight of water = 62.4 (lb/ft^3);
R = hydraulic radius of flow cross-section (ft.); and
S = longitudinal slope of the channel (ft/ft).

CALCULATION PARAMETERS

Discharges for the 25-year design storm were calculated using HydroCAD and are provided in Appendix G.1. Specific design characteristics associated with the final cover access road channel, perimeter drainage channels, and downchutes are used to evaluate the flow velocity and depth at the 25-year design discharge. Specific designs are based on the maximum channel velocities, which were taken from Attachment 1 [MDE, 2011] for each proposed channel lining type.

Final Cover Access Road Channels -

- Trapezoidal cross-section
- Bottom width of 2.5 feet
- Side slopes of 4H:1V and 3H:1V
- Constant depth of 2.5 feet
- Longitudinal slope of 0.04
- Lining material: Class I Riprap (Manning's n = 0.05, recommended maximum permissible shear stress of 3 psf, see Attachment 1)

Perimeter Drainage Channels -

- Trapezoidal cross-section
- Bottom width of 3 feet
- Side slopes of 2.5H:1V
- Constant depth of 3 feet
- Longitudinal slope of 0.87% (minimum); 0.03.2% (maximum)
- Lining material: Temporary erosion control mat (Manning's n = 0.04, recommended maximum velocity of 6.0 ft/s, see Attachment 1)

Downchutes **-**

- Rectangular cross-section
- Side slopes of 0H:1V
- Bottom width of 22 feet for DC-DA8 and 15 ft for all other downchutes.
- Constant depth of 1.5 feet
- Longitudinal slope of approximately 4H:1V (equivalent to slope of landfill cap)
- Lining material: gabions (Manning's n = 0.03, see Attachment 1.)

A summary of the input parameters for specific design of stormwater conveyance features is presented in Tables 1 and 2.

CALCULATION

The flow depth within the various stormwater management features was calculated using Equation 1, for the peak discharge from the 25-year, 24-hour design storm. The minimum performance standards for channel lining material are based on: (i) the peak discharge flow velocity resulting from the 25-year, 24-hour design storm, calculated using Equation 2; and (ii) the peak tractive stresses calculated for the 25-year, 24-hour design storm using Equation 3.

Table 1 summarizes the inputs for the features and Table 2 summarizes the peak flow depth, the peak tractive stress, and velocity associated with the 25-year design storm for the stormwater management features.

RECOMMENDATIONS

The temporary erosion control mat used to stabilize cover terraces and perimeter channels shall meet the following specifications:

- Longevity: 6 months minimum
- Permissible flow velocity: 6 ft/s
- Permissible shear stress: 1.5 lb/ft^2

The riprap used to stabilize to stabilize Final Cover Access Road channels shall meet the following specifications:

- MSDSHA Class I riprap, d_{50} =8 inches
- Layer thickness >19 inches

Design recommendation for gabion-line downchutes are addressed in Appendix G.3.

REFERENCES

Applied Microcomputer Systems, "*HydroCAD® Stormwater Modeling System*", Version 10.00, Chocorua, New Hampshire 2016.

Chow, V.T., *Open Channel-Hydraulics*. New York: McGraw-Hill, 1959.

Maryland Department of the Environment, "Maryland Standards and Specifications for Soil Erosion and Sediment Control," 2011.

TABLES

TABLE 1
CALCULATION PARAMETERS FOR DESIGN STORMWATER MANAGEMENT FEATURES

Channel ID[1]	Peak Discharge[3] Q_{25} (ft3/sec)	Slope of Channel[3] S (ft/ft)	Manning's Roughness n	Channel Cross-Section				Channel Lining
				Bottom Width b (ft.)	Side Slope (Left) z (H: 1V)	Side Slope (Right) z (H: 1V)	Available Depth D (ft.)	
PC-DA1	128.1	0.0141	0.04	3	2.5	2.5	3	Erosion Mat
PC-DA2	119.7	0.0162	0.04	3	2.5	2.5	3	Erosion Mat
PC-DA3	66.8	0.0319	0.04	3	2.5	2.5	3	Erosion Mat
PC-DA4	62.6	0.0481	0.05	3	2.5	2.5	3	Class I Riprap
PC-DA7	29.3	0.0087	0.04	3	2.5	2.5	3	Erosion Mat
PC-DA8	34.7	0.0131	0.04	3	2.5	2.5	3	Erosion Mat
DC-DA2	70.8	0.25	0.03	15	0	0	1.5	Gabion
DC-DA5	60.0	0.25	0.03	15	0	0	1.5	Gabion
DC-DA8	102.9	0.25	0.03	22	0	0	1.5	Gabion

NOTES

1. Designation of the channel is from the Hydrocad model presented in the Appendix G.1.
2. Peak discharge for the 25-year, 24-hour design storm is presented in Appendix G.1.
3. Slope information is taken from Appendix G.2.

TABLE 2
ANALYSIS OF CHANNEL GEOMETRY (Q_{25}) AND ANALYSIS OF CHANNEL EROSION STABILITY (Q_{25})

Channel ID[1]	Channel Geometry (Q_{25})			Channel Stability (Q_{25})	
	Available Depth D (ft.)	Depth at Peak Discharge[2] y (ft.)	Freeboard Depth[5] FB (ft.)	Maximum Velocity[3] V (ft/sec)	Max Tractive Stress[4] τ (ft.)
PC-DA1	3	2.50	0.50	5.55	1.24
PC-DA2	3	2.35	0.65	5.74	1.35
PC-DA3	3	1.79	1.21	2.12	0.20
PC-DA4	2.5	1.51	0.99	6.18	2.76
PC-DA7	3	1.42	1.58	3.17	0.47
PC-DA8	3	1.40	1.60	3.87	0.71
DC-DA2	1.5	0.38	1.12	12.60	5.64
DC-DA5	1.5	0.35	1.15	11.96	5.22
DC-DA8	1.5	0.38	1.12	12.73	5.73

NOTES
1. Designation of the channel is from the Hydrocad model presented in the Appendix G.1.
2. Depth is a function of the cross sectional flow area, A, defined by solution to Equation 1.
3. From Equation 2.
4. From Equation 3.
5. Freeboard = Peak Depth - Available Depth.

ATTACHMENT 1

Recommendations for Manning's Roughness and Maximum Flow Velocities [MDE, 2011]

H-3 STANDARDS AND SPECIFICATIONS

FOR

CHANNEL

Definition

An open drainage conveyance lined with vegetation, riprap, gabions, concrete or other approved material.

Purpose

To convey concentrated runoff in a non-erosive manner.

Conditions Where Practice Applies

A channel is used when permanent conveyance of runoff is necessary. A channel lined with concrete should be considered only after all other design options have been deemed infeasible.

Design Criteria

1. Capacity: The channel must have a minimum capacity to adequately convey the peak rate of runoff from the 10-year, 24-hour storm.

   Use the following Manning's coefficient of roughness (n):

Lined Material	**Manning's n**
Grass with soil stabilization matting for	
$d \leq 6$ inches	0.060
$d > 6$ inches	0.040
Concrete (type):	
Trowel Finish	0.015
Float Finish	0.019
Gunite	0.019
Riprap	Determine from Figure H.2
Gabion	0.030

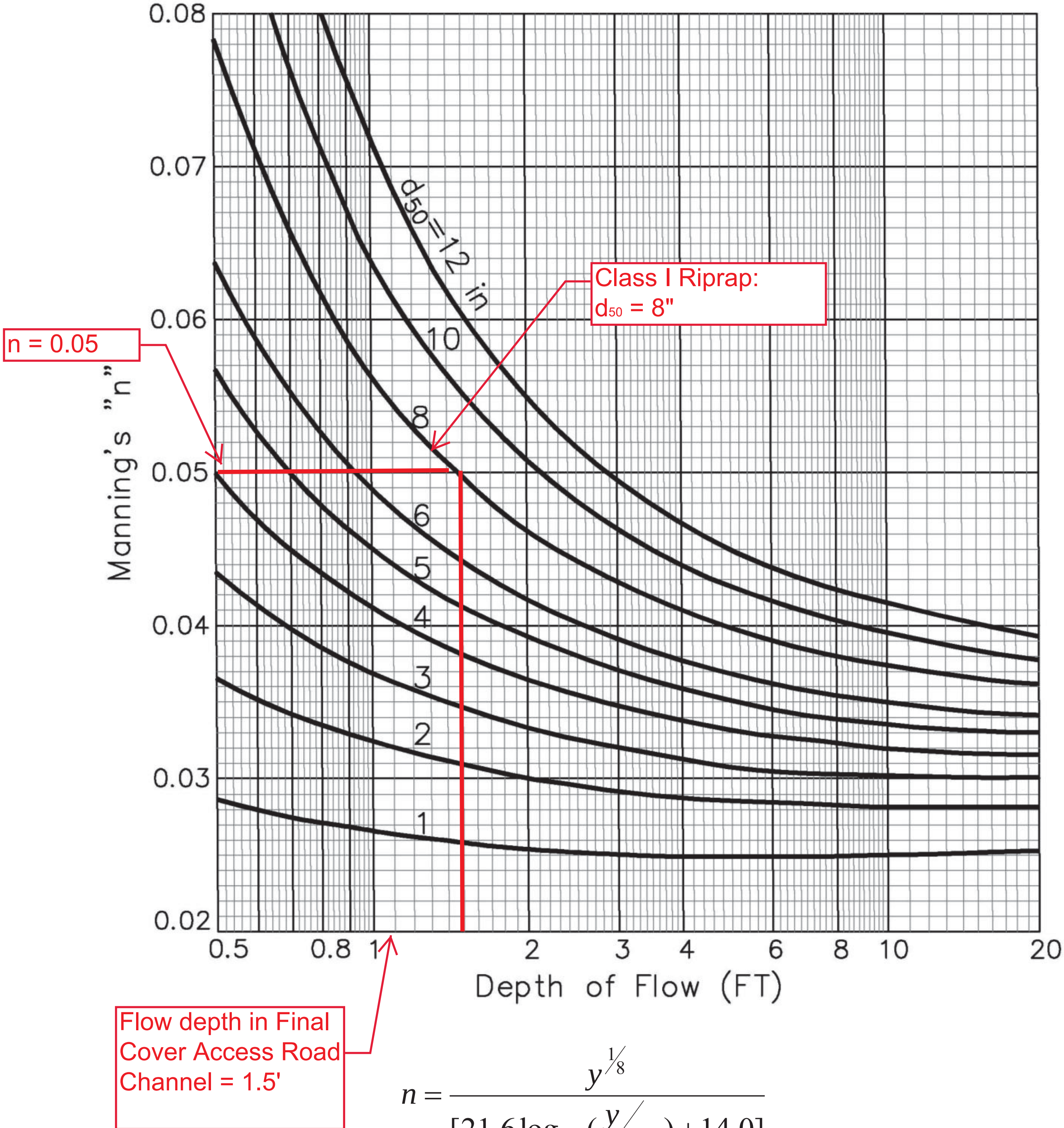
2. Velocity: The maximum allowable design velocity for type of channel lining is shown in Table H.4.

Table H.4: Maximum Velocities for Channels

Channel Lining	Maximum Velocity (fps)
Seed and mulch	2.5
Solid sodding	4.0
Temporary soil stabilization matting over seed and mulch	6.0
Grass with permanent soil stabilization matting	8.5
Riprap	Refer to Figures D.2 and D.3
Gabion	Unlimited
Concrete	Unlimited

Manning's Roughness in PC-DA4
(Final Cover Access Road Channel)

Figure H.2: Determining "n" for Riprap Lined Channel using Depth of Flow



$$n = \frac{y^{1/8}}{[21.6 \log_{10}(y/d_{50}) + 14.0]}$$

(y =Depth of Flow)

Appendix G.3: Downchute Lining Design

Geosyntec consultants

COMPUTATION COVER SHEET

Client: Tolson & Associates **Project:** TRL Vertical Expansion **Project #:** ME1606 **Phase #:** 03

TITLE OF COMPUTATIONS: DOWNCHUTE LINING DESIGN

COMPUTATIONS BY: Signature ______ February 7, 2020
DATE

Printed Name and Title: Helena Harris

ASSUMPTIONS AND PROCEDURES CHECKED BY: (Peer Reviewer) Signature ______ August 3, 2020
DATE

Printed Name and Title: William M. Steier, P.E.
Principal

COMPUTATIONS CHECKED BY: Signature ______ August 3, 2020
DATE

Printed Name and Title: William M. Steier, P.E.
Principal

COMPUTATIONS BACKCHECKED BY: (Originator) Signature ______ August 4, 2020
DATE

Printed Name and Title: Simone Smith, P.E.
Senior Engineer

APPROVED BY: (PM or Designate) Signature C.H. Pendleton August 4, 2020
DATE

Printed Name and Title: Carrie H Pendleton, P.E.
Principal

APPROVAL NOTES: ______

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

DOWNCHUTE LINING DESIGN
TOLSON RUBBLE LANDFILL SWM DESIGN

PURPOSE

The purpose of this calculation package is to verify the proposed lining material for the downchutes of the proposed expansion of Tolson Rubble Landfill (TRL) final cover system. Downchutes will convey stormwater runoff from a series of side slope terraces to a series of stormwater conveyance channels located at the perimeter of the landfill. The downchutes will be inclined at approximately 4 horizontal to 1 vertical (4H:1V) and will be constructed using gabion mattresses.

PROPOSED DOWNCHUTE LINING

The downchutes at TRL will be lined with the following materials, listed from top to bottom:

- Gabion mattress, 15 or 22 feet wide, 12 inches thick;
- 8 ounce per square yard (oz/sy) non-woven geotextile;
- MDOT No. 7 stone, 6 inches thick;
- 8 oz/sy geotextile;

The downchutes will be constructed within the closure cap, directly above the cap drainage and hydraulic barrier.

METHOD

The design procedure and methodology presented in this calculation are specifically for gabion revert mattresses and are based on the procedure presented in the design reference, "*Flexible Linings in Reno Mattress and Gabions for Canals and Canalized Water Courses*," [Agostini et al., 1985].

The downchutes were sized to accommodate the peak discharge from the 25-year, 24-hour design storm. The peak discharges for the 25-year, 24-hour design storm for the final cover system sub-drainage areas are provided in Appendix G.1. The proposed downchutes consist of rectangular cross section open channels 15 or 22 feet wide at the base and 1.5 feet deep.

The water flow depth and velocity are estimated by solving Manning's equation [Chow, 1959], which is expressed as:

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2} \tag{1}$$

$$V = \frac{Q}{A} \tag{2}$$

$$y = \frac{A}{b} \tag{3}$$

where: Q = discharge (ft^3/sec);
n = Manning's roughness coefficient (dimensionless);
A = area of flow (ft^2);
R = hydraulic radius = A/P (ft);
P = wetted perimeter (ft);
S = longitudinal slope of the channel (ft/ft);
V = velocity (ft/sec);
y = flow depth (ft); and
b = channel width (ft).

Manning's roughness coefficient (n) for aggregate is calculated using the following equation from Agostini et al. [1985].

$$n = \frac{d_{90}^{1/6}}{26} \tag{4}$$

where: d_{90} = sieve size passing 90 percent by of the aggregate particles (m).

The tractive stress resulting from the anticipated flow and critical tractive stress within in the unit downchute channel are estimated using the following equations [Agostini et al., 1985]:

$$t_b = \gamma_w \; y \, i \tag{5}$$

$$t_c = 0.10(\gamma_s - \gamma_w)\, d_{50} \tag{6}$$

where: t_b = tractive stress at the bottom of the channel (kg/m^2);
t_c = critical tractive stress (kg/m^2);

γ_s = unit weight of solid stone, assumed specific gravity 2.6 = 2600 kg/m^3;
γ_w = unit weight of water = 1,000 kg/m^3;
y = flow depth (m);
i = channel slope = 0.25 m/m; and
d_{50} = median diameter of aggregate (m).

In the case where t_b exceeds t_c the individual stones within the gabion mattress may move within the steel cages. If this happens, the revetment will lose effectiveness if the base soil under the mattress is exposed. However, if the mattress is thick enough, the strength of the steel wire mesh will keep the gabion stones from shifting enough to expose the underlying soil and the effectiveness of the mattress is maintained. As the gabion mattress design is for the 25-year, 24-hour storm event, deformation of gabion stones will be allowed as long as the effectiveness of the mattress is maintained. The gabion mattress is still considered functional if the following condition is met [Agostini et al., 1985].

$$\frac{\Delta z}{d_{50}} \leq 2 * \left(\frac{t}{d_{50}} - 1\right) \tag{7}$$

where: $\frac{\Delta z}{d_{50}}$ = degree of deformation parameter;
Δz = height difference of stone in a mattress compartment (m);
t = thickness of mattress (m);

The degree of deformation parameter can be determined using Attachment 1 and the effective Shields Parameter (C'_*), which is calculated using the following equation [Agostini et al., 1985].

$$C'_* = \frac{(t_b - t_c)}{(\gamma_s - \gamma_w)d_{50}} \tag{8}$$

The critical design channel velocity for stability of the revert mattress aggregate is a function of the Froude number and the median aggregate diameter (i.e., d_{50}). The relationship between these parameters and the critical velocity are presented in Attachment 2, [Agostini et al., 1985].

The design flow at the base of the revert mattress is evaluated using the following equation [Agostini et al., 1985].

$$v_b = \frac{1}{n_f}\left(\frac{d_{50}}{2}\right)^{2/3} i^{1/2} \tag{9}$$

If a geotextile is used between the revert mattress and the base soil, then the design flow at the base of the geotextile, $v_{b,geo}$, can be calculated as follows:

$$v_{b,geo} = \frac{v_b}{r} \tag{10}$$

where: r = reduction factor for geotextile (between 2 and 4) – choose 3 for this design.

The critical flow velocity at the base of the revert mattress for non-cohesive soils is evaluated using the following equation [Agostini et al., 1985].

$$v_e = 16.1 * (d_{50,b})^{1/2} \qquad \text{(non-cohesive soil)} \tag{11}$$

where: v_b = velocity at the bottom of revert mattress (m/sec);
v_e = critical velocity at the bottom of revert mattress (m/sec);
n_f = 0.02 if a geotextile present or 0.025 if there is an aggregate layer (dimensionless); and
$d_{50,b}$= median soil particle diameter for bedding soil (m).

The critical flow velocity, v_b, at the base of the revert mattress for various cohesive soils is presented in Table 1.

CALCULATION PARAMETERS

The proposed revert mattresses will have a thickness of 12 in. and will be filled with 5 to 10-in. diameter stone. Underlying the revert mattresses will be geotextile and a layer of aggregate that meets the requirements of Maryland No. 7 of Standard Specification 901 [MDOT, 2017], which is summarized below. The geotextile and aggregate layers are designed to reduce flow velocities and tractive stresses below the downchute.

MDOT No.	**Sieve Size (in., square openings) millimeters except where noted**							
	1 (25)	3/4 (19)	0.5 (12.5)	3/8 (9.5)	No. 4 (4.75)	No. 8 (2.36)	No. 16 (1.18)	No. 100 (150 µm)
7	-	100	90-100	40-70	0-15	0-5	-	-

CALCULATION

Evaluation and comparison of critical design values for downchute DC-DA8 and downchute DC-DA2 are provided in Attachment 3. Downchute DC-DA8 and downchute DC-DA2 were chosen because they have the highest expected discharge and tractive stresses. Design values for these downchutes are acceptable if they are less than the critical values. Comparison of design values to critical values are made for the following parameters: (i) tractive stress ($\tau_b < \tau_c$ or acceptable deformation), (ii) flow velocity at revert mattress surface ($v < v_c$); and (iii) flow velocity at base soil level ($v_b < v_e$).

As shown in Attachment 3, tractive stresses and flow velocity at the surface and base of the gabion mattress are less than the critical values for each parameter.

REFERENCES

Agostini, R., Conte, A., Malaguti, G, and Papetti, A., "*Flexible Linings in Reno Mattress and Gabions for Canals and Canalized Water Courses*", Officine Maccaferri, S.P.A., Bolonga, Italy, 1985.

Chow, V.T., "*Open Channel Hydraulics*", McGraw-Hill, New York, 1959.

Maryland Department of Transportation (MDOT). "*Aggregates*",< https://policymanual.mdot.maryland.gov/mediawiki/index.php?title=901_AGGREGATES#901.01>, 2017.

TABLE

Table 1: Limiting Velocity at Soil Bed Level for Various Soils [Agostini et al., 1985]

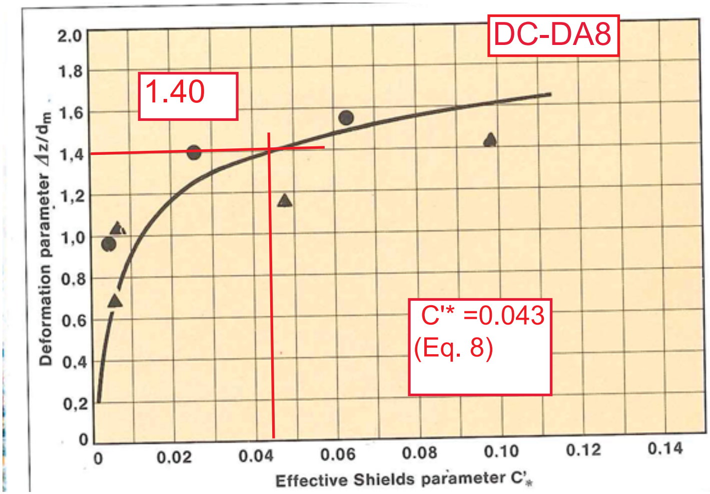
Tolson Rubble Landfill

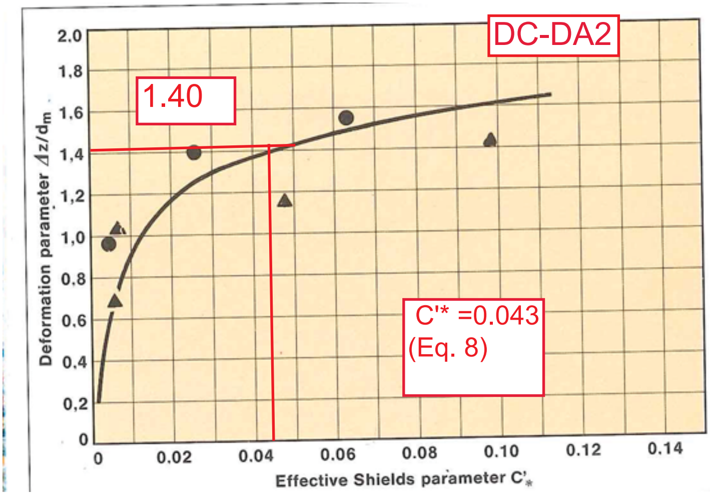
Soil Type	Bed Material	Velocity (m/s)	
		No Material Carried in Suspension	Colloidal Material Carried in Suspension
2	Fine Sand (Non-colloidal)	0.45	0.75
	Sandy Clay (Non-colloidal)	0.55	0.75
3	Soft Clay	0.60	0.90
4	Muds	0.75	1.05
	Coarse Sand	0.75	1.50
	Medium Clay	1.15	1.50
5	Gravel	1.20	1.85
	Shingle	1.50	1.70
	Hard Clay	1.85	1.85

Note: Type 1 soils are non-cohesive.

ATTACHMENT 1

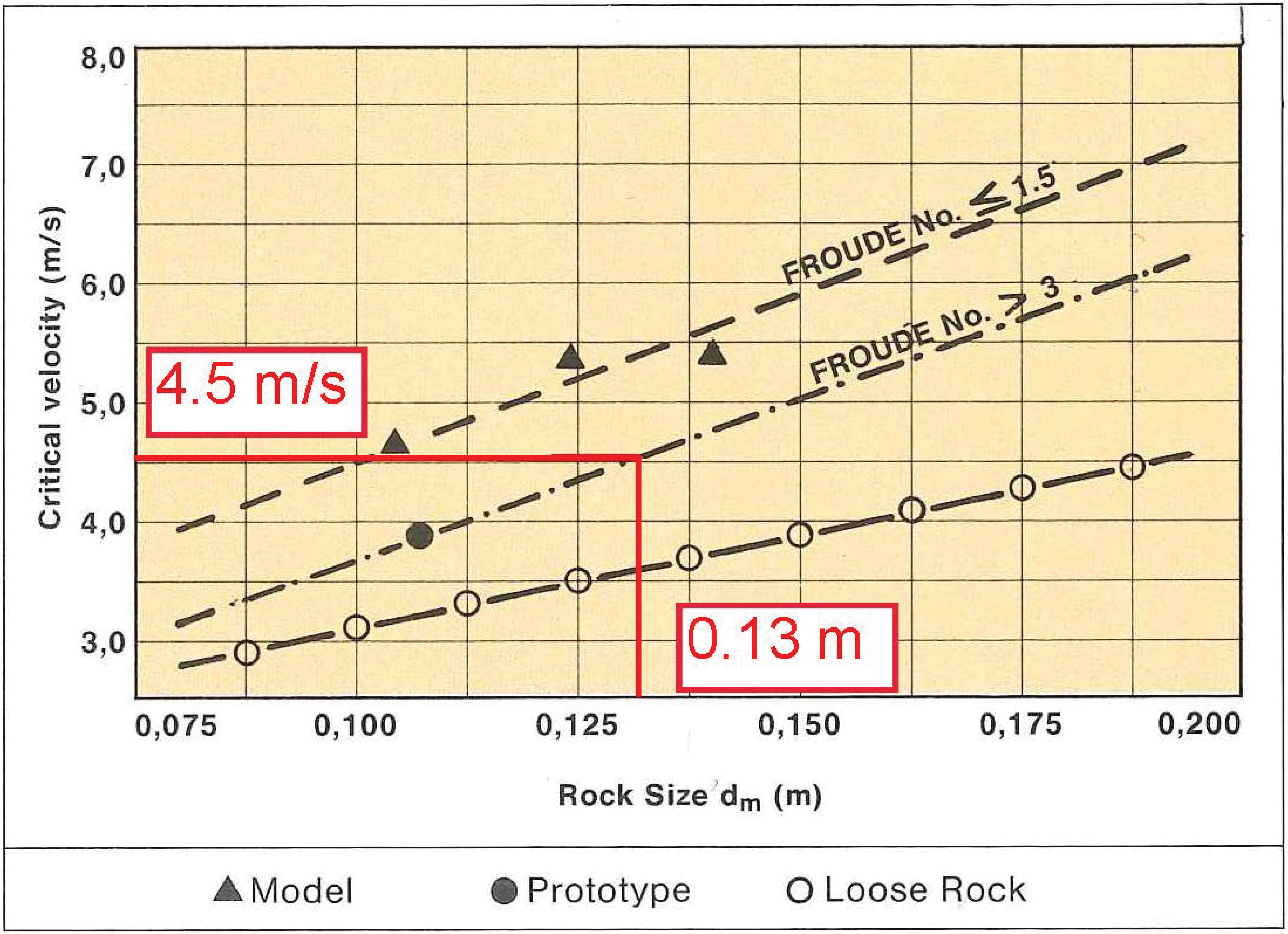
Relationship Between the Deformation Factor and the Effective Shields Parameter [Agostini et al., 1985]


DC-DA8
1.40
C'* =0.043
(Eq. 8)
Deformation parameter Δz/dm
Effective Shields parameter C'*
2.0
1,8
1,6
1,4
1,2
1,0
0,8
0,6
0,4
0,2
0
0
0.02
0.04
0.06
0.08
0.10
0.12
0.14


DC-DA2
1.40
C'* =0.043
(Eq. 8)
2.0
1,8
1,6
1,4
1,2
1,0
0,8
0,6
0,4
0,2
0
Deformation parameter Δz/dm
0
0.02
0.04
0.06
0.08
0.10
0.12
0.14
Effective Shields parameter C'*

ATTACHMENT 2

Critical Velocity as a Function of Froude Number and Median Riprap Size [Agostini et al., 1985]



8,0
7,0
6,0
5,0
4,0
3,0
Critical velocity (m/s)
FROUDE No. ≤ 1.5
FROUDE No. > 3
4.5 m/s
0.13 m
0,075
0,100
0,125
0,150
0,175
0,200
Rock Size dm (m)
Model
Prototype
Loose Rock

ATTACHMENT 3

Calculation of Channel Flow Velocity and Tractive Stress

ATTACHMENT 3

Design/Check: Lining Design by Allowable Velocity, Tractive Stress
Methodology: See Calculation Package
Project: Tolson Rubble Landfill
Feature: FINAL COVER DOWNCHUTE (DC-DA8)

Constants and Design Parameters

Discharge, Q_{max}=	102.9	ft^3/sec
Width, B =	22	ft.
Left Side Slope, Z_1 =	0.00	horizontal :1 vertical
Right Side Slope, Z_2 =	0.00	horizontal :1 vertical
Manning's Roughness Coeff., n =	0.028	(calculated from Eq. 4)
Longitudinal Channel Slope, S_o =	0.25	ft/ft

Specific Weight of Water, γ_w =	1000	kg/m^3
Specific Weight of Aggregate, G_s =	2600	kg/m^3
Base Soil Type (See Table 1) =	1	(Enter: 1-5; 1 = non cohesive)
Base Soil Protection =	Gravel	(Enter: Geotextile or Gravel)
		(if both present, Enter Gravel

Note: Shaded Cells Indicate Input Data

Reno Mattress Lining Reference Table

Lining Thickness	D100	D90	D50	D0
(in.)	(m)	(m)	(m)	(m)
6	0.102	0.099	0.089	0.076
9	0.152	0.144	0.114	0.076
12	0.152	0.147	0.127	0.102
18	0.25	0.237	0.19	0.12

Base Soil Critical Velocity Reference Table, From Table 1

Soil Type	Description	Critical Velocity, (m/s)
1	Non-Cohesive	From Eq. 11
2	Sandy Clay (non-colloidal)	0.55
3	Soft Clay	0.6
4	Medium Clay	1.15
5	Hard Clay	1.85

Calculation of average flow depth and velocity for critical downchute section Reach DC-DA8

Depth of Flow Y ft.	Area of Flow A ft^2	Wetted Perimeter P ft.	Hydraulic Radius R=A/P ft.	Channel Slope ft/ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ lb/ft^2	Froude Number F --	Comments
0.38	8.36	22.76	0.37	0.25	13.67	114.29	5.93	3.91	Design Q Taken from Appendix G.3

Gabion Mattress Thickness (6 in.,9 in.,12 in.,18 in.) =	12	
Maximum Riprap Size, d_{100} =	0.152	m
Riprap Size, d_{90} =	0.147	m
Median Riprap Size, d_{50} =	0.127	m
Minimum Riprap Size , d_0 =	0.102	m

Channel Flow Velocity (Top of Reno Mattress)

Flow Velocity, v =	4.17	m/sec
Froude Number, F =	3.91	
Critical Flow Velocity, v_c =	4.5	See Attachment 2
$v < v_c$?	**OK**	Function of F and d_{50},

Manning Coefficient Estimate

Manning Coefficient, n =	0.028	Eq 4

Channel Flow Velocity (Bottom of Gabion Mattress)

Flow Velocity, v_b =	3.18	m/s; Eq. 9
Flow Velocity with Geotextile, $v_{b,geo}$ =	1.06	m/s; Eq. 10
Allowable Base Soil Velocity Cohesive Soil, v_e =	NA	Table 1
Median particle size of bedding soil, $d_{50,b}$ =	0.0095	MDOT No. 7 stone
Allowable Base Soil Velocity Non-Cohesive Soil, v_e =	1.57	m/s; Eq. 11
$v_b < v_e$?	**OK**	

Tractive Stress

Tractive Stress (Design Discharge), τ_b =	28.96	kg/m^2,Eq 5
Critical Tractive Stress, τ_c =	20.32	kg/m^2,Eq 6
Effective Shields Parameter, C_*'	0.043	Eq. 8
Degree of Deformation parameter, $\Delta z/d_{50}$	1.4	see Attachment 1
$\Delta z/d_{50} < 2*(t/d_{50} - 1)$?	**OK**	Eq. 7

Note: Shaded Cells Indicate Input Data

ATTACHMENT 3

Design/Check: Lining Design by Allowable Velocity, Tractive Stres
Methodology: See Calculation Package
Project: Tolson Rubble Landfill
Feature: FINAL COVER DOWNCHUTE (DC-DA2)

Constants and Design Parameters

Discharge, Q_{max} = 70.8 ft^3/sec
Width, B = 15 ft.
Left Side Slope, Z_1 = 0.0 horizontal :1 vertical
Right Side Slope, Z_2 = 0.0 horizontal :1 vertical
Manning's Roughness Coeff., n = 0.028 (calculated from Eq. 4)
Longitudinal Channel Slope, S_0 = 0.25 ft/ft

Specific Weight of Water, γ_w = 1000 kg/m^3
Specific Weight of Aggregate, G_s = 2600 kg/m^3
Base Soil Type (See Table 1) = 1 (Enter: 1-5; 1 = non cohesive)
Base Soil Protection = Gravel (Enter: Geotextile or Gravel) (if both present, Enter Gravel

Note: Shaded Cells Indicate Input Data

Reno Mattress Lining Reference Table

Lining Thickness	D100	D90	D50	D0
(in.)	(m)	(m)	(m)	(m)
6	0.102	0.099	0.089	0.076
9	0.152	0.144	0.114	0.076
12	0.152	0.147	0.127	0.102
18	0.25	0.237	0.19	0.12

Base Soil Critical Velocity Reference Table, From Table 1

Soil Type	Description	Critical Velocity, (m/s)
1	Non-Cohesive	From Eq. 11
2	Sandy Clay (non-colloidal)	0.55
3	Soft Clay	0.6
4	Medium Clay	1.15
5	Hard Clay	1.85

Calculation of average flow depth and velocity for critical downchute section Reach DC-DA2

Depth of Flow Y ft.	Area of Flow A ft^2	Wetted Perimeter P ft.	Hydraulic Radius R=A/P ft.	Channel Slope ft/ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ lb/ft^2	Froude Number F --	Comments
0.38	5.70	15.76	0.36	0.25	13.53	77.12	5.93	3.87	Design Q Taken from Appendix G.1

Gabion Mattress Thickness (6 in.,9 in.,12 in.,18 in.) = 12
Maximum Riprap Size, d_{100} = 0.152 m
Riprap Size, d_{90} = 0.147 m
Median Riprap Size, d_{50} = 0.127 m
Minimum Riprap Size , d_0 = 0.102 m

Channel Flow Velocity (Top of Reno Mattress)

Flow Velocity, v = 4.12 m/sec
Froude Number, F = 3.87
Critical Flow Velocity, v_c = 4.5 See Attachment 2
$v < v_c$? **OK** Function of F and d_{50},

Manning Coefficient Estimate

Manning Coefficient, n = 0.028 Eq 4

Channel Flow Velocity (Bottom of Gabion Mattress)

Flow Velocity, v_b = 3.18 m/s; Eq. 9
Flow Velocity with Geotextile, $v_{b,geo}$ = 1.06 m/s; Eq. 10
Allowable Base Soil Velocity Cohesive Soil, v_e = NA Table 1
Median particle size of bedding soil, $d_{50,b}$ = 0.0095 MDOT No. 7 stone
Allowable Base Soil Velocity Non-Cohesive Soil, v_e = 1.57 m/s; Eq. 11
$v_b < v_e$? **OK**

Tractive Stress

Tractive Stress (Design Discharge), τ_b = 28.96 kg/m^2, Eq 5
Critical Tractive Stress, τ_c = 20.32 kg/m^2, Eq 6
Effective Shields Parameter, C_*' 0.043 Eq. 8
Degree of Deformation parameter, $\Delta z/d_{50}$ 1.43 see Attachment 1
$\Delta z/d_{50} < 2*(t/d_{50} - 1)$? **OK** Eq. 7

Note: Shaded Cells Indicate Input Data

Appendix G.4: Stormwater Basin Evaluation

Geosyntec consultants

COMPUTATION COVER SHEET

Client: Tolson & Associates **Project:** TRL Vertical Expansion **Project #:** ME1606 **Phase #:** 03

TITLE OF COMPUTATIONS: STORMWATER BASIN EVALUATION

COMPUTATIONS BY:

Signature

July 22, 2020
DATE

Printed Name and Title: Helena Harris

ASSUMPTIONS AND PROCEDURES CHECKED BY: (Peer Reviewer)

Signature

July 22, 2020
DATE

Printed Name and Title: Jeff Wheeler, Principal

COMPUTATIONS CHECKED BY:

Signature

August 3, 2020
DATE

Printed Name and Title: William M. Steier, P.E., Principal

COMPUTATIONS BACKCHECKED BY: (Originator)

Signature

August 4, 2020
DATE

Printed Name and Title: Simone Smith, P.E., Senior Engineer

APPROVED BY: (PM or Designate)

Signature C.H. Pendleton

August 4, 2020
DATE

Printed Name and Title: Carrie Pendleton, P.E., Principal

APPROVAL NOTES:

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

STORMWATER BASIN EVALUATION

TOLSON RUBBLE LANDFILL

PURPOSE

The purpose of this calculation package is to verify that the sizing and hydraulic function Tolson Rubble Landfill (TRL) stormwater management pond and sediment traps, as previously designed (ERM, 2016) [Approved Design], are not exceeded by the proposed landfill development presented in the document, *Phase III Report, Permit Modification Application, Vertical Expansion of Tolson Rubble Landfill Crofton, Anne Arundel County, Maryland* (Geosyntec Consultants, 2020) [Expansion Design].

EVALUATION OF SEDIMENT FEATURE SIZING

The Approved Design incorporates three a Stone/Riprap Outlet Sediment Traps (ST-IV) that are each designed to manage a maximum specific drainage area. The Expansion Design incorporates three sediment traps that are identical in size and horizontal location to those presented in the Approved Design. The following table presents a summary of the size of each drainage area leading to the sediment traps in the Approved Design and in the Expansion Design.

Trap	Acres Treated	Acres Permitted
Trap 1	4.0	4
Trap 2	7.0	9.5
Trap 3	8.8	9.5

The drainage areas associated with Expansion Design are equal or less than the Approved Design.

ANALYSIS OF STORMWATER POND SIZING

The approved Design includes a stormwater management pond that is designed to meet Maryland Pond 378 Standards. The stormwater management pond was constructed in accordance with the Approved Design and is currently operational. To verify that stormwater runoff associated with the Expansion Design grading plans do not result in water surface elevations or discharge rates that exceed the Approved Design, a hydraulic analysis of the pond is performed using the computer program "*HydroCAD® Stormwater Modeling System*," version 10.00-18 [Applied Microcomputer Systems, 2016] (HydroCAD®), and the results compared to the Approved Design.

METHOD

Pond routing and discharge computations described in this calculation are performed within HydroCAD® using the Storage-Indication Routing method [Ponce, 1989]:

$$I - O = \frac{\Delta S}{\Delta t}$$

where: I = inflow rate into the structure (ft^3/sec);
O = outflow rate from the structure (ft^3/sec);
ΔS = change in storage (ft^3); and
Δt = time change increment (hr).

Hydrologic inputs for determination of the inflow hydrograph are provided in Appendix G.1. Details of the pond outlet structure, as obtained from the Approved Design, are summarized below:

- Pond bottom elevation (El.) 118 feet above mean sea level (ft-msl);
- Pond cleanout (sedimentation level) at El. 118.5 ft-msl;
- Seven (7) inch diameter low flow orifice at 119.0 ft-msl; and
- 2-ft by 35-ft principal spillway at El. 122 ft-msl;
- Regenerative step pool storm conveyance feature

RESULTS

The peak discharge and water surface elevation associated with the 2-yr, and 100-yr design storms for the Approved Design and Expansion Design are presented in the following table. HydroCAD output is provide in Attachment 1.

Storm Event	Peak Water Surface Elevation		Peak Discharge	
	Approved Design	Expansion Design	Approved Design	Expansion Design
2-yr	122.32	122.28	104	19.0
100-yr	123.99	123.98	349	323.1

The peak discharge and water surface elevations associated with the Expansion Design are approximately equivalent to the Approved Design. Therefore, no modification to the existing stormwater management pond are necessary to accommodate the Expansion Design.

REFERENCES

Applied Microcomputer Systems, "*HydroCAD® Stormwater Modeling System*", Version 10.00, Chocorua, New Hampshire 2016.

Environmental Resources Management (ERM), 2016. *Phase III Engineering Report*, *Tolson Rubble Landfill, Crofton*, *Maryland*. Prepared for Tolson & Associates, LLC. May 31.

Ponce, Victor, Engineering Hydrology Principles and Practice. Prentice Hall, Englewood, New Jersey 1989.

United States Department of Agriculture, Soil Conservation Service, "Computer Program for Project Formulation Hydrology, Technical Release 20", Washington, D.C., 1982.

United States Department of Agriculture, Soil Conservation Service, "Urban Hydrology for Small Watersheds, Technical Release 55", 2nd ed., Washington, D.C., 1986

.

ATTACHMENT 1
HydroCAD Output

Summary for Pond 39P: North Pond

Inflow Area = 66.470 ac, 1.91% Impervious, Inflow Depth > 1.29" for 2 yr event
Inflow = 64.30 cfs @ 12.09 hrs, Volume= 7.127 af
Outflow = 19.02 cfs @ 12.95 hrs, Volume= 3.607 af, Atten= 70%, Lag= 51.4 min
Primary = 19.02 cfs @ 12.95 hrs, Volume= 3.607 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 119.00' Surf.Area= 1.158 ac Storage= 1.155 af
Peak Elev= 122.28' @ 12.95 hrs Surf.Area= 1.178 ac Storage= 4.982 af (3.827 af above start)

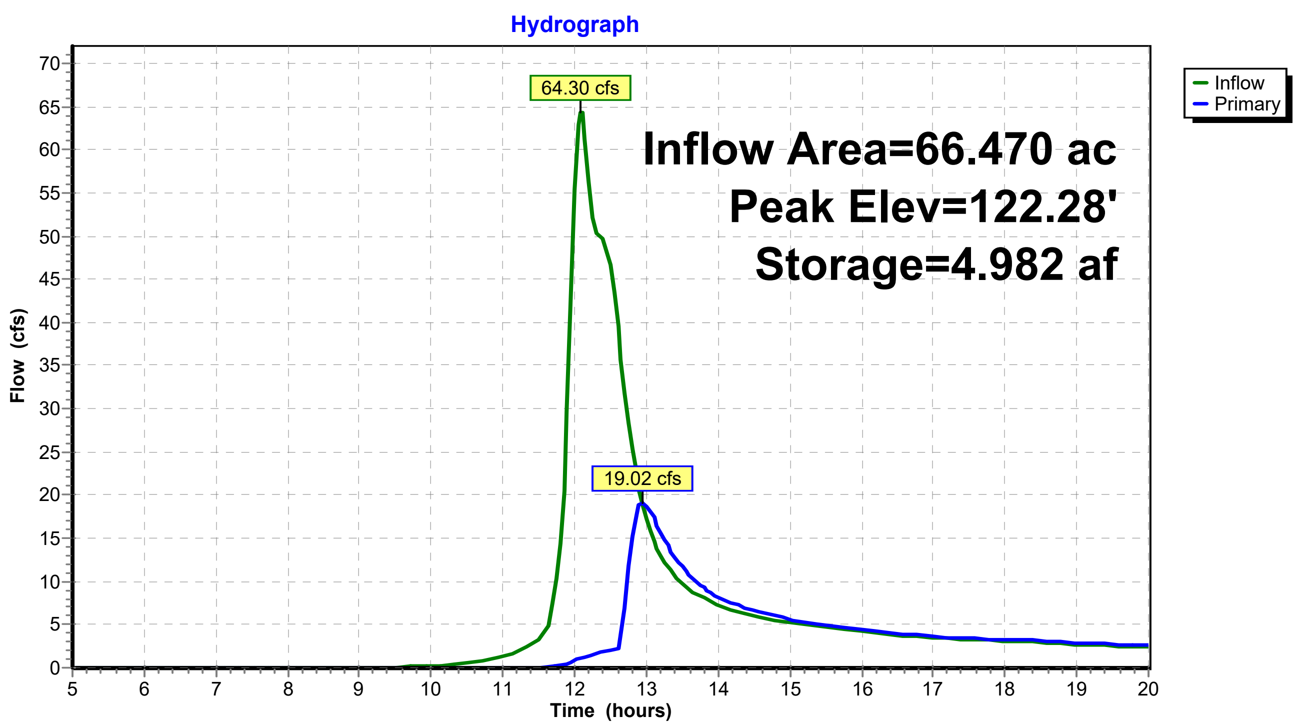
Plug-Flow detention time= 242.9 min calculated for 2.452 af (34% of inflow)
Center-of-Mass det. time= 91.7 min (904.5 - 812.8)

Volume	Invert	Avail.Storage	Storage Description
#1	118.00'	10.618 af	**226.00'W x 222.00'L x 9.00'H Prismatoid Z=0.3**

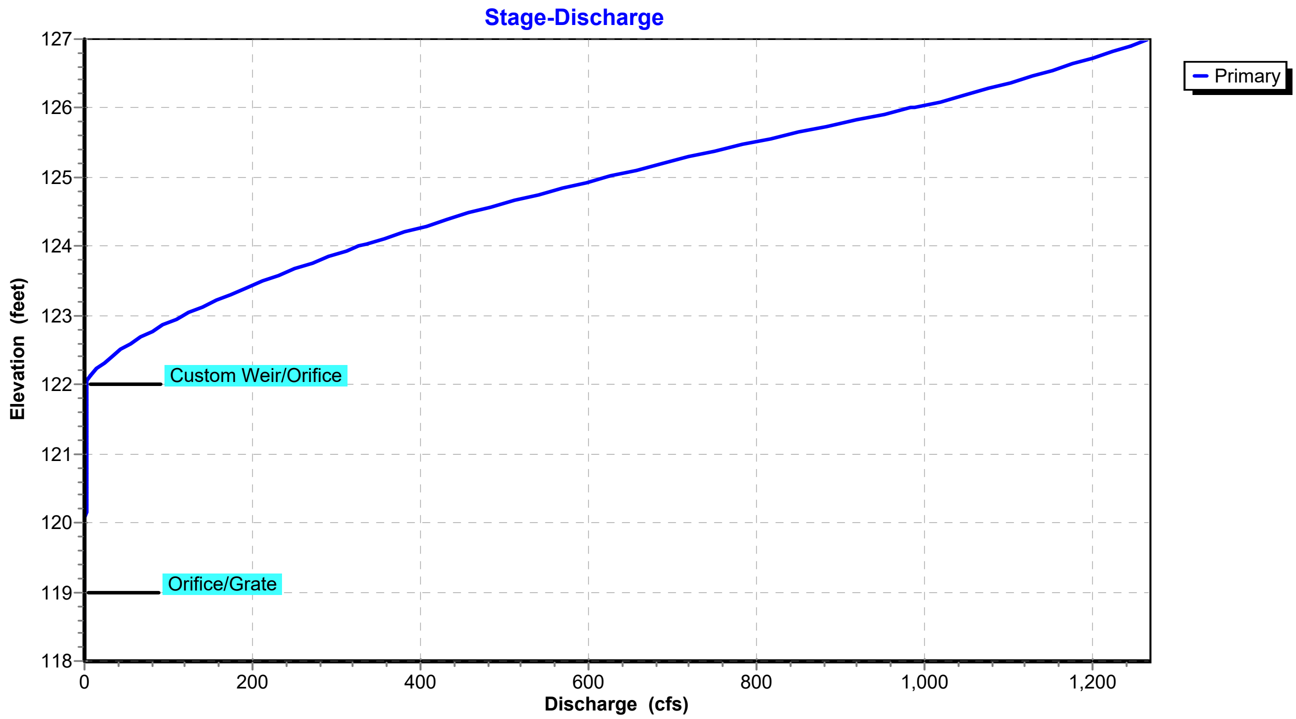
Device	Routing	Invert	Outlet Devices
#1	Primary	122.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 4.00 5.00 6.00 6.00 7.00 8.00 Width (feet) 35.00 35.00 35.00 41.00 42.00 43.00
#2	Primary	119.00'	**7.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=18.85 cfs @ 12.95 hrs HW=122.28' (Free Discharge)
1=Custom Weir/Orifice (Weir Controls 16.63 cfs @ 1.72 fps)
2=Orifice/Grate (Orifice Controls 2.22 cfs @ 8.32 fps)

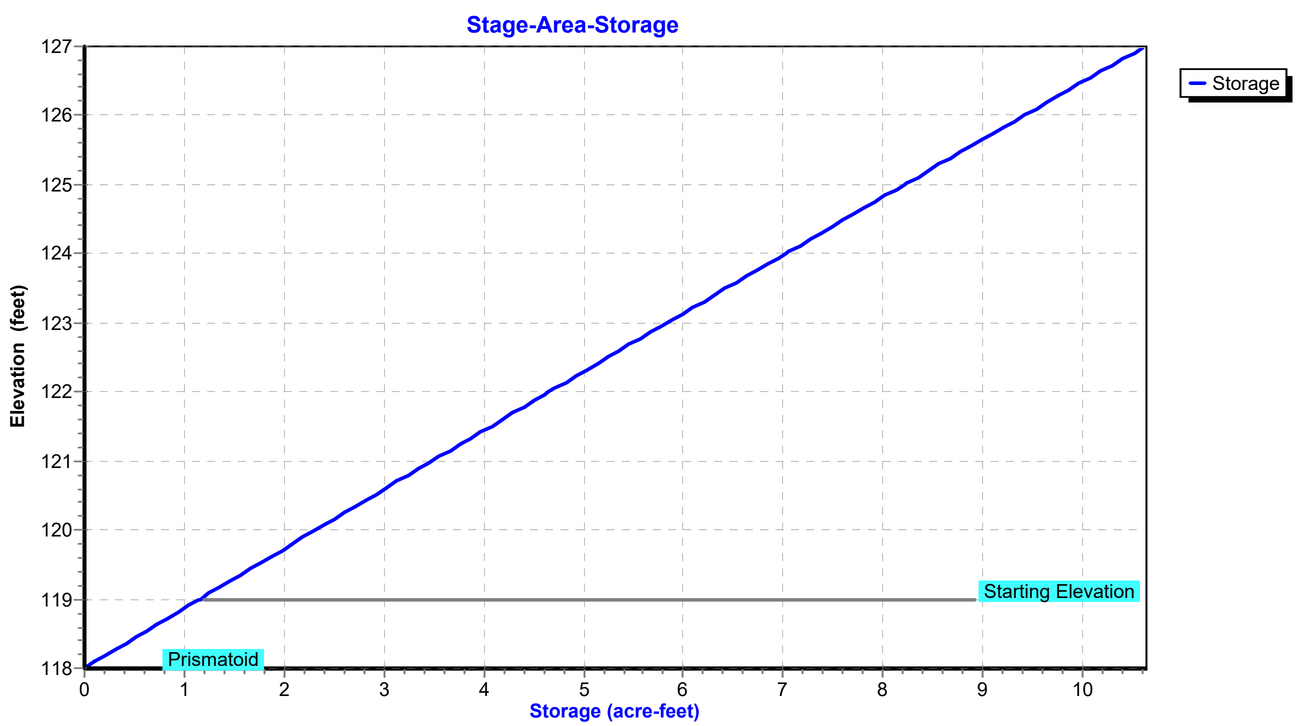
Pond 39P: North Pond



Pond 39P: North Pond



Pond 39P: North Pond



Stage-Discharge for Pond 39P: North Pond

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
118.00	0.00	123.30	172.48
118.10	0.00	123.40	192.48
118.20	0.00	123.50	213.22
118.30	0.00	123.60	234.66
118.40	0.00	123.70	256.77
118.50	0.00	123.80	279.55
118.60	0.00	123.90	302.96
118.70	0.00	124.00	327.00
118.80	0.00	124.10	352.27
118.90	0.00	124.20	378.67
119.00	0.00	124.30	406.00
119.10	0.03	124.40	434.20
119.20	0.12	124.50	463.21
119.30	0.26	124.60	493.01
119.40	0.42	124.70	523.58
119.50	0.59	124.80	554.88
119.60	0.71	124.90	586.91
119.70	0.82	125.00	619.64
119.80	0.92	125.10	653.07
119.90	1.00	125.20	687.18
120.00	1.08	125.30	721.95
120.10	1.16	125.40	757.39
120.20	1.23	125.50	793.47
120.30	1.29	125.60	830.19
120.40	1.35	125.70	867.55
120.50	1.41	125.80	905.52
120.60	1.47	125.90	944.12
120.70	1.53	126.00	983.32
120.80	1.58	126.10	1,018.67
120.90	1.63	126.20	1,050.92
121.00	1.68	126.30	1,081.33
121.10	1.73	126.40	1,110.36
121.20	1.78	126.50	1,138.26
121.30	1.82	126.60	1,165.20
121.40	1.87	126.70	1,191.32
121.50	1.91	126.80	1,216.69
121.60	1.96	126.90	1,241.40
121.70	2.00	127.00	**1,265.51**
121.80	2.04		
121.90	2.08		
122.00	2.12		
122.10	5.78		
122.20	12.45		
122.30	21.07		
122.40	31.27		
122.50	42.83		
122.60	55.61		
122.70	69.51		
122.80	84.43		
122.90	100.31		
123.00	117.10		
123.10	134.75		
123.20	153.22		

Stage-Area-Storage for Pond 39P: North Pond

Elevation (feet)	Storage (acre-feet)	Elevation (feet)	Storage (acre-feet)
118.00	0.000	123.30	6.192
118.10	0.115	123.40	6.310
118.20	0.230	123.50	6.429
118.30	0.346	123.60	6.547
118.40	0.461	123.70	6.666
118.50	0.577	123.80	6.785
118.60	0.692	123.90	6.904
118.70	0.808	124.00	7.022
118.80	0.923	124.10	7.141
118.90	1.039	124.20	7.260
119.00	1.155	124.30	7.379
119.10	1.271	124.40	7.499
119.20	1.387	124.50	7.618
119.30	1.503	124.60	7.737
119.40	1.619	124.70	7.856
119.50	1.735	124.80	7.976
119.60	1.851	124.90	8.095
119.70	1.967	125.00	8.215
119.80	2.083	125.10	8.334
119.90	2.200	125.20	8.454
120.00	2.316	125.30	8.574
120.10	2.432	125.40	8.693
120.20	2.549	125.50	8.813
120.30	2.665	125.60	8.933
120.40	2.782	125.70	9.053
120.50	2.899	125.80	9.173
120.60	3.016	125.90	9.293
120.70	3.132	126.00	9.413
120.80	3.249	126.10	9.533
120.90	3.366	126.20	9.654
121.00	3.483	126.30	9.774
121.10	3.600	126.40	9.894
121.20	3.717	126.50	10.015
121.30	3.835	126.60	10.135
121.40	3.952	126.70	10.256
121.50	4.069	126.80	10.377
121.60	4.187	126.90	10.497
121.70	4.304	127.00	**10.618**
121.80	4.422		
121.90	4.539		
122.00	4.657		
122.10	4.774		
122.20	4.892		
122.30	5.010		
122.40	5.128		
122.50	5.246		
122.60	5.364		
122.70	5.482		
122.80	5.600		
122.90	5.718		
123.00	5.836		
123.10	5.955		
123.20	6.073		

Summary for Pond 39P: North Pond

Inflow Area = 66.470 ac, 1.91% Impervious, Inflow Depth > 5.70" for 100 yr event
Inflow = 345.68 cfs @ 12.08 hrs, Volume= 31.589 af
Outflow = 323.13 cfs @ 12.14 hrs, Volume= 27.930 af, Atten= 7%, Lag= 4.2 min
Primary = 323.13 cfs @ 12.14 hrs, Volume= 27.930 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 119.00' Surf.Area= 1.158 ac Storage= 1.155 af
Peak Elev= 123.98' @ 12.14 hrs Surf.Area= 1.189 ac Storage= 7.003 af (5.849 af above start)

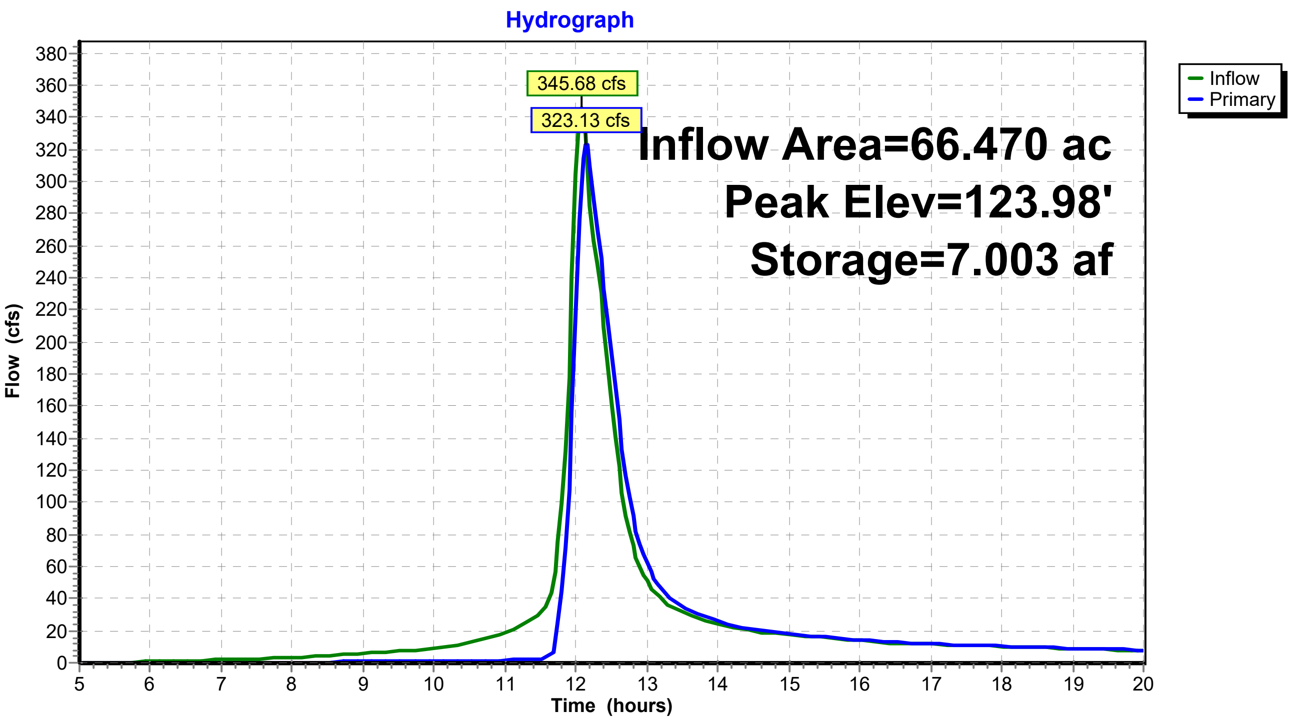
Plug-Flow detention time= 77.3 min calculated for 26.774 af (85% of inflow)
Center-of-Mass det. time= 26.8 min (803.7 - 776.9)

Volume	Invert	Avail.Storage	Storage Description
#1	118.00'	10.618 af	**226.00'W x 222.00'L x 9.00'H Prismatoid Z=0.3**

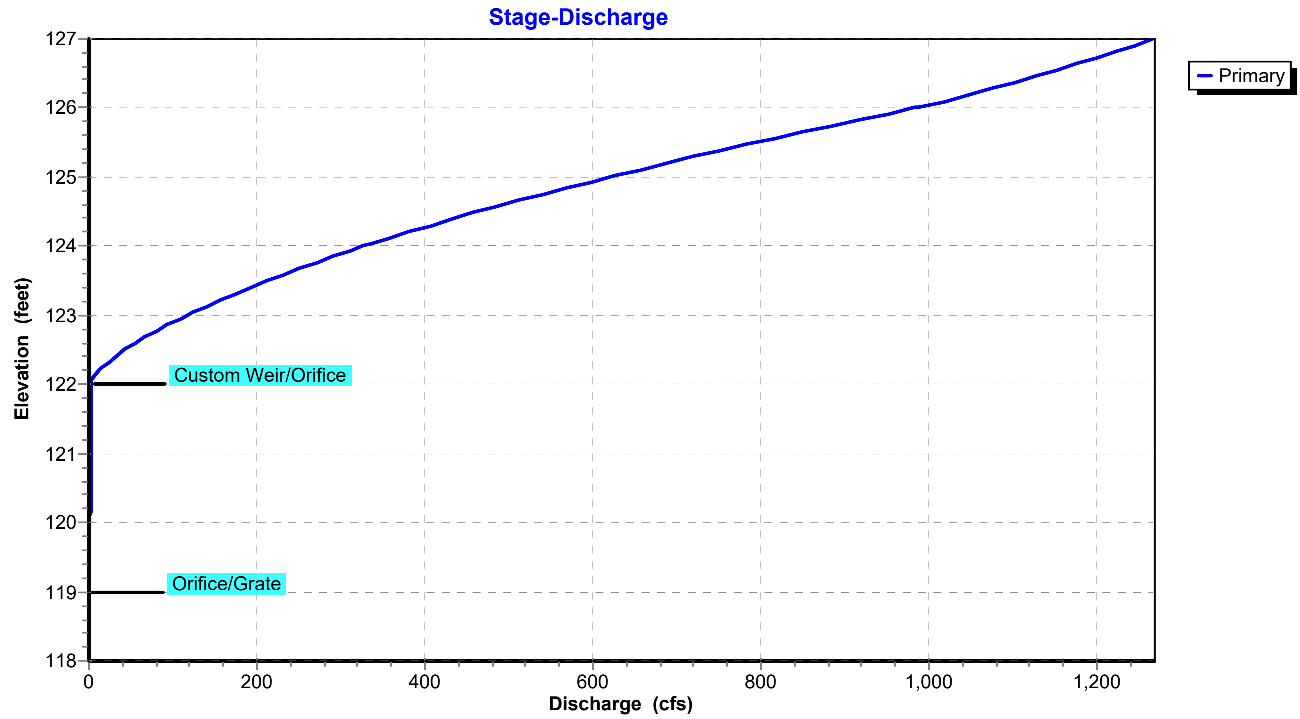
Device	Routing	Invert	Outlet Devices
#1	Primary	122.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 4.00 5.00 6.00 6.00 7.00 8.00 Width (feet) 35.00 35.00 35.00 41.00 42.00 43.00
#2	Primary	119.00'	**7.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=322.06 cfs @ 12.14 hrs HW=123.98' (Free Discharge)
1=Custom Weir/Orifice (Weir Controls 319.28 cfs @ 4.61 fps)
2=Orifice/Grate (Orifice Controls 2.79 cfs @ 10.43 fps)

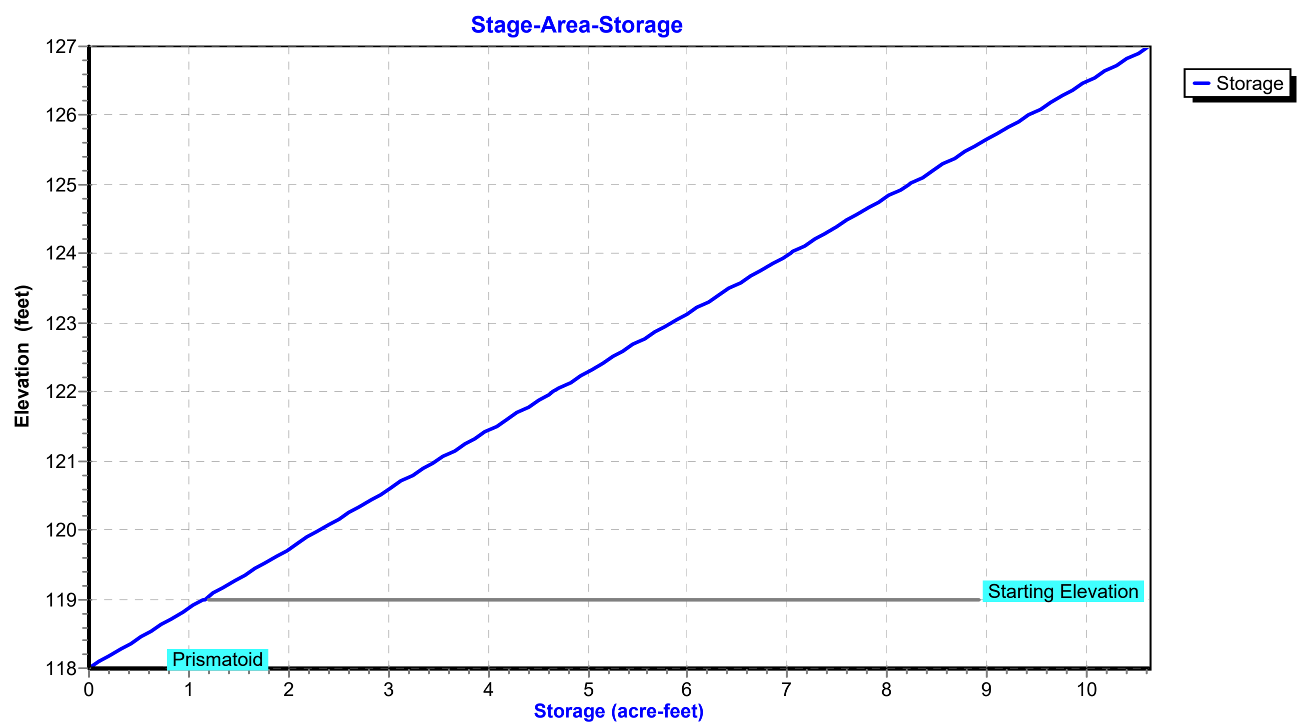
Pond 39P: North Pond



Pond 39P: North Pond



Pond 39P: North Pond



Stage-Discharge for Pond 39P: North Pond

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
118.00	0.00	123.30	172.48
118.10	0.00	123.40	192.48
118.20	0.00	123.50	213.22
118.30	0.00	123.60	234.66
118.40	0.00	123.70	256.77
118.50	0.00	123.80	279.55
118.60	0.00	123.90	302.96
118.70	0.00	124.00	327.00
118.80	0.00	124.10	352.27
118.90	0.00	124.20	378.67
119.00	0.00	124.30	406.00
119.10	0.03	124.40	434.20
119.20	0.12	124.50	463.21
119.30	0.26	124.60	493.01
119.40	0.42	124.70	523.58
119.50	0.59	124.80	554.88
119.60	0.71	124.90	586.91
119.70	0.82	125.00	619.64
119.80	0.92	125.10	653.07
119.90	1.00	125.20	687.18
120.00	1.08	125.30	721.95
120.10	1.16	125.40	757.39
120.20	1.23	125.50	793.47
120.30	1.29	125.60	830.19
120.40	1.35	125.70	867.55
120.50	1.41	125.80	905.52
120.60	1.47	125.90	944.12
120.70	1.53	126.00	983.32
120.80	1.58	126.10	1,018.67
120.90	1.63	126.20	1,050.92
121.00	1.68	126.30	1,081.33
121.10	1.73	126.40	1,110.36
121.20	1.78	126.50	1,138.26
121.30	1.82	126.60	1,165.20
121.40	1.87	126.70	1,191.32
121.50	1.91	126.80	1,216.69
121.60	1.96	126.90	1,241.40
121.70	2.00	127.00	**1,265.51**
121.80	2.04		
121.90	2.08		
122.00	2.12		
122.10	5.78		
122.20	12.45		
122.30	21.07		
122.40	31.27		
122.50	42.83		
122.60	55.61		
122.70	69.51		
122.80	84.43		
122.90	100.31		
123.00	117.10		
123.10	134.75		
123.20	153.22		

Stage-Area-Storage for Pond 39P: North Pond

Elevation (feet)	Storage (acre-feet)	Elevation (feet)	Storage (acre-feet)
118.00	0.000	123.30	6.192
118.10	0.115	123.40	6.310
118.20	0.230	123.50	6.429
118.30	0.346	123.60	6.547
118.40	0.461	123.70	6.666
118.50	0.577	123.80	6.785
118.60	0.692	123.90	6.904
118.70	0.808	124.00	7.022
118.80	0.923	124.10	7.141
118.90	1.039	124.20	7.260
119.00	1.155	124.30	7.379
119.10	1.271	124.40	7.499
119.20	1.387	124.50	7.618
119.30	1.503	124.60	7.737
119.40	1.619	124.70	7.856
119.50	1.735	124.80	7.976
119.60	1.851	124.90	8.095
119.70	1.967	125.00	8.215
119.80	2.083	125.10	8.334
119.90	2.200	125.20	8.454
120.00	2.316	125.30	8.574
120.10	2.432	125.40	8.693
120.20	2.549	125.50	8.813
120.30	2.665	125.60	8.933
120.40	2.782	125.70	9.053
120.50	2.899	125.80	9.173
120.60	3.016	125.90	9.293
120.70	3.132	126.00	9.413
120.80	3.249	126.10	9.533
120.90	3.366	126.20	9.654
121.00	3.483	126.30	9.774
121.10	3.600	126.40	9.894
121.20	3.717	126.50	10.015
121.30	3.835	126.60	10.135
121.40	3.952	126.70	10.256
121.50	4.069	126.80	10.377
121.60	4.187	126.90	10.497
121.70	4.304	127.00	**10.618**
121.80	4.422		
121.90	4.539		
122.00	4.657		
122.10	4.774		
122.20	4.892		
122.30	5.010		
122.40	5.128		
122.50	5.246		
122.60	5.364		
122.70	5.482		
122.80	5.600		
122.90	5.718		
123.00	5.836		
123.10	5.955		
123.20	6.073		

Appendix H: Leachate Management System

Appendix H.1: Leachate Generation Rate (HELP Model)

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COMPUTATION COVER SHEET

Client: Tolson & Associates **Project:** TRL Vertical Expansion **Project/Proposal #:** ME1606 **Task:** 03

TITLE OF COMPUTATIONS: Leachate Generation Analysis

COMPUTATIONS BY: Signature ____ 07/14/2020 DATE

Printed Name and Title: Andrew Stallings, P.E. Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY: (Peer Reviewer) Signature ____ 07/22/2020 DATE

Printed Name and Title: Davis Garrett, P.E. Engineer

COMPUTATIONS CHECKED BY: Signature ____ 07/22/2020 DATE

Printed Name and Title: Davis Garrett, P.E. Engineer

COMPUTATIONS BACKCHECKED BY: (Originator) Signature ____ 07/29/2020 DATE

Printed Name and Title: Andrew Stallings, P.E. Engineer

APPROVED BY: (PM or Designate) Signature C.H. Pendleton 07/31/2020 DATE

Printed Name and Title: Carrie Pendleton, P.E. Principal

APPROVAL NOTES:

REVISIONS: (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

LEACHATE GENERATION ANALYSIS

1. PURPOSE

The purpose of this calculation package is to evaluate the leachate generation rate and potential leachate head above the liner system for the proposed Tolson Rubble Landfill (TRL) Expansion located in Crofton, Anne Arundel County, Maryland. The Hydrologic Evaluation of Landfill Performance (HELP) Version 3.07 [USEPA, 1994] computer program is used to perform the analysis.

2. METHOD

Analysis of potential leachate generation for the landfill is performed by considering typical operational practices at the existing rubble landfill currently operating on the Site. Figure 1 shows the base grades as well as general landfill layout and cell configurations of the proposed TRL Expansion. Figure 2 shows the proposed final grades of the landfill. In modeling these different conditions using the HELP program, several assumptions related to input data are made, as summarized in the following paragraphs.

3. INPUT DATA

3.1 Introduction

The input data for the HELP model is classified into site/design specific data (e.g., layering configuration and material properties) and location specific data (e.g., climatic data). For both types of input data properties, HELP offers the option of using default values or user defined values. Each set of input data is described in the following sections.

3.2 Weather Data

The HELP model requires the following weather-related input data: (i) evapotranspiration; (ii) precipitation; (iii) temperature; and (iv) solar radiation data. The HELP model provides default values and synthetically-generated weather data for specific cities in the United States. Baltimore, Maryland, the closest city to the site available in HELP (approximately 20 miles from the Site), was selected for weather data input. Weather data was synthetically generated for a 30-year period.

To calculate evapotranspiration at the site, the HELP model requires inputs for evaporation zone depth and maximum leaf area index (LAI). For both parameters, default values from the HELP model are used. For open cell, daily cover, and intermediate cover conditions, bare soil is assumed to cover the site, leading to a default evaporation zone depth of 9 inches and a default LAI value of zero. The final cover condition of the landfill is assumed to support a fair stand of grass, leading to a default evaporation zone depth of 21 inches and an LAI value of two.

3.3 Landfill Development Assumptions

The total lined area of the landfill is approximately 72 acres, which will be divided into seven cells, namely Cell 1 through Cell 7 (see Figure 1). The area of the cells ranges from 6.8 acres (i.e., Cell 6) to 12.9 acres (i.e., Cell 3). Typical operational practices are for only one cell to be open and used for active disposal at any one time, during which previously active cells are temporarily inactive. Furthermore, it is assumed that cells will be built sequentially only when they are needed (i.e., Cell 1 will be built first, Cell 2 will be built when additional capacity is needed, etc.). Four possible cell conditions are analyzed to determine the overall landfill leachate generation rate: open cell, periodic cover, intermediate cover, and final cover. Table 1 presents the operational sequences and scenarios assumed in the analysis.

The liner system (Figure 3) and final cover system (Figure 4) designs are anticipated to be the same for all seven cells and continuous between cells. The proposed final grades of TRL will reach a maximum elevation of 244 feet above mean sea level (ft-msl), as shown in Figure 2. It is assumed that the landfill will only be capped after the available disposal capacity has been consumed.

3.4 Soil, Waste, and Geosynthetic Material Data

3.4.1 Liner Design

The liner system configuration is as follows, from top to bottom:

- 12-inch sand drainage layer/protective cover (minimum hydraulic conductivity of 1.0×10^{-3} cm/s);
- 250-mil geocomposite drainage layer;
- 60-mil high-density polyethylene (HDPE) geomembrane; and
- 24-inch compacted clay subbase (maximum hydraulic conductivity of 1.0×10^{-5} cm/s).

3.4.2 Final Cover Design

The final cover system configuration is as follows, from top to bottom:

- 6-inch topsoil;
- 18-inch cap cover soil;
- 200-mil geocomposite drainage layer;
- 40-mil HDPE geomembrane; and
- 24-inch final cover soil.

3.5.3 Material Properties

A brief description of each of the materials found in the cross sections in Figures 3 and 4 is presented below.

Periodic Covers:

The periodic cover layer, required by the Refuse Disposal Permit, represents the soils or other materials that are placed over the waste at the end of a three-day period, the last day of the work week, or before a holiday in which the landfill will not be operating to reduce infiltration into the waste. The default material texture number in the HELP model chosen for periodic cover is 13 (clayey sand), which is similar to the soils that are anticipated to be used for the final cover soil at the landfill. The default material properties in the HELP model are used in the analysis, unless otherwise specified. The periodic cover is assumed to be 6 inches in thickness.

Intermediate Cover Soils:

The intermediate cover layer is placed over the waste in between periods of waste placement (i.e., when an area of the landfill will be left untouched for a prolonged period of time). Intermediate cover is also placed over the active face of the landfill at the end of each month. The default material texture number in the HELP model chosen for intermediate cover is 13 (clayey sand), which is similar to the soils that are anticipated to be used for the final cover soil at the landfill. The intermediate cover is assumed to be 12 inches in thickness.

Final Cover Soils:

The final cover soil layer is assumed to be approximately 24 inches in thickness, including 6-inch topsoil and 18-inch protective soil cover. The default material texture number in the HELP model chosen for the final cover soil is 13 (clayey sand).

Waste:

A default material texture number 18 (municipal solid waste) in the HELP model was chosen for the waste. The default saturated hydraulic conductivity of 1.0×10^{-3} cm/s is chosen for this material.

Sand Protective Layer:

The 12-in. sand protective layer is designed to protect the liner during cell construction and waste placement. It is modeled as a percolation layer in the HELP model. The hydraulic conductivity of the protective layer is required be to 1.0×10^{-3} cm/s or more. It is modeled using material texture number 5 (silty sand) in the HELP model. A hydraulic conductivity of 1.0×10^{-3} cm/s is used.

Geocomposite Drainage Layer (Liner System):

The leachate collection system selected for the landfill is a geocomposite. Geocomposites are commercially available in 200, 250 and 300 mil thicknesses; a 250-mil double-sided geocomposite is selected for the liner system drainage layer.

To appropriately model the anticipated hydraulic conductivity of the geocomposite drainage layer, the hydraulic properties of a typical geocomposite drainage product provided by the manufacturer are modified based on methodology presented by Koerner [1998]. For this analysis the following geocomposite products were reviewed as the basis of model analysis:

- GSE Environmental FabriNet Geocomposite
- SKAPS Industries Transnet Geocomposite

Manufacturer data sheets are provided in Attachment 1.

The approach used to modify the manufacturer-provided transmissivity values into hydraulic conductivity values required for HELP model input is presented below. Based on the published transmissivity data from the two materials referenced (Attachment 1), transmissivity of 5.0×10^{-4} m^2/s was determined by laboratory testing for the selected products and is selected for the analysis.

The hydraulic conductivity of a geocomposite drainage layer is related to the hydraulic transmissivity (θ) and the thickness of the geocomposite drainage layer (t) as follows:

$$k = \frac{\theta}{t} \tag{1}$$

where:

k	=	hydraulic conductivity (cm/s);
θ	=	hydraulic transmissivity (cm^2/s); and
t	=	drainage layer thickness (cm).

The following equation proposed by Giroud et al. [2000] is used to estimate an appropriate transmissivity design value for the geocomposite drainage layer:

$$\theta_{LTIS} = \frac{\theta_{measured}}{\prod RF} = \frac{\theta_{measured}}{RF_{IMCO} \times RF_{IMIN} \times RF_{CR} \times RF_{IN} \times RF_{CD} \times RF_{PC} \times RF_{CC} \times RF_{BC}} \tag{2}$$

where:

θ_{LTIS}	=	long-term-in-soil hydraulic transmissivity of the geocomposite;
$\theta_{measured}$	=	value of hydraulic transmissivity measured in laboratory tests (ASTM D 4716);
$\Pi\ RF$	=	product of all reduction factors;
RF_{IMCO}	=	reduction factor for immediate compression, i.e. decrease of hydraulic transmissivity due to compression of the geocomposite core immediately following the application of stress;
RF_{IMIN}	=	reduction factor for immediate intrusion, i.e. decrease hydraulic transmissivity due to geotextile intrusion into the geocomposite core immediately following the application of stress;
RF_{CR}	=	reduction factor for creep, i.e. time-dependent hydraulic transmissivity reduction due to creep of the geocomposite core under the applied stress;
RF_{IN}	=	reduction factor for delayed intrusion, i.e. decrease of hydraulic transmissivity over time due to geotextile intrusion into the geocomposite core resulting from time-dependent deformation of the geotextile;
RF_{CD}	=	reduction factor for chemical degradation, i.e. decrease of hydraulic transmissivity due to chemical degradation of the polymeric compound(s) used to make the geocomposite;
RF_{PC}	=	reduction factor for particulate clogging, i.e. decrease of hydraulic transmissivity due to clogging by particles migrating into the geocomposite core;
RF_{CC}	=	reduction factor for chemical clogging, i.e. decrease of hydraulic transmissivity due to chemical clogging of the geocomposite core; and
RF_{BC}	=	reduction factor for biological clogging, i.e. decrease of hydraulic transmissivity due to biological clogging of the geocomposite core.

$$\theta_{design} = \frac{\theta_{LTIS}}{FS} \tag{3}$$

where:

θ_{design}	=	geocomposite transmissivity appropriate for use in design; and
FS	=	overall factor of safety to account for all possible uncertainties.

The values of measured hydraulic transmissivity and material thickness are obtained from the manufacturer literature for the modeled material (Attachment 1). Selection of the remaining reduction factors is based on the following factors: (i) uncertainty regarding a specific parameter; and (ii) the degree to which the laboratory test mimics the condition being evaluated. A typical range of values for the reduction factors are provided in Koerner [1998]. The following table summarizes the reduction factors selected for this analysis and provides a brief description of the reasoning.

Reduction Factor		Typical Value(s)	Selected Value	Reasoning
RF_{IMCO}	reduction factor for immediate compression	1.0	1.0	Manufacturer laboratory testing conditions mimic this mechanism
RF_{IMIN}	reduction factor for immediate intrusion	1.5	1.0	Manufacturer laboratory testing conditions mimic this mechanism
RF_{CR}	reduction factor for creep	1.4-2.0	1.7	Use median value of recommended range
RF_{IN}	reduction factor for delayed intrusion	1.0-1.2	1.1	Use median value of recommended range
RF_{CD}	reduction factor for chemical degradation	1.5	1.2	CDD waste should result in limited chemical degradation
RF_{PC}	reduction factor for particulate clogging	1.2	1.2	Selected as recommended value
RF_{CC}	reduction factor for chemical clogging	1.5-2.0	1.2	CDD waste should result in limited chemical degradation
RF_{BC}	reduction factor for biological clogging	1.5-2.0	1.2	Biological clogging should not be an issue in CDD waste.

The product of the reduction factors, $\Pi\ RF = 3.88$. For this analysis, an overall factor of safety (FS) of 1.2 is selected. Based on the reduction factors described above, θ_{LTIS} and k_{design} values were calculated based on the $\theta_{measured}$ and using Equations (1) through (3). The following presents a summary of the calculation of k_{design}.

Step 1. Convert $\theta_{measured}$ from manufacturer provided units of meters squared per second to units of centimeters squared per second:

$$\theta_{measured} = 5.0\times10^{-4}\ \text{m}^2/\text{s} \times (100\ \text{cm/m})^2 = 5.0\ \text{cm}^2/\text{s}$$

Step 2. Calculate θ_{LTIS} using Equations (2) and (3).

$$\theta_{LTIS} = \theta_{measured} / \Pi\ RF = 5.0\ \text{cm}^2/\text{s} / 3.88 = 1.29\ \text{cm}^2/\text{s}$$

$$\theta_{design} = 1.29\ \text{cm}^2/\text{s} / 1.2 = 1.075\ \text{cm}^2/\text{s}$$

Based on the manufacturer-provided thickness of the geocomposite drainage layer and the modified transmissivity value, the hydraulic conductivity value required for the HELP model input can be calculated as follows:

Step 3. Calculate k_{design} using Equation (1).

$$k_{design} = 1.075 \text{ cm}^2\text{/s} / (0.25 \text{ in.} \times 2.54 \text{ cm/in.}) = 1.69 \text{ cm/s}$$

The design hydraulic conductivity of 1.69 cm/s was assumed for periodic, intermediate, and final cover conditions to account for the decreased transmissivity under long-term conditions. The open cell condition is temporary and the hydraulic conductivity of the geocomposite drainage layer is calculated without reduction factors as follows:

$$\theta_{design} = 5.0 \text{ cm}^2\text{/s} / 1.2 = 4.167 \text{ cm}^2\text{/s}$$

$$k_{design} = 4.167 \text{ cm}^2\text{/s} / (0.25 \text{ in.} \times 2.54 \text{ cm/in.}) = 6.56 \text{ cm/s}$$

The design hydraulic conductivity of 6.56 cm/s was assumed for the open cell condition.

Geocomposite Drainage Layer (Final Cover System):

The drainage layer for the final cover system is assumed to be a 200-mil geocomposite. In the HELP model, this layer is modeled as a drainage net with a thickness of 0.2 in. For this analysis the same type of geocomposite product as used for the liner system is assumed. Because the stormwater which percolates through the final cover system is relatively clean, reduction factors different from those used for the liner system were assumed.

Reduction Factor		Typical Value(s)	Selected Value	Reasoning
RF_{IMCO}	reduction factor for immediate compression	1.0	1.0	Manufacturer laboratory testing conditions mimic this mechanism
RF_{IMIN}	reduction factor for immediate intrusion	1.5	1.0	Manufacturer laboratory testing conditions mimic this mechanism
RF_{CR}	reduction factor for creep	1.4-2.0	1.7	Use median value of recommended range
RF_{IN}	reduction factor for delayed intrusion	1.0-1.2	1.1	Use median value of recommended range
RF_{CD}	reduction factor for chemical degradation	1.5	1.0	Selected considering water percolated from the final cover soil is relatively clean
RF_{PC}	reduction factor for particulate clogging	1.2	1.2	Selected as recommended value
RF_{CC}	reduction factor for chemical clogging	1.5-2.0	1.2	Selected considering water percolated from the final cover soil is relatively clean
RF_{BC}	reduction factor for biological clogging	1.5-2.0	1.2	Selected considering water percolated from the final cover soil is relatively clean

The combined reduction factor is 3.23. Using the transmissivity of 1.0×10^{-4} m^2/s as shown in Attachment 1 for a 200 mil geocomposite, the long-term hydraulic conductivity of the final cover geocomposite drainage layer is estimated to be 0.51 cm/s, with the reduction factors as described below and a factor of safety of 1.2.

Geomembrane Liner:

HDPE geomembranes of 60-mil (0.06 in.) and 40-mil (0.04 in.) in thickness are assumed to be used for the liner system and final cover system, respectively. The geosynthetic material number chosen for the HELP simulations is 35. The geomembrane liner is modeled as having a pinhole density of two per acre, a defect density of two per acre, and is assumed to have a good placement quality.

Subbase (Clay Liner):

The clay liner is assumed to have a hydraulic conductivity of 1.0×10^{-5} cm/s and the material texture number used in the HELP model is 16 (barrier soil).

3.4 Surface Data

HELP simulates surface runoff using the Soil Conservation Service (SCS) curve number method. HELP uses the surface slopes, lengths, soil type, and vegetative cover to determine a runoff curve number, which is used for runoff calculations. The surface characteristics vary depending upon the cell condition. For final cover, runoff is generated from 100 percent of the total area (i.e., no water ponding is allowed). For periodic and intermediate cover conditions, it is assumed that ponding will occur on 15 percent of the surface area (i.e., 85 percent runoff). For the open cell condition, it is assumed that runoff will occur on half of the cell area, while the other half is being filled with waste such that runoff is not possible (i.e., 50 percent runoff). The conditions used for this analysis are shown in Table 2.

3.5 Drainage Distance and Slope

Table 2 summarizes the surface drainage distances and slopes assumed in the analysis. The surface slope and length are assumed to be 2.0 percent and 500 ft for the open cell condition. The surface slope of periodic and intermediate cover is assumed to be 0.6 percent (minimum allowable input in HELP) and the drainage distance of the surface slope is assumed to be 500 ft in the analysis. The final grading plan of the cover system is shown in Figure 2. The flat area has a drainage distance of 700 ft with a 3 percent slope. Given that the 3H:1V sideslopes are significantly steeper than the plateau area, modeling the entire cover area as having slopes of 3 percent will yield a conservative design.

Table 3 summarizes the liner drainage distances and slopes assumed in the analysis. According to the base grading plan shown in Figure 1, the base grades will have various slopes and drainage distances. The design liner drainage slope and distance of 2.0 percent and 500 ft are considered for an open cell condition. For periodic, intermediate, and final cover conditions, the drainage slope of the base liner system is assumed to be 2.0 percent (i.e., the minimum required post-settlement slope).

4. HELP MODEL RESULTS

HELP simulation outputs for the four cell conditions are included as Attachment 2. The open cell condition is a short-term temporary condition where stormwater will be drained to the leachate collection system. Leachate is only generated in the periodic cover, intermediate cover, and final cover conditions. The peak daily average leachate heads above the liner system are summarized in Table 3. The maximum daily average leachate head above the primary liner does not exceed 12 inches.

5. LEACHATE GENERATION RATE

HELP model output for leachate volume impingement is given in units of acre-inch per month (Table 4). Calculation of the yearly leachate volume estimate begins with conversion of the HELP output into units of gallons per acre per month. The following equation is used for unit conversion:

$$\frac{acre \cdot in. per\ acre}{month} \times \frac{43{,}560\ ft^2}{acre} \times \frac{ft}{12\ in.} \times \frac{7.48\ gal}{ft^3} = \frac{gal}{month \cdot acre}$$

The landfill will be closed when the entire site reaches its capacity. Considering the various combinations of the cell conditions for each landfill cell (Table 1), the total leachate generation rates for the landfill are calculated and provided in Table 5. Daily generation of 71,332 gal/day (calculated from the maximum monthly generation) will be used for leachate transmission and sump design. The maximum monthly and annual leachate generation volumes for the expanded landfill are summarized below:

Leachate Generation Rate	gal/mon	gal/day
Maximum Generation Month	2,175,613	71,332
Maximum Generation Year	15,712,147	43,047

REFERENCES

Schroeder, P. Rs., Aziz, N. M., Lloyd, C. M. and Zappi, P. A. [1994]. "The Hydrologic Evaluation of Landfill Performance (HELP) Model: User's Guide for Version 3," EPA/600/R-94/168a, September 1994, U.S. Environmental Protection Agency Office of Research and Development, Washington, DC.

Koerner, R.M. [1998]. "Designing with Geosynthetics," 4th ed. New Jersey: Prentice Hall, Inc.

J. Giroud, J. Zornberg, and A. Zhao. [2000] "Hydraulic Design of Geosynthetic and Granular Liquid Collection Layers," Geosynthetics International. 7

TABLES

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Table 1. Cell Conditions and Operational Sequences
Tolson Rubble Landfill Expansion
Crofton, Anne Arundel County, Maryland

Scenario	Cell Operating Condition						
	1	2	3	4	5	6	7
1	O						
2	P	O					
3	I	P	O				
4	I	I	P	O			
5	I	I	I	P	O		
6	I	I	I	I	P	O	
7	I	I	I	I	I	P	O
8	I	I	I	I	I	I	P
9	I	I	I	I	I	I	I
10	F	F	F	F	F	F	F

Acronyms:

O = Open Cell
P = Periodic Cover
I = Intermediate Cover
F = Final Cover

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Table 2. Surface Condition and Runoff Curve Numbers
Tolson Rubble Landfill Expansion
Crofton, Anne Arundel County, Maryland

Case	Surface Slope (%)	Slope Length (ft)	Soil Texture No.	Vegetative Cover	Percent Possible Runoff (%)	Runoff Curve Number
Open Cell	2.0	500	5	Bare Ground	50	83.0
Periodic Cover [1]	0.6 [2]	500	13	Bare Ground	85	95.1
Intermediate Cover	0.6 [2]	500	13	Bare Ground	85	95.1
Final Cover	3.0 [3]	700	13	Fair Stand of Grass	100	87.8

Notes:

1. HELP requires the top layer to be a soil material. Tarp is used in daily cover operations. Soil texture number 13 is assumed in HELP with a thickness of 6 inches.
2. Minimum acceptable surface slope in HELP is 0.6 percent.
3. Design slope of plateau is 4 percent, surface slope reduced to account for differential settlement.

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Table 3. Leachate Head above Liner
Tolson Rubble Landfill Expansion
Crofton, Anne Arundel County, Maryland

Case	Drainage Slope (%)	Drainage Distance [1] (ft)	Average Peak Daily Leachate Head above Liner (in.)
Open Cell [2]	2.0	500	11.90
Periodic Cover	2.0 [3]	500	7.48
Intermediate Cover	2.0 [3]	500	5.33
Final Cover	2.0 [3]	500	0.01

Notes:

1. Maximum drainage distance conservatively assumed for all cells.
2. The open cell condition is a short-term temporary condition for which stormwater, not the leachate, will also be drained to the leachate collection system.
3. Drainage slope reduced to account for differential settlement. Required minimum post-settlement slope is 2.0.

Table 4. Maximum Monthly Leachate Volume
Tolson Rubble Landfill Expansion
Crofton, Anne Arundel County, Maryland

Case	Drainage Slope (%)	Drainage Distance [1] (ft)	Max. Average Monthly Leachate Volume (in.-ac/mon)
Open Cell [2]	2.0	500	2.06
Periodic Cover	2.0 [3]	500	0.90
Intermediate Cover	2.0 [3]	500	0.92
Final Cover	2.0 [3]	500	0.04

Notes:

1. Maximum drainage distance conservatively assumed for all cells.
2. The open cell condition is a short-term temporary condition for which stormwater, not the leachate, will also be drained to the leachate collection system.
3. Drainage slope reduced to account for differential settlement. Required minimum post-settlement slope is 2.0.

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Table 5. Estimated Volume of Leachate Collected by the Drainage System
Tolson Rubble Landfill Expansion
Crofton, Anne Arundel County, Maryland

Cell	1	2	3	4	5	6	7	Total
Area (ac)	7.2	9.2	12.9	11.6	12.0	6.8	12.3	72.0

Cell Condition	O	P	I	F
Max. Monthly Infiltration Water Vol. (in.-ac/month)	2.06	0.90	0.92	0.04
Max. Monthly Infiltration Water Vol. (gal/month/ac)	55,934	24,437	24,980	1,086
Average Yearly Infiltration Water Vol. (cf/yr/ac)	53,183	20,479	24,707	860
Average Yearly Infiltration Water Vol. (gal/yr/ac)	397,836	153,194	184,821	6,433

Scenario	Cell Operating Condition							Area (ac)				Max. Monthly Flow (gal/mon)	Average Yearly Water Gen. (gal/yr)
	1	2	3	4	5	6	7	O	P	I	F		
1	O							7.2				402,724	2,864,423
2	P	O						9.2	7.2			690,540	4,763,089
3	I	P	O					12.9	9.2	7.2		1,126,227	7,872,184
4	I	I	P	O				11.6	12.9	16.4		1,373,749	9,622,168
5	I	I	I	P	O			12.0	11.6	29.3		1,686,598	11,966,345
6	I	I	I	I	P	O		6.8	12.0	40.9		1,695,287	12,102,798
7	I	I	I	I	I	P	O	12.3	6.8	52.9		2,175,613	15,712,147
8	I	I	I	I	I	I	P		12.3	59.7		1,791,895	12,918,107
9	I	I	I	I	I	I	I			72.0		1,798,575	13,307,127
10	F	F	F	F	F	F	F				72.0	78,199	463,194

Acronyms:

O = Open Cell
P = Periodic Cover
I = Intermediate Cover
F = Final Cover

Maximum Monthly Generation (gal/mon):	2,175,613
Average Daily Generation in Max. Month (gal/day):	71,332
Maximum Annual Infiltration Water Generation (gal/year):	15,712,147
Average Daily Generation in Max. Year (gal/day):	43,047

Notes:

1. It is conservatively assumed that the infiltration at the floor/plateau area is applied to entire area.
2. Non-operating sub-cells will be open for infiltration.

FIGURES

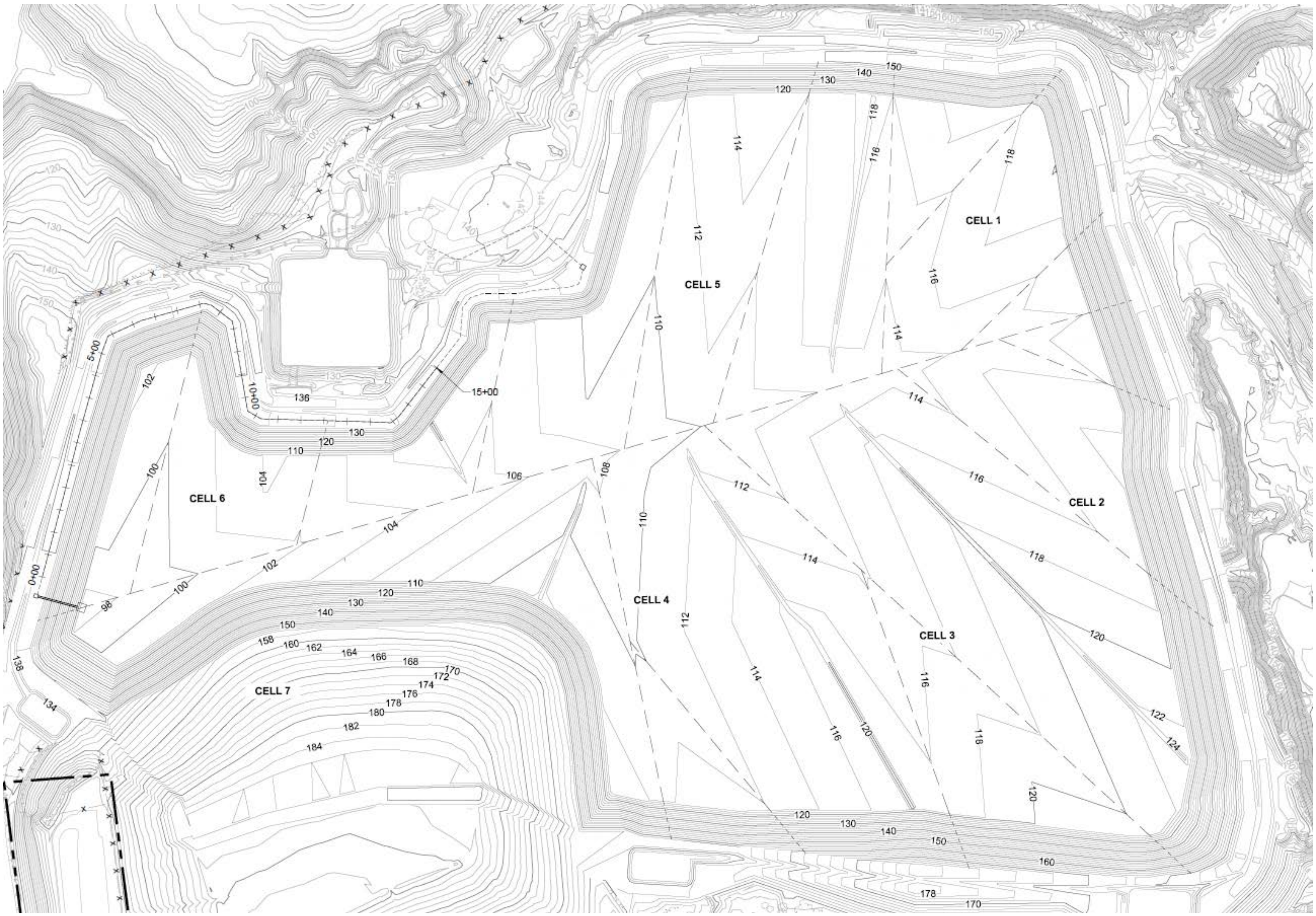

Figure 1. Base Grading Plan.

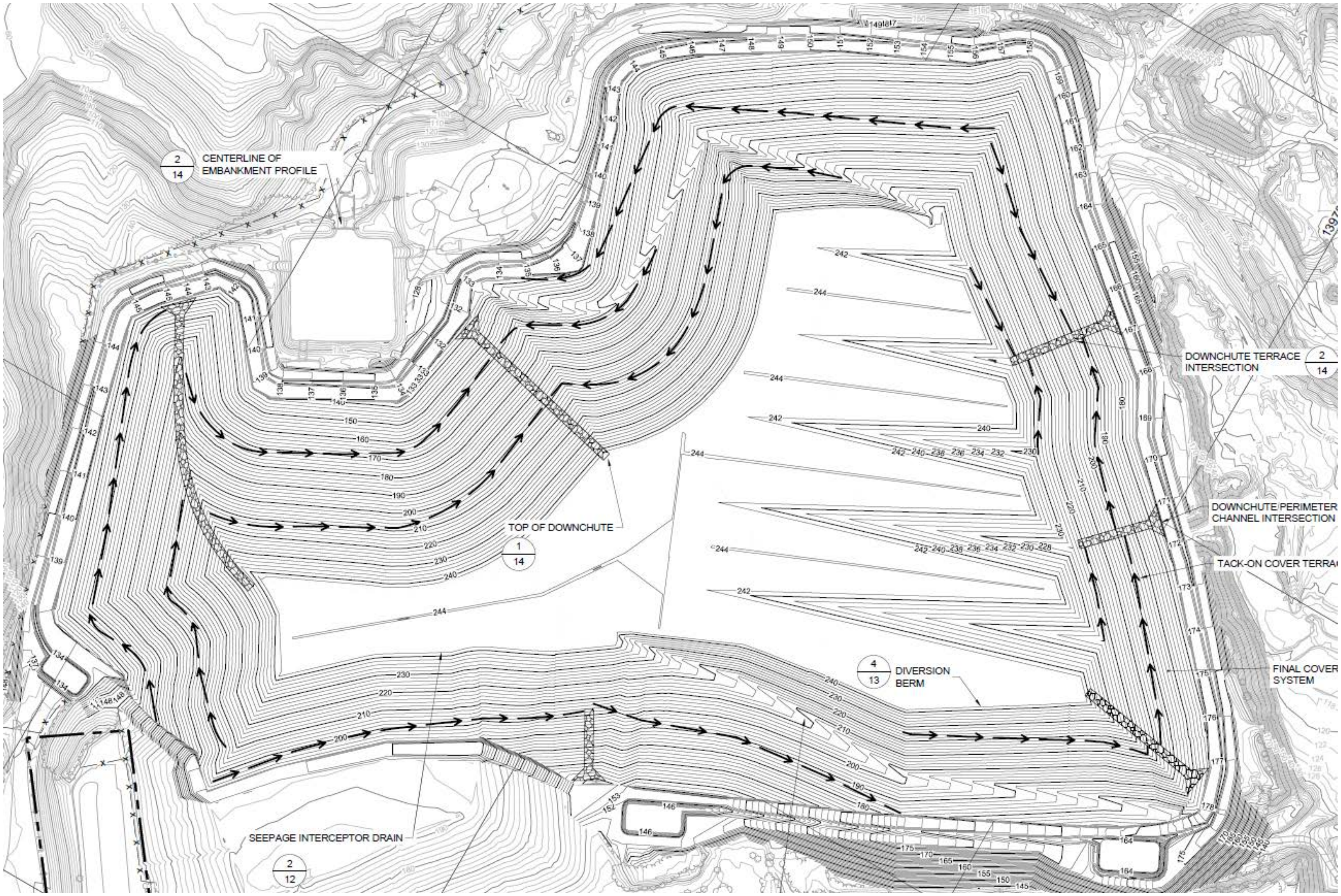

Figure 2. Final Grading Plan.

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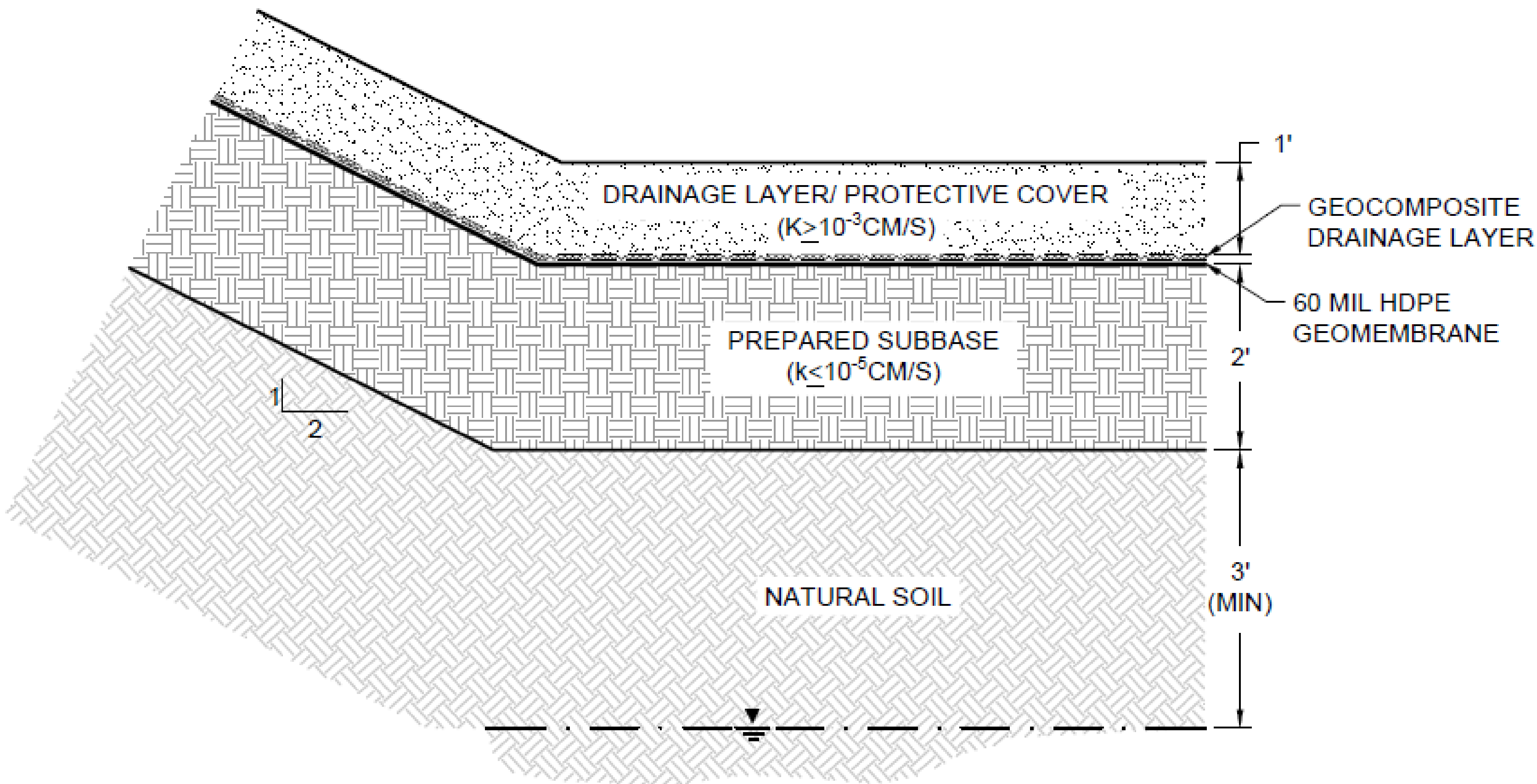

Figure 3. Liner System Detail.

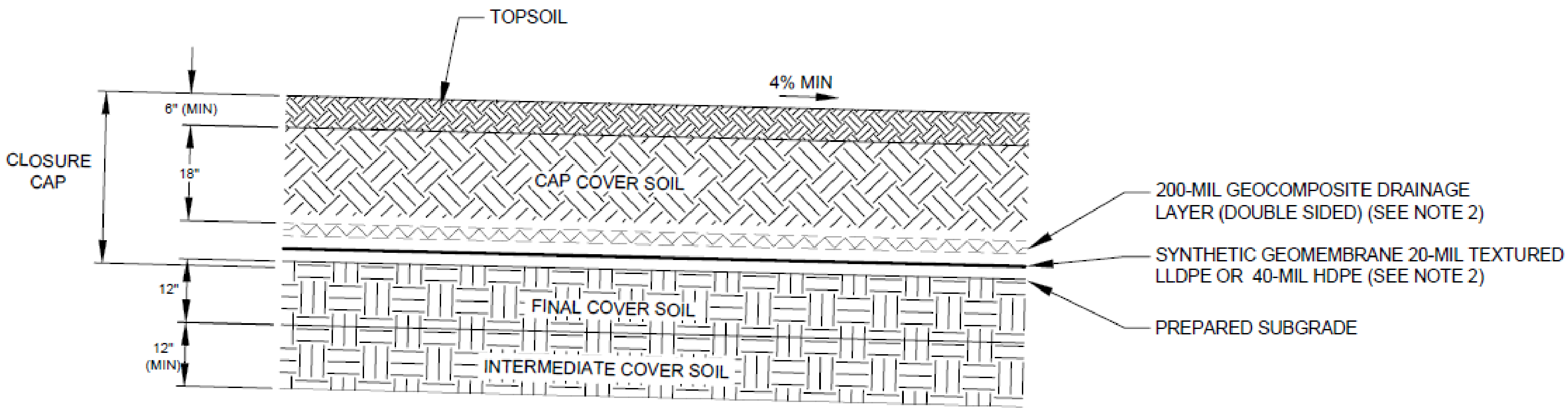

Figure 4. Cover System Detail.

ATTACHMENT 1

GEOCOMPOSITE DATA SHEETS

PRODUCT DATA SHEET

GSE FabriNet 250 mil Geocomposite

GSE FabriNet 250 mil geocomposite consists of a 250 mil thick GSE HyperNet geonet heat-laminated on one or both sides with a GSE nonwoven needle-punched geotextile. The geotextile is available in mass per unit area range of 6 oz/yd² to 16 oz/yd². The geocomposite is designed and formulated to perform drainage function under a range of anticipated site loads, gradients and boundary conditions.

[*]

AT THE CORE:
A 250 mil thick GSE HyperNet geonet heat-laminated on one or both sides with a nonwoven needle-punched geotextile.

Product Specifications

Tested Property	Test Method	Frequency	Minimum Average Roll Value [1]		
Geocomposite			6 oz/yd²	8 oz/yd²	10 oz/yd²
Transmissivity[2], gal/min/ft (m²/sec) Double-Sided Composite Single-Sided Composite	ASTM D 4716	1/540,000 ft²	2.4 (5×10^{-4}) 7.2 (1.5×10^{-3})	2.4 (5×10^{-4}) 7.2 (1.5×10^{-3})	1.4 (3×10^{-4}) 4.8 (1×10^{-3})
Ply Adhesion, lb/in	ASTM D 7005	1/50,000 ft²	1.0	1.0	1.0
Geonet Core[1,3] – GSE HyperNet					
Geonet Core Thickness, mil	ASTM D 5199	1/50,000 ft²	250	250	250
Transmissivity[2], gal/min/ft (m²/sec)	ASTM D 4716		14.5 (3×10^{-3})	14.5 (3×10^{-3})	14.5 (3×10^{-3})
Density, g/cm³	ASTM D 1505	1/50,000 ft²	0.94	0.94	0.94
Tensile Strength (MD), lb/in	ASTM D 7179	1/50,000 ft²	55	55	55
Carbon Black Content, %	ASTM D 4218	1/50,000 ft²	2.0	2.0	2.0
Geotextile[1,3]					
Mass per Unit Area, oz/yd²	ASTM D 5261	1/90,000 ft²	6	8	10
Grab Tensile Strength, lb	ASTM D 4632	1/90,000 ft²	160	220	260
Grab Elongation	ASTM D 4632	1/90,000 ft²	50%	50%	50%
CBR Puncture Strength, lb	ASTM D 6241	1/540,000 ft²	435	575	725
Trapezoidal Tear Strength, lb	ASTM D 4533	1/90,000 ft²	65	90	100
AOS, US sieve[1] (mm)	ASTM D 4751	1/540,000 ft²	70 (0.212)	80 (0.180)	100 (0.150)
Permittivity, sec^{-1}	ASTM D 4491	1/540,000 ft²	1.5	1.3	1.0
Water Flow Rate, gpm/ft²	ASTM D 4491	1/540,000 ft²	110	95	75
UV Resistance, % retained	ASTM D 4355 (after 500 hours)	per formulation	70	70	70
NOMINAL ROLL DIMENSIONS[4]					
Roll Width, ft			15	15	15
Roll Length, ft	Double-Sided Composite Single-Sided Composite		230 260	210 260	210 250
Roll Area, ft²	Double-Sided Composite Single-Sided Composite		3,450 3,900	3,150 3,900	3,150 3,750

NOTES:
- [1]All geotextile properties are minimum average roll values except AOS which is maximum average roll value and UV resistance is typical value. Geonet core thickness is nominal value.
- [2]Gradient of 0.1, normal load of 10,000 psf, water at 70˚F between steel plates for 15 minutes. Contact GSE for performance transmissivity value for use in design.
- [3]Component properties prior to lamination.
- [4]Roll widths and lengths have a tolerance of ±1%.

GSE is a leading manufacturer and marketer of geosynthetic lining products and services. We've built a reputation of reliability through our dedication to providing consistency of product, price and protection to our global customers.

Our commitment to innovation, our focus on quality and our industry expertise allow us the flexibility to collaborate with our clients to develop a custom, purpose-fit solution.

GSE ENVIRONMENTAL™

[DURABILITY RUNS DEEP] For more information on this product and others, please visit us at GSEworld.com, call 800.435.2008 or contact your local sales office.

SKAPS TRANSNET™ HDPE GEOCOMPOSITE WITH TN 270 GEONET

SKAPS INDUSTRIES
571 Industrial Pkwy,
Commerce, GA 30529
Phone: (706) 336-7000
Fax: (706) 336-7007
E-Mail: contact@skaps.com

SKAPS TRANSNET™ Geocomposite consists of SKAPS Geonet made from HDPE resin with nonwoven polypropylene geotextile fabric heat bonded on one side or both sides of Geonet.

PROPERTY	TEST METHOD	UNIT	VALUE		QUALIFIER
GEONET					
Thickness	ASTM D 5199	mil	250	250	MAV(3)
Carbon Black	ASTM D 4218	%	2.0	2.0	MAV
Tensile Strength	ASTM D 7179	lb/in	55	55	MAV
Melt Flow	ASTM D 1238(2)	g/10 min	1.0	1.0	Maximum
Density	ASTM D 1505	g/cm^3	0.94	0.94	MAV
Transmissivity(1)	ASTM D 4716	gal/min/ft (m^2/sec)	14.50 (3.0×10^{-3})	14.50 (3.0×10^{-3})	MAV
GEOCOMPOSITE			**6 oz/yd^2**	**8 oz/yd^2**	
Ply Adhesion	ASTM D 7005	lb/in	1.00	1.00	MAV
Transmissivity(1) DS	ASTM D 4716	gal/min/ft (m^2/sec)	**TN 270-2-6**	**TN 270-2-8**	
			2.42 (5.0×10^{-4})	2.42 (5.0×10^{-4})	MAV
Transmissivity(1) SS	ASTM D 4716	gal/min/ft (m^2/sec)	**TN 270-1-6**	**TN 270-1-8**	
			7.25 (1.5×10^{-3})	7.25 (1.5×10^{-3})	MAV
GEOTEXTILE					
Fabric Weight	ASTM D 5261	oz/yd^2	6	8	MARV(4)
Grab Tensile	ASTM D 4632	lb	160	225	MARV
Grab Elongation	ASTM D 4632	%	50	50	MARV
Trapezoid Tear	ASTM D 4533	lb	65	90	MARV
CBR Puncture	ASTM D 6241	lb	450	600	MARV
Water Flow(5)	ASTM D 4491	gpm/ft^2	125	100	MARV
Permittivity(5)	ASTM D 4491	sec^{-1}	1.63	1.26	MARV
Permeability(5)	ASTM D 4491	cm/sec	0.30	0.30	MARV
AOS	ASTM D 4751	US Sieve	70	80	MaxARV

Notes:

(1) Transmissivity measured using water at 21 $\pm$ 2 °C (70 $\pm$ 4 °F) with a gradient of 0.1 and a confining pressure of 10000 psf between steel plates after 15 minutes. Values may vary with individual labs.
DS - Double Sided, SS - Single Sided

(2) Condition 190/2.16

(3) Minimum average value.

(4) MARV is statistically defined as mean minus two standard deviations and it is the value which is exceeded by 97.5% of all the test data.

(5) At the time of manufacturing. Handling may change these properties.

This information is provided for reference purposes only and is not intended as a warranty or guarantee.

SKAPS assumes no liability in connection with the use of this information. Geotextile and Geonet properties are prior to lamination.

PRODUCT DATA SHEET

GSE FabriNet 200 mil Geocomposite

GSE FabriNet geocomposite consists of a 200 mil thick GSE HyperNet geonet heat-laminated on one or both sides with a GSE nonwoven needle-punched geotextile. The geotextile is available in mass per unit area range of 6 oz/yd^2 to 16 oz/yd^2. The geocomposite is designed and formulated to perform drainage function under a range of anticipated site loads, gradients and boundary conditions.

[*]

AT THE CORE:
A 200 mil thick HyperNet geonet heat-laminated on one or both sides with a nonwoven needlepunched geotextile.

Product Specifications

Tested Property	Test Method	Frequency	Minimum Average Roll Value[1]		
Geocomposite			6 oz/yd^2	8 oz/yd^2	10 oz/yd^2
Transmissivity[2], gal/min/ft, (m^2/sec) Double-Sided Composite Single-Sided Composite	ASTM D 4716	1/540,000 ft^2	0.5 (1x10^{-4}) 4.8 (1x10^{-3})	0.5 (1x10^{-4}) 4.8 (1x10^{-3})	0.4 (9x10^{-5}) 4.3 (9x10^{-4})
Ply Adhesion, lb/in	ASTM D 7005	1/50,000 ft^2	1.0	1.0	1.0
Geonet Core[1,3] – GSE HyperNet					
Geonet Core Thickness, mil	ASTM D 5199	1/50,000 ft^2	200	200	200
Transmissivity[2], gal/min/ft (m^2/sec)	ASTM D 4716		9.6 (2 x 10^{-3})	9.6 (2 x 10^{-3})	9.6 (2 x 10^{-3})
Density, g/cm^3	ASTM D 1505	1/50,000 ft^2	0.94	0.94	0.94
Tensile Strength (MD), lb/in	ASTM D 7179	1/50,000 ft^2	45	45	45
Carbon Black Content, %	ASTM D 4218	1/50,000 ft^2	2.0	2.0	2.0
Geotextile[1,3]					
Mass per Unit Area, oz/yd^2	ASTM D 5261	1/90,000 ft^2	6	8	10
Grab Tensile Strength, lb	ASTM D 4632	1/90,000 ft^2	160	220	260
Grab Elongation	ASTM D 4632	1/90,000 ft^2	50%	50%	50%
CBR Puncture Strength, lb	ASTM D 6241	1/540,000 ft^2	435	575	725
Trapezoidal Tear Strength, lb	ASTM D 4533	1/90,000 ft^2	65	90	100
AOS, US sieve[1], (mm)	ASTM D 4751	1/540,000 ft^2	70 (0.212)	80 (0.180)	100 (0.150)
Permittivity, sec^{-1}	ASTM D 4491	1/540,000 ft^2	1.5	1.3	1.0
Water Flow Rate, gpm/ft^2	ASTM D 4491	1/540,000 ft^2	110	95	75
UV Resistance, % retained	ASTM D 4355 (after 500 hours)	per formulation	70	70	70
NOMINAL ROLL DIMENSIONS[4]					
Roll Width, ft			14.75	14.75	14.75
Roll Length, ft	Double-Sided Composite Single-Sided Composite		270 300	260 300	230 290
Roll Area, ft^2	Double-Sided Composite Single-Sided Composite		3,982 4,425	3,835 4,425	3,392 4,277

NOTES:

- [1] All geotextile properties are minimum average roll values except AOS which is maximum average roll value and UV resistance is typical value. Geonet core thickness is nominal value.
- [2] Gradient of 0.1, normal load of 10,000 psf, water at 70˚F between steel plates for 15 minutes. Contact GSE for performance transmissivity value for use in design.
- [3] Component properties prior to lamination.
- [4] Roll widths and lengths have a tolerance of ±1%.

SKAPS TRANSNET™ HDPE GEOCOMPOSITE WITH TN 220 GEONET

SKAPS INDUSTRIES
571 Industrial Pkwy,
Commerce, GA 30529
Phone: (706) 336-7000
Fax: (706) 336-7007
E-Mail: contact@skaps.com

SKAPS TRANSNET™ Geocomposite consists of SKAPS Geonet made from HDPE resin with nonwoven polypropylene geotextile fabric heat bonded on one side or both sides of Geonet.

PROPERTY	TEST METHOD	UNIT	VALUE		QUALIFIER
GEONET					
Thickness	ASTM D 5199	mil	200	200	MAV(3)
Carbon Black	ASTM D 4218	%	2.0	2.0	MAV
Tensile Strength	ASTM D 7179	lb/in	45	45	MAV
Melt Flow	ASTM D 1238(2)	g/10 min	1.0	1.0	Maximum
Density	ASTM D 1505	g/cm^3	0.94	0.94	MAV
Transmissivity(1)	ASTM D 4716	gal/min/ft (m^2/sec)	9.67 (2.0×10^{-3})	9.67 (2.0×10^{-3})	MAV
GEOCOMPOSITE			**6 oz/yd²**	**8 oz/yd²**	
Ply Adhesion	ASTM D 7005	lb/in	1.00	1.00	MAV
Transmissivity(1) DS	ASTM D 4716	gal/min/ft (m^2/sec)	**TN 220-2-6**	**TN 220-2-8**	
			0.48 (1.0×10^{-4})	0.48 (1.0×10^{-4})	MAV
Transmissivity(1) SS	ASTM D 4716	gal/min/ft (m^2/sec)	**TN 220-1-6**	**TN 220-1-8**	
			4.83 (1.0×10^{-3})	4.83 (1.0×10^{-3})	MAV
GEOTEXTILE					
Fabric Weight	ASTM D 5261	oz/yd²	6	8	MARV(4)
Grab Tensile	ASTM D 4632	lb	160	225	MARV
Grab Elongation	ASTM D 4632	%	50	50	MARV
Trapezoid Tear	ASTM D 4533	lb	65	90	MARV
CBR Puncture	ASTM D 6241	lb	450	600	MARV
Water Flow(5)	ASTM D 4491	gpm/ft²	125	100	MARV
Permittivity(5)	ASTM D 4491	sec^{-1}	1.63	1.26	MARV
Permeability(5)	ASTM D 4491	cm/sec	0.30	0.30	MARV
AOS	ASTM D 4751	US Sieve	70	80	MaxARV

Notes:

(1) Transmissivity measured using water at 21 $\pm$ 2 °C (70 $\pm$ 4 °F) with a gradient of 0.1 and a confining pressure of 10000 psf between steel plates after 15 minutes. Values may vary with individual labs.
DS - Double Sided, SS - Single Sided

(2) Condition 190/2.16

(3) Minimum average value.

(4) MARV is statistically defined as mean minus two standard deviations and it is the value which is exceeded by 97.5% of all the test data.

(5) At the time of manufacturing. Handling may change these properties.

ATTACHMENT 2

HELP MODEL OUTPUT

```
↑
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    C:\HELP3\TOL\DATA4.D4
TEMPERATURE DATA FILE:      C:\HELP3\TOL\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\HELP3\TOL\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\HELP3\TOL\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\HELP3\TOL\OP.D10
OUTPUT DATA FILE:           C:\HELP3\TOL\OP.OUT


TIME:  10:30     DATE:   7/15/2020


******************************************************************************

     TITLE:  OPEN CELL CONDITION

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                    LAYER  1
                                    --------

                       TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER   5
           THICKNESS                  =     12.00   INCHES
```

```
POROSITY                     =      0.4570 VOL/VOL
FIELD CAPACITY               =      0.1310 VOL/VOL
WILTING POINT                =      0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.1990 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC


                        LAYER  2
                        --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =      0.25   INCHES
POROSITY                     =      0.8500 VOL/VOL
FIELD CAPACITY               =      0.0100 VOL/VOL
WILTING POINT                =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.1738 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =   6.55999994000     CM/SEC
SLOPE                        =      2.00   PERCENT
DRAINAGE LENGTH              =    500.0    FEET


                        LAYER  3
                        --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                    =      0.06   INCHES
POROSITY                     =      0.0000 VOL/VOL
FIELD CAPACITY               =      0.0000 VOL/VOL
WILTING POINT                =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY          =      2.00   HOLES/ACRE
FML INSTALLATION DEFECTS     =      2.00   HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD


                        LAYER  4
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =     24.00   INCHES
```

```
POROSITY                   =      0.4270 VOL/VOL
FIELD CAPACITY             =      0.4180 VOL/VOL
WILTING POINT              =      0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT =      0.4164 VOL/VOL
EFFECTIVE SAT. HYD. COND.  =  0.999999975000E-05 CM/SEC
```

```
        GENERAL DESIGN AND EVAPORATIVE ZONE DATA
        ----------------------------------------

 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
          SOIL DATA BASE USING SOIL TEXTURE # 5 WITH BARE
          GROUND CONDITIONS, A SURFACE SLOPE OF  2.% AND
          A SLOPE LENGTH OF  500. FEET.

SCS RUNOFF CURVE NUMBER            =     83.00
FRACTION OF AREA ALLOWING RUNOFF   =     50.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE =      1.000  ACRES
EVAPORATIVE ZONE DEPTH             =      9.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE  =      1.687  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE =      4.113  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE =      0.522  INCHES
INITIAL SNOW WATER                 =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS   =     12.425  INCHES
TOTAL INITIAL WATER                =     12.425  INCHES
TOTAL SUBSURFACE INFLOW            =      0.00   INCHES/YEAR
```

```
          EVAPOTRANSPIRATION AND WEATHER DATA
          -----------------------------------

 NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
          BALTIMORE             MARYLAND

     STATION LATITUDE                        =  39.18 DEGREES
     MAXIMUM LEAF AREA INDEX                 =   0.00
     START OF GROWING SEASON (JULIAN DATE)   =    102
     END OF GROWING SEASON (JULIAN DATE)     =    300
     EVAPORATIVE ZONE DEPTH                  =   9.0  INCHES
     AVERAGE ANNUAL WIND SPEED               =   9.30 MPH
     AVERAGE 1ST QUARTER RELATIVE HUMIDITY   =  62.00 %
     AVERAGE 2ND QUARTER RELATIVE HUMIDITY   =  65.00 %
     AVERAGE 3RD QUARTER RELATIVE HUMIDITY   =  71.00 %
     AVERAGE 4TH QUARTER RELATIVE HUMIDITY   =  68.00 %
```

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BALTIMORE MARYLAND

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.00	2.98	3.72	3.35	3.44	3.76
3.89	4.62	3.46	3.11	3.11	3.40

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BALTIMORE MARYLAND

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
32.70	34.70	43.30	54.00	63.40	72.20
76.80	75.60	68.90	56.90	46.30	36.50

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BALTIMORE MARYLAND
AND STATION LATITUDE = 39.18 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.50	3.30	3.36	3.35	3.77	3.77
	3.77	5.57	3.38	2.65	2.96	3.00
STD. DEVIATIONS	1.25	1.51	1.27	1.69	1.70	2.29
	1.76	2.71	2.41	1.41	1.46	1.56

```
RUNOFF
------
  TOTALS                 0.198    0.559    0.252    0.014    0.034    0.085
                         0.132    0.192    0.153    0.060    0.028    0.097

  STD. DEVIATIONS        0.380    0.661    0.546    0.029    0.101    0.142
                         0.333    0.288    0.247    0.138    0.051    0.350

EVAPOTRANSPIRATION
------------------
  TOTALS                 1.159    1.047    2.290    2.663    2.977    2.683
                         2.648    3.073    1.986    1.594    1.624    1.167

  STD. DEVIATIONS        0.405    0.437    0.486    0.844    0.839    1.098
                         0.818    1.072    0.792    0.608    0.394    0.252

LATERAL DRAINAGE COLLECTED FROM LAYER  2
----------------------------------------
  TOTALS                 1.2328   1.0709   2.0562   0.6436   0.7097   1.1432
                         1.1530   1.8417   1.6066   0.8178   1.0678   1.3076

  STD. DEVIATIONS        1.5145   1.1321   1.1886   0.7120   0.6695   1.1562
                         1.1043   1.4683   1.4499   0.7012   0.9768   1.3827

PERCOLATION/LEAKAGE THROUGH LAYER  3
------------------------------------
  TOTALS                 0.0003   0.0002   0.0006   0.0001   0.0001   0.0003
                         0.0003   0.0006   0.0005   0.0002   0.0002   0.0002

  STD. DEVIATIONS        0.0007   0.0003   0.0006   0.0001   0.0001   0.0005
                         0.0007   0.0011   0.0007   0.0003   0.0003   0.0004

PERCOLATION/LEAKAGE THROUGH LAYER  4
------------------------------------
  TOTALS                 0.0000   0.0000   0.0014   0.0000   0.0000   0.0000
                         0.0000   0.0014   0.0000   0.0000   0.0000   0.0000

  STD. DEVIATIONS        0.0000   0.0000   0.0074   0.0000   0.0000   0.0000
                         0.0000   0.0074   0.0000   0.0000   0.0000   0.0000


-------------------------------------------------------------------------------
               AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


DAILY AVERAGE HEAD ON TOP OF LAYER  3
-------------------------------------
  AVERAGES               0.2004   0.1263   0.3873   0.0391   0.0457   0.1664
                         0.2082   0.3792   0.3021   0.0949   0.1159   0.1216
```

STD. DEVIATIONS	0.4420	0.2089	0.3725	0.0605	0.0935	0.2987
	0.4318	0.7027	0.4377	0.1915	0.1706	0.2417

****

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.37 (6.611)	150156.2	100.00
RUNOFF	1.804 (1.1053)	6547.10	4.360
EVAPOTRANSPIRATION	24.910 (3.0169)	90423.78	60.220
LATERAL DRAINAGE COLLECTED FROM LAYER 2	14.65100 (4.19500)	53183.121	35.41854
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.00353 (0.00182)	12.799	0.00852
AVERAGE HEAD ON TOP OF LAYER 3	0.182 (0.099)		
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00271 (0.01033)	9.853	0.00656
CHANGE IN WATER STORAGE	-0.002 (1.1944)	-7.67	-0.005

****

****

PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	5.68	20618.398
RUNOFF	1.654	6005.5723
DRAINAGE COLLECTED FROM LAYER 2	0.37439	1359.04102

```
PERCOLATION/LEAKAGE THROUGH LAYER  3       0.000565          2.05021

AVERAGE HEAD ON TOP OF LAYER  3          11.899

MAXIMUM HEAD ON TOP OF LAYER  3          18.168

LOCATION OF MAXIMUM HEAD IN LAYER  2
      (DISTANCE FROM DRAIN)             118.2 FEET

PERCOLATION/LEAKAGE THROUGH LAYER  4       0.040745        147.90398

SNOW WATER                                 3.90         14161.6172


MAXIMUM VEG. SOIL WATER (VOL/VOL)                  0.4570

MINIMUM VEG. SOIL WATER (VOL/VOL)                  0.0580


 ***  Maximum heads are computed using McEnroe's equations.  ***

      Reference:  Maximum Saturated Depth over Landfill Liner
                  by Bruce M. McEnroe, University of Kansas
                  ASCE Journal of Environmental Engineering
                  Vol. 119, No. 2, March 1993, pp. 262-270.

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******************************************************************************

              FINAL WATER STORAGE AT END OF YEAR   30
    ----------------------------------------------------------------------
               LAYER         (INCHES)        (VOL/VOL)
               -----         --------        ---------
                 1             2.3235          0.1936

                 2             0.0198          0.0790

                 3             0.0000          0.0000

                 4            10.0186          0.4174

              SNOW WATER       0.000
```

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    C:\HELP3\TOL\DATA4.D4
TEMPERATURE DATA FILE:      C:\HELP3\TOL\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\HELP3\TOL\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\HELP3\TOL\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\HELP3\TOL\PE.D10
OUTPUT DATA FILE:           C:\HELP3\TOL\PE.OUT


TIME:  15:18     DATE:   7/14/2020


******************************************************************************

     TITLE:  PERIODIC COVER

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  13
          THICKNESS                  =     6.00   INCHES
```

```
POROSITY                    =      0.4300 VOL/VOL
FIELD CAPACITY              =      0.3210 VOL/VOL
WILTING POINT               =      0.2210 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.2858 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.330000003000E-04 CM/SEC


                        LAYER  2
                        --------

             TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER  18
THICKNESS                   =    120.00   INCHES
POROSITY                    =      0.6710 VOL/VOL
FIELD CAPACITY              =      0.2920 VOL/VOL
WILTING POINT               =      0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.3161 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


                        LAYER  3
                        --------

             TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER   5
THICKNESS                   =     12.00   INCHES
POROSITY                    =      0.4570 VOL/VOL
FIELD CAPACITY              =      0.1310 VOL/VOL
WILTING POINT               =      0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.2470 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


                        LAYER  4
                        --------

               TYPE 2 - LATERAL DRAINAGE LAYER
                MATERIAL TEXTURE NUMBER   0
THICKNESS                   =      0.25   INCHES
POROSITY                    =      0.8500 VOL/VOL
FIELD CAPACITY              =      0.0100 VOL/VOL
WILTING POINT               =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.7722 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =   1.69000006000     CM/SEC
```

```
   SLOPE                         =      2.00   PERCENT
   DRAINAGE LENGTH               =    500.0    FEET


                        LAYER  5
                        --------

              TYPE 4 - FLEXIBLE MEMBRANE LINER
                MATERIAL TEXTURE NUMBER  35
   THICKNESS                     =      0.06   INCHES
   POROSITY                      =      0.0000 VOL/VOL
   FIELD CAPACITY                =      0.0000 VOL/VOL
   WILTING POINT                 =      0.0000 VOL/VOL
   INITIAL SOIL WATER CONTENT    =      0.0000 VOL/VOL
   EFFECTIVE SAT. HYD. COND.     =  0.199999996000E-12 CM/SEC
   FML PINHOLE DENSITY           =      2.00   HOLES/ACRE
   FML INSTALLATION DEFECTS      =      2.00   HOLES/ACRE
   FML PLACEMENT QUALITY         =  3 - GOOD


                        LAYER  6
                        --------

             TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER   0
   THICKNESS                     =     24.00   INCHES
   POROSITY                      =      0.4270 VOL/VOL
   FIELD CAPACITY                =      0.4180 VOL/VOL
   WILTING POINT                 =      0.3670 VOL/VOL
   INITIAL SOIL WATER CONTENT    =      0.4163 VOL/VOL
   EFFECTIVE SAT. HYD. COND.     =  0.999999975000E-05 CM/SEC


           GENERAL DESIGN AND EVAPORATIVE ZONE DATA
           ----------------------------------------

 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
          SOIL DATA BASE USING SOIL TEXTURE #13 WITH BARE
          GROUND CONDITIONS, A SURFACE SLOPE OF  1.% AND
          A SLOPE LENGTH OF  500. FEET.

   SCS RUNOFF CURVE NUMBER            =     95.10
   FRACTION OF AREA ALLOWING RUNOFF   =     85.0    PERCENT
```

```
AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
EVAPORATIVE ZONE DEPTH              =      9.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE   =      2.467  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE  =      4.593  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE  =      1.557  INCHES
INITIAL SNOW WATER                  =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS    =     52.792  INCHES
TOTAL INITIAL WATER                 =     52.792  INCHES
TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR
```

EVAPOTRANSPIRATION AND WEATHER DATA

```
NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
         BALTIMORE             MARYLAND

    STATION LATITUDE                          =  39.18 DEGREES
    MAXIMUM LEAF AREA INDEX                   =   0.00
    START OF GROWING SEASON (JULIAN DATE)     =    102
    END OF GROWING SEASON (JULIAN DATE)       =    300
    EVAPORATIVE ZONE DEPTH                    =   9.0  INCHES
    AVERAGE ANNUAL WIND SPEED                 =   9.30 MPH
    AVERAGE 1ST QUARTER RELATIVE HUMIDITY     =  62.00 %
    AVERAGE 2ND QUARTER RELATIVE HUMIDITY     =  65.00 %
    AVERAGE 3RD QUARTER RELATIVE HUMIDITY     =  71.00 %
    AVERAGE 4TH QUARTER RELATIVE HUMIDITY     =  68.00 %


NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
         COEFFICIENTS FOR    BALTIMORE           MARYLAND
```

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.00	2.98	3.72	3.35	3.44	3.76
3.89	4.62	3.46	3.11	3.11	3.40

```
NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
         COEFFICIENTS FOR    BALTIMORE           MARYLAND
```

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL   FEB/AUG   MAR/SEP   APR/OCT   MAY/NOV   JUN/DEC

-------	-------	-------	-------	-------	-------
32.70	34.70	43.30	54.00	63.40	72.20
76.80	75.60	68.90	56.90	46.30	36.50

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BALTIMORE MARYLAND
AND STATION LATITUDE = 39.18 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.50	3.30	3.36	3.35	3.77	3.77
	3.77	5.57	3.38	2.65	2.96	3.00
STD. DEVIATIONS	1.25	1.51	1.27	1.69	1.70	2.29
	1.76	2.71	2.41	1.41	1.46	1.56
RUNOFF						
TOTALS	0.623	1.242	0.895	0.477	0.671	0.981
	1.058	1.699	1.137	0.629	0.552	0.560
STD. DEVIATIONS	0.721	1.046	0.898	0.481	0.605	1.027
	1.041	1.261	1.213	0.675	0.488	0.747
EVAPOTRANSPIRATION						
TOTALS	1.196	1.093	2.492	2.612	2.936	2.675
	2.621	3.127	2.104	1.606	1.628	1.175
STD. DEVIATIONS	0.434	0.471	0.510	0.954	0.950	1.231
	0.945	1.171	1.026	0.732	0.460	0.274
LATERAL DRAINAGE COLLECTED FROM LAYER 4						
TOTALS	0.9044	0.6576	0.8649	0.7398	0.2933	0.2108
	0.1882	0.2333	0.3850	0.3203	0.3112	0.5327

```
   STD. DEVIATIONS        0.7669   0.6611   0.5980   0.6746   0.2368   0.2196
                          0.1759   0.2534   0.4127   0.2899   0.2735   0.4686

  PERCOLATION/LEAKAGE THROUGH LAYER  5
  ------------------------------------
   TOTALS                 0.0010   0.0007   0.0007   0.0008   0.0001   0.0001
                          0.0000   0.0000   0.0002   0.0001   0.0001   0.0002

   STD. DEVIATIONS        0.0020   0.0017   0.0013   0.0019   0.0001   0.0001
                          0.0000   0.0001   0.0005   0.0001   0.0002   0.0004

  PERCOLATION/LEAKAGE THROUGH LAYER  6
  ------------------------------------
   TOTALS                 0.0014   0.0000   0.0014   0.0000   0.0000   0.0000
                          0.0014   0.0000   0.0000   0.0000   0.0000   0.0000

   STD. DEVIATIONS        0.0074   0.0000   0.0074   0.0000   0.0000   0.0000
                          0.0074   0.0000   0.0000   0.0000   0.0000   0.0000


-------------------------------------------------------------------------------
               AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


  DAILY AVERAGE HEAD ON TOP OF LAYER  5
  -------------------------------------
   AVERAGES               0.6616   0.4618   0.4371   0.5256   0.0335   0.0314
                          0.0159   0.0207   0.1285   0.0407   0.0640   0.1196

   STD. DEVIATIONS        1.3251   1.2635   0.8834   1.2647   0.0619   0.0850
                          0.0148   0.0262   0.3294   0.0914   0.1479   0.2300

*******************************************************************************


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    AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH   30
-------------------------------------------------------------------------------
                                   INCHES           CU. FEET       PERCENT
                              -------------------  -------------  ---------
 PRECIPITATION                 41.37    (   6.611)     150156.2     100.00

 RUNOFF                        10.525   (  3.1721)      38205.18     25.444

 EVAPOTRANSPIRATION            25.265   (  3.4019)      91712.79     61.078
```

LATERAL DRAINAGE COLLECTED FROM LAYER 4	5.64151 (	2.24095)	20478.686	13.63826
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00406 (	0.00425)	14.752	0.00982
AVERAGE HEAD ON TOP OF LAYER 5	0.212 (	0.240)		
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00407 (	0.01242)	14.775	0.00984
CHANGE IN WATER STORAGE	-0.070 (	1.2778)	-255.25	-0.170

****

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	5.68	20618.398
RUNOFF	4.242	15398.4814
DRAINAGE COLLECTED FROM LAYER 4	0.09741	353.59576
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000361	1.31126
AVERAGE HEAD ON TOP OF LAYER 5	7.477	
MAXIMUM HEAD ON TOP OF LAYER 5	12.166	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	93.1 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.040720	147.81528
SNOW WATER	3.90	14161.6172

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4481

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1730

```
        ***  Maximum heads are computed using McEnroe's equations.  ***

             Reference:  Maximum Saturated Depth over Landfill Liner
                         by Bruce M. McEnroe, University of Kansas
                         ASCE Journal of Environmental Engineering
                         Vol. 119, No. 2, March 1993, pp. 262-270.


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                   FINAL WATER STORAGE AT END OF YEAR   30
    ----------------------------------------------------------------------
                    LAYER        (INCHES)       (VOL/VOL)
                    -----        --------       ---------
                      1           1.7996          0.2999

                      2          35.9903          0.2999

                      3           2.8965          0.2414

                      4           0.0044          0.0177

                      5           0.0000          0.0000

                      6           9.9915          0.4163

                   SNOW WATER     0.000

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    C:\HELP3\TOL\DATA4.D4
TEMPERATURE DATA FILE:      C:\HELP3\TOL\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\HELP3\TOL\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\HELP3\TOL\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\HELP3\TOL\IN.D10
OUTPUT DATA FILE:           C:\HELP3\TOL\IN.OUT


TIME:  15:33     DATE:   7/14/2020


******************************************************************************

     TITLE:  INTERMEDIATE COVER

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  13
          THICKNESS                   =     12.00   INCHES
```

```
POROSITY                    =      0.4300 VOL/VOL
FIELD CAPACITY              =      0.3210 VOL/VOL
WILTING POINT               =      0.2210 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.3104 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.330000003000E-04 CM/SEC



                       LAYER  2
                       --------

         TYPE 1 - VERTICAL PERCOLATION LAYER
             MATERIAL TEXTURE NUMBER  18
THICKNESS                   =    756.00   INCHES
POROSITY                    =      0.6710 VOL/VOL
FIELD CAPACITY              =      0.2920 VOL/VOL
WILTING POINT               =      0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.2969 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC



                       LAYER  3
                       --------

         TYPE 1 - VERTICAL PERCOLATION LAYER
             MATERIAL TEXTURE NUMBER   5
THICKNESS                   =     12.00   INCHES
POROSITY                    =      0.4570 VOL/VOL
FIELD CAPACITY              =      0.1310 VOL/VOL
WILTING POINT               =      0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.2138 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC



                       LAYER  4
                       --------

           TYPE 2 - LATERAL DRAINAGE LAYER
             MATERIAL TEXTURE NUMBER   0
THICKNESS                   =      0.25   INCHES
POROSITY                    =      0.8500 VOL/VOL
FIELD CAPACITY              =      0.0100 VOL/VOL
WILTING POINT               =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.3316 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =   1.69000006000     CM/SEC
```

```
   SLOPE                         =      2.00   PERCENT
   DRAINAGE LENGTH               =    500.0    FEET


                        LAYER  5
                        --------

              TYPE 4 - FLEXIBLE MEMBRANE LINER
                MATERIAL TEXTURE NUMBER  35
   THICKNESS                     =      0.06   INCHES
   POROSITY                      =      0.0000 VOL/VOL
   FIELD CAPACITY                =      0.0000 VOL/VOL
   WILTING POINT                 =      0.0000 VOL/VOL
   INITIAL SOIL WATER CONTENT    =      0.0000 VOL/VOL
   EFFECTIVE SAT. HYD. COND.     =  0.199999996000E-12 CM/SEC
   FML PINHOLE DENSITY           =      2.00   HOLES/ACRE
   FML INSTALLATION DEFECTS      =      2.00   HOLES/ACRE
   FML PLACEMENT QUALITY         =  3 - GOOD


                        LAYER  6
                        --------

            TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER   0
   THICKNESS                     =     24.00   INCHES
   POROSITY                      =      0.4270 VOL/VOL
   FIELD CAPACITY                =      0.4180 VOL/VOL
   WILTING POINT                 =      0.3670 VOL/VOL
   INITIAL SOIL WATER CONTENT    =      0.4163 VOL/VOL
   EFFECTIVE SAT. HYD. COND.     =  0.999999975000E-05 CM/SEC



           GENERAL DESIGN AND EVAPORATIVE ZONE DATA
           ----------------------------------------

 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
          SOIL DATA BASE USING SOIL TEXTURE #13 WITH BARE
          GROUND CONDITIONS, A SURFACE SLOPE OF  1.% AND
          A SLOPE LENGTH OF  500. FEET.

   SCS RUNOFF CURVE NUMBER             =     95.10
   FRACTION OF AREA ALLOWING RUNOFF    =     85.0    PERCENT
```

```
AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
EVAPORATIVE ZONE DEPTH              =      9.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE   =      2.711  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE  =      3.870  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE  =      1.989  INCHES
INITIAL SNOW WATER                  =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS    =    240.801  INCHES
TOTAL INITIAL WATER                 =    240.801  INCHES
TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR


            EVAPOTRANSPIRATION AND WEATHER DATA
            -----------------------------------

 NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
          BALTIMORE             MARYLAND

     STATION LATITUDE                         =  39.18 DEGREES
     MAXIMUM LEAF AREA INDEX                  =   0.00
     START OF GROWING SEASON (JULIAN DATE)    =    102
     END OF GROWING SEASON (JULIAN DATE)      =    300
     EVAPORATIVE ZONE DEPTH                   =   9.0  INCHES
     AVERAGE ANNUAL WIND SPEED                =   9.30 MPH
     AVERAGE 1ST QUARTER RELATIVE HUMIDITY    =  62.00 %
     AVERAGE 2ND QUARTER RELATIVE HUMIDITY    =  65.00 %
     AVERAGE 3RD QUARTER RELATIVE HUMIDITY    =  71.00 %
     AVERAGE 4TH QUARTER RELATIVE HUMIDITY    =  68.00 %


 NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
          COEFFICIENTS FOR    BALTIMORE          MARYLAND

          NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
-------     -------     -------     -------     -------     -------
  3.00        2.98        3.72        3.35        3.44        3.76
  3.89        4.62        3.46        3.11        3.11        3.40


 NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
          COEFFICIENTS FOR    BALTIMORE          MARYLAND

     NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
```

32.70	34.70	43.30	54.00	63.40	72.20
76.80	75.60	68.90	56.90	46.30	36.50

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BALTIMORE MARYLAND
AND STATION LATITUDE = 39.18 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.50	3.30	3.36	3.35	3.77	3.77
	3.77	5.57	3.38	2.65	2.96	3.00
STD. DEVIATIONS	1.25	1.51	1.27	1.69	1.70	2.29
	1.76	2.71	2.41	1.41	1.46	1.56
RUNOFF						
TOTALS	0.646	1.273	0.923	0.484	0.671	0.985
	1.075	1.700	1.146	0.624	0.565	0.569
STD. DEVIATIONS	0.753	1.069	0.922	0.497	0.609	1.037
	1.043	1.269	1.222	0.671	0.504	0.752
EVAPOTRANSPIRATION						
TOTALS	1.177	1.071	2.302	2.495	2.814	2.558
	2.402	2.944	1.934	1.522	1.596	1.155
STD. DEVIATIONS	0.416	0.445	0.576	0.902	0.913	1.168
	0.879	1.081	0.975	0.734	0.469	0.268
LATERAL DRAINAGE COLLECTED FROM LAYER 4						
TOTALS	0.8080	0.7399	0.7903	0.9243	0.4567	0.3136
	0.3175	0.4082	0.6003	0.4860	0.3960	0.5656

```
   STD. DEVIATIONS        0.5795   0.6979   0.5008   0.7402   0.4596   0.2830
                          0.2786   0.3401   0.4677   0.4070   0.3016   0.4458

 PERCOLATION/LEAKAGE THROUGH LAYER  5
 ------------------------------------
   TOTALS                 0.0005   0.0006   0.0003   0.0007   0.0002   0.0001
                          0.0001   0.0001   0.0002   0.0001   0.0001   0.0002

   STD. DEVIATIONS        0.0010   0.0011   0.0003   0.0013   0.0006   0.0002
                          0.0001   0.0002   0.0004   0.0002   0.0002   0.0002

 PERCOLATION/LEAKAGE THROUGH LAYER  6
 ------------------------------------
   TOTALS                 0.0000   0.0000   0.0000   0.0014   0.0000   0.0000
                          0.0014   0.0000   0.0000   0.0000   0.0000   0.0000

   STD. DEVIATIONS        0.0000   0.0000   0.0000   0.0074   0.0000   0.0000
                          0.0074   0.0000   0.0000   0.0000   0.0000   0.0000


-------------------------------------------------------------------------------
               AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


 DAILY AVERAGE HEAD ON TOP OF LAYER  5
 -------------------------------------
   AVERAGES               0.3307   0.3875   0.1429   0.4674   0.1247   0.0497
                          0.0267   0.0570   0.1207   0.0769   0.0635   0.0815

   STD. DEVIATIONS        0.6177   0.7792   0.1685   0.9072   0.3743   0.1108
                          0.0235   0.1058   0.2657   0.1248   0.1138   0.1289

*******************************************************************************


*******************************************************************************

    AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH   30
-------------------------------------------------------------------------------
                                   INCHES           CU. FEET      PERCENT
                              -------------------  ------------  ---------
 PRECIPITATION                 41.37    (   6.611)    150156.2     100.00

 RUNOFF                        10.662   (  3.2341)     38701.37     25.774

 EVAPOTRANSPIRATION            23.970   (  3.1627)     87010.35     57.947
```

```
 LATERAL DRAINAGE COLLECTED      6.80632 (   2.39381)     24706.951    16.45417
   FROM LAYER   4

 PERCOLATION/LEAKAGE THROUGH     0.00324 (   0.00268)        11.748     0.00782
   LAYER   5

 AVERAGE HEAD ON TOP             0.161 (     0.149)
   OF LAYER   5

 PERCOLATION/LEAKAGE THROUGH     0.00271 (   0.01032)         9.848     0.00656
   LAYER   6

 CHANGE IN WATER STORAGE        -0.075    (  1.2956)       -272.37     -0.181

*******************************************************************************
```

```
******************************************************************************

                PEAK DAILY VALUES FOR YEARS    1 THROUGH   30
   -----------------------------------------------------------------------
                                                 (INCHES)      (CU. FT.)
                                                ----------    -------------
      PRECIPITATION                                5.68          20618.398

      RUNOFF                                       4.244         15406.6445

      DRAINAGE COLLECTED FROM LAYER   4            0.09692         351.82574

      PERCOLATION/LEAKAGE THROUGH LAYER   5        0.000262          0.95207

      AVERAGE HEAD ON TOP OF LAYER   5             5.326

      MAXIMUM HEAD ON TOP OF LAYER   5             9.006

      LOCATION OF MAXIMUM HEAD IN LAYER   4
            (DISTANCE FROM DRAIN)                 77.1 FEET

      PERCOLATION/LEAKAGE THROUGH LAYER   6        0.040695        147.72287

      SNOW WATER                                   3.90          14161.6172


      MAXIMUM VEG. SOIL WATER (VOL/VOL)                    0.4300

      MINIMUM VEG. SOIL WATER (VOL/VOL)                    0.2210
```

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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****

FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	3.8274	0.3189
2	221.8811	0.2935
3	2.8264	0.2355
4	0.0071	0.0286
5	0.0000	0.0000
6	10.0075	0.4170
SNOW WATER	0.000	

****
****

```
↑
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    C:\HELP3\TOL\FI.D4
TEMPERATURE DATA FILE:      C:\HELP3\TOL\FI.D7
SOLAR RADIATION DATA FILE:  C:\HELP3\TOL\FI.D13
EVAPOTRANSPIRATION DATA:    C:\HELP3\TOL\FI.D11
SOIL AND DESIGN DATA FILE:  C:\HELP3\TOL\FI.D10
OUTPUT DATA FILE:           C:\HELP3\TOL\FI.OUT


TIME:  15:42     DATE:   7/14/2020


******************************************************************************

     TITLE:  FINAL COVER

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  13
           THICKNESS                  =     24.00   INCHES
```

```
  POROSITY                    =      0.4300 VOL/VOL
  FIELD CAPACITY              =      0.3210 VOL/VOL
  WILTING POINT               =      0.2210 VOL/VOL
  INITIAL SOIL WATER CONTENT  =      0.4164 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =  0.330000003000E-04 CM/SEC
NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
         FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                          LAYER  2
                          --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   0
  THICKNESS                   =      0.20   INCHES
  POROSITY                    =      0.8500 VOL/VOL
  FIELD CAPACITY              =      0.0100 VOL/VOL
  WILTING POINT               =      0.0050 VOL/VOL
  INITIAL SOIL WATER CONTENT  =      0.8500 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =  0.509999990000     CM/SEC
  SLOPE                       =      3.00   PERCENT
  DRAINAGE LENGTH             =    700.0    FEET


                          LAYER  3
                          --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
  THICKNESS                   =      0.04   INCHES
  POROSITY                    =      0.0000 VOL/VOL
  FIELD CAPACITY              =      0.0000 VOL/VOL
  WILTING POINT               =      0.0000 VOL/VOL
  INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
  EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
  FML PINHOLE DENSITY         =      2.00   HOLES/ACRE
  FML INSTALLATION DEFECTS    =      2.00   HOLES/ACRE
  FML PLACEMENT QUALITY       =  3 - GOOD


                          LAYER  4
                          --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
```

```
               MATERIAL TEXTURE NUMBER  13
THICKNESS                    =     24.00   INCHES
POROSITY                     =      0.4300 VOL/VOL
FIELD CAPACITY               =      0.3210 VOL/VOL
WILTING POINT                =      0.2210 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.3230 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.330000003000E-04 CM/SEC


                        LAYER  5
                        --------

           TYPE 1 - VERTICAL PERCOLATION LAYER
               MATERIAL TEXTURE NUMBER  18
THICKNESS                    =   1512.00   INCHES
POROSITY                     =      0.6710 VOL/VOL
FIELD CAPACITY               =      0.2920 VOL/VOL
WILTING POINT                =      0.0770 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2920 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC


                        LAYER  6
                        --------

           TYPE 1 - VERTICAL PERCOLATION LAYER
               MATERIAL TEXTURE NUMBER   5
THICKNESS                    =     12.00   INCHES
POROSITY                     =      0.4570 VOL/VOL
FIELD CAPACITY               =      0.1310 VOL/VOL
WILTING POINT                =      0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.1407 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC


                        LAYER  7
                        --------

             TYPE 2 - LATERAL DRAINAGE LAYER
               MATERIAL TEXTURE NUMBER   0
THICKNESS                    =      0.25   INCHES
POROSITY                     =      0.8500 VOL/VOL
FIELD CAPACITY               =      0.0100 VOL/VOL
WILTING POINT                =      0.0050 VOL/VOL
```

```
INITIAL SOIL WATER CONTENT  =      0.0100 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =   1.69000006000     CM/SEC
SLOPE                       =      2.00   PERCENT
DRAINAGE LENGTH             =    500.0    FEET
```

```
                        LAYER  8
                        --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                   =      0.06   INCHES
POROSITY                    =      0.0000 VOL/VOL
FIELD CAPACITY              =      0.0000 VOL/VOL
WILTING POINT               =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY         =      2.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      2.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD
```

```
                        LAYER  9
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                   =     24.00   INCHES
POROSITY                    =      0.4270 VOL/VOL
FIELD CAPACITY              =      0.4180 VOL/VOL
WILTING POINT               =      0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.4163 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.999999975000E-05 CM/SEC
```

```
        GENERAL DESIGN AND EVAPORATIVE ZONE DATA
        ----------------------------------------

NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE #13 WITH A
         FAIR STAND OF GRASS, A SURFACE SLOPE OF  3.%
         AND A SLOPE LENGTH OF  700. FEET.
```

```
SCS RUNOFF CURVE NUMBER              =     87.80
FRACTION OF AREA ALLOWING RUNOFF     =    100.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE   =      1.000  ACRES
EVAPORATIVE ZONE DEPTH               =     21.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE    =      8.704  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE   =      9.030  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE   =      4.641  INCHES
INITIAL SNOW WATER                   =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS     =    471.102  INCHES
TOTAL INITIAL WATER                  =    471.102  INCHES
TOTAL SUBSURFACE INFLOW              =      0.00   INCHES/YEAR
```

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
BALTIMORE MARYLAND

```
STATION LATITUDE                         =  39.18 DEGREES
MAXIMUM LEAF AREA INDEX                  =   2.00
START OF GROWING SEASON (JULIAN DATE)    =    102
END OF GROWING SEASON (JULIAN DATE)      =    300
EVAPORATIVE ZONE DEPTH                   =  21.0  INCHES
AVERAGE ANNUAL WIND SPEED                =   9.30 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY    =  62.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY    =  65.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY    =  71.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY    =  68.00 %
```

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BALTIMORE MARYLAND

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.00	2.98	3.72	3.35	3.44	3.76
3.89	4.62	3.46	3.11	3.11	3.40

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BALTIMORE MARYLAND

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
32.70	34.70	43.30	54.00	63.40	72.20
76.80	75.60	68.90	56.90	46.30	36.50

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BALTIMORE MARYLAND
AND STATION LATITUDE = 39.18 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.50	3.30	3.36	3.35	3.77	3.77
	3.77	5.57	3.38	2.65	2.96	3.00
STD. DEVIATIONS	1.25	1.51	1.27	1.69	1.70	2.29
	1.76	2.71	2.41	1.41	1.46	1.56
RUNOFF						
TOTALS	0.749	1.445	0.922	0.172	0.194	0.325
	0.358	0.592	0.512	0.228	0.231	0.654
STD. DEVIATIONS	1.105	1.259	1.177	0.265	0.291	0.502
	0.664	0.705	0.738	0.389	0.366	1.285
EVAPOTRANSPIRATION						
TOTALS	1.095	1.037	2.482	2.861	3.623	4.249
	3.679	3.938	2.511	1.366	1.348	1.048
STD. DEVIATIONS	0.338	0.426	0.403	0.846	0.824	1.411
	1.589	1.485	0.832	0.412	0.264	0.172

LATERAL DRAINAGE COLLECTED FROM LAYER 2

TOTALS	0.6160	0.5022	0.7291	0.7223	0.6302	0.4426
	0.2201	0.1396	0.2002	0.2801	0.4325	0.5928
STD. DEVIATIONS	0.2552	0.2483	0.0828	0.0593	0.2345	0.3055
	0.2695	0.2136	0.2704	0.3022	0.3078	0.2645

PERCOLATION/LEAKAGE THROUGH LAYER 3

TOTALS	0.0340	0.0268	0.0448	0.0306	0.0211	0.0111
	0.0026	0.0025	0.0067	0.0075	0.0188	0.0319
STD. DEVIATIONS	0.0276	0.0244	0.0164	0.0183	0.0195	0.0141
	0.0048	0.0067	0.0148	0.0150	0.0192	0.0282

LATERAL DRAINAGE COLLECTED FROM LAYER 7

TOTALS	0.0110	0.0113	0.0093	0.0147	0.0274	0.0321
	0.0369	0.0302	0.0216	0.0196	0.0127	0.0102
STD. DEVIATIONS	0.0109	0.0107	0.0102	0.0129	0.0187	0.0196
	0.0184	0.0133	0.0093	0.0082	0.0090	0.0124

PERCOLATION/LEAKAGE THROUGH LAYER 8

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 9

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	9.4996	8.2024	12.5371	8.7946	5.8358	3.1358
	0.6853	0.6877	1.9173	2.0715	5.3876	8.8906
STD. DEVIATIONS	7.7877	7.5210	4.6482	5.3701	5.5193	4.0621

```
                              1.3006   1.8790   4.2847   4.1956   5.5852   7.9314

 DAILY AVERAGE HEAD ON TOP OF LAYER  8
 -------------------------------------
   AVERAGES                   0.0009   0.0010   0.0008   0.0013   0.0023   0.0028
                              0.0031   0.0025   0.0019   0.0017   0.0011   0.0009

   STD. DEVIATIONS            0.0009   0.0010   0.0009   0.0011   0.0016   0.0017
                              0.0016   0.0011   0.0008   0.0007   0.0008   0.0010

*******************************************************************************


*******************************************************************************

     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH   30
-------------------------------------------------------------------------------
                                    INCHES            CU. FEET        PERCENT
                               -------------------   -------------   ---------
 PRECIPITATION                  41.37    (   6.611)     150156.2     100.00

 RUNOFF                          6.382   (  2.9938)      23166.04     15.428

 EVAPOTRANSPIRATION             29.237   (  3.6922)     106131.49     70.681

 LATERAL DRAINAGE COLLECTED      5.50768 (  1.33731)     19992.863   13.31471
   FROM LAYER  2

 PERCOLATION/LEAKAGE THROUGH     0.23837 (  0.10854)       865.301    0.57627
   LAYER  3

 AVERAGE HEAD ON TOP             5.637 (    2.603)
   OF LAYER  3

 LATERAL DRAINAGE COLLECTED      0.23685 (  0.09593)       859.755    0.57257
   FROM LAYER  7

 PERCOLATION/LEAKAGE THROUGH     0.00006 (  0.00002)         0.235    0.00016
   LAYER  8

 AVERAGE HEAD ON TOP             0.002 (    0.001)
   OF LAYER  8

 PERCOLATION/LEAKAGE THROUGH     0.00000 (  0.00000)         0.000    0.00000
   LAYER  9

 CHANGE IN WATER STORAGE         0.002   (  1.1960)          5.98     0.004
*******************************************************************************
```

****

PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	5.68	20618.398
RUNOFF	3.093	11229.0127
DRAINAGE COLLECTED FROM LAYER 2	0.02512	91.18709
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.002792	10.13376
AVERAGE HEAD ON TOP OF LAYER 3	24.200	
MAXIMUM HEAD ON TOP OF LAYER 3	37.128	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	162.5 FEET	
DRAINAGE COLLECTED FROM LAYER 7	0.00363	13.18803
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000001	0.00308
AVERAGE HEAD ON TOP OF LAYER 8	0.009	
MAXIMUM HEAD ON TOP OF LAYER 8	0.024	
LOCATION OF MAXIMUM HEAD IN LAYER 7 (DISTANCE FROM DRAIN)	0.0 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.000000	0.00000
SNOW WATER	3.90	14161.6172

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4300

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.2210

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas

ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	9.9974	0.4166
2	0.1700	0.8500
3	0.0000	0.0000
4	7.7258	0.3219
5	441.5040	0.2920
6	1.7585	0.1465
7	0.0025	0.0100
8	0.0000	0.0000
9	9.9933	0.4164
SNOW WATER	0.000	

****
****

Appendix H.2: Leachate Collection Pipe Capacity

Geosyntec consultants

COMPUTATION COVER SHEET

Client: Tolson & Associates **Project:** TRL Vertical Expansion **Project/Proposal #:** ME1606 **Task:** 03

TITLE OF COMPUTATIONS: Leachate Collection Pipe Flow Capacity

COMPUTATIONS BY: Signature [signature] 07/15/2020 DATE

Printed Name and Title: Andrew Stallings, P.E. Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY: (Peer Reviewer) Signature [signature] 07/22/2020 DATE

Printed Name and Title: Davis Garrett, P.E. Engineer

COMPUTATIONS CHECKED BY: Signature [signature] 07/22/2020 DATE

Printed Name and Title: Davis Garrett, P.E. Engineer

COMPUTATIONS BACKCHECKED BY: (Originator) Signature [signature] 07/29/2020 DATE

Printed Name and Title: Andrew Stallings, P.E. Engineer

APPROVED BY: (PM or Designate) Signature C.H. Pendleton 07/31/2020 DATE

Printed Name and Title: Carrie Pendleton, P.E. Principal

APPROVAL NOTES:

REVISIONS: (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

LEACHATE COLLECTION PIPE FLOW CAPACITY

1. PURPOSE

The purpose of this calculation is to evaluate the flow capacity of the leachate collection system (LCS) pipe network for the proposed Tolson Rubble Landfill (TRL) Expansion located in Crofton, Anne Arundel County, Maryland. In this calculation, the maximum flow capacity of the leachate collection pipes is evaluated, and the minimum required pipe perforation size is also calculated.

2. BACKGROUND

The maximum monthly leachate generation has been calculated in the design calculation entitled, "Leachate Generation Analysis" (Appendix H.1 of this application report). The required flow capacity of each LCS pipe is estimated based on the maximum monthly leachate generation rate expected for the landfill and the contributing cell area. Figure 1 shows the plan layout of each cell along with the LCS pipe in each cell. The LCS pipes each feed into a primary LCS pipe which routes leachate to the sump.

3. PROCEDURE

3.1 LCS Pipe Maximum Flow Rate

The maximum monthly leachate flow rate calculated on a per-acre basis for the different cell conditions expected at the landfill are summarized below:

Cell Condition	Maximum Monthly Leachate Volume*	
	(in.-ac/month)	(gal/month/ac)
Open Cell	2.06	55,934
Periodic Cover	0.90	24,437
Intermediate Cover	0.92	24,980
Final Cover	0.04	1,086

* See Table 5 of Appendix H.1.

The maximum flow rate of leachate entering any LCS pipe may be conservatively calculated by multiplying the rate of impingement on the LCS drainage layer by the plan area of the largest cell. The largest cell in the proposed expanded TRL is Cell 3 with a drainage area of 12.9 acres. The maximum flow in Cell 3 is calculated using the following equation:

$$Q_{max} = q_i \, A_d \qquad (1)$$

where:

Q_{max}	=	flow rate (gal/month)
q_i	=	impingement rate (gal/month/ac)
A_d	=	plan area of largest cell (ac)

Equation (1) is also used to calculate the maximum flow entering the primary LCS pipe which routes leachate to the sump.

3.2 Pipe Flow Capacity

The pipe flow capacity is calculated using Manning's equation:

$$Q_{avail} = \frac{1.486}{n} A\, R_h^{2/3}\, S^{1/2} \qquad (2)$$

where:

Q_{avail}	=	available flow rate (ft^3/s [cfs])
R_h	=	hydraulic radius (ft) (wetted area/wetted perimeter)
S	=	hydraulic gradient (ft/ft)
A	=	cross-sectional flow area (ft^2)
n	=	Manning's roughness coefficient

The factor of safety (FS) against pipe overflow is:

$$FS = \frac{Q_{avail}}{Q_{max}} \qquad (3)$$

4. CALCULATIONS

The proposed LCS pipe design is an 8-inch nominal diameter SDR11 high-density polyethylene (HDPE) pipe which has a typical Manning's coefficient (n) of 0.009 and an inner diameter of 6.96 inches. Based on the results of the liner settlement analysis, the minimum post-settlement grade along the length of the LCS pipe corridor due to differential settlement under the weight of the waste is expected to be approximately 0.51 percent. Accordingly, the hydraulic gradient used in calculating the full flow pipe capacity is assumed to be 0.5 percent.

4.1 Maximum Flow Rate

Using the equations described in the procedure section of this calculation package, the peak daily leachate generation into the leachate collection system of a single cell is:

$$Q_{max} = 55{,}934 \frac{gal}{month \cdot acre} \times 12.9\ ac = 721{,}549 \frac{gal}{month}$$

When converted to gallons per minute (gpm), flow equals:

$$Q_{max} = 721{,}549 \frac{gal}{month} \times \frac{1\ month}{30.5\ days} \times \frac{1\ day}{24\ hours} \times \frac{1\ hour}{60\ minutes} = 16.4\ gpm$$

Similarly, the peak daily leachate generation into the leachate collection system of the entire landfill is calculated as 91.7 gpm.

4.2 Pipe Flow Capacity

The full flowing pipe capacity for an 8-inch nominal pipe size:

$$A = \frac{\pi}{4}\left(\frac{6.96\ in.}{12\ in./ft}\right)^2 = 0.264\ ft^2$$

$$P_w = \pi\left(\frac{6.96\ in.}{12\ in./ft}\right) = 1.822\ ft$$

$$Q_{avail} = \frac{1.486}{0.009}\ (0.264\ ft^2)\left(\frac{0.264\ ft^2}{1.822\ ft}\right)^{2/3}\ (0.005)^{1/2} = 0.851\ cfs = 382\ gpm$$

The factor of safety for leachate collection pipes in a single cell is:

$$FS = \frac{382\ gpm}{16.4\ gpm} = 23.3$$

The factor of safety for leachate collection pipes for the entire landfill is:

$$FS = \frac{382\ gpm}{91.7\ gpm} = 4.2$$

4.3 Pipe Perforation Sizing

The maximum allowable diameter of perforations in the LCS pipe will be specified to ensure the exclusion of gravel particles in the LCS pipe corridor (LCS pipes will be surrounded by AASHTO No. 57 stone). The maximum allowable diameter of the perforations in the LCS pipes to provide particle retention of gravel particles may be determined as follows [USEPA, 1983]:

$$d_{h\,max} = \frac{d_{85}}{F} \qquad (4)$$

where:

$d_{h\,max}$ = maximum perforation diameter to provide particle retention
d_{85} = particle size of the pipe bedding material for which 85 percent by weight of the particles are finer
F = factor varying between 1.2 to 2.0

The particle gradation curve of AASHTO No. 57 stone is shown in Figure 2. The range of d_{85} taken from Figure 2 varies from 23 mm (0.905 inches) to 30 mm (1.18 inches). For design, the minimum d_{85} will be used (0.905 inches) with an F factor of 1.8. Using these values, the maximum pipe perforation size allowable for pipes surrounded by AASHTO No. 57 stone is 0.5 inch.

The ability of the pipe perforations to convey leachate collected in the LCS is evaluated using the equation for flow (Q) through an orifice:

$$Q = aC_B\sqrt{2gh} \qquad (5)$$

where:

a = area of the orifice (in.^{2})
C_B = the orifice coefficient (usually 0.6)
g = the acceleration of gravity, 32.2 ft/s^2
h = liquid depth above the hole (ft)

Thus, for a pipe perforation with a diameter of 0.5 in. and an average head equal to 11.9 in. above the liner in the open cell condition, as calculated in "Leachate Generation Analysis" (Appendix H.1 of this application report), minus the 4 inch radius of the collection pipe to conservatively account for the minimum head of leachate directly above the collection pipe, the calculated flow is:

$$Q = \frac{\pi}{4}\left(\frac{0.5\ in.}{12\ in./ft}\right)^2 \times 0.6 \times \sqrt{2 \times \left(32.2\ \frac{ft}{sec^2}\right) \times 0.658\ ft} = 0.0053\,\frac{cfs}{hole} = 2.39\,\frac{gpm}{hole}$$

The above procedure was repeated for each cell to determine the maximum flow rate for leachate collection pipes in each cell and for the entire landfill. The flow rate per linear foot of pipe was then calculated. This was done to ensure that there was an appropriate factor of safety to accommodate flow demand along the entire length of the pipe, and any clogging along portions of the pipe which would increase flow demand in sections of the pipe downgradient of the clogged portion. The maximum leachate flow demand per linear foot of leachate collection pipe for each cell is shown below:

Landfill Cell	Acreage (ac)	Designed Leachate Flow (gpm)	Length of Leachate Pipe (ft)	Pipe Flow per Foot (gpm/ft)
1	7.2	9.2	700	0.013
2	9.2	11.7	700	0.017
3	12.9	16.4	1,300	0.013
4	11.6	14.8	900	0.016
5	12.0	15.3	750	0.020
6	6.8	8.7	500	0.017
7	12.3	15.7	1,150	0.014
ALL	72.0	91.7	2,300	0.040

The maximum pipe flow rate per linear foot is estimated to be 0.040 gpm per linear foot in the primary LCS pipe which routes leachate to the sump. Assuming all LCS pipes have a 0.5-in. perforation spaced every 6-in. (i.e., 4.78 gpm per linear foot), the LCS pipes will have more than enough capacity to handle the total leachate flow in each cell and the entire landfill and could accommodate upgradient flow blocked by clogs that may occur in the pipe.

5. CONCLUSION

The above calculations were performed for the design of LCS pipes in Cells 1 through 7 of TRL and for the primary LCS pipe which routes leachate to the sump. The assumed LCS pipe size of 8-inch diameter SDR11 HDPE pipe is adequate for all landfill cells and for the primary LCS pipe. Based on these analyses, the minimum factor of safety for LCS pipe flow is 4.2. The pipe perforation of 0.5 inch with six-inch spacing is sufficient to handle the leachate flow.

REFERENCES

USEPA [1983]. “Lining of Waste Impoundments and Disposal Facilities,” Office of Solid Waste & Emergency Response. SW-870.

FIGURES

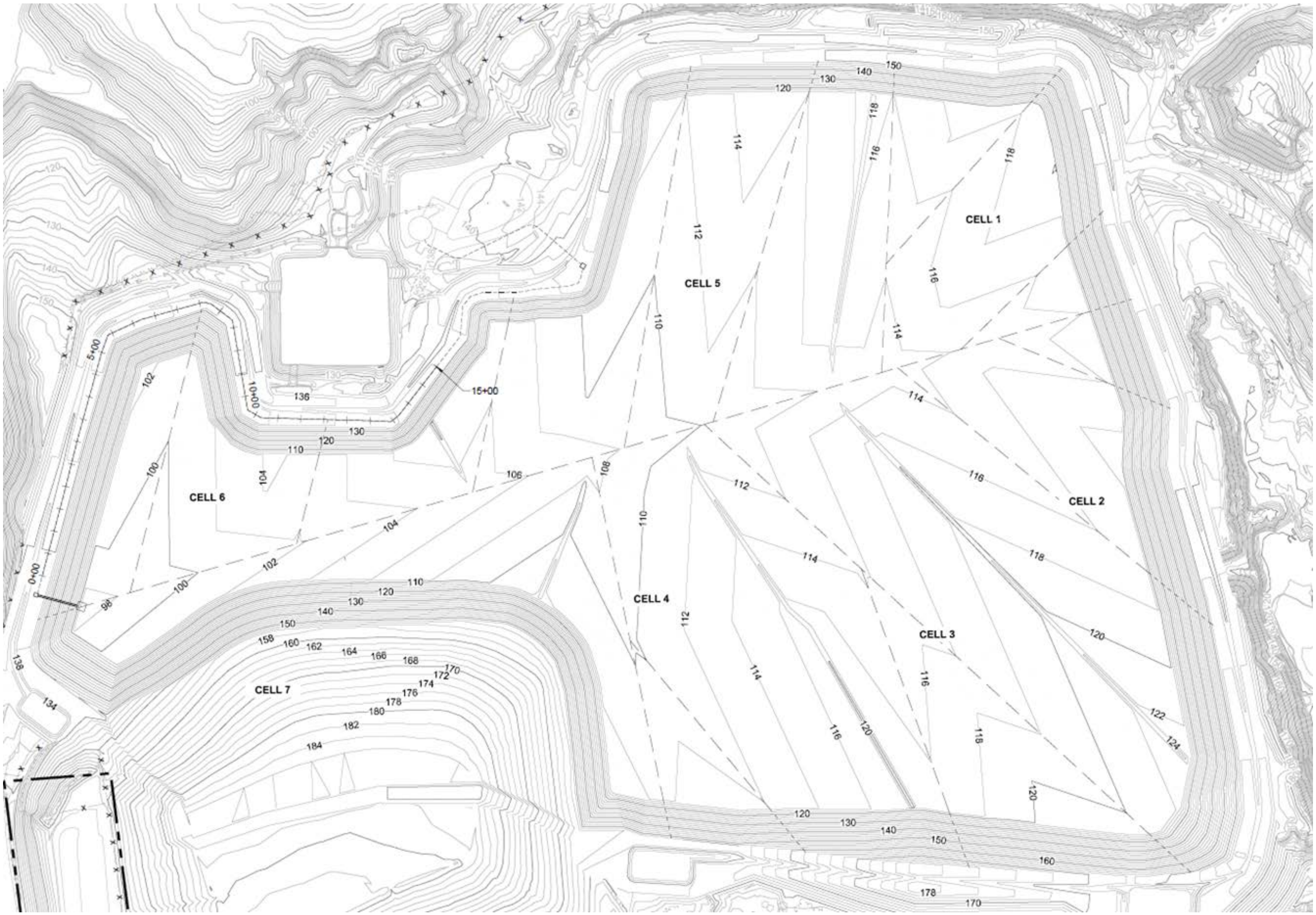

Figure 1. Base Grading Plan and Leachate Collection System.

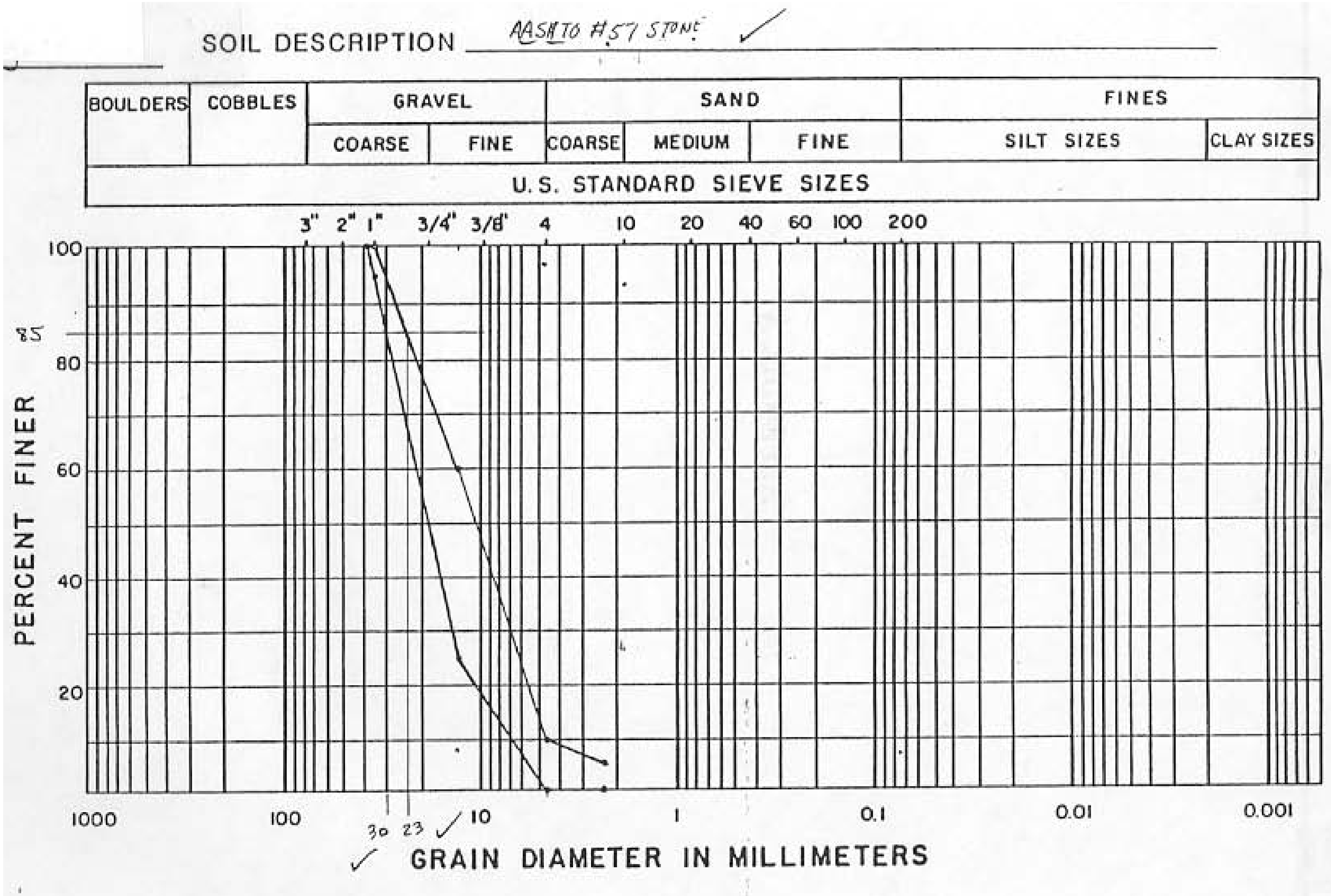

Figure 2. AASHTO No. 57 Stone Gradation.

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Appendix H.3: Leachate Transmission System Design

Geosyntec consultants

COMPUTATION COVER SHEET

Client: Tolson & Associates **Project:** TRL Vertical Expansion **Project/Proposal #:** ME1606 **Task:** 03

TITLE OF COMPUTATIONS: Leachate Transmission System Design

COMPUTATIONS BY: Signature [signature] 07/15/2020 DATE

Printed Name and Title: Andrew Stallings, P.E. Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY: (Peer Reviewer) Signature [signature] 07/22/2020 DATE

Printed Name and Title: Davis Garrett, P.E. Engineer

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APPROVAL NOTES:

REVISIONS: (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

LEACHATE TRANSMISSION SYSTEM DESIGN

1. PURPOSE

The purpose of this calculation is to design the leachate transmission system (LTS) for the proposed Tolson Rubble Landfill (TRL) Expansion located in Crofton, Anne Arundel County, Maryland. The LTS will convey leachate from the leachate collection system (LCS) to the leachate storage tank via a perimeter forcemain. Leachate in the storage tank will be periodically hauled off site for treatment.

2. BACKGROUND

The proposed layout of the LTS is shown in Figure 1. The leachate transmission system consists of a 4-inch nominal diameter SDR11 high-density polyethylene (HDPE) forcemain on the western perimeter of the landfill. Leachate collected at the western sump will be pumped into a leachate collection valve vault at the top of the landfill sideslope where the leachate will enter the forcemain. The forcemain will run from the valve vault along the western perimeter of the landfill to a leachate transmission forcemain vault and then directly to the existing leachate storage tank.

The leachate collection sump pump will be designed to pump leachate directly into the storage tank from the sump. The sump pump will be required to overcome the elevation difference between the sump and the leachate storage tank, as well as the frictional losses along the leachate forcemain. The following leachate transmission analyses are evaluated in this calculation:

- Required sump, pump, forcemain pipe, and storage tank size; and
- Design pumping rate and required pumping head.

3. DESIGN LEACHATE FLOW RATE

The "Leachate Generation Analysis" calculation package (Appendix H.1 of this application report) presents results of leachate generation calculations which serve as the primary input to this analysis. The maximum monthly leachate generation volume calculated for the landfill is 2,175,613 gallons per month which equates to an average leachate generation rate of 49.5 gallons per minute (gpm). This flow rate in conjunction with the head requirements, outlined below, are used to design the leachate collection system and transmission system sump pump to convey the leachate to the leachate storage tank.

4. SUMP AND PUMP RATE

The size requirements of the sump pump are dependent on the leachate inflow to the sump. The size of the sump, in turn, influences the required pumping rate and other pump requirements. The sump size, pump rate, and on-off cycles per day of the pump are calculated using the following procedure.

Liquid flow rate (gpm) to the sump (q_{in}) is estimated based on the output of the Hydrologic Evaluation of Landfill Performance (HELP) model analysis performed as part of the "Leachate Generation Analysis" calculation package. Initial sump dimensions (i.e., length [L], width [W], and depth [D] in feet) are assumed to accommodate the leachate collection riser pipes and q_{in}.

Pump-on and pump-off depths (z_{on} and z_{off}, respectively) are assumed based on previous experience and the selected sump dimensions. The permanent pool elevation area (A_p) and maximum pool elevation area (A_m) are calculated as shown below, assuming sump side slope grades S horizontal to 1 vertical.

$$A_p = \left(L + \left(z_{off} \times S \times 2\right)\right) \times \left(W + \left(z_{off} \times S \times 2\right)\right) \tag{1}$$

$$A_m = \left(L + (z_{on} \times S \times 2)\right) \times \left(W + (z_{on} \times S \times 2)\right) \tag{2}$$

The net drainage storage volume (V) within the sump is calculated using the frustum of a pyramid and gravel porosity (n) and the difference in on and off levels ($H = z_{on} - z_{off}$) as follows:

$$V = \frac{n \times H}{3}\left(A_p + A_m + \sqrt{A_p \times A_m}\right) \tag{3}$$

The minimum pumping rate ($q_{p,min}$) (gpm) is calculated based on the minimum desired velocity in piping (v) and pipe diameter (d). An initial value for design pumping rate (q_p) (gpm) that is greater than $q_{p,min}$and q_{in} is selected.

$$q_{p,min} = v \times A = v \times \frac{\pi \times d^2}{4} \times \frac{1\,ft^2}{144 in^2} \times \frac{60\,sec}{min} \times \frac{7.48\,gal}{ft^3} \tag{4}$$

The pump time off (t_{off}) and time on (t_{on}) are calculated as follows:

$$t_{off} = \frac{V}{q_{in}} \tag{5}$$

$$t_{on} = \frac{V}{(q_p - q_{in})} \tag{6}$$

The resulting pump off/on ratio (r) is calculated as follows:

$$r = \frac{t_{off}}{t_{on}} \tag{7}$$

Finally, the number of pumping cycles per day is calculated as follows:

$$cycles\ per\ day = \frac{1440\ minutes}{\left(t_{off} + t_{on}\right)} \tag{8}$$

5. LEACHATE TRANSMISSION SYSTEM DESIGN

Once a design pumping rate can be established the remainder of the leachate transmission system can be designed. This procedure begins with the determination of the amount of head or elevation that is required of the sump pump. A pump can be specified from the design pump rate and elevation head requirement.

5.1 <u>Selection of Required Head for Pumps</u>

The LCS pump will be designed to supply the required head to overcome the elevation difference between the sump and the existing leachate storage tank, as well as the frictional losses along the leachate force main. Frictional losses increase as flow velocity increases. Although there is a high point along the LTS forcemain, the high point elevation is below the top of the leachate storage tank. Therefore, the head required to overcome this high point will not be evaluated because the head required to reach the leachate storage tank will be critical.

The head required to transfer leachate between two points is calculated using the conservation of energy equation as follows:

$$Z_1 + \frac{P_1}{\gamma} + \frac{V_1^2}{2g} + H_p = Z_2 + \frac{P_2}{\gamma} + \frac{V_2^2}{2g} + \sum h_{L1-2} \tag{9}$$

where:

$Z_{1,2}$	=	elevations at points 1 and 2
$P_{1,2}$	=	pressures at points 1 and 2
γ	=	unit weight of leachate
$V_{1,2}$	=	velocities at points 1 and 2
g	=	acceleration due to gravity
H_p	=	required head by pump at point 1
$\sum h_{L1-2}$	=	summation of frictional head losses between points 1 and 2

The velocity and pressure head terms ($V^2/2g$, P/γ) can be neglected because: (i) the pipe cross section is constant and, therefore, the velocity head terms cancel; and (ii) both ends of the transmission system pipe (the sump and leachate storage tank) are at atmospheric pressure and therefore the pressure head terms cancel. Thus, Equation (9) can be reduced and rearranged as follows:

$$H_p = (Z_2 - Z_1) + \sum h_{L1-2} \quad (9)$$

Therefore, the required head to be delivered by a pump is equal to the elevation difference between the pump and leachate storage tank plus and frictional losses in the force main.

Frictional losses occur due to the leachate travelling through the pipe and various fittings. Frictional losses due to the fittings are calculated using the following equation:

$$h_{LF} = K\left(\frac{V^2}{2g}\right) \quad (10)$$

where:

h_{LF} = frictional head loss due to fitting
K = loss coefficient for fitting (dimensionless)
V = average flow velocity through fitting (flow rate/flow area)

Frictional losses due to the pipe wall are calculated using the Darcy-Weisbach equation:

$$h_{LP} = f\left(\frac{L}{D}\right)\left(\frac{V^2}{2g}\right) \quad (11)$$

where:

h_{LP} = frictional head loss due to fitting
f = friction factor (see below)
L = length of pipe
D = inside diameter of pipe
V = average flow velocity through pipe (flow rate/flow area)

The friction factor (f) is a function of Reynold's number (Re) and the relative roughness of the pipe wall and can be estimated using Moody's diagram. The equation for the Reynolds number is:

$$Re = \frac{VD}{\upsilon} \quad (12)$$

where:

υ = kinematic viscosity of leachate, which is assumed to be same as water at 50°F
= 1.41×10^{-5} ft^2/sec

In the range of Reynold's numbers between 4,000 and 1.0×10^6, the Moody diagram for smooth walled pipe can be approximated by the following equation:

$$f = 0.195\ (Re)^{-0.206} \tag{13}$$

A graph of this equation and the part of the Moody diagram which it represents are shown together in Figure 2. For Reynolds numbers less than 4,000 the friction factor is calculated by the equation:

$$f = \frac{64}{Re} \tag{14}$$

5.2 Leachate Transmission Pipe

After establishing the design pumping rate and required head for the sump pump, the required diameter of the forcemain can be determined. Typically, the minimum design velocity of the forcemain needs to be 2.0 ft/sec to prevent solids from settling out in the in pipe. Using the equation for flow (q) below and solving for the minimum required velocity (υ), the area of the pipe (A) can be determined and the required pipe diameter can be derived.

$$q = \upsilon \times A \tag{15}$$

6. CALCULATIONS AND RESULTS

6.1 Sump and Pump Rate

The results of the sump size and pumping rate design are included in Table 1. The minimum required pumping rate was calculated to be 11 gpm and a design pump rate was set at 70 gpm.

6.2 Total Pump Head Results

The total required pump head was calculated as 115.7 ft of which 55.7 ft is frictional head loss and 60.0 ft is elevation head. The total head requirement calculations are included in Table 2.

The pumping rate and maximum total head requirements were used to size an appropriate sump pump. An EPG Series 12 Model 7 SurePump™ or equivalent could adequately provide the calculated head and pump rate requirements. The pump sizing chart is provided as Figure 3.

6.3 Forcemain Sizing

A 4-inch nominal diameter SDR11 HDPE forcemain may be used to meet the minimum required velocity.

6.4 Forcemain Allowable Pressure Verification

To ensure the design forcemain is able to withstand the pressure exerted by the leachate sump pump, the total maximum head (115.7 ft) needs to be converted to pressure and compared to the maximum allowable pressure rating of the forcemain pipe. A 4-inch SDR11 HDPE pipe has a maximum pressure rating of 160 pounds per square inch (psi). The equation below is used to convert the total head requirement (feet) to total pressure requirement (psi) within a pipe:

$$p = 0.433 \times h \times SG \tag{16}$$

where:

p	=	pressure (psi)
h	=	head (ft)
SG	=	specific gravity of liquid (assumed to be 1.0)

$$p = 0.433 \times 115.7\ ft \times 1.0 = 50.1\ psi$$

Comparing the maximum allowable pressure of the forcemain pipe to the pressure requirement calculated above the resulting factor of safety is determined.

$$FS = \frac{160\ psi}{50.1\ psi} = 3.2$$

The designed forcemain size has an adequate pressure rating for the total pressure requirement per the leachate sump pump design.

7. LEACHATE STORAGE TANKS

Leachate collected at TRL will be stored in the existing above-grade storage tank. The maximum design leachate generation rate flowing to the tank is 2,175,613 gallons per month which equates to an average leachate generation rate of 71,332 gallons per day or 9,536 ft^3 per day.

The existing leachate tank on site is 20 feet tall and has a 42 foot inside diameter (as shown in the leachate storage tank schematic in Figure 4) which results in a maximum storage volume of 27,709 ft^3. This results a maximum storage limit of:

$$\frac{27{,}709\ ft^3}{9{,}536\ ft^3/day} = 2.9\ days$$

This daily leachate generation rate mimics the maximum expected generation rate during the life of the landfill, which is approximately mid-life cycle. Geosyntec recommends that additional evaluation of the leachate storage capacity should occur as the landfill reaches this mid-life stage.

8. CONCLUSION

The design of the leachate transmission system is specific to TRL and takes into account the specifics of the landfill base grades, storage tank, forcemain configuration, and anticipated maximum leachate generation rate. If any of these variables were to change, additional review of the forcemain design should be implemented to ensure its proper operation.

TABLES

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Table 1. Required Sump Size and Pump Cycles
Tolson Rubble Landfill Expansion
Crofton, Anne Arundel County, Maryland

Parameter		Value	Units
Area		72.0	acres
Sump Sideslopes		2.0	H:V
Gravel Porosity		0.3	-
Pump Hose Diameter		1.5	inches
Min. Velocity in Hose		2.0	ft/sec
Impingement Rate		2,175,613	gal/mo
Drainage Flow Rate	q_{in}	49.5	gpm
Sump Width	W	30.0	ft
Sump Length	L	30.0	ft
Sump Depth	D	2.0	ft
Pump On Level	z_{on}	1.5	ft
Pump Off Level	z_{off}	0.5	ft
ΔOn/Off	H	1.0	ft
Max. Pool Area	A_m	1,300	ft^2
Perm. Pool Area	A_p	1,030	ft^2
Net Drainage Storage Volume	V	348.7	ft^3
		2,610	gal
Min. Pump Rate	$q_{p,min}$	11.0	gpm
Pump Rate	q_p	70	gpm
Time Pump Off	t_{off}	52.7	min
Time Pump On	t_{on}	127.5	min
Off/On Ratio	r	0.41	-
Cycles Per Day		8.0	-

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Table 2. Frictional Losses Between Sump and Leachate Storage Tank
Tolson Rubble Landfill Expansion
Crofton, Anne Arundel County, Maryland

Frictional Head Loss in Fittings						
Fitting	**Quantity**	**Diameter**		**Head Loss Coefficient, *K***	**Flow Velocity**	**Frictional Head Loss, h_{LF}**
		Nominal (in.)	**Inner (in.)**		**(ft/sec)**	**(ft)**
90° Ell (2 inch) [1]	1	2	2.08	0.9	6.61	0.61
Check Valve (2 inch) [2]	1	2	2.08	2.0	6.61	1.36
Branch 'T' (2 inch) [3]	1	2	2.08	0.8	6.61	0.54
90° Ell (4 inch) [1]	1	3	3.63	0.8	2.17	0.05
Ball Valve (4 inch) [4]	1	3	3.63	7.0	2.17	0.51
90° Ell (4 inch) [1]	15	3	3.63	0.8	2.17	0.82
Check Valve (4 inch) [2]	1	3	3.63	2.0	2.17	0.15
90° Ell (4 inch) [1]	1	3	3.63	0.8	2.17	0.05
					Sum of Fitting Frictional Head Losses (ft) =	**4.10**

Frictional Head Loss in Hose and Pipe						
Pipe	**Length, *L* (ft)**	**Inner Diameter (in.)**	**Flow Velocity (ft/sec)**	**Reynolds Number, *Re***	**Friction Factor, *f***	**Frictional Head Loss, h_{LP} (ft)**
2 inch Flexible Hose	110	1.50	12.71	1.1E+05	0.0178	39.24
4 inch HDPE Pipe (SDR11)	2,400	3.63	2.17	4.7E+04	0.0213	12.37
					Sum of Hose Frictional Head Losses (ft) =	**51.61**

Design Flow Rate (gpm) =	**70**
Total Head Loss (ft) =	**55.71**
Start Elevation (ft-msl) =	**100.0**
End Elevation (ft-msl) =	**160.0**
Required Pump Head (ft) =	**115.71**

Notes:

1. Assumed regular screwed 90° ell.
2. Assumed flanged check valve.
3. Assumed flanged 'T' fitting.
4. Assumed flanged globe valve.

FIGURES

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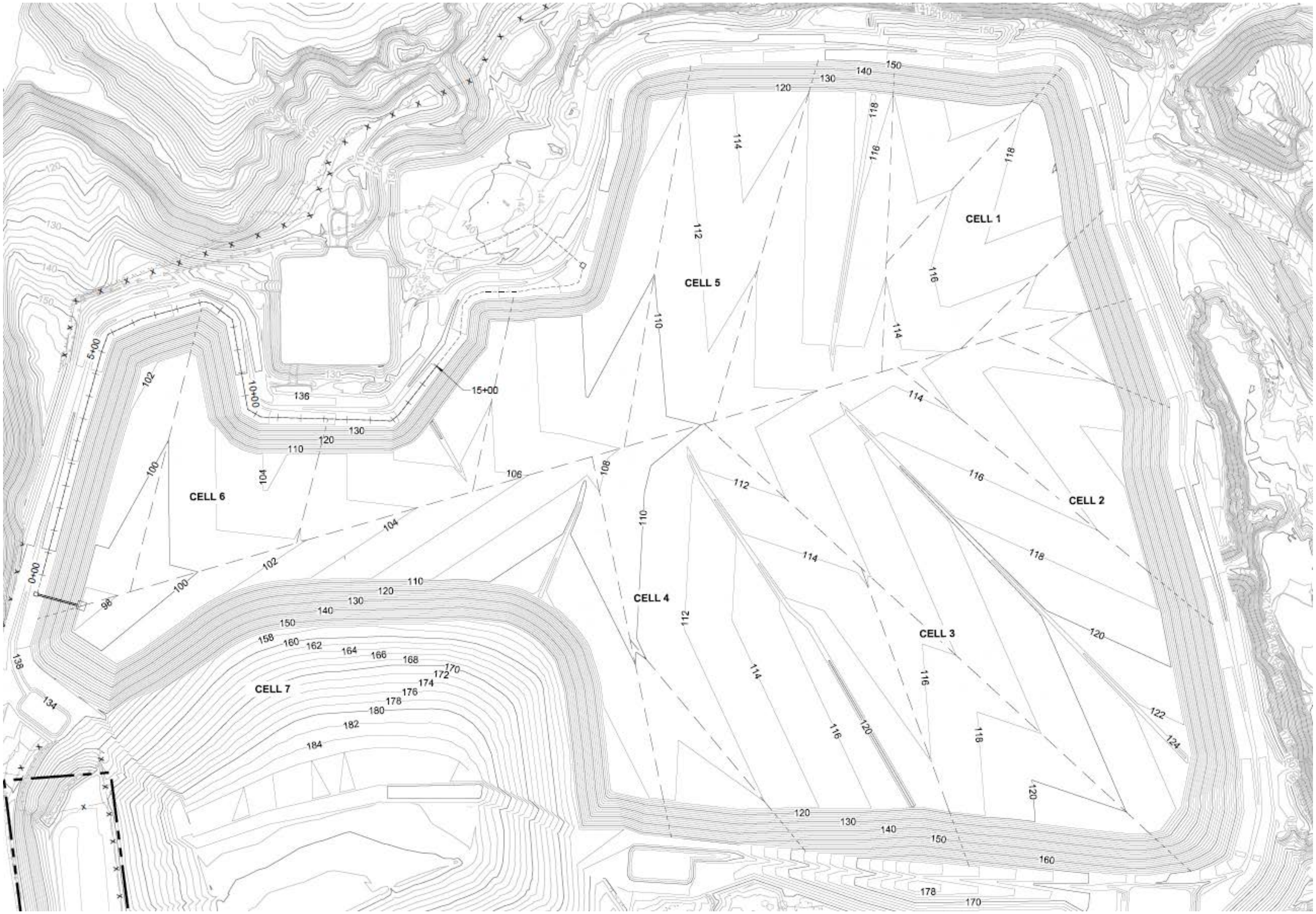


Figure 1. Base Grading Plan and Leachate Transmission System.

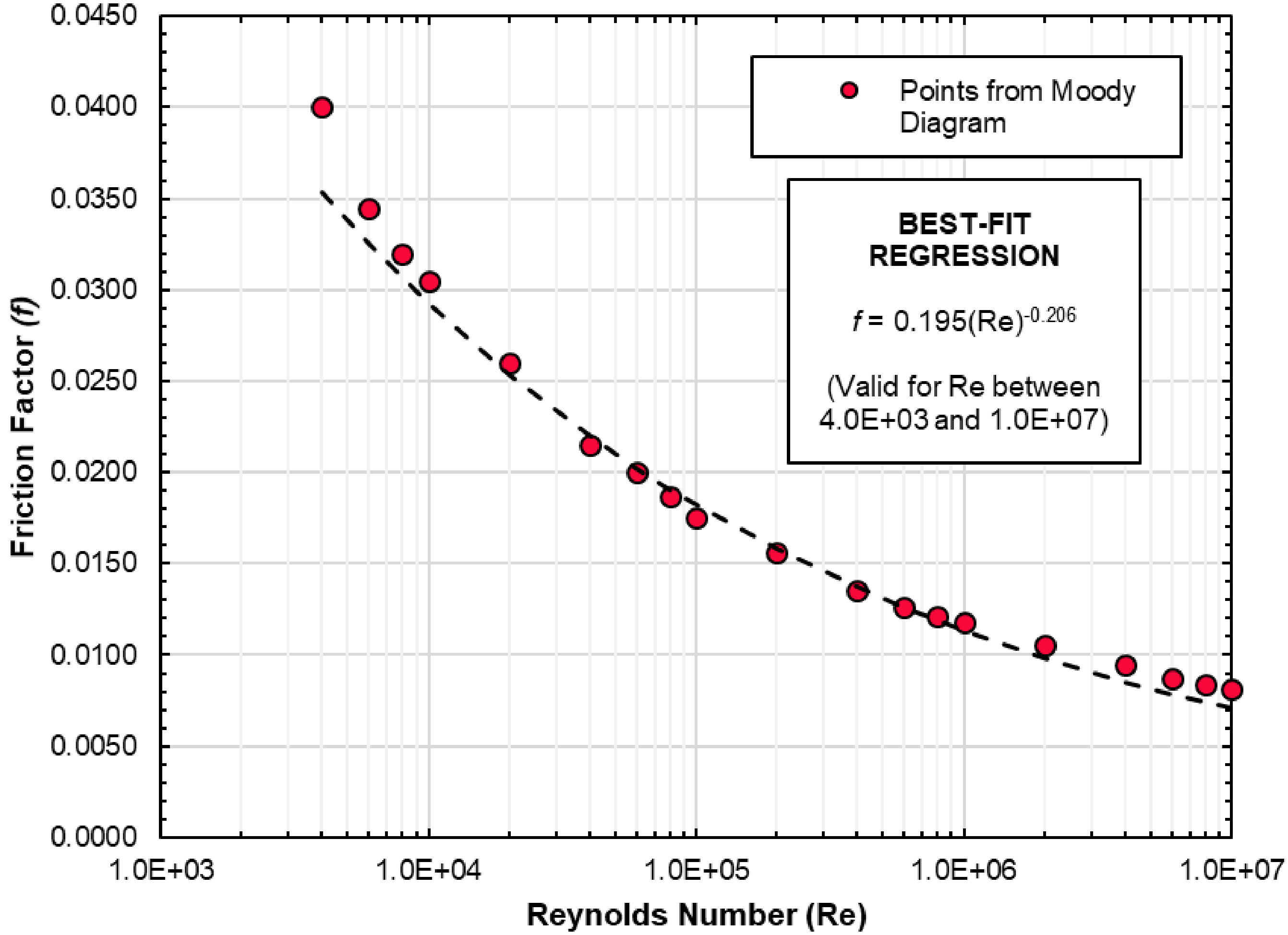


Figure 2. Moody Diagram.

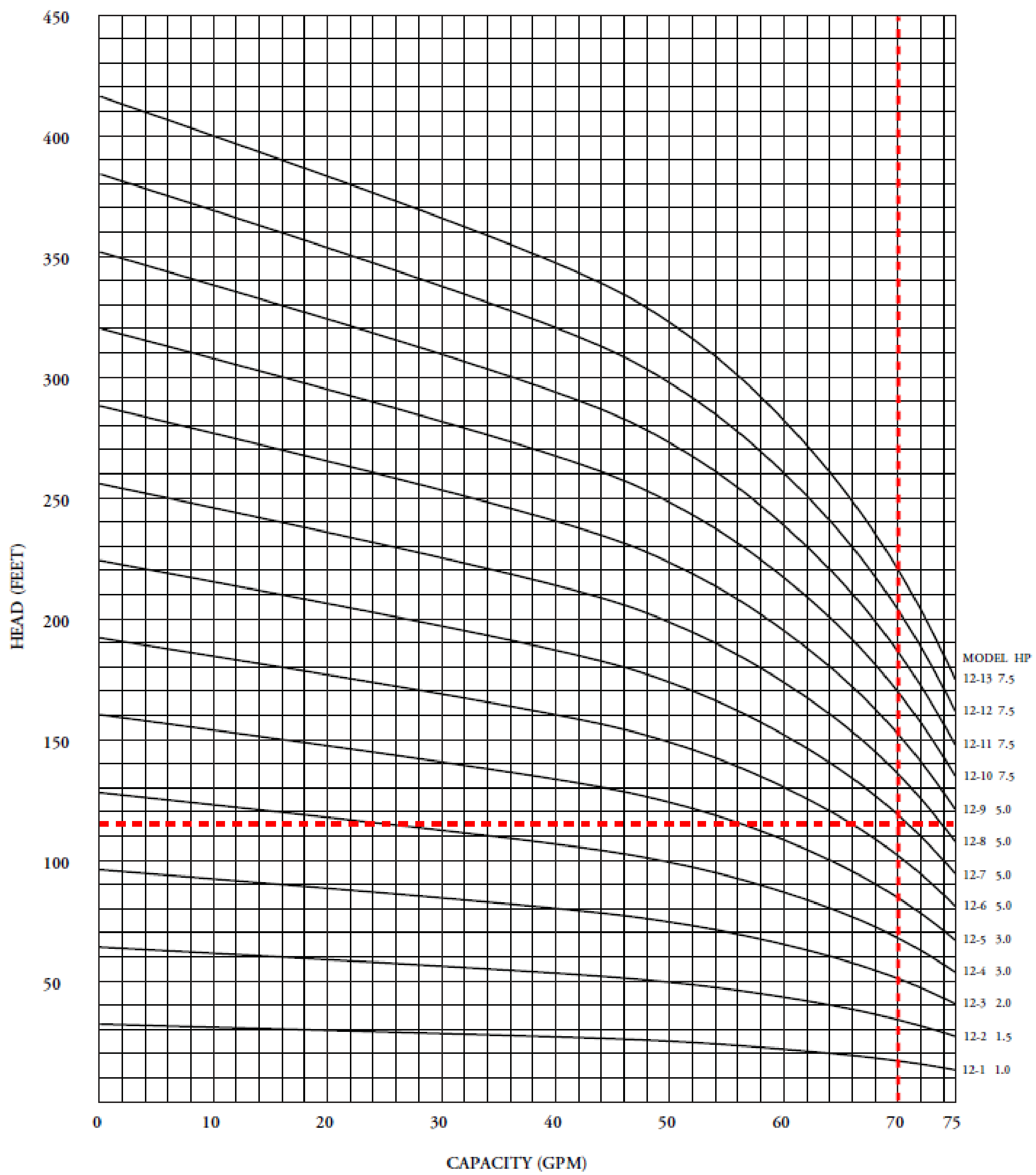
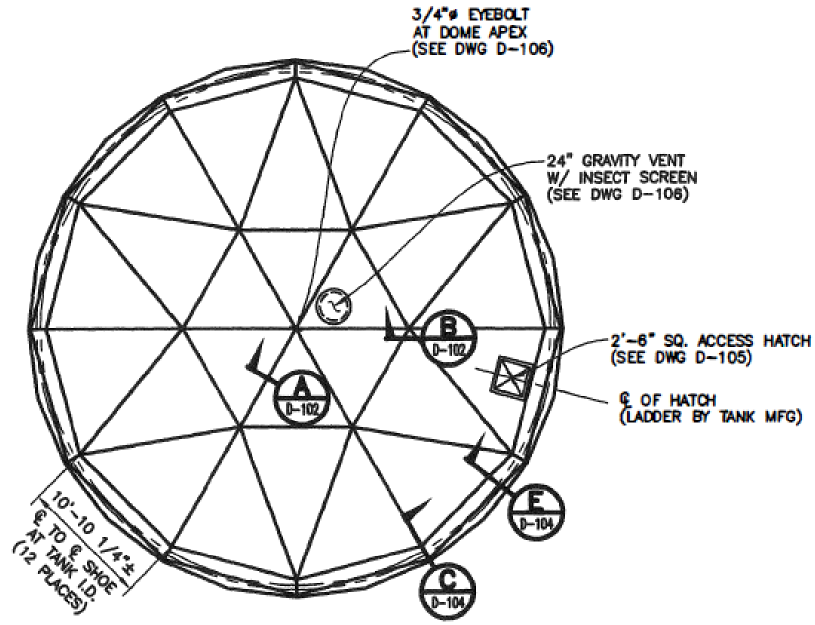
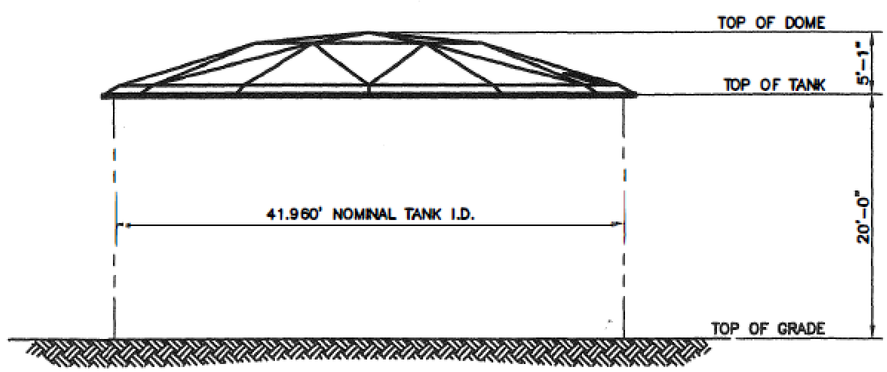


Figure 3. Pump Curve (EPG Series 12 SurePump™).



PLAN
(MIP# 1609232)



ELEVATION

Figure 4. Leachate Storage Tank Schematic.

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Appendix H.4: Leachate Collection Pipe Strength

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COMPUTATION COVER SHEET

Client: Tolson & Associates **Project:** TRL Vertical Expansion **Project/Proposal #:** ME1606 **Task:** 03

TITLE OF COMPUTATIONS: Leachate Collection Pipe Strength

COMPUTATIONS BY: Signature [signature] 07/16/2020 DATE

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ASSUMPTIONS AND PROCEDURES CHECKED BY: (Peer Reviewer) Signature [signature] 07/22/2020 DATE

Printed Name and Title: Davis Garrett, P.E. Engineer

COMPUTATIONS CHECKED BY: Signature [signature] 07/22/2020 DATE

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COMPUTATIONS BACKCHECKED BY: (Originator) Signature [signature] 07/29/2020 DATE

Printed Name and Title: Andrew Stallings, P.E. Engineer

APPROVED BY: (PM or Designate) Signature C.H. Pendleton 07/31/2020 DATE

Printed Name and Title: Carrie Pendleton, P.E. Principal

APPROVAL NOTES:

REVISIONS: (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

LEACHATE COLLECTION PIPE STRENGTH

1. PURPOSE

The purpose of this calculation is to evaluate the structural stability of the leachate collection pipes to be used as part of the leachate collection system (LCS) along the floor base of landfill cells, and the leachate transmission system (LTS) perimeter forcemain for the proposed Tolson Rubble Landfill (TRL) Expansion located in Crofton, Anne Arundel County, Maryland. The LCS and LTS pipes are evaluated for structural stability based on resistance to wall crushing, buckling, and excessive ring deflection.

2. BACKGROUND

The proposed leachate collection pipes will be high-density polyethylene (HDPE) perforated pipe with a nominal diameter of 8 inches (in.) and a standard dimension ratio (SDR) of 11. SDR is the ratio of outer diameter of the pipe to wall thickness. The parameters used for the design of the HDPE pipe are based on the *Plastic Pipe Institute® Handbook of Polyethylene Pipe* and provided in Attachment 1. The basic properties of the proposed LCS pipes are given below:

Parameter *	Leachate Collection Pipe **
Nominal Diameter	8 in.
Standard Dimension Ratio (SDR)	11
Outer Diameter	8.625 in.
Inner Diameter	6.96 in.
Wall Thickness	0.784 in

* Parameter references are provided in Attachment 1-1.

** Proposed LTS pipes are less than 8 in. nominal diameter. The analysis assumes the LTS pipes are 8 in. which are more vulnerable to loading failure compared to pipes with a smaller diameter.

The LCS pipes will be placed along the liner base grades shown in Figure 1. LTS pipes will be placed outside of the landfill footprint along the inside of the proposed perimeter access road. The proposed final grades for TRL are shown in Figure 2 (maximum elevation 244 ft-msl). The maximum waste thickness at TRL is expected to be approximately 140 ft.

3. INDUCED PIPE STRESSES

Evaluation of the stability of the leachate collection pipes is done based on engineering procedures described in *Plastic Pipe Institute® Handbook of Polyethylene Pipe*. To ensure the stability of the pipe, loads imposed on the pipe must be limited to stresses which will not cause failure of the pipe. Two typical loading conditions are analyzed:

- *During Construction*: The maximum pressure on the pipe induced by equipment during construction of the landfill liner.
- *After Closure*: The maximum pressure exerted on the pipe due to overburden loads of the landfill waste and cover material after the final grades have been achieved.

The LTS pipes will be buried approximately 2 ft below the ground surface and will be located off the edge of access road where no waste or final cover material will be placed. Therefore, the loading conditions will be the same both *During Construction* and *After Closure* for LTS pipes.

3.1 During Construction

The initial condition for the LCS assumes that the pipe is buried under 12 in. (1 ft) minimum of the drainage/protective layer (leachate collection pipe bedding materials) before construction equipment will cross the pipe. For the LTS, the pipes will be buried a minimum of 2 ft below ground surface. For the calculations, a concentrated load of 30,000 lbs from one tire is assumed to be applied above the crown of the pipe (based on Caterpillar 730 Articulated Haul Vehicle). The stress on the pipe induced by the construction equipment is calculated as follows:

$$\sigma_{equipment} = C_H \frac{IW_l}{LD} \tag{1}$$

where:

$\sigma_{equipment}$	=	stress induced on the pipe by construction equipment (psf)
I	=	impact factor
L	=	pipe length (ft)
C_H	=	load coefficient
D	=	pipe outer diameter (ft)
W_l	=	wheel load (pounds)

The *Handbook of Polyethylene Pipe* suggests an impact factor of 1.5 be used for calculations of highway vehicles traveling at low speeds over pipes which are 3 feet or longer. The load coefficient (C_H) is a function of the pipe burial depth (H), length (L), and outer diameter (D).

$$C_H = f\left(\frac{L}{2H}, \frac{D}{2H}\right)$$

The stress on the pipe induced by the overlying soil of unit weight (γ) is calculated as follows:

$$\sigma_{soil} = \gamma H \tag{2}$$

The stress applied to the perforated pipes is greater than that applied to a similar non-perforated pipe due to the reduction in supporting material. The stress increase for perforated pipe can be calculated by multiplying the stress calculated for a non-perforated pipe with a factor P_L which is calculated as follows:

$$P_L = \frac{L}{L - L_P} \tag{3}$$

where L_P is the total length of the perforation. The vertical stresses can then be calculated as:

$$\sigma_{construction} = P_L(\sigma_{equipment} + \sigma_{soil}) \tag{4}$$

3.2 <u>During Closure</u>

During post closure conditions, the LCS pipes will be subjected to overburden stresses due to the materials above the pipe (i.e., waste and final cover soils). The vertical stresses for a perforated pipe can be calculated as follows:

$$\sigma_{closure} = P_L I_s(\gamma H) \tag{5}$$

where:

P_L	=	perforated pipe factor
γ	=	unit weight of waste (pcf)
H	=	maximum depth of waste in the landfill (ft)
I_s	=	influence factor for vertical stress

4. FACTOR OF SAFETY

4.1 Case 1: Pipes installed with overburden soil less than 50 ft

For pipes installed within a trench or underneath an embankment with an overburden soil thickness less than 50 ft, the following calculation procedure can be used:

4.1.1 Wall Crushing

Wall crushing can occur when the stresses in the pipe wall due to external vertical pressure exceed the compressive strength of the pipe material. The pipe wall compressive stress can be calculated as:

$$\sigma_{compressive} = \frac{\sigma_{max} \cdot (SDR)}{2} \tag{6}$$

where:

$\sigma_{compressive}$	=	compressive design strength of the pipe (psi)
SDR	=	standard dimension ratio of the pipe (i.e., outer diameter/wall thickness)
σ_{max}	=	maximum stress applied to the pipe (psi)

The calculated pipe wall compressive stress should be less than the allowable compressive stress shown in Attachment 1-2.

4.1.2 Wall Buckling

Wall buckling, a longitudinal wrinkling in the pipe wall, can occur when the external vertical pressure exceeds the critical buckling pressure of the pipe/bedding aggregate system. The factor of safety against pipe wall buckling can be calculated using the following equation adapted from the *Plastic Pipe Institute® Handbook of Polyethylene Pipe.*

$$FS_{wb} = \frac{5.65}{\sigma_{max}} \left[\frac{RB'E'E}{12(SDR-1)^3} \right]^{1/2} \tag{7}$$

where:

FS_{wb}	=	factor of safety against pipe wall buckling
σ_{max}	=	maximum stress applied to the pipe (psi)
E'	=	modulus of soil reaction for pipe bedding (Attachment 1-3) (psi)

E	=	modulus of elasticity of the pipe material (Attachment 1-4) (psi)
SDR	=	standard dimension ratio of the pipe
B'	=	support factor, $B' = [1 + 4e^{-0.065H}]^{-1}$
R	=	buoyancy reduction factor, $R = 1 - 0.33\, H_{GW}/H$
H_{GW}	=	height of ground water above pipe

4.1.3 Ring Deflection

Ring deflection is the change in vertical diameter of the pipe as the pipe/bedding aggregate system deforms under the external vertical pressure. The pipe ring deflection may be estimated by the following equation, according to the *Plastic Pipe Institute® Handbook of Polyethylene Pipe*:

$$\frac{\Delta X}{D_M} = \frac{1}{144}\left(\frac{KL_{DL}P_E + KP_L}{2\frac{E}{3}\left(\frac{1}{SDR-1}\right)^3 + 0.061F_sE'}\right) \tag{8}$$

where:

ΔX	=	horizontal deflection (in.)
D_M	=	mean diameter (in.) ($D_o - t$)
P_E	=	pressure induced by earth (psf)
P_L	=	pressure induced by live load (psf)
F_s	=	soil support factor (Attachment 1-5)
K	=	bedding factor, typically 0.1
L_{DL}	=	deflection lag factor, typically between 1.0 and 1.5 (1.0 often chosen for soil column loads, 1.5 conservatively used)
E'	=	modulus of soil reaction for pipe bedding (Attachment 1-3) (psi)
E	=	modulus of elasticity of the pipe material (Attachment 1-4) (psi)

According to *Plastic Pipe Institute® Handbook of Polyethylene Pipe*, the safe deflection limit for non-pressurized pipe ($\Delta X/D_M$) is 7.5 percent, which contains a factor of safety greater than 3 (Attachment 1-6).

4.2 Case 2: Pipes installed with overburden soil greater than 50 ft

For pipes installed with overburden soil thickness greater than 50 ft, significant arching effect will occur, and the following calculation procedures are recommended by the *Plastic Pipe Institute® Handbook of Polyethylene Pipe*.

4.2.1 Earth Pressure due to Arching Effect

A vertical arching factor (VAF) defined as follows can be used to account for the arching effect.

$$VAF = 0.88 - 0.71\frac{S_A - 1}{S_A + 2.5} \tag{9}$$

where S_A is the hoop thrust stiffness ratio, which can be calculated as follows:

$$S_A = \frac{1.43 M_s r_{cent}}{EA} \tag{10}$$

where:

r_{cent}	=	radius to centroidal axis of the pipe
M_s	=	one-dimensional modulus of soil (Attachment 1-9)
E	=	elastic modulus of pipe material
A	=	wall thickness of solid-wall pipes (in.)

The radial-directed pressure induced on the pipe can then be calculated as:

$$p_{rd} = VAF\sigma_{max} \tag{11}$$

where σ_{max} is the overburden calculated without consideration of arching effect.

4.2.2 Wall Crushing

$$\sigma = \frac{p_{rd} SDR}{2} \tag{12}$$

where p_{rd} is the radial-directed earth pressure (psi).

The calculated pipe wall compressive stress should be less than the allowable compressive stress shown in Attachment 1-2.

4.2.3 Wall Buckling

The Moore-Selig equation can be used to estimate the critical earth pressure (P_{cr}) at which wall buckling may occur:

$$P_{cr} = \frac{2.4\varphi R_H}{D_M}(EI)^{1/3}\left(\frac{E_s}{1-\mu}\right)^{2/3} \tag{13}$$

where:

φ	=	calibration factor (0.55 for granular soil)
R_H	=	geometry factor (1.0 for deep uniform fill)
I	=	pipe wall moment of inertia ($t^3/12$ for solid wall pipe, t = wall thickness)
E_s	=	secant modulus of the soil
M	=	Poisson's ratio

The secant modulus (E_s) can be calculated as:

$$E_s = \frac{M_s(1+\mu)(1-2\mu)}{1-\mu} \tag{14}$$

The factor of safety against wall buckling can be calculated as:

$$FS_{wb} = \frac{P_{CR}}{\sigma_{max}} \tag{15}$$

4.2.4 Ring Deflection

The ring deflection of pipe buried under deep fill can be calculated using the Watkins-Gaube Graph. To use the Watkins-Gaube Graph, first determine the relative stiffness between the pipe and soil, which is given by the Rigidity Factor, defined as follows:

$$R_F = \frac{12E_s(SDR-1)^3}{E} \tag{16}$$

With the calculated rigidity factor, a deformation factor (D_F) can be determined from the Watkins Gaube Graph (Attachment 1-7). The deflection ratio can be calculated as follows:

$$\frac{\Delta X}{D_M} = \frac{\sigma_{max}}{E_s} D_F \tag{17}$$

5. CALCULATIONS

The stresses induced by the loading are calculated as follows.

5.1 During Construction – LCS and LTS Pipes

The load coefficient is taken from Attachment 1-8 for this calculation. The tire width of Caterpillar 730 haul trucks is approximately 2 ft. The analysis conservatively assumes the tire width of 1.5 ft and a 1H:2V load distribution. Therefore, for a depth (H) of 2 ft and a pipe outer diameter of 8.625 in. (0.719 ft):

$$L = 1.5\, ft + (2 \times 2\, ft \times 1H{:}2V) = 3.5\, ft$$

$$L/2H = \frac{3.5\, ft}{2 \times 2\, ft} = 0.875$$

$$D/2H = \frac{0.719\, ft}{2 \times 2\, ft} = 0.180$$

The corresponding C_H = 0.188 (Attachment 1-8).

Stress induced by construction equipment:

$$\sigma_{equipment} = \left(0.188 \times \frac{1.5 \times 30{,}000\, lbs}{(3.5\, ft)\left(\frac{8.625}{12} ft\right)}\right) \times \left(\frac{ft^2}{144\, in^2}\right) = 23.4\, psi$$

Stress induced by overlying soil (e.g., gravel surrounding the leachate collection pipes):

$$\sigma_{soil} = (135\, pcf \times 2\, ft) \times \left(\frac{1\, ft^2}{144\, in.^2}\right) = 1.9\, psi$$

Assuming that the leachate collection pipe will have 0.5-in. diameter perforations (the final design size may be 3/8 in.) spaced every 6-in., the factor to account for perforations is:

$$P_L = 6\ in./(6\ in. - 0.5\ in.) = 1.09$$

Thus, total stress induced on pipes during construction:

$$\sigma_{construction} = 1.09 \times (23.4 + 1.9) = 27.6\ psi$$

5.2 After Closure – LCS Pipes

The assumed unit weight of the waste is 50 pcf and the maximum thickness of waste above the liner for the proposed final grade is approximately 140 ft. Based on the design chart (Figure 3: x/H = 0; L/H = ∞; z/H = 1) for the given embankment stress, the influence factor is estimated to be approximately 1.0 for the pipe buried under the maximum height of the landfill. To account for increased stresses in a perforated pipe, the stress in the pipe obtained in the calculation above is multiplied by the perforation factor to obtain the maximum stress after closure as:

$$\sigma_{closure} = 1.09 \times 1.0 \times 50\ pcf \times 140\ ft \times \left(\frac{1\ ft^2}{144\ in.^2}\right) = 53.0\ psi$$

5.3 Pipe Structural Capacity Calculations

The modulus of soil reaction, *E'*, for the pipe bedding material is based on information provided in *Handbook of Polyethylene Pipe*. Values range from 1,000 to 2,500 psi based on 95 percent compaction and cover soil thickness (Attachment 1-3). For this analysis, the value of *E'* is conservatively selected to be 1,000 psi for construction conditions. For post-closure conditions, the value of M_s is selected to be 4,600 psi (Attachment 1-9).

The modulus of elasticity of the pipe varies based on the load duration. For this analysis, the short-term modulus (2-hr duration) of 71,000 psi is used during construction stage and a long-term modulus (100 years duration) of 27,000 psi is used for post-closure conditions (Attachment 1-4). Poisson's ratio is assumed to be 0.2.

The structural capacity calculation results are shown in Tables 1 and 2. A summary of the calculated values and allowable values for the pipe under these conditions is provided below:

Design Parameters	During Construction – LCS/LTS Pipes	After Closure – LCS Pipes	Requirement
Pipe Wall Compressive Stress	151.6 psi	244.5 psi	< 1,000 psi
F.S. Wall Buckling	7.42	9.76	> 2.0
Ring Deflection Ratio	3.61 %	1.79 %	< 7.5 %

6. CONCLUSION

The pipe wall compressive stresses and ring deflection ratios computed for this calculation are less than the allowable values, and the calculated factor of safety against wall buckling is greater than 2.0. The selected leachate collection and transmission pipes will withstand the anticipated loads that may be imposed during construction and after closure of the landfill.

REFERENCES

Plastic Pipe Institute, "Handbook of Polyethylene Pipe," Second Edition, http://plasticpipe.org/publications/pe_handbook.html.

Perloff, W. H., G. Y. Baladi, and M. E. Harr [1967]. "Stress Distribution within and under Long Elastic Embankments: Research Paper," Publication FHWA/IN/JHRP-67/14. Joint Highway Research Project, Indiana Department of Transportation and Purdue University, West Lafayette, Indiana.

TABLES

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Table 1. Leachate Collection Pipe Structural Capacity Calculation
Tolson Rubble Landfill Expansion
Crofton, Anne Arundel County, MD

During Construction - LCS and LTS Pipes

General Input Parameters													
σ_{max} =	27.6	psi	SDR =	11		t =	0.784	in.					
D_i =	6.96	in.	D_o =	8.625	in.								
Wall Crushing													
σ_y =	1,000	psi	σ =	151.6	psi				**OK**	$\sigma < \sigma_y$			
Ring Deflection													
K =	0.1		L_{DL} =	1.5		F_s =	1.1		**OK**	$\Delta X/D_M$ =	3.61%	< 7.5%	
E_N =	1,500	psi	E_N/E' =	1.5									
Wall Buckling													
E' =	1,000	psi	E =	71,000	psi	B' =	0.222		**OK**	FS_{wb} =	7.42	> 2	
H =	2	ft	H_{GW} =	0.0	ft	R =	1.0						

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Table 2. Leachate Collection Pipe Structural Capacity Calculation
Tolson Rubble Landfill Expansion
Crofton, Anne Arundel County, MD

After Closure - LCS Pipes

General Input Parameters

σ_{max} =	53.0	psi	SDR =	11		t =	0.784	in.					
D_i =	6.96	in.	D_o =	8.625	in.								

Wall Crushing

σ_y =	1,000	psi	M_s =	4,600	psi	r_{cent} =	3.92	in.	**OK**	$\sigma < \sigma_y$			
E =	27,000	psi	S_A =	1.218		VAF =	0.838						
p_{rd} =	44.5	psi	σ =	244.5	psi								

Ring Deflection

μ =	0.2		E_s =	4,140	psi	R_F =	1,840		**OK**	$\Delta X/D_M$ =	1.79%	< 7.5%	
D_F =	1.4												

Wall Buckling

P_{cr} =	517.4	psi							**OK**	FS_{wb} =	9.76	> 2	

FIGURES

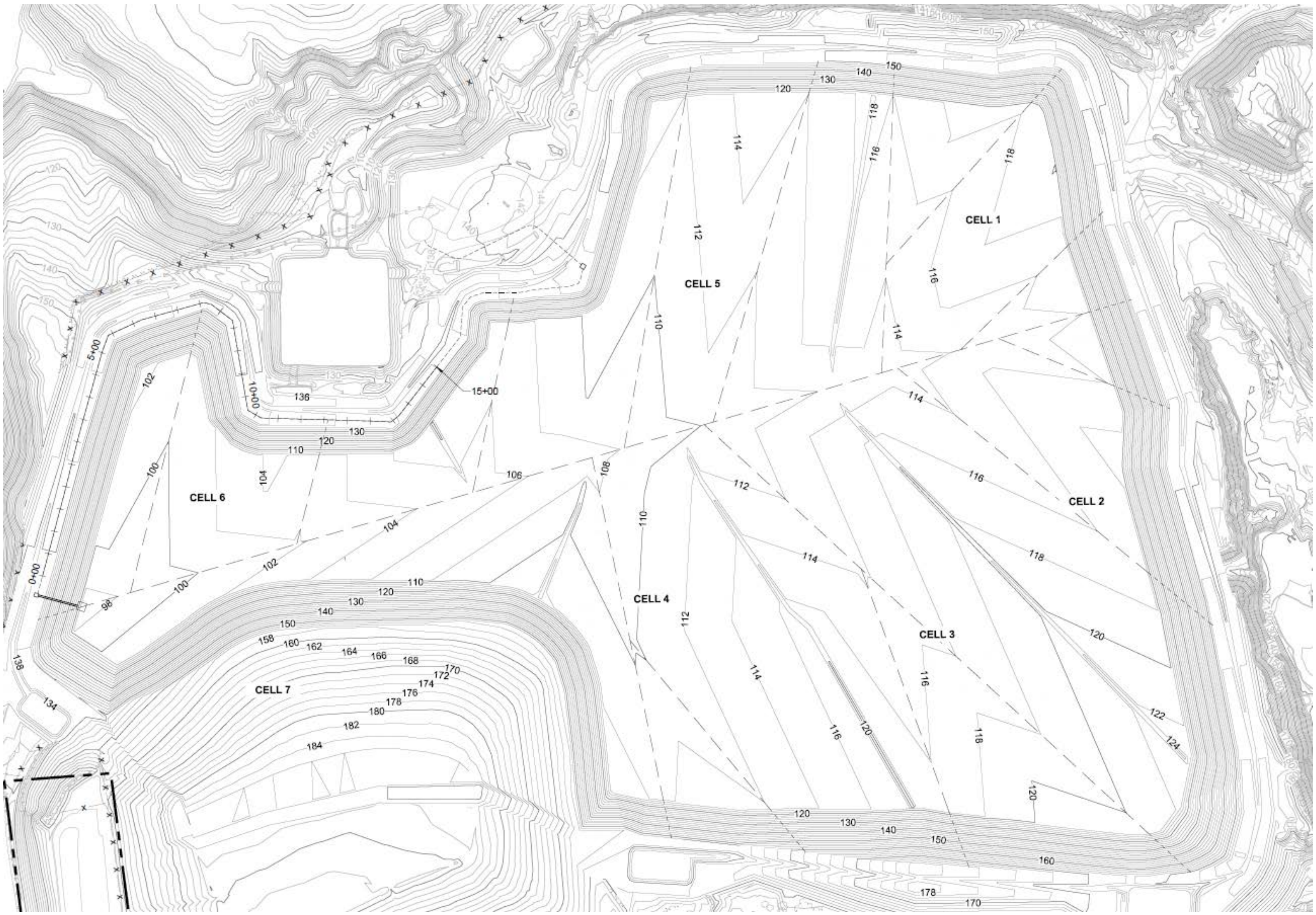


Figure 1. Base Grading Plan.

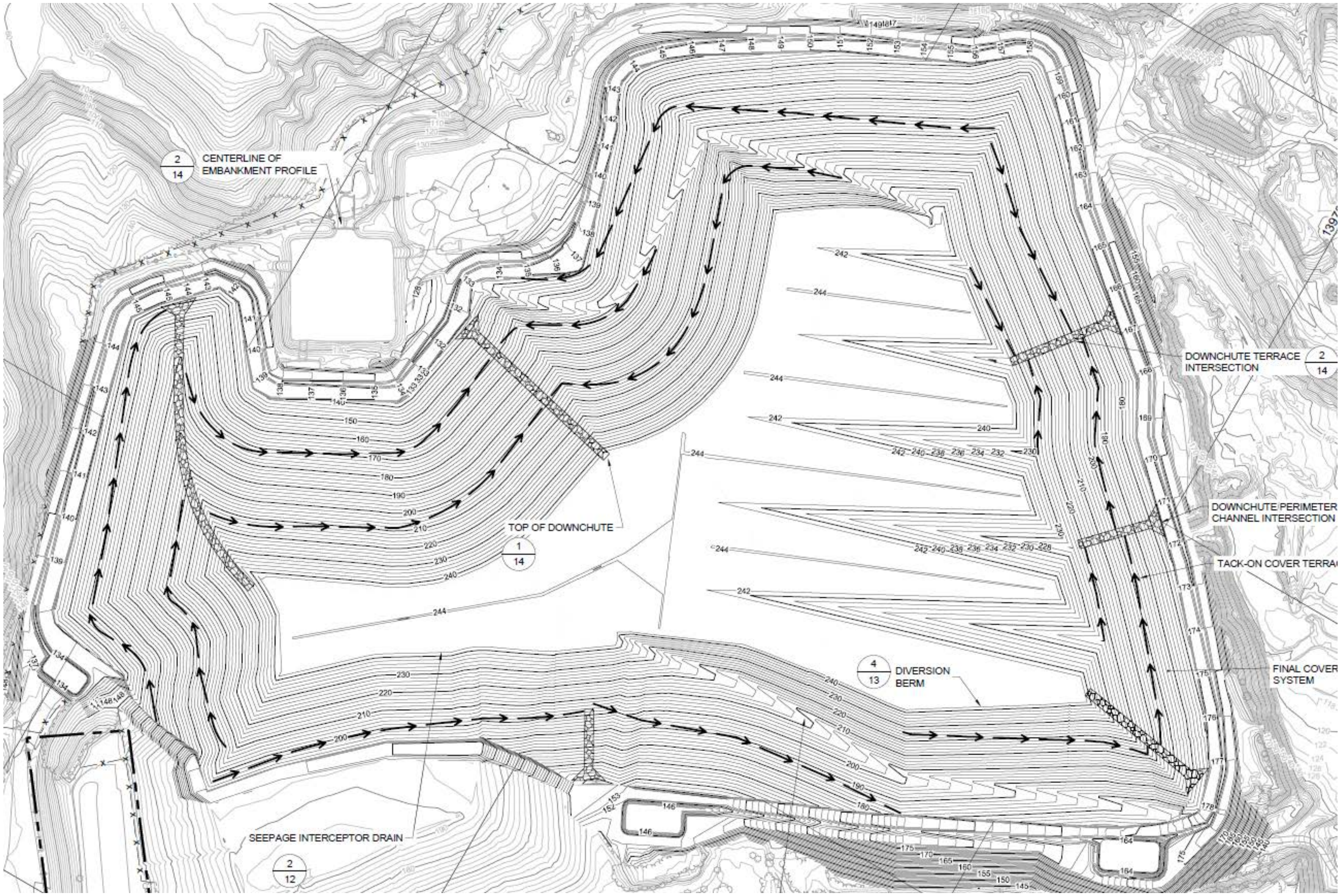


Figure 2. Final Grading Plan.

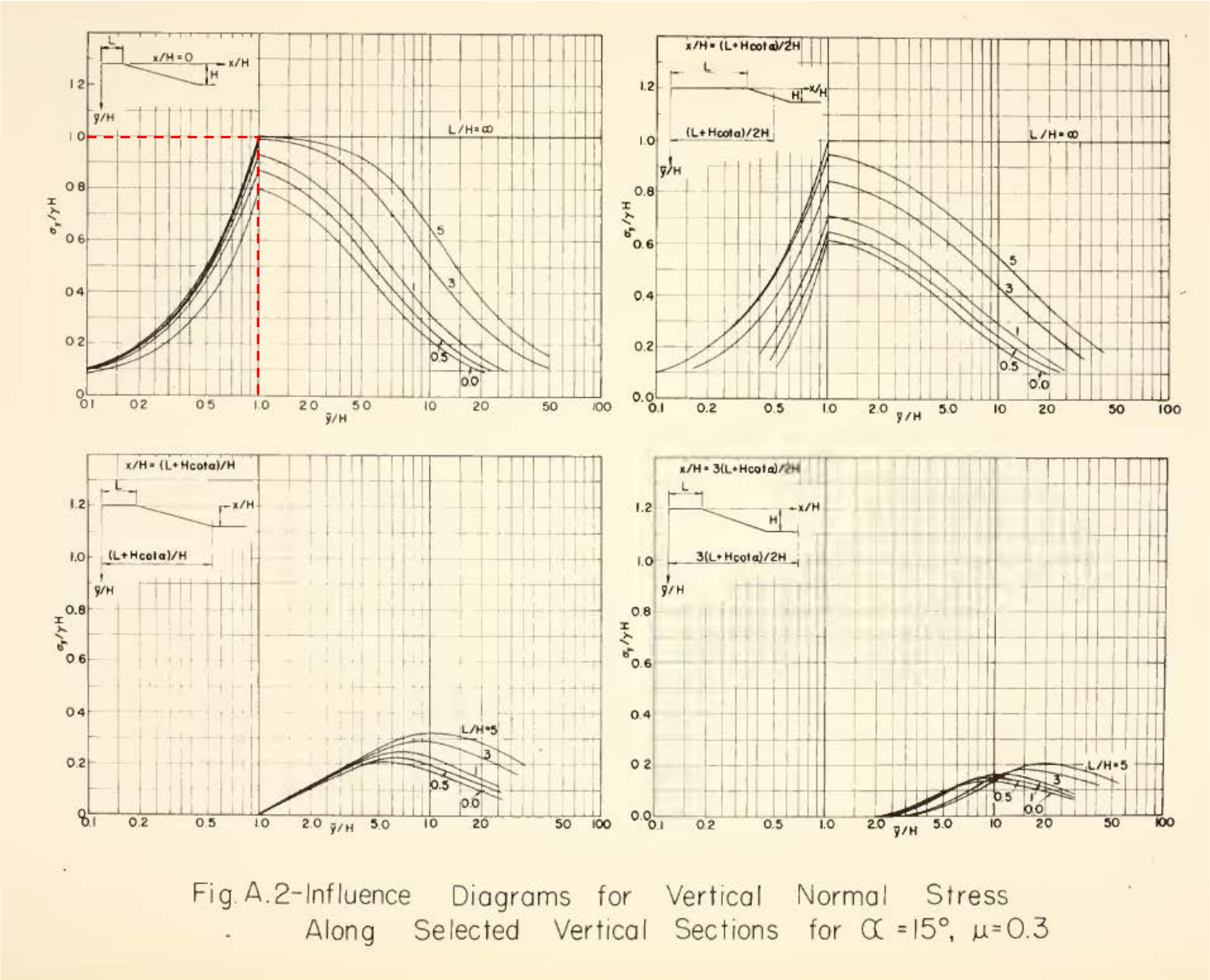


Figure 3. Vertical Stress Distribution Underneath an Embankment (Perloff et al., 1967).

ATTACHMENT 1

Pipe Performance Literature

Attachment 1-1

HDPE IRON PIPE SIZE (IPS) PRESSURE PIPE PE4710

		DR 7 (333 psi)			DR 7.3 (318 psi)			DR 9 (250 psi)			DR 9.3 (241 psi)			DR 11 (200 psi)			DR 13.5 (160 psi)		
Pipe Size	Avg OD	Min Wall	Avg ID	Weight lb/ft	Min Wall	Avg ID	Weight lb/ft	Min Wall	Avg ID	Weight lb/ft	Min Wall	Avg ID	Weight lb/ft	Min Wall	Avg ID	Weight lb/ft	Min Wall	Avg ID	Weight lb/ft
1/2	0.840	0.120	0.59	0.12	0.115	0.60	0.11	0.093	0.64	0.10	0.090	0.65	0.09	0.076	0.68	0.08	0.062	0.71	0.07
3/4	1.050	0.150	0.73	0.19	0.144	0.75	0.18	0.117	0.80	0.15	0.113	0.81	0.15	0.095	0.85	0.12	0.078	0.88	0.10
1	1.315	0.188	0.92	0.29	0.180	0.93	0.28	0.146	1.01	0.23	0.141	1.02	0.23	0.120	1.06	0.20	0.097	1.11	0.16
2	2.375	0.339	1.66	0.95	0.325	1.69	0.91	0.264	1.82	0.77	0.255	1.83	0.74	0.216	1.92	0.64	0.176	2.00	0.53
3	3.500	0.500	2.44	2.06	0.479	2.48	1.98	0.389	2.68	1.66	0.376	2.70	1.61	0.318	2.83	1.39	0.259	2.95	1.16
4	4.500	0.643	3.14	3.40	0.616	3.19	3.28	0.500	3.44	2.75	0.484	3.47	2.67	0.409	3.63	2.30	0.333	3.79	1.91
5 3/8	5.375	0.768	3.75	4.85	0.736	3.81	4.68	0.597	4.11	3.92	0.578	4.15	3.81	0.489	4.34	3.29	0.398	4.53	2.73
5	5.563	0.795	3.88	5.20	0.762	3.95	5.02	0.618	4.25	4.20	0.598	4.29	4.08	0.506	4.49	3.52	0.412	4.69	2.92
6	6.625	0.946	4.62	7.36	0.908	4.70	7.12	0.736	5.06	5.96	0.712	5.11	5.79	0.602	5.35	4.99	0.491	5.58	4.15
7	7.125	0.976	5.06	8.23	0.976	5.06	8.23	0.792	5.45	6.89	0.766	5.50	6.70	0.648	5.75	5.78	0.528	6.01	4.80
8	8.625	1.232	6.01	12.48	1.182	6.12	12.06	0.958	6.59	10.09	0.927	6.66	9.81	0.784	6.96	8.46	0.639	7.27	7.03
10	10.750	1.536	7.49	19.40	1.473	7.63	18.74	1.194	8.22	15.68	1.156	8.30	15.24	0.977	8.68	13.14	0.796	9.06	10.92
12	12.750	1.821	8.89	27.28	1.747	9.05	26.36	1.417	9.75	22.07	1.371	9.84	21.44	1.159	10.29	18.49	0.944	10.75	15.36
14	14.000	2.000	9.76	32.90	1.918	9.93	31.78	1.556	10.70	26.61	1.505	10.81	25.85	1.273	11.30	22.30	1.037	11.80	18.52
16	16.000	2.286	11.15	42.97	2.192	11.35	41.51	1.778	12.23	34.75	1.720	12.35	33.76	1.455	12.92	29.12	1.185	13.49	24.19
18	18.000	2.571	12.55	54.37	2.466	12.77	52.53	2.000	13.76	43.97	1.935	13.90	42.73	1.636	14.53	36.84	1.333	15.17	30.61
20	20.000	2.857	13.94	67.13	2.740	14.19	64.85	2.222	15.29	54.28	2.151	15.44	52.77	1.818	16.15	45.49	1.481	16.86	37.79
24	24.000	3.429	16.73	96.68	3.288	17.03	93.39	2.667	18.35	78.18	2.581	18.53	75.98	2.182	19.37	65.52	1.778	20.23	54.44
26	26.000							2.889	19.88	91.75	2.796	20.07	89.17	2.364	20.99	76.89	1.926	21.92	63.89
28	28.000							3.111	21.40	106.40	3.011	21.62	103.42	2.545	22.60	89.15	2.074	23.60	74.09
30	30.000							3.333	22.93	122.13	3.226	23.16	118.72	2.727	24.22	102.35	2.222	25.29	85.04
32	32.000													2.909	25.83	116.46	2.370	26.98	96.76
34	34.000													3.091	27.45	131.48	2.519	28.66	109.26
36	36.000													3.273	29.06	147.41	2.667	30.35	122.49

Attachment 1-2

Appendix C

Allowable Compressive Stress

Table C.1 lists allowable compressive stress values for 73°F (23°C). Values for allowable compressive stress for other temperatures may be determined by application of the same multipliers that are used for pipe pressure rating (See Table A.2).

TABLE C.1
Allowable Compressive Stress for 73°F (23°C)

	Pe Pipe Material Designation Code [1]					
	PE 2406 PE 2708		PE3408 PE 3608 PE 3708 PE 3710 PE 4708		PE 4710	
	psi	MPa	psi	MPa	psi	MPa
Allowable Compressive Stress	800	5.52	1000	6.90	1150	7.93

(1) See Chapter 5 for an explanation of the PE Pipe Material Designation Code.

Attachment 1-3

TABLE 3-8
Values of E' for Pipe Embedment (See Duncan and Hartley[10])

Type of Soil	Depth of Cover, ft	E' for Standard AASHTO Relative Compaction, lb/in^2			
		85%	90%	95%	100%
Fine-grained soils with less than 25% sand content (CL, ML, CL-ML)	0-5	500	700	1000	1500
	5-10	600	1000	1400	2000
	10-15	700	1200	1600	2300
	15-20	800	1300	1800	2600
Coarse-grained soils with fines (SM, SC)	0-5	600	1000	1200	1900
	5-10	900	1400	1800	2700
	10-15	1000	1500	2100	3200
	15-20	1100	1600	2400	3700
Coarse-grained soils with little or no fines (SP, SW, GP, GW)	0-5	700	1000	1600	2500
	5-10	1000	1500	2200	3300
	10-15	1050	1600	2400	3600
	15-20	1100	1700	2500	3800

Attachment 1-4

Appendix B
Apparent Elastic Modulus

B.1 – Apparent Elastic Modulus for the Condition of Either a Sustained Constant Load or a Sustained Constant Deformation

B.1.1 – Design Values for the Base Temperature of 73°F (23°C)

TABLE B.1.1
Apparent Elastic Modulus for 73°F (23°C)

During Construction

After Construction

Duration of Sustained Loading	Design Values For 73°F (23°C) (1,2,3)					
	PE 2XXX		PE3XXX		PE4XXX	
	psi	MPa	psi	MPa	psi	MPa
0.5hr	62,000	428	78,000	538	82,000	565
1hr	59,000	407	74,000	510	78,000	538
$\boxed{\text{2hr}}$	57,000	393	$\boxed{\text{71,000}}$	490	74,000	510
10hr	50,000	345	62,000	428	65,000	448
12hr	48,000	331	60,000	414	63,000	434
24hr	46,000	317	57,000	393	60,000	414
100hr	42,000	290	52,000	359	55,000	379
1,000hr	35,000	241	44,000	303	46,000	317
1 year	30,000	207	38,000	262	40,000	276
10 years	26,000	179	32,000	221	34,000	234
50 years	22,000	152	28,000	193	29,000	200
$\boxed{\text{100 years}}$	21,000	145	$\boxed{\text{27,000}}$	186	28,000	193

(1) Although there are various factors that determine the exact apparent modulus response of a PE, a major factor is its ratio of crystalline to amorphous content – a parameter that is reflected by a PE's density. Hence, the major headings PE2XXX, PE3XXX and, PE4XXX, which are based on PE's Standard Designation Code. The first numeral of this code denotes the PE's density category in accordance with ASTM D3350 (An explanation of this code is presented in Chapter 5).

(2) The values in this table are applicable to both the condition of sustained and constant loading (under which the resultant strain increases with increased duration of loading) and that of constant strain (under which an initially generated stress gradually relaxes with increased time).

(3) The design values in this table are based on results obtained under uni-axial loading, such as occurs in a test bar that is being subjected to a pulling load. When a PE is subjected to multi-axial stressing its strain response is inhibited, which results in a somewhat higher apparent modulus. For example, the apparent modulus of a PE pipe that is subjected to internal hydrostatic pressure – a condition that induces bi-axial stressing – is about 25% greater than that reported by this table. Thus, the Uni-axial condition represents a conservative estimate of the value that is achieved in most applications.

It should also be kept in mind that these values are for the condition of continually sustained loading. If there is an interruption or a decrease in the loading this, effectively, results in a somewhat larger modulus.

In addition, the values in this table apply to a stress intensity ranging up to about 400psi, a value that is seldom exceeded under normal service conditions.

Attachment 1-5

TABLE 3-9
Values of E'_N, Native Soil Modulus of Soil Reaction, Howard [3]

Native In Situ Soils				
Granular		Cohesive		E'_N (psi)
Std. Pentration ASTM D1586 Blows/ft	Description	Unconfined Compressive Strength (TSF)	Description	
> 0 - 1	very, very loose	> 0 - 0.125	very, very soft	50
1 - 2	very loose	0.125 - 0.25	very soft	200
2 - 4	very loose	0.25 - 0.50	soft	700
4 - 8	loose	0.50 - 1.00	medium	1,500
8 - 15	slightly compact	1.00 - 2.00	stiff	3,000
15 - 30	compact	2.00 - 4.00	very stiff	5,000
30 - 50	dense	4.00 - 6.00	hard	10,000
> 50	very dense	> 6.00	very hard	20,000
Rock	–	–	–	50,000

Loose gravel

TABLE 3-10
Soil Support Factor, F_S

E'_N/E'	B_d/D_o 1.5	B_d/D_o 2.0	B_d/D_o 2.5	B_d/D_o 3.0	B_d/D_o 4.0	B_d/D_o 5.0
0.1	0.15	0.30	0.60	0.80	0.90	1.00
0.2	0.30	0.45	0.70	0.85	0.92	1.00
0.4	0.50	0.60	0.80	0.90	0.95	1.00
0.6	0.70	0.80	0.90	0.95	1.00	1.00
0.8	0.85	0.90	0.95	0.98	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00
1.5	1.30	1.15	1.10	1.05	1.00	1.00
2.0	1.50	1.30	1.15	1.10	1.05	1.00
3.0	1.75	1.45	1.30	1.20	1.08	1.00
5.0	2.00	1.60	1.40	1.25	1.10	1.00

Attachment 1-6

crown may completely reverse its curvature inward and collapse. See Figure 3-1A. A deflection limit of 7.5% provides at least a 3 to 1 safety factor against reverse curvature.

Bending strain occurs in the pipe wall as a result of ring deflection—outer-fiber tensile strain at the pipe springline and outer-fiber compressive strain at the crown and invert. While strain limits of 5% have been proposed, Jansen [12] reported that, on tests of PE pipe manufactured from pressure-rated resins and subjected to soil pressure only, "no upper limit from a practical design point of view seems to exist for the bending strain." In other words, as deflection increases, the pipe's performance limit will not be overstraining but reverse curvature collapse.

Thus, for non-pressure applications, a 7.5 percent deflection limit provides a large safety factor against instability and strain and is considered a safe design deflection. Some engineers will design profile wall pipe and other non-pressure pipe applications to a 5% deflection limit, but allow spot deflections up to 7.5% during field inspection.

The deflection limits for pressurized pipe are generally lower than for non-pressurized pipe. This is primarily due to strain considerations. Hoop strain from pressurization adds to the outer-fiber tensile strain. But the internal pressure acts to reround the pipe and, therefore, Eq. 3-10 overpredicts the actual long-term deflection for pressurized pipe. Safe allowable deflections for pressurized pipe are given in Table 3-11. Spangler and Handy [13] give equations for correcting deflection to account for rerounding.

Geosyntec consultants

Attachment 1-7

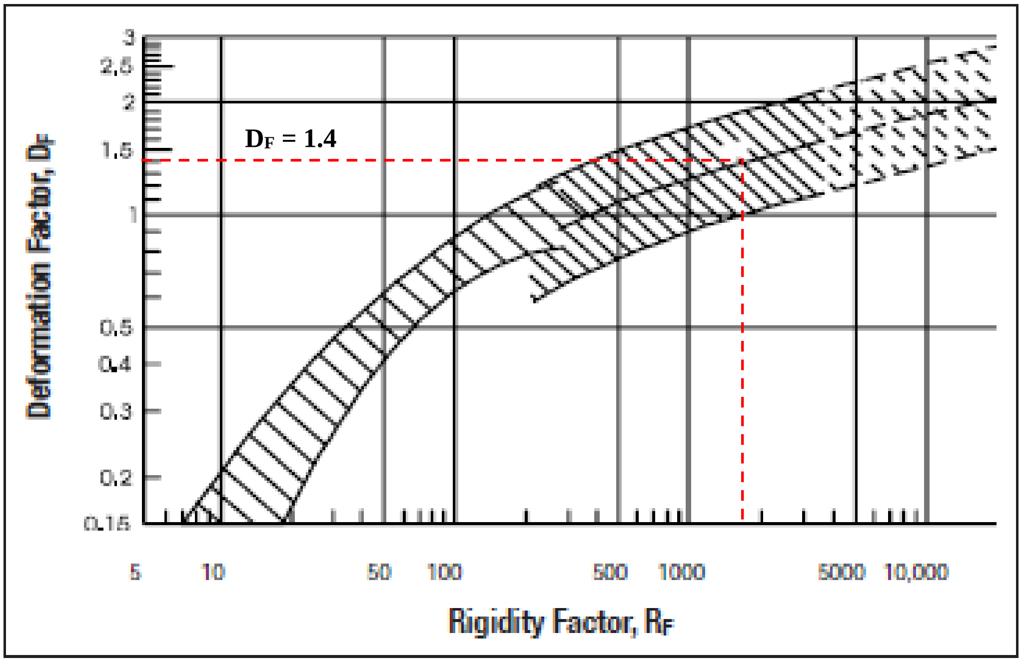
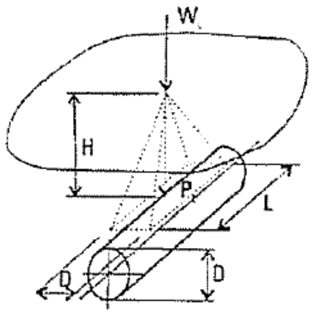


Figure 3-6 Watkins-Gaube Graph

Attachment 1-8

Table 7-4 Load Coefficient, C_H, for Holl's Integration of Boussinesq's Equation



D/2H	L/2H													
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.5	2.0	20.0
0.1	0.019	0.037	0.053	0.067	0.079	0.089	0.097	0.103	0.108	0.112	0.117	0.121	0.124	0.127
0.2	0.037	0.072	0.103	0.131	0.155	0.174	0.189	0.202	0.211	0.219	0.229	0.238	0.244	0.248
0.3	0.053	0.103	0.149	0.190	0.224	0.252	0.274	0.292	0.306	0.318	0.333	0.346	0.355	0.361
0.4	0.067	0.131	0.190	0.241	0.284	0.320	0.349	0.373	0.391	0.405	0.425	0.442	0.454	0.462
0.5	0.079	0.155	0.224	0.284	0.336	0.379	0.414	0.441	0.463	0.481	0.505	0.525	0.540	0.550
0.6	0.089	0.174	0.252	0.320	0.379	0.428	0.467	0.499	0.524	0.544	0.572	0.596	0.613	0.625
0.7	0.097	0.189	0.274	0.349	0.414	0.467	0.511	0.546	0.574	0.597	0.628	0.655	0.674	0.688
0.8	0.103	0.202	0.292	0.373	0.441	0.499	0.546	0.584	0.615	0.639	0.674	0.703	0.725	0.740
0.9	0.108	0.211	0.306	0.391	0.463	0.524	0.574	0.615	0.647	0.673	0.711	0.743	0.766	0.783
1.0	0.112	0.219	0.318	0.405	0.481	0.544	0.597	0.639	0.673	0.701	0.740	0.775	0.800	0.818
1.2	0.117	0.229	0.333	0.425	0.505	0.572	0.628	0.674	0.711	0.740	0.783	0.821	0.849	0.871
1.5	0.121	0.238	0.346	0.422	0.525	0.596	0.655	0.703	0.743	0.775	0.821	0.863	0.895	0.920
2.0	0.124	0.244	0.355	0.454	0.540	0.613	0.674	0.725	0.766	0.800	0.849	0.895	0.930	0.960
20.0	0.127	0.248	0.361	0.462	0.550	0.625	0.688	0.740	0.783	0.818	0.871	0.920	0.960	1.000

C_H linearly interpolated:
L/2H = 0.875
D/2H = 0.180
C_H = 0.188

Attachment 1-9

TABLE 3-12
Typical Values of M_S, One-Dimensional Modulus of Soil

Vertical Soil Stress[1] (psi)	Gravelly Sand/Gravels 95% Std. Proctor (psi)	Gravelly Sand/Gravels 90% Std. Proctor (psi)	Gravelly Sand/Gravels 85% Std. Proctor (psi)
10	3000	1600	550
20	3500	1800	650
40	4200	2100	800
60	5000	2500	1000
80	6000	2900	1300
100	6500	3200	1450

* Adapted and extended from values given by McGrath[20]. For depths not shown in McGrath[20], the MS values were approximated using the hyperbolic soil model with appropriate values for K and n where n=0.4 and K=200, K=100, and K=45 for 95% Proctor, 90% Proctor, and 85% Proctor, respectively.

[1] Vertical Soil Stress (psi) = [soil depth (ft) x soil density (pcf)]/144

Appendix I: Landfill Gas Management System

Geosyntec consultants

Appendix I.1: Landfill Gas Generation Estimate

Geosyntec
consultants

COMPUTATION COVER SHEET

Client: Tolson & Associates **Project:** TRL Expansion **Project #:** ME1606 **Task #:** 03

TITLE OF COMPUTATIONS LANDFILL GAS GENERATION ESTIMATE

COMPUTATIONS BY: Signature ______ 01/16/2020 DATE

Printed Name and Title: Andrew Stallings, Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY: (Peer Reviewer) Signature ______ 02/14/2020 DATE

Printed Name and Title: Jennifer M. Padgett, Project Engineer

COMPUTATIONS CHECKED BY: Signature ______ 02/14/2020 DATE

Printed Name and Title: Jennifer M. Padgett, Project Engineer

COMPUTATIONS BACKCHECKED BY: (Originator) Signature ______ 02/24/2020 DATE

Printed Name and Title: Andrew Stallings, Engineer

APPROVED BY: (PM or Designate) Signature ______ 02/20/2020 DATE

Printed Name and Title: Jeremy Morris, Principal

APPROVAL NOTES:

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

LANDFILL GAS GENERATION ESTIMATE

PURPOSE

The purpose of this calculation is to estimate the landfill gas (LFG) generation potential of the proposed Tolson Rubble Landfill (TRL) Expansion, a construction and demolition (C&D) debris landfill located in Crofton, Anne Arundel County, Maryland. This is used to size an active LFG collection system, installation of which is a requirement of the facility-specific conditions under the Refuse Disposal Permit for the TRL Expansion. An LFG collection system consisting of vertical LFG extraction wells, a series of lateral and header piping, and a blower/flare station is proposed.

METHODOLOGY

In order to properly design and size the landfill gas (LFG) extraction system components, it is necessary to estimate the total quantity of LFG being produced in all areas of the landfill through its expected operational and post-closure periods. LFG generation was estimated using the Landfill Gas Emissions Model (LandGEM) developed by the United States Environmental Protection Agency (U.S. EPA). This model was coded into a Microsoft Excel® spreadsheet published by the U.S. EPA [2005]. LandGEM is defined by the following first-order decomposition rate equation:

$$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} k L_o \left(\frac{M_i}{10}\right) e^{-kt_{ij}} \tag{1}$$

where:

Q_{CH_4} = annual methane generation in the year of the calculation (m^3/year)

i = one-year time increment

n = year of the calculation minus initial year of waste acceptance

j = 0.1-year time increment

k = methane generation rate (yr^{-1})

L_o = potential methane generation capacity (m^3/Mg)

M_i = mass of waste accepted in the i^{th} year (Mg)

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (years)

LandGEM was primarily developed for estimating emissions from decomposition of municipal solid waste (MSW). Because TRL is a C&D debris landfill that is expected to contain significantly more nondegradable waste (e.g., concrete, asphalt, bricks, glass, plastics, metals) than MSW landfills, this analysis is expected to provide a conservative estimate of gas generation at TRL. In calculating the gas generation curves, the following assumptions were made:

1. The methane generation rate constant (k) is a function of moisture, pH, temperature, and landfill operating conditions. The LandGEM default value for MSW landfills in non-arid climates (0.04 yr^{-1}) is used for this calculation [U.S. EPA, 1995]. The generation rate selected is greater than that used in previous calculations performed by ERM [2016], which gives a conservative estimate of methane generation.

2. Methane generation potential (L_o) has been observed to vary from 6 to 270 m^3/Mg depending on the organic content of the waste material [U.S. EPA, 1995]. For MSW landfills, a L_o value of 100 m^3/Mg is typically recommended. Because TRL is a C&D debris landfill which is expected to have waste with a significantly lower organic content than MSW landfills, a L_o value of 50 m^3/Mg is assumed for this calculation. This value is consistent with previous calculations performed by ERM [2016].

3. Most emissions of non-methane organic compounds (NMOCs) result from volatilization of organic compounds in waste. The default NMOC concentration recommended for MSW landfills is 595 parts per million volume (ppmv) as hexane [MDE, 2007]. Because TRL is a C&D debris landfill which is expected to have waste with a significantly lower organic content than MSW landfills, an NMOC concentration of 298 ppmv is assumed for this calculation. This value is consistent with previous calculations performed by ERM [2016].

4. The total volume of LFG generated in a given year is estimated assuming landfill gas is 40 percent methane by volume. This value is consistent with previous calculations performed by ERM [2016].

5. Per the *Landfill Disposal Airspace Estimate* (Appendix C), the total design disposal volume is 9.19 million cubic yards (CY) and the airspace utilization factor is 0.6 tons per CY, which equates to 5.51 million tons.

6. Per the *Landfill Disposal Airspace Estimate* (Appendix C), approximately 291,000 CY (174,600 tons) of waste has been placed between 2017 and 2020. It is assumed that this waste was disposed of equally over these four years (i.e., 43,650 tons per year). It is

projected that the annual waste tonnage accepted for disposal will be about 400,000 tons per year beginning in 2021.

CALCULATIONS

The inputs described above were used in LandGEM to estimate: (i) the peak LFG generation rate for sizing of LFG components and (ii) the peak NMOC emission rate for determining LFG collection requirements.

RESULTS AND CONCLUSIONS

The LandGEM output is provided in Attachment 1. The peak LFG generation rate estimated by LandGEM is 1,270 cubic feet per minute at standard temperature and pressure (scfm). Peak LFG generation is expected to occur during the final year of landfill operation in 2034.

The peak NMOC emission rate estimated by LandGEM is 38 Mg per year, again in 2034. This is below the threshold of 50 Mg/year for mandatory LFG collection at MSW landfills under 40 CFR 60. However, active LFG control at the TRL Expansion is required as a facility-specific permit condition.

REFERENCES

ERM [2016]. "Phase III Engineering Report, Tolson Rubble Landfill, Crofton, Maryland," prepared for Tolson & Associates, LLC, 31 May.

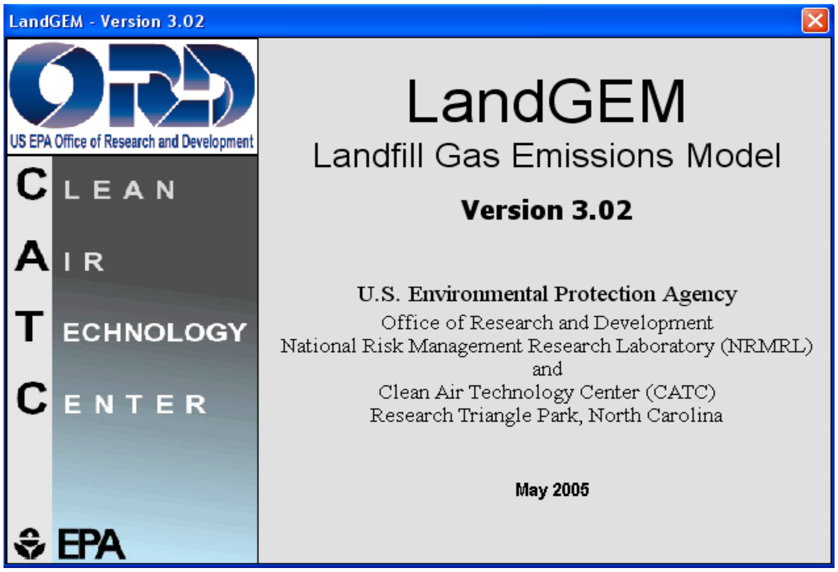
Maryland Department of the Environment [2007]. "2002 Base Year State Implementation Plan Emissions Inventory and Methodologies for $PM_{2.5}$ and Precursors," Maryland Department of the Environment Air and Radiation Management Administration, prepared for United States Environmental Protection Agency, updated 24 October 2007.

United State Environmental Protection Agency [1995]. "AP-42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources," Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, January, Supplement E (November 1998), update in review (October 2008).

United State Environmental Protection Agency [2005]. "Landfill Gas Emissions Model (LandGEM), Version 3.02," EPA-600/R-05/047.

ATTACHMENT 1

LandGEM Output



Summary Report

Landfill Name or Identifier: Tolson Rubble Landfill Expansion

Date: Tuesday, February 25, 2020

Description/Comments:

The purpose of this calculation is to determine the landfill gas generation potential of the proposed Tolson Rubble Landfill Expansion, a construction and demolition debris landfill located in Crofton, Anne Arundel County, Maryland.

About LandGEM:

First-Order Decomposition Rate Equation:

$$Q_{CH_4} = \sum_{i=1}^{n}\sum_{j=0.1}^{1} kL_o\left(\frac{M_i}{10}\right)e^{-kt_{ij}}$$

Where,

Q_{CH4} = annual methane generation in the year of the calculation (*m^3/year*)
i = 1-year time increment
n = (year of the calculation) - (initial year of waste acceptance)
j = 0.1-year time increment
k = methane generation rate (*$year^{-1}$*)
L_o = potential methane generation capacity (*m^3/Mg*)

M_i = mass of waste accepted in the i^{th} year (*Mg*)
t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (*decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	**2017**	
Landfill Closure Year (with 80-year limit)	**2034**	
Actual Closure Year (without limit)	***2034***	
Have Model Calculate Closure Year?	**No**	
Waste Design Capacity		*short tons*

MODEL PARAMETERS

Methane Generation Rate, k	**0.040**	*$year^{-1}$*
Potential Methane Generation Capacity, L_o	**50**	*m^3/Mg*
NMOC Concentration	**298**	*ppmv as hexane*
Methane Content	**40**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**NMOC**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Hydrogen sulfide**
Gas / Pollutant #4:	**Total landfill gas**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
2017	39,682	43,650	0	0
2018	39,682	43,650	39,682	43,650
2019	39,682	43,650	79,364	87,300
2020	39,682	43,650	119,045	130,950
2021	363,636	400,000	158,727	174,600
2022	363,636	400,000	522,364	574,600
2023	363,636	400,000	886,000	974,600
2024	363,636	400,000	1,249,636	1,374,600
2025	363,636	400,000	1,613,273	1,774,600
2026	363,636	400,000	1,976,909	2,174,600
2027	363,636	400,000	2,340,545	2,574,600
2028	363,636	400,000	2,704,182	2,974,600
2029	363,636	400,000	3,067,818	3,374,600
2030	363,636	400,000	3,431,455	3,774,600
2031	363,636	400,000	3,795,091	4,174,600
2032	363,636	400,000	4,158,727	4,574,600
2033	363,636	400,000	4,522,364	4,974,600
2034	126,232	138,855	4,886,000	5,374,600
2035	0	0	5,012,232	5,513,455
2036	0	0	5,012,232	5,513,455
2037	0	0	5,012,232	5,513,455
2038	0	0	5,012,232	5,513,455
2039	0	0	5,012,232	5,513,455
2040	0	0	5,012,232	5,513,455
2041	0	0	5,012,232	5,513,455
2042	0	0	5,012,232	5,513,455
2043	0	0	5,012,232	5,513,455
2044	0	0	5,012,232	5,513,455
2045	0	0	5,012,232	5,513,455
2046	0	0	5,012,232	5,513,455
2047	0	0	5,012,232	5,513,455
2048	0	0	5,012,232	5,513,455
2049	0	0	5,012,232	5,513,455
2050	0	0	5,012,232	5,513,455
2051	0	0	5,012,232	5,513,455
2052	0	0	5,012,232	5,513,455
2053	0	0	5,012,232	5,513,455
2054	0	0	5,012,232	5,513,455
2055	0	0	5,012,232	5,513,455
2056	0	0	5,012,232	5,513,455

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)
2057	0	0	5,012,232	5,513,455
2058	0	0	5,012,232	5,513,455
2059	0	0	5,012,232	5,513,455
2060	0	0	5,012,232	5,513,455
2061	0	0	5,012,232	5,513,455
2062	0	0	5,012,232	5,513,455
2063	0	0	5,012,232	5,513,455
2064	0	0	5,012,232	5,513,455
2065	0	0	5,012,232	5,513,455
2066	0	0	5,012,232	5,513,455
2067	0	0	5,012,232	5,513,455
2068	0	0	5,012,232	5,513,455
2069	0	0	5,012,232	5,513,455
2070	0	0	5,012,232	5,513,455
2071	0	0	5,012,232	5,513,455
2072	0	0	5,012,232	5,513,455
2073	0	0	5,012,232	5,513,455
2074	0	0	5,012,232	5,513,455
2075	0	0	5,012,232	5,513,455
2076	0	0	5,012,232	5,513,455
2077	0	0	5,012,232	5,513,455
2078	0	0	5,012,232	5,513,455
2079	0	0	5,012,232	5,513,455
2080	0	0	5,012,232	5,513,455
2081	0	0	5,012,232	5,513,455
2082	0	0	5,012,232	5,513,455
2083	0	0	5,012,232	5,513,455
2084	0	0	5,012,232	5,513,455
2085	0	0	5,012,232	5,513,455
2086	0	0	5,012,232	5,513,455
2087	0	0	5,012,232	5,513,455
2088	0	0	5,012,232	5,513,455
2089	0	0	5,012,232	5,513,455
2090	0	0	5,012,232	5,513,455
2091	0	0	5,012,232	5,513,455
2092	0	0	5,012,232	5,513,455
2093	0	0	5,012,232	5,513,455
2094	0	0	5,012,232	5,513,455
2095	0	0	5,012,232	5,513,455
2096	0	0	5,012,232	5,513,455

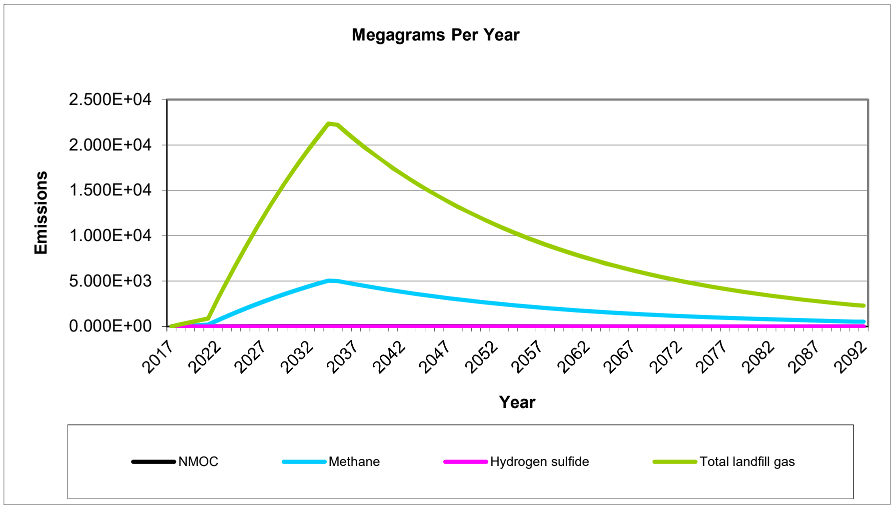
Pollutant Parameters

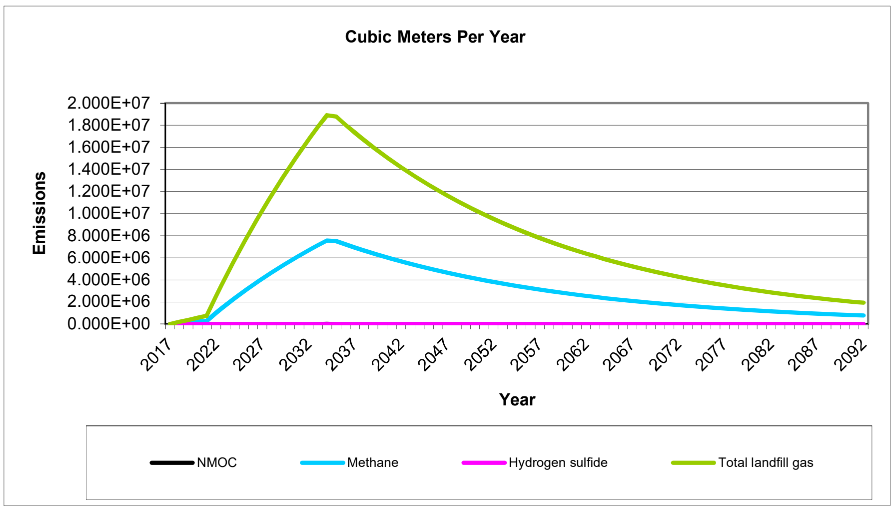
	Gas / Pollutant Default Parameters:			User-specified Pollutant Parameters:	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

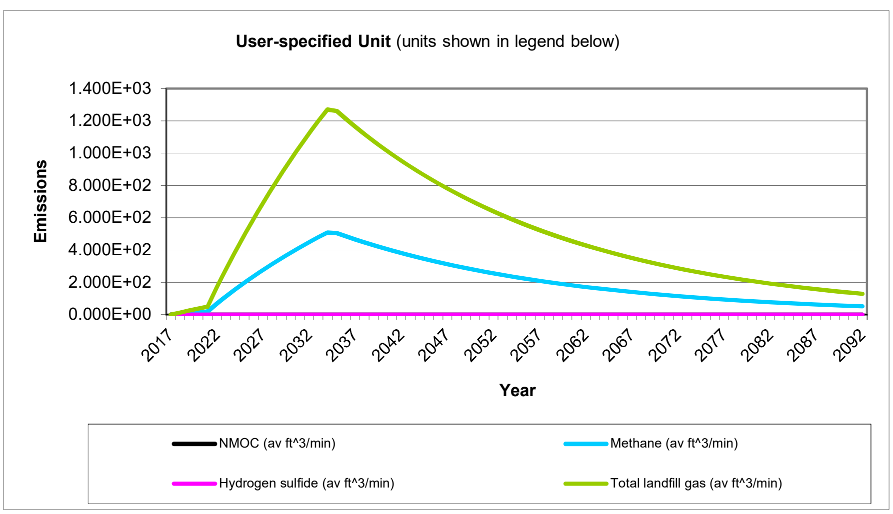
Pollutant Parameters (Continued)

	Gas / Pollutant Default Parameters:			User-specified Pollutant Parameters:	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs


Megagrams Per Year
2.500E+04
2.000E+04
1.500E+04
1.000E+04
5.000E+03
0.000E+00
Emissions
2017 2022 2027 2032 2037 2042 2047 2052 2057 2062 2067 2072 2077 2082 2087 2092
Year
NMOC
Methane
Hydrogen sulfide
Total landfill gas


Cubic Meters Per Year
2.000E+07
1.800E+07
1.600E+07
1.400E+07
1.200E+07
1.000E+07
8.000E+06
6.000E+06
4.000E+06
2.000E+06
0.000E+00
Emissions
2017 2022 2027 2032 2037 2042 2047 2052 2057 2062 2067 2072 2077 2082 2087 2092
Year
NMOC
Methane
Hydrogen sulfide
Total landfill gas


User-specified Unit (units shown in legend below)
1.400E+03
1.200E+03
1.000E+03
8.000E+02
6.000E+02
4.000E+02
2.000E+02
0.000E+00
Emissions
2017 2022 2027 2032 2037 2042 2047 2052 2057 2062 2067 2072 2077 2082 2087 2092
Year
NMOC (av ft^3/min)
Methane (av ft^3/min)
Hydrogen sulfide (av ft^3/min)
Total landfill gas (av ft^3/min)

Results

Year	NMOC			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2017	0	0	0	0	0	0
2018	2.082E-01	5.807E+01	3.902E-03	5.201E+01	7.795E+04	5.238E+00
2019	4.082E-01	1.139E+02	7.651E-03	1.020E+02	1.528E+05	1.027E+01
2020	6.003E-01	1.675E+02	1.125E-02	1.500E+02	2.248E+05	1.510E+01
2021	7.850E-01	2.190E+02	1.471E-02	1.961E+02	2.939E+05	1.975E+01
2022	2.662E+00	7.426E+02	4.989E-02	6.650E+02	9.968E+05	6.697E+01
2023	4.465E+00	1.246E+03	8.370E-02	1.115E+03	1.672E+06	1.123E+02
2024	6.198E+00	1.729E+03	1.162E-01	1.548E+03	2.321E+06	1.559E+02
2025	7.862E+00	2.193E+03	1.474E-01	1.964E+03	2.944E+06	1.978E+02
2026	9.461E+00	2.640E+03	1.774E-01	2.364E+03	3.543E+06	2.381E+02
2027	1.100E+01	3.068E+03	2.062E-01	2.748E+03	4.118E+06	2.767E+02
2028	1.247E+01	3.480E+03	2.338E-01	3.116E+03	4.671E+06	3.139E+02
2029	1.389E+01	3.876E+03	2.604E-01	3.471E+03	5.203E+06	3.496E+02
2030	1.526E+01	4.256E+03	2.860E-01	3.811E+03	5.713E+06	3.838E+02
2031	1.657E+01	4.621E+03	3.105E-01	4.138E+03	6.203E+06	4.168E+02
2032	1.782E+01	4.972E+03	3.341E-01	4.453E+03	6.674E+06	4.484E+02
2033	1.903E+01	5.310E+03	3.568E-01	4.755E+03	7.127E+06	4.789E+02
2034	2.019E+01	5.634E+03	3.785E-01	5.045E+03	7.562E+06	5.081E+02
2035	2.006E+01	5.597E+03	3.761E-01	5.013E+03	7.513E+06	5.048E+02
2036	1.928E+01	5.378E+03	3.613E-01	4.816E+03	7.219E+06	4.850E+02
2037	1.852E+01	5.167E+03	3.472E-01	4.627E+03	6.936E+06	4.660E+02
2038	1.780E+01	4.964E+03	3.336E-01	4.446E+03	6.664E+06	4.477E+02
2039	1.710E+01	4.770E+03	3.205E-01	4.271E+03	6.402E+06	4.302E+02
2040	1.643E+01	4.583E+03	3.079E-01	4.104E+03	6.151E+06	4.133E+02
2041	1.578E+01	4.403E+03	2.958E-01	3.943E+03	5.910E+06	3.971E+02
2042	1.516E+01	4.230E+03	2.842E-01	3.788E+03	5.678E+06	3.815E+02
2043	1.457E+01	4.065E+03	2.731E-01	3.640E+03	5.456E+06	3.666E+02
2044	1.400E+01	3.905E+03	2.624E-01	3.497E+03	5.242E+06	3.522E+02
2045	1.345E+01	3.752E+03	2.521E-01	3.360E+03	5.036E+06	3.384E+02
2046	1.292E+01	3.605E+03	2.422E-01	3.228E+03	4.839E+06	3.251E+02
2047	1.242E+01	3.464E+03	2.327E-01	3.102E+03	4.649E+06	3.124E+02
2048	1.193E+01	3.328E+03	2.236E-01	2.980E+03	4.467E+06	3.001E+02
2049	1.146E+01	3.197E+03	2.148E-01	2.863E+03	4.292E+06	2.884E+02
2050	1.101E+01	3.072E+03	2.064E-01	2.751E+03	4.123E+06	2.771E+02
2051	1.058E+01	2.951E+03	1.983E-01	2.643E+03	3.962E+06	2.662E+02
2052	1.016E+01	2.836E+03	1.905E-01	2.539E+03	3.806E+06	2.558E+02
2053	9.766E+00	2.725E+03	1.831E-01	2.440E+03	3.657E+06	2.457E+02
2054	9.383E+00	2.618E+03	1.759E-01	2.344E+03	3.514E+06	2.361E+02
2055	9.015E+00	2.515E+03	1.690E-01	2.252E+03	3.376E+06	2.268E+02
2056	8.662E+00	2.416E+03	1.624E-01	2.164E+03	3.244E+06	2.179E+02
2057	8.322E+00	2.322E+03	1.560E-01	2.079E+03	3.116E+06	2.094E+02
2058	7.996E+00	2.231E+03	1.499E-01	1.998E+03	2.994E+06	2.012E+02
2059	7.682E+00	2.143E+03	1.440E-01	1.919E+03	2.877E+06	1.933E+02
2060	7.381E+00	2.059E+03	1.384E-01	1.844E+03	2.764E+06	1.857E+02
2061	7.092E+00	1.978E+03	1.329E-01	1.772E+03	2.656E+06	1.784E+02
2062	6.814E+00	1.901E+03	1.277E-01	1.702E+03	2.551E+06	1.714E+02
2063	6.546E+00	1.826E+03	1.227E-01	1.635E+03	2.451E+06	1.647E+02
2064	6.290E+00	1.755E+03	1.179E-01	1.571E+03	2.355E+06	1.583E+02
2065	6.043E+00	1.686E+03	1.133E-01	1.510E+03	2.263E+06	1.520E+02
2066	5.806E+00	1.620E+03	1.088E-01	1.451E+03	2.174E+06	1.461E+02

Results (Continued)

Year	NMOC			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2067	5.578E+00	1.556E+03	1.046E-01	1.394E+03	2.089E+06	1.404E+02
2068	5.360E+00	1.495E+03	1.005E-01	1.339E+03	2.007E+06	1.349E+02
2069	5.150E+00	1.437E+03	9.653E-02	1.287E+03	1.928E+06	1.296E+02
2070	4.948E+00	1.380E+03	9.274E-02	1.236E+03	1.853E+06	1.245E+02
2071	4.754E+00	1.326E+03	8.911E-02	1.188E+03	1.780E+06	1.196E+02
2072	4.567E+00	1.274E+03	8.561E-02	1.141E+03	1.710E+06	1.149E+02
2073	4.388E+00	1.224E+03	8.226E-02	1.096E+03	1.643E+06	1.104E+02
2074	4.216E+00	1.176E+03	7.903E-02	1.053E+03	1.579E+06	1.061E+02
2075	4.051E+00	1.130E+03	7.593E-02	1.012E+03	1.517E+06	1.019E+02
2076	3.892E+00	1.086E+03	7.295E-02	9.723E+02	1.457E+06	9.793E+01
2077	3.739E+00	1.043E+03	7.009E-02	9.342E+02	1.400E+06	9.409E+01
2078	3.593E+00	1.002E+03	6.735E-02	8.976E+02	1.345E+06	9.040E+01
2079	3.452E+00	9.630E+02	6.470E-02	8.624E+02	1.293E+06	8.685E+01
2080	3.317E+00	9.252E+02	6.217E-02	8.286E+02	1.242E+06	8.345E+01
2081	3.186E+00	8.890E+02	5.973E-02	7.961E+02	1.193E+06	8.017E+01
2082	3.062E+00	8.541E+02	5.739E-02	7.649E+02	1.146E+06	7.703E+01
2083	2.941E+00	8.206E+02	5.514E-02	7.349E+02	1.102E+06	7.401E+01
2084	2.826E+00	7.884E+02	5.298E-02	7.061E+02	1.058E+06	7.111E+01
2085	2.715E+00	7.575E+02	5.090E-02	6.784E+02	1.017E+06	6.832E+01
2086	2.609E+00	7.278E+02	4.890E-02	6.518E+02	9.769E+05	6.564E+01
2087	2.507E+00	6.993E+02	4.699E-02	6.262E+02	9.386E+05	6.307E+01
2088	2.408E+00	6.719E+02	4.514E-02	6.017E+02	9.018E+05	6.059E+01
2089	2.314E+00	6.455E+02	4.337E-02	5.781E+02	8.665E+05	5.822E+01
2090	2.223E+00	6.202E+02	4.167E-02	5.554E+02	8.325E+05	5.594E+01
2091	2.136E+00	5.959E+02	4.004E-02	5.336E+02	7.999E+05	5.374E+01
2092	2.052E+00	5.725E+02	3.847E-02	5.127E+02	7.685E+05	5.164E+01
2093	1.972E+00	5.501E+02	3.696E-02	4.926E+02	7.384E+05	4.961E+01
2094	1.894E+00	5.285E+02	3.551E-02	4.733E+02	7.094E+05	4.767E+01
2095	1.820E+00	5.078E+02	3.412E-02	4.547E+02	6.816E+05	4.580E+01
2096	1.749E+00	4.879E+02	3.278E-02	4.369E+02	6.549E+05	4.400E+01
2097	1.680E+00	4.687E+02	3.150E-02	4.198E+02	6.292E+05	4.228E+01
2098	1.614E+00	4.504E+02	3.026E-02	4.033E+02	6.045E+05	4.062E+01
2099	1.551E+00	4.327E+02	2.907E-02	3.875E+02	5.808E+05	3.902E+01
2100	1.490E+00	4.157E+02	2.793E-02	3.723E+02	5.580E+05	3.749E+01
2101	1.432E+00	3.994E+02	2.684E-02	3.577E+02	5.362E+05	3.602E+01
2102	1.376E+00	3.838E+02	2.579E-02	3.437E+02	5.151E+05	3.461E+01
2103	1.322E+00	3.687E+02	2.477E-02	3.302E+02	4.949E+05	3.325E+01
2104	1.270E+00	3.543E+02	2.380E-02	3.173E+02	4.755E+05	3.195E+01
2105	1.220E+00	3.404E+02	2.287E-02	3.048E+02	4.569E+05	3.070E+01
2106	1.172E+00	3.270E+02	2.197E-02	2.929E+02	4.390E+05	2.949E+01
2107	1.126E+00	3.142E+02	2.111E-02	2.814E+02	4.218E+05	2.834E+01
2108	1.082E+00	3.019E+02	2.028E-02	2.703E+02	4.052E+05	2.723E+01
2109	1.040E+00	2.901E+02	1.949E-02	2.597E+02	3.893E+05	2.616E+01
2110	9.989E-01	2.787E+02	1.872E-02	2.496E+02	3.741E+05	2.513E+01
2111	9.598E-01	2.678E+02	1.799E-02	2.398E+02	3.594E+05	2.415E+01
2112	9.221E-01	2.573E+02	1.728E-02	2.304E+02	3.453E+05	2.320E+01
2113	8.860E-01	2.472E+02	1.661E-02	2.213E+02	3.318E+05	2.229E+01
2114	8.512E-01	2.375E+02	1.596E-02	2.127E+02	3.188E+05	2.142E+01
2115	8.178E-01	2.282E+02	1.533E-02	2.043E+02	3.063E+05	2.058E+01
2116	7.858E-01	2.192E+02	1.473E-02	1.963E+02	2.943E+05	1.977E+01
2117	7.550E-01	2.106E+02	1.415E-02	1.886E+02	2.827E+05	1.900E+01

Results (Continued)

Year	NMOC			Methane		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2118	7.254E-01	2.024E+02	1.360E-02	1.812E+02	2.716E+05	1.825E+01
2119	6.969E-01	1.944E+02	1.306E-02	1.741E+02	2.610E+05	1.754E+01
2120	6.696E-01	1.868E+02	1.255E-02	1.673E+02	2.507E+05	1.685E+01
2121	6.433E-01	1.795E+02	1.206E-02	1.607E+02	2.409E+05	1.619E+01
2122	6.181E-01	1.724E+02	1.159E-02	1.544E+02	2.315E+05	1.555E+01
2123	5.939E-01	1.657E+02	1.113E-02	1.484E+02	2.224E+05	1.494E+01
2124	5.706E-01	1.592E+02	1.070E-02	1.425E+02	2.137E+05	1.436E+01
2125	5.482E-01	1.529E+02	1.028E-02	1.370E+02	2.053E+05	1.379E+01
2126	5.267E-01	1.469E+02	9.873E-03	1.316E+02	1.972E+05	1.325E+01
2127	5.061E-01	1.412E+02	9.486E-03	1.264E+02	1.895E+05	1.273E+01
2128	4.862E-01	1.356E+02	9.114E-03	1.215E+02	1.821E+05	1.223E+01
2129	4.672E-01	1.303E+02	8.757E-03	1.167E+02	1.749E+05	1.175E+01
2130	4.488E-01	1.252E+02	8.413E-03	1.121E+02	1.681E+05	1.129E+01
2131	4.312E-01	1.203E+02	8.084E-03	1.077E+02	1.615E+05	1.085E+01
2132	4.143E-01	1.156E+02	7.767E-03	1.035E+02	1.552E+05	1.042E+01
2133	3.981E-01	1.111E+02	7.462E-03	9.945E+01	1.491E+05	1.002E+01
2134	3.825E-01	1.067E+02	7.169E-03	9.555E+01	1.432E+05	9.623E+00
2135	3.675E-01	1.025E+02	6.888E-03	9.181E+01	1.376E+05	9.246E+00
2136	3.531E-01	9.850E+01	6.618E-03	8.821E+01	1.322E+05	8.884E+00
2137	3.392E-01	9.464E+01	6.359E-03	8.475E+01	1.270E+05	8.535E+00
2138	3.259E-01	9.093E+01	6.109E-03	8.143E+01	1.221E+05	8.201E+00
2139	3.131E-01	8.736E+01	5.870E-03	7.823E+01	1.173E+05	7.879E+00
2140	3.009E-01	8.394E+01	5.640E-03	7.517E+01	1.127E+05	7.570E+00
2141	2.891E-01	8.065E+01	5.419E-03	7.222E+01	1.082E+05	7.273E+00
2142	2.777E-01	7.748E+01	5.206E-03	6.939E+01	1.040E+05	6.988E+00
2143	2.668E-01	7.445E+01	5.002E-03	6.667E+01	9.993E+04	6.714E+00
2144	2.564E-01	7.153E+01	4.806E-03	6.405E+01	9.601E+04	6.451E+00
2145	2.463E-01	6.872E+01	4.617E-03	6.154E+01	9.224E+04	6.198E+00
2146	2.367E-01	6.603E+01	4.436E-03	5.913E+01	8.863E+04	5.955E+00
2147	2.274E-01	6.344E+01	4.262E-03	5.681E+01	8.515E+04	5.721E+00
2148	2.185E-01	6.095E+01	4.095E-03	5.458E+01	8.181E+04	5.497E+00
2149	2.099E-01	5.856E+01	3.935E-03	5.244E+01	7.860E+04	5.281E+00
2150	2.017E-01	5.626E+01	3.780E-03	5.038E+01	7.552E+04	5.074E+00
2151	1.938E-01	5.406E+01	3.632E-03	4.841E+01	7.256E+04	4.875E+00
2152	1.862E-01	5.194E+01	3.490E-03	4.651E+01	6.972E+04	4.684E+00
2153	1.789E-01	4.990E+01	3.353E-03	4.469E+01	6.698E+04	4.501E+00
2154	1.719E-01	4.795E+01	3.221E-03	4.294E+01	6.436E+04	4.324E+00
2155	1.651E-01	4.607E+01	3.095E-03	4.125E+01	6.183E+04	4.155E+00
2156	1.586E-01	4.426E+01	2.974E-03	3.963E+01	5.941E+04	3.992E+00
2157	1.524E-01	4.252E+01	2.857E-03	3.808E+01	5.708E+04	3.835E+00

Results (Continued)

Year	Hydrogen sulfide			Total landfill gas		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2017	0	0	0	0	0	0
2018	9.945E-03	7.016E+00	4.714E-04	2.304E+02	1.949E+05	1.309E+01
2019	1.950E-02	1.376E+01	9.243E-04	4.517E+02	3.821E+05	2.567E+01
2020	2.868E-02	2.023E+01	1.359E-03	6.644E+02	5.620E+05	3.776E+01
2021	3.750E-02	2.646E+01	1.778E-03	8.687E+02	7.349E+05	4.938E+01
2022	1.272E-01	8.971E+01	6.028E-03	2.946E+03	2.492E+06	1.674E+02
2023	2.133E-01	1.505E+02	1.011E-02	4.941E+03	4.180E+06	2.809E+02
2024	2.961E-01	2.089E+02	1.403E-02	6.859E+03	5.802E+06	3.898E+02
2025	3.756E-01	2.650E+02	1.780E-02	8.701E+03	7.360E+06	4.945E+02
2026	4.520E-01	3.189E+02	2.143E-02	1.047E+04	8.858E+06	5.951E+02
2027	5.254E-01	3.707E+02	2.490E-02	1.217E+04	1.030E+07	6.918E+02
2028	5.959E-01	4.204E+02	2.825E-02	1.381E+04	1.168E+07	7.847E+02
2029	6.637E-01	4.682E+02	3.146E-02	1.537E+04	1.301E+07	8.739E+02
2030	7.288E-01	5.142E+02	3.455E-02	1.688E+04	1.428E+07	9.596E+02
2031	7.914E-01	5.583E+02	3.751E-02	1.833E+04	1.551E+07	1.042E+03
2032	8.515E-01	6.007E+02	4.036E-02	1.972E+04	1.669E+07	1.121E+03
2033	9.092E-01	6.414E+02	4.310E-02	2.106E+04	1.782E+07	1.197E+03
2034	9.647E-01	6.806E+02	4.573E-02	2.235E+04	1.890E+07	1.270E+03
2035	9.585E-01	6.762E+02	4.543E-02	2.220E+04	1.878E+07	1.262E+03
2036	9.209E-01	6.497E+02	4.365E-02	2.133E+04	1.805E+07	1.213E+03
2037	8.848E-01	6.242E+02	4.194E-02	2.050E+04	1.734E+07	1.165E+03
2038	8.501E-01	5.997E+02	4.030E-02	1.969E+04	1.666E+07	1.119E+03
2039	8.168E-01	5.762E+02	3.872E-02	1.892E+04	1.601E+07	1.075E+03
2040	7.848E-01	5.536E+02	3.720E-02	1.818E+04	1.538E+07	1.033E+03
2041	7.540E-01	5.319E+02	3.574E-02	1.747E+04	1.478E+07	9.928E+02
2042	7.244E-01	5.111E+02	3.434E-02	1.678E+04	1.420E+07	9.538E+02
2043	6.960E-01	4.910E+02	3.299E-02	1.612E+04	1.364E+07	9.164E+02
2044	6.687E-01	4.718E+02	3.170E-02	1.549E+04	1.310E+07	8.805E+02
2045	6.425E-01	4.533E+02	3.046E-02	1.488E+04	1.259E+07	8.460E+02
2046	6.173E-01	4.355E+02	2.926E-02	1.430E+04	1.210E+07	8.128E+02
2047	5.931E-01	4.184E+02	2.811E-02	1.374E+04	1.162E+07	7.809E+02
2048	5.698E-01	4.020E+02	2.701E-02	1.320E+04	1.117E+07	7.503E+02
2049	5.475E-01	3.863E+02	2.595E-02	1.268E+04	1.073E+07	7.209E+02
2050	5.260E-01	3.711E+02	2.493E-02	1.219E+04	1.031E+07	6.926E+02
2051	5.054E-01	3.566E+02	2.396E-02	1.171E+04	9.904E+06	6.655E+02
2052	4.856E-01	3.426E+02	2.302E-02	1.125E+04	9.516E+06	6.394E+02
2053	4.666E-01	3.291E+02	2.212E-02	1.081E+04	9.143E+06	6.143E+02
2054	4.483E-01	3.162E+02	2.125E-02	1.038E+04	8.784E+06	5.902E+02
2055	4.307E-01	3.038E+02	2.041E-02	9.977E+03	8.440E+06	5.671E+02
2056	4.138E-01	2.919E+02	1.961E-02	9.586E+03	8.109E+06	5.448E+02
2057	3.976E-01	2.805E+02	1.885E-02	9.210E+03	7.791E+06	5.235E+02
2058	3.820E-01	2.695E+02	1.811E-02	8.849E+03	7.486E+06	5.030E+02
2059	3.670E-01	2.589E+02	1.740E-02	8.502E+03	7.192E+06	4.832E+02
2060	3.526E-01	2.488E+02	1.671E-02	8.168E+03	6.910E+06	4.643E+02
2061	3.388E-01	2.390E+02	1.606E-02	7.848E+03	6.639E+06	4.461E+02
2062	3.255E-01	2.296E+02	1.543E-02	7.540E+03	6.379E+06	4.286E+02
2063	3.127E-01	2.206E+02	1.482E-02	7.245E+03	6.129E+06	4.118E+02
2064	3.005E-01	2.120E+02	1.424E-02	6.961E+03	5.888E+06	3.956E+02
2065	2.887E-01	2.037E+02	1.368E-02	6.688E+03	5.657E+06	3.801E+02
2066	2.774E-01	1.957E+02	1.315E-02	6.425E+03	5.436E+06	3.652E+02

Results (Continued)

Year	Hydrogen sulfide			Total landfill gas		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2067	2.665E-01	1.880E+02	1.263E-02	6.174E+03	5.222E+06	3.509E+02
2068	2.560E-01	1.806E+02	1.214E-02	5.931E+03	5.018E+06	3.371E+02
2069	2.460E-01	1.736E+02	1.166E-02	5.699E+03	4.821E+06	3.239E+02
2070	2.364E-01	1.667E+02	1.120E-02	5.475E+03	4.632E+06	3.112E+02
2071	2.271E-01	1.602E+02	1.076E-02	5.261E+03	4.450E+06	2.990E+02
2072	2.182E-01	1.539E+02	1.034E-02	5.054E+03	4.276E+06	2.873E+02
2073	2.096E-01	1.479E+02	9.937E-03	4.856E+03	4.108E+06	2.760E+02
2074	2.014E-01	1.421E+02	9.547E-03	4.666E+03	3.947E+06	2.652E+02
2075	1.935E-01	1.365E+02	9.173E-03	4.483E+03	3.792E+06	2.548E+02
2076	1.859E-01	1.312E+02	8.813E-03	4.307E+03	3.644E+06	2.448E+02
2077	1.786E-01	1.260E+02	8.468E-03	4.138E+03	3.501E+06	2.352E+02
2078	1.716E-01	1.211E+02	8.136E-03	3.976E+03	3.363E+06	2.260E+02
2079	1.649E-01	1.163E+02	7.817E-03	3.820E+03	3.232E+06	2.171E+02
2080	1.584E-01	1.118E+02	7.510E-03	3.670E+03	3.105E+06	2.086E+02
2081	1.522E-01	1.074E+02	7.216E-03	3.526E+03	2.983E+06	2.004E+02
2082	1.463E-01	1.032E+02	6.933E-03	3.388E+03	2.866E+06	1.926E+02
2083	1.405E-01	9.914E+01	6.661E-03	3.255E+03	2.754E+06	1.850E+02
2084	1.350E-01	9.525E+01	6.400E-03	3.128E+03	2.646E+06	1.778E+02
2085	1.297E-01	9.151E+01	6.149E-03	3.005E+03	2.542E+06	1.708E+02
2086	1.246E-01	8.793E+01	5.908E-03	2.887E+03	2.442E+06	1.641E+02
2087	1.197E-01	8.448E+01	5.676E-03	2.774E+03	2.347E+06	1.577E+02
2088	1.151E-01	8.117E+01	5.453E-03	2.665E+03	2.255E+06	1.515E+02
2089	1.105E-01	7.798E+01	5.240E-03	2.561E+03	2.166E+06	1.455E+02
2090	1.062E-01	7.493E+01	5.034E-03	2.460E+03	2.081E+06	1.398E+02
2091	1.020E-01	7.199E+01	4.837E-03	2.364E+03	2.000E+06	1.344E+02
2092	9.804E-02	6.916E+01	4.647E-03	2.271E+03	1.921E+06	1.291E+02
2093	9.420E-02	6.645E+01	4.465E-03	2.182E+03	1.846E+06	1.240E+02
2094	9.050E-02	6.385E+01	4.290E-03	2.097E+03	1.774E+06	1.192E+02
2095	8.695E-02	6.134E+01	4.122E-03	2.014E+03	1.704E+06	1.145E+02
2096	8.354E-02	5.894E+01	3.960E-03	1.935E+03	1.637E+06	1.100E+02
2097	8.027E-02	5.663E+01	3.805E-03	1.859E+03	1.573E+06	1.057E+02
2098	7.712E-02	5.441E+01	3.656E-03	1.787E+03	1.511E+06	1.015E+02
2099	7.410E-02	5.227E+01	3.512E-03	1.716E+03	1.452E+06	9.756E+01
2100	7.119E-02	5.022E+01	3.375E-03	1.649E+03	1.395E+06	9.374E+01
2101	6.840E-02	4.825E+01	3.242E-03	1.585E+03	1.340E+06	9.006E+01
2102	6.572E-02	4.636E+01	3.115E-03	1.522E+03	1.288E+06	8.653E+01
2103	6.314E-02	4.454E+01	2.993E-03	1.463E+03	1.237E+06	8.314E+01
2104	6.067E-02	4.280E+01	2.876E-03	1.405E+03	1.189E+06	7.988E+01
2105	5.829E-02	4.112E+01	2.763E-03	1.350E+03	1.142E+06	7.675E+01
2106	5.600E-02	3.951E+01	2.655E-03	1.297E+03	1.097E+06	7.374E+01
2107	5.381E-02	3.796E+01	2.550E-03	1.246E+03	1.054E+06	7.084E+01
2108	5.170E-02	3.647E+01	2.450E-03	1.198E+03	1.013E+06	6.807E+01
2109	4.967E-02	3.504E+01	2.354E-03	1.151E+03	9.733E+05	6.540E+01
2110	4.772E-02	3.367E+01	2.262E-03	1.105E+03	9.352E+05	6.283E+01
2111	4.585E-02	3.235E+01	2.173E-03	1.062E+03	8.985E+05	6.037E+01
2112	4.405E-02	3.108E+01	2.088E-03	1.020E+03	8.633E+05	5.800E+01
2113	4.232E-02	2.986E+01	2.006E-03	9.805E+02	8.294E+05	5.573E+01
2114	4.067E-02	2.869E+01	1.928E-03	9.420E+02	7.969E+05	5.354E+01
2115	3.907E-02	2.756E+01	1.852E-03	9.051E+02	7.657E+05	5.144E+01
2116	3.754E-02	2.648E+01	1.779E-03	8.696E+02	7.356E+05	4.943E+01
2117	3.607E-02	2.544E+01	1.710E-03	8.355E+02	7.068E+05	4.749E+01

Results (Continued)

Year	Hydrogen sulfide			Total landfill gas		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2118	3.465E-02	2.445E+01	1.643E-03	8.027E+02	6.791E+05	4.563E+01
2119	3.329E-02	2.349E+01	1.578E-03	7.713E+02	6.524E+05	4.384E+01
2120	3.199E-02	2.257E+01	1.516E-03	7.410E+02	6.269E+05	4.212E+01
2121	3.073E-02	2.168E+01	1.457E-03	7.120E+02	6.023E+05	4.047E+01
2122	2.953E-02	2.083E+01	1.400E-03	6.840E+02	5.787E+05	3.888E+01
2123	2.837E-02	2.002E+01	1.345E-03	6.572E+02	5.560E+05	3.736E+01
2124	2.726E-02	1.923E+01	1.292E-03	6.315E+02	5.342E+05	3.589E+01
2125	2.619E-02	1.848E+01	1.241E-03	6.067E+02	5.132E+05	3.448E+01
2126	2.516E-02	1.775E+01	1.193E-03	5.829E+02	4.931E+05	3.313E+01
2127	2.418E-02	1.706E+01	1.146E-03	5.600E+02	4.738E+05	3.183E+01
2128	2.323E-02	1.639E+01	1.101E-03	5.381E+02	4.552E+05	3.058E+01
2129	2.232E-02	1.574E+01	1.058E-03	5.170E+02	4.373E+05	2.939E+01
2130	2.144E-02	1.513E+01	1.016E-03	4.967E+02	4.202E+05	2.823E+01
2131	2.060E-02	1.453E+01	9.765E-04	4.772E+02	4.037E+05	2.713E+01
2132	1.979E-02	1.396E+01	9.382E-04	4.585E+02	3.879E+05	2.606E+01
2133	1.902E-02	1.342E+01	9.015E-04	4.406E+02	3.727E+05	2.504E+01
2134	1.827E-02	1.289E+01	8.661E-04	4.233E+02	3.581E+05	2.406E+01
2135	1.756E-02	1.239E+01	8.321E-04	4.067E+02	3.440E+05	2.312E+01
2136	1.687E-02	1.190E+01	7.995E-04	3.907E+02	3.305E+05	2.221E+01
2137	1.621E-02	1.143E+01	7.682E-04	3.754E+02	3.176E+05	2.134E+01
2138	1.557E-02	1.098E+01	7.381E-04	3.607E+02	3.051E+05	2.050E+01
2139	1.496E-02	1.055E+01	7.091E-04	3.465E+02	2.932E+05	1.970E+01
2140	1.437E-02	1.014E+01	6.813E-04	3.330E+02	2.817E+05	1.893E+01
2141	1.381E-02	9.742E+00	6.546E-04	3.199E+02	2.706E+05	1.818E+01
2142	1.327E-02	9.360E+00	6.289E-04	3.074E+02	2.600E+05	1.747E+01
2143	1.275E-02	8.993E+00	6.043E-04	2.953E+02	2.498E+05	1.679E+01
2144	1.225E-02	8.641E+00	5.806E-04	2.837E+02	2.400E+05	1.613E+01
2145	1.177E-02	8.302E+00	5.578E-04	2.726E+02	2.306E+05	1.549E+01
2146	1.131E-02	7.976E+00	5.359E-04	2.619E+02	2.216E+05	1.489E+01
2147	1.086E-02	7.664E+00	5.149E-04	2.516E+02	2.129E+05	1.430E+01
2148	1.044E-02	7.363E+00	4.947E-04	2.418E+02	2.045E+05	1.374E+01
2149	1.003E-02	7.074E+00	4.753E-04	2.323E+02	1.965E+05	1.320E+01
2150	9.635E-03	6.797E+00	4.567E-04	2.232E+02	1.888E+05	1.269E+01
2151	9.257E-03	6.531E+00	4.388E-04	2.144E+02	1.814E+05	1.219E+01
2152	8.894E-03	6.274E+00	4.216E-04	2.060E+02	1.743E+05	1.171E+01
2153	8.545E-03	6.028E+00	4.051E-04	1.980E+02	1.675E+05	1.125E+01
2154	8.210E-03	5.792E+00	3.892E-04	1.902E+02	1.609E+05	1.081E+01
2155	7.888E-03	5.565E+00	3.739E-04	1.827E+02	1.546E+05	1.039E+01
2156	7.579E-03	5.347E+00	3.592E-04	1.756E+02	1.485E+05	9.979E+00
2157	7.282E-03	5.137E+00	3.452E-04	1.687E+02	1.427E+05	9.588E+00

Appendix I.2: Landfill Gas Well Radius of Influence

Geosyntec consultants

COMPUTATION COVER SHEET

Client: Tolson & Associates **Project:** TRL Expansion **Project #:** ME1606 **Task #:** 03

TITLE OF COMPUTATIONS LANDFILL GAS RADIUS OF INFLUENCE

COMPUTATIONS BY: Signature ______________ 01/16/2020 DATE

Printed Name and Title: Andrew Stallings, Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY: (Peer Reviewer) Signature ______________ 02/14/2020 DATE

Printed Name and Title: Jennifer M. Padgett, Project Engineer

COMPUTATIONS CHECKED BY: Signature ______________ 02/14/2020 DATE

Printed Name and Title: Jennifer M. Padgett, Project Engineer

COMPUTATIONS BACKCHECKED BY: (Originator) Signature ______________ 02/25/2020 DATE

Printed Name and Title: Andrew Stallings, Engineer

APPROVED BY: (PM or Designate) Signature ______________ 02/20/2020 DATE

Printed Name and Title: Jeremy Morris, Principal

APPROVAL NOTES:

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

LANDFILL GAS RADIUS OF INFLUENCE

PURPOSE

In order to provide adequate landfill gas (LFG) extraction coverage, vertical gas wells must be placed in close enough proximity such that "dead spots" do not exist between the wells. Well locations are assigned by estimating the radius of influence (ROI) of each well and providing adequate overlap. The purpose of this calculation is to estimate ROI values to support the selection of well locations and design the layout of the wellfield for the proposed Tolson Rubble Landfill (TRL) Expansion, a construction and demolition (C&D) debris landfill located in Crofton, Anne Arundel County, Maryland.

METHODOLOGY

The ROI can be defined as the distance from the center of the well outward to the extent at which a vacuum is applied within the waste mass. A method based on Darcy's equation was used to estimate the ROI of each pipe within the network [Kulasingam and Othman, 2006]. This equation is presented below:

$$ROI = \sqrt{\frac{2g \cdot K \cdot T_s \cdot \left(\frac{H_s}{H_T}\right)}{P_s \cdot GGR \cdot \gamma_w \cdot \mu \cdot T} \cdot (P_1^2 - P_O^2)} \quad (1)$$

where:

g = gravitational acceleration (32.2 ft/sec^2)

K = intrinsic permeability of waste (ft^2)

T_s = standard temperature (R)

H_s = length of perforated pipe (ft)

H_T = total length of pipe (ft)

P_1 = pressure (vacuum) at ROI circumference

P_O = pressure (vacuum) at wellhead (lb/ft^2)

P_s = standard pressure (lb/ft^2)

GGR = gas generation rate (ft^3/lb/sec)

γ_w = unit weight of waste (lb/ft^3)

μ = dynamic viscosity of the landfill gas (lb/ft/sec)

T = average landfill gas temperature (R)

CALCULATIONS

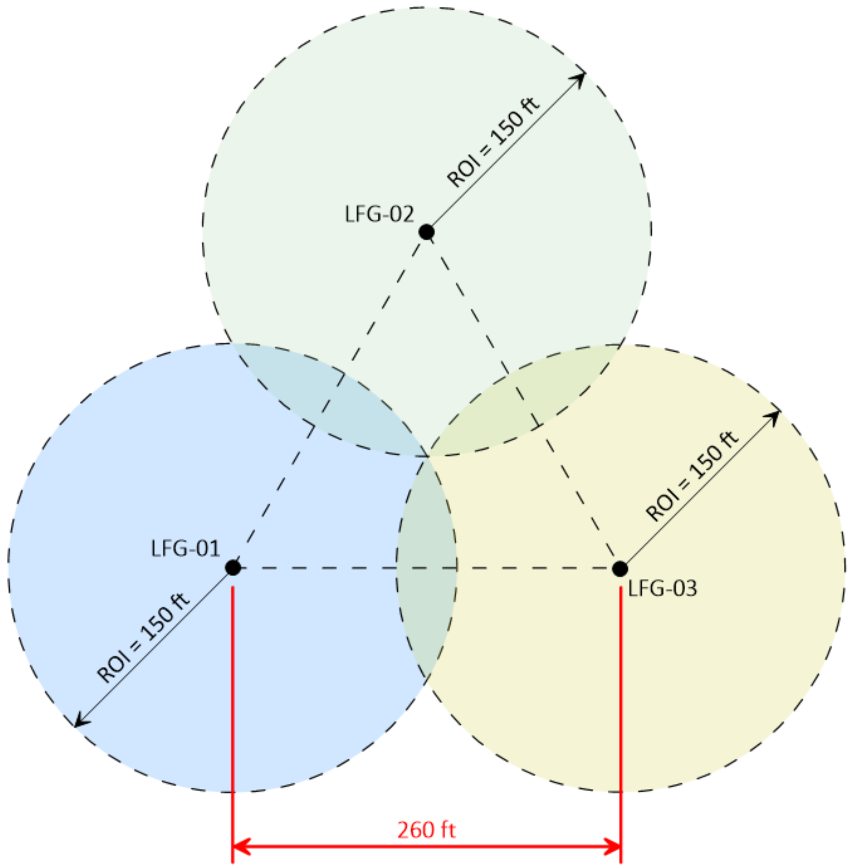
The input parameters used to compute the ROI, including the rationale used in choosing parameters, are presenting in Table 1. The ROI is limited to a maximum radius of 150 feet, which provides for a nominal wellfield density of one well per acre consistent with industry norms.

GGR was calculated based on the peak LFG generation rate of 1,270 cubic feet per minute at standard temperature and pressure (scfm) as estimated by LandGEM [U.S. EPA, 2005] in the *Landfill Gas Generation Estimate* calculation package (Appendix I.1). For calculating ROI, the generation rate is normalized by the landfill capacity, calculated as 5.51×10^6 tons in the *Landfill Gas Generation Estimate* calculation package (Appendix I.1).

RESULTS AND CONCLUSIONS

ROI calculations for vertical LFG wells are included in Table 2. A conceptual plan for installation of 31 vertical LFG wells at the TRL Expansion, along with a conceptual layout of lateral/header piping and a blower/flare station, is illustrated in Attachment 1.

The calculated horizontal ROI for wells is 150 feet. To provide a reasonable amount of overlap in coverage and mitigate “dead spots” between wells, wells should be placed in a triangular pattern with a spacing of no more than 260 feet, as illustrated below. To the extent reasonable possible while allowing for geometric constraints, the layout of the wellfield in Attachment 1 adopts this pattern.



REFERENCES

Kulasingam, R. and Othman, M.A. [2006]. "Gas Collection and Control System Phasing Plan," WASTCON, Charlotte, North Carolina.

United State Environmental Protection Agency [2005]. "Landfill Gas Emissions Model (LandGEM), Version 3.02," EPA-600/R-05/047.

TABLES

Table 1 - Input Parameters for ROI Calculations

Tolson Rubble Landfill Expansion, Anne Arundel County, Maryland

Parameter	Value	Unit	Comment
g	32.2	ft/sec^2	Gravitational acceleration
K	2.68E-11	ft^2	Typical intrinsic permeability of waste
T_s	520	R	Corresponds to a temperature of 60° F
T	570	R	Average temperature of landfill gas assumed to be 110° F
H_s	Varies	ft	Length of slotted pipe
H_T	Varies	ft	Total landfill thickness/length, which accounts for waste that the trenches and wells are not constructed through
P_1	2,116.8	psf	Corresponds to a gage pressure of zero (i.e., no vacuum present at the extent of the ROI)
P_o	2,101.2	psf	Selected based on allowable vacuum of 3 in. w.c.
P_s	2,116.8	psf	Standard atmospheric pressure
γ_w	50	pcf	Typical unit weight of C&D waste
μ	8.31E-06	lb/ft/sec	Based on a mixture of methane and carbon dioxide at average temperature and pressure anticipated within the landfill

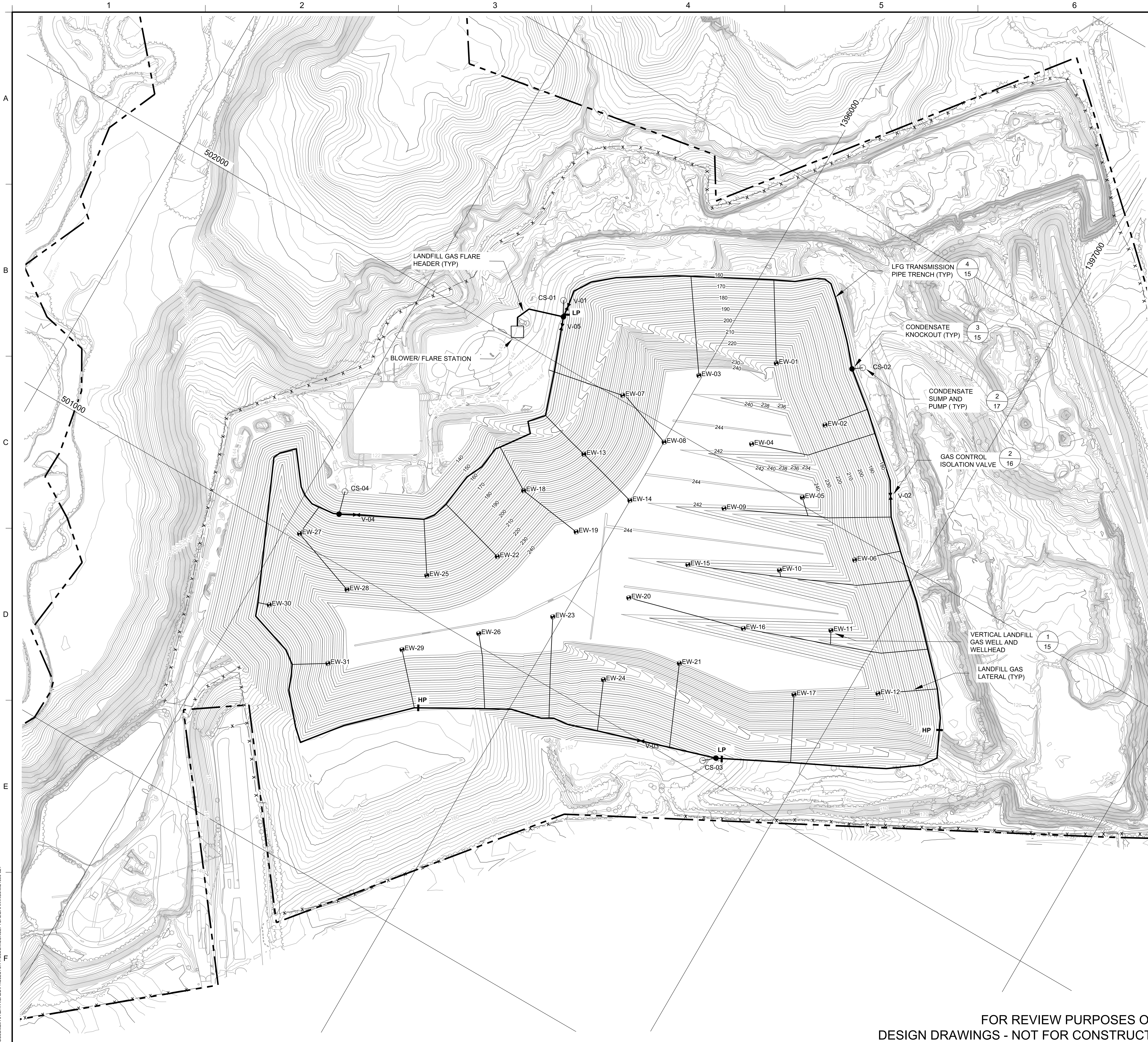
Table 2 - Radius of Influence Calculation

Tolson Rubble Landfill Expansion, Anne Arundel County, Maryland

Location	Peak LFG Generation Rate	Waste Design Capacity		Gas Generation Rate, *GGR*		Average Well Depth, H_s	Average Landfill Thickness, H_T	Radius of Influence, *ROI*
	(scfm)	(ton)	(lb)	(ft^3/lb/yr)	(ft^3/lb/sec)	(ft)	(ft)	(ft)
Cell 1	1,270	5.51E+06	1.10E+10	0.061	1.92E-09	111	126	150
Cell 2	1,270	5.51E+06	1.10E+10	0.061	1.92E-09	109	124	150
Cell 3	1,270	5.51E+06	1.10E+10	0.061	1.92E-09	110	125	150
Cell 4	1,270	5.51E+06	1.10E+10	0.061	1.92E-09	114	129	150
Cell 5	1,270	5.51E+06	1.10E+10	0.061	1.92E-09	115	130	150
Cell 6	1,271	5.51E+06	1.10E+10	0.061	1.92E-09	124	139	150
Cell 7	1,272	5.51E+06	1.10E+10	0.061	1.92E-09	122	137	150

ATTACHMENT 1

Conceptual LFG Collection System Design



LEGEND

55	EXISTING MINOR GRADE CONTOUR
50	EXISTING MAJOR GRADE CONTOUR
	EXISTING TREE LINE
x x x	EXISTING FENCE
	EXISTING ROAD
	PROPERTY LINE
118	PROPOSED MINOR GRADE CONTOUR
120	PROPOSED MAJOR GRADE CONTOUR
	LANDFILL GAS HEADER
	LANDFILL GAS LATERAL
EW-12	LANDFILL GAS EXTRACTION WELL
CS-02	CONDENSATE SUMP
LP	LOW POINT
HP	HIGH POINT
●	CONDENSATE KNOCKOUT
	GAS CONTROL/ ISOLATION VALVE

NOTES:

1. CONTOURS SHOWN REPRESENT TOP OF WASTE GRADES.
2. IN LOCATIONS WHERE THE PROPERTY BOUNDARY IS NOT APPARENT, THE SITE BOUNDARY AND PROPERTY BOUNDARY ARE COINCIDENTAL.

REV	DATE	DESCRIPTION	DRN	APP

Geosyntec consultants
10211 WINCOPIN CIRCLE, FLOOR 4
COLUMBIA, MARYLAND 21044
PHONE: (410) 381-4333

TOLSON AND ASSOCIATES, LLC
24024 FREDERICK ROAD
CLARKSBURG, MARYLAND 20871

TITLE: LANDFILL GAS MANAGEMENT SYSTEM PLAN

PROJECT: **VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL**

SITE: **TOLSON RUBBLE LANDFILL**

DRAFT

SIGNATURE

DATE

DESIGN BY:	SS	DATE:	JULY 2020
DRAWN BY:	ANA	PROJECT NO.:	ME1606
CHECKED BY:	SS	FILE:	ME1606-021
REVIEWED BY:	---	DRAWING NO.:	
APPROVED BY:	CHP	15 OF 18	

FOR REVIEW PURPOSES ONLY
DESIGN DRAWINGS - NOT FOR CONSTRUCTION

Geosyntec
consultants

Appendix I.3: Sizing of Landfill Gas Collection and Control System Components

COMPUTATION COVER SHEET

Client: Tolson & Associates **Project:** TRL Expansion **Project #:** ME1606 **Task #:** 03

TITLE OF COMPUTATIONS SIZING LANDFILL GAS TRANSMISSION SYSTEM COMPONENTS

COMPUTATIONS BY:

Signature ______________________ 01/20/2020
DATE

Printed Name Andrew Stallings
and Title Engineer

ASSUMPTIONS AND PROCEDURES
CHECKED BY:
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Printed Name Jennifer M. Padgett
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COMPUTATIONS CHECKED BY:

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COMPUTATIONS
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DATE

Printed Name Jeremy Morris
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APPROVAL NOTES: ______________________

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

SIZING LANDFILL GAS TRANSMISSION SYSTEM COMPONENTS

PURPOSE

The purpose of this calculation is to design the pipe sizes for the landfill gas (LFG) transmission header and laterals at the proposed Tolson Rubble Landfill (TRL) Expansion, a construction and demolition (C&D) debris landfill located in Crofton, Anne Arundel County, Maryland. A conceptual plan for the proposed LFG collection system, which includes installation of vertical LFG extraction wells, lateral and header piping, condensate sumps, and a blower/flare station, is illustrated in Attachment 1.

METHODOLOGY

LFG is typically saturated with water vapor, which may condense on the side walls of transmission pipes due to temperature variations between the wells and the blower/flare station. Therefore, all transmission piping components are sized in accordance with recommendations by USACE [2008] such that:

(i) gas velocity is less than 2,400 feet per minute (fpm) for downslope pipe when LFG and condensate are flowing concurrently;

(ii) gas velocity is less than 1,200 fpm for upslope pipe when LFG flow direction is opposite to that of the condensate to avoid blockage of condensate flow; and

(iii) head loss less than 1 in.-water per 100 feet of pipe to minimize the required blower horsepower.

Gas velocity in a pipe, V, is calculated using the following standard formula:

$$V = \frac{Q}{A} \tag{1}$$

where:

Q = flow (ft^3/sec)

A = cross sectional area of the pipe (ft^2)

Head loss is calculated using a form of the Spitzglass formula (valid for gases at pressure less than 1 psig):

$$\Delta h_w = \frac{q_h^2 \cdot L \cdot S_g}{C_s^2 \cdot d^5} \tag{2}$$

where:

Δh_w = head loss (in.-water)

q_h = flow rate (ft^3/hr)

L = pipe length (ft)

S_g = specific gravity of gas relative to air = 1.04

d = pipe diameter (in.)

$C_s = 3550/(1 + 3.6/d + 0.03d)^{1/2}$

CALCULATIONS

Sizing of lateral and header pipes is based on the peak LFG generation rate of 1,270 cubic feet per minute at standard temperature and pressure (scfm) as estimated by LandGEM [U.S. EPA, 2005] in the *Landfill Gas Generation Estimate* calculation package (Appendix I.1). It is conservatively assumed that 100 percent of this generation rate will be collected by the LFG collection system.

Laterals

The peak LFG generation rate is assumed to be collected evenly by the 31 vertical gas wells and distributed proportionally between laterals based on the number of wells attached to each lateral. The number of wells attributed to each lateral was determined based on the conceptual LFG collection system design (Attachment 1).

Perimeter Header

Gas flow from the vertical wells enters the perimeter header through laterals. Gas will flow through a single header pipe around the perimeter of the landfill towards the blower/flare station. The header is a complete loop around the landfill perimeter and was designed in two sections (termed West Header and East Header) beginning at the southern condensate sump (located at a low point on the header loop) and ending at the blower/flare station. The number of wells attributed to each header section was determined based on the conceptual LFG collection system design (Attachment 1). A third header pipe section (termed Flare Header) leading from the perimeter header loop to the blower/flare station was designed separately because this section will need to convey the full LFG generation rate.

RESULTS AND CONCLUSIONS

Calculations for lateral piping and the perimeter header can be found in Tables 1 and 2, respectively.

- Laterals will be installed with a downward slope to drain condensate. Thus, gas and condensate will be flowing concurrently, and gas velocity should be less than 2,400 fpm. It was calculated that 6-inch nominal diameter pipe would be adequate to transmit gas through the lateral pipes. The calculation was performed assuming SDR 17 pipe, which corresponds to an inner pipe diameter of 5.798 inches. Although smaller pipe could be used to accommodate the predicted flow, it is not recommended to use a smaller diameter pipe to avoid potential clogging issues due to differential settlement.

- The slope of the perimeter header pipe will vary along its length, with sections where gas flows in the opposite direction as condensate. Therefore, both the East and West Header sections were designed such that the gas velocity is less than 1,200 fpm. It was calculated that 12-inch nominal diameter pipe would be adequate to transmit gas through the perimeter header pipe. The calculation was performed assuming SDR 17 pipe, which corresponds to an inner pipe diameter of 11.160 inches.

- The Flare Header section will be installed with a downward slope to drain condensate away from the blower/flare station to a condensate sump located at the intersection of the Flare Header and the perimeter header loop. Thus, gas and condensate will be flowing in opposite directions, and gas velocity should be less than 1,200 fpm. It was calculated that a 16-inch nominal diameter SDR 17 pipe, which corresponds to an inner pipe diameter of 14.005 inches, would be adequate to transmit gas through this header section.

REFERENCES

U.S. Army Corps of Engineers (USACE) [2008]. "Landfill Off-Gas Collection and Treatment Systems," EM 1110-1-4016.

TABLES

Table 1 - Head Loss and Pipe Sizing Calculation: Laterals

Tolson Rubble Landfill Expansion, Anne Arundel County, Maryland

Well IDs	Number of Wells	Peak LFG Generation (scfm)	Pipe LFG Flow (scfm)	Pipe Inner Diameter (in.)	Velocity [1,2] (ft/min)	Total Pipe Length (ft)	C_s^2	Pressure Drop (in.-w.c.)	Pressure Drop per 100 ft [3] (in.-w.c.)
EW-01	1	1,270	41	5.798	223	300	7,021,503	0.04	0.01
EW-02	1	1,270	41	5.798	223	160	7,021,503	0.02	0.01
EW-03	1	1,270	41	5.798	223	340	7,021,503	0.05	0.01
EW-04	1	1,270	41	5.798	223	460	7,021,503	0.06	0.01
EW-05, EW-09	2	1,270	82	5.798	447	590	7,021,503	0.32	0.05
EW-06	1	1,270	41	5.798	223	160	7,021,503	0.02	0.01
EW-07, EW-08	2	1,270	82	5.798	447	490	7,021,503	0.27	0.05
EW-10, EW-15	2	1,270	82	5.798	447	790	7,021,503	0.43	0.05
EW-11, EW-16, EW-20	3	1,270	123	5.798	670	1,070	7,021,503	1.32	0.12
EW-12	1	1,270	41	5.798	223	180	7,021,503	0.02	0.01
EW-13, EW-14	2	1,270	82	5.798	447	430	7,021,503	0.23	0.05
EW-17	1	1,270	41	5.798	223	240	7,021,503	0.03	0.01
EW-18, EW-19	2	1,270	82	5.798	447	420	7,021,503	0.23	0.05
EW-21	1	1,270	41	5.798	223	300	7,021,503	0.04	0.01
EW-22	1	1,270	41	5.798	223	260	7,021,503	0.04	0.01
EW-23	1	1,270	41	5.798	223	360	7,021,503	0.05	0.01
EW-24	1	1,270	41	5.798	223	180	7,021,503	0.02	0.01
EW-25	1	1,270	41	5.798	223	200	7,021,503	0.03	0.01
EW-26	1	1,270	41	5.798	223	170	7,021,503	0.02	0.01
EW-27, EW-28	2	1,270	82	5.798	447	380	7,021,503	0.21	0.05
EW-29	1	1,270	41	5.798	223	210	7,021,503	0.03	0.01
EW-30	1	1,270	41	5.798	223	50	7,021,503	0.01	0.01
EW-31	1	1,270	41	5.798	223	130	7,021,503	0.02	0.01

Notes:

1. Gas velocity should be less than 2,400 fpm for downslope pipe when LFG and condensate are flowing concurrently.
2. Gas velocity should be less than 1,200 fpm for upslope pipe when LFG flow direction is opposite that of the condensate.
3. Head loss should be less than 1 in.-w.c. per 100 feet of pipe to minimize the required blower horsepower.

Table 2 - Head Loss and Pipe Sizing Calculation: Header

Tolson Rubble Landfill Expansion, Anne Arundel County, Maryland

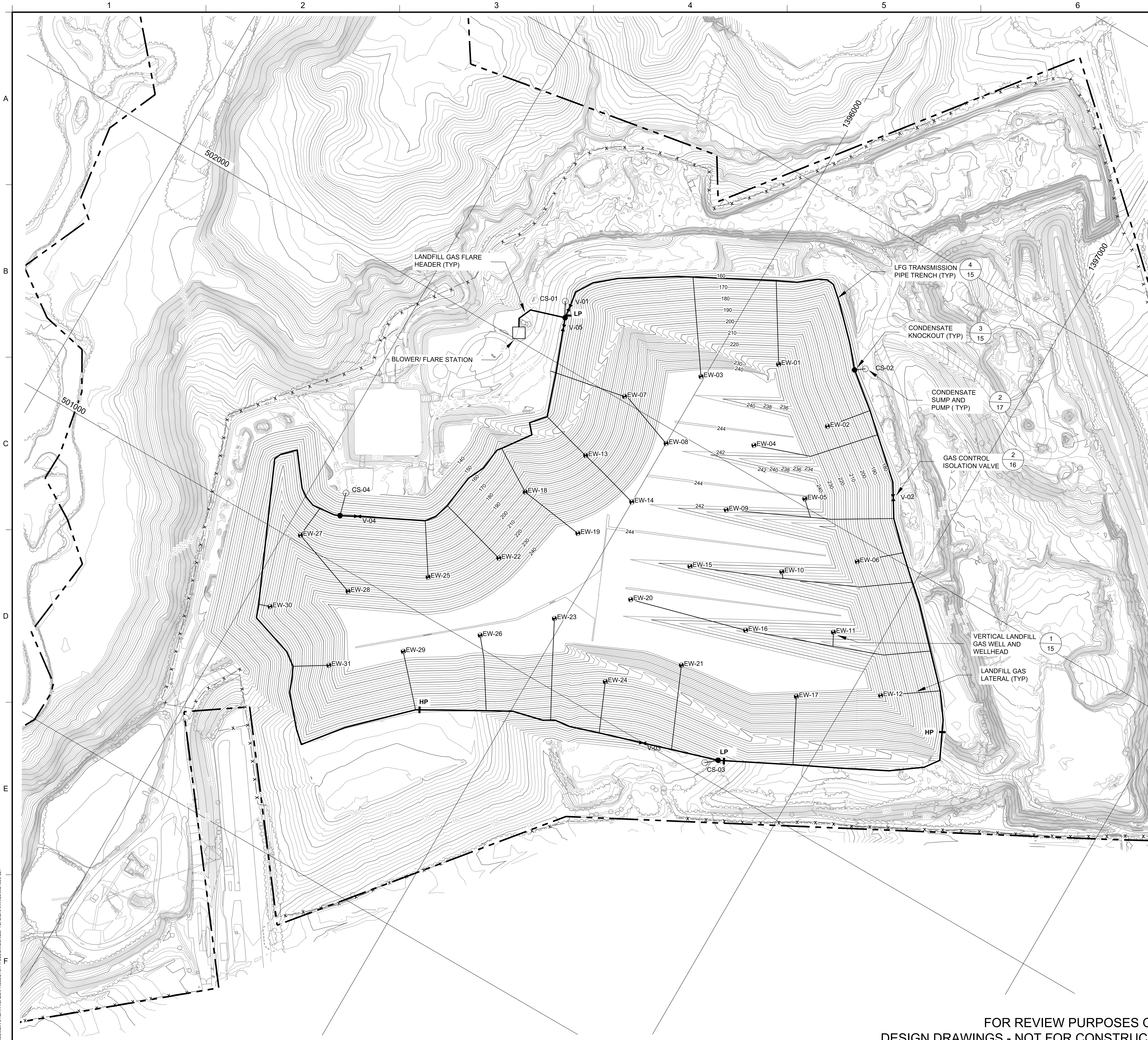
Header ID	Number of Wells	Peak LFG Generation (scfm)	Pipe LFG Flow (scfm)	Pipe Inner Diameter (in.)	Velocity [1,2] (ft/min)	Total Pipe Length (ft)	C_s^2	Pressure Drop (in.-w.c.)	Pressure Drop per 100 ft [3] (in.-w.c.)
West Header	17	1,270	654	11.160	963	4,200	7,603,866	5.11	0.12
East Header	16	1,270	616	11.160	906	3,500	7,603,866	3.77	0.11
Flare Header	31	1,270	1,270	14.005	1,187	200	7,514,007	0.30	0.15

Notes:

1. Gas velocity should be less than 2,400 fpm for downslope pipe when LFG and condensate are flowing concurrently.
2. Gas velocity should be less than 1,200 fpm for upslope pipe when LFG flow direction is opposite that of the condensate.
3. Head loss should be less than 1 in.-w.c. per 100 feet of pipe to minimize the required blower horsepower.

ATTACHMENT 1

Conceptual LFG Collection System Design



LEGEND

55	EXISTING MINOR GRADE CONTOUR
50	EXISTING MAJOR GRADE CONTOUR
	EXISTING TREE LINE
	EXISTING FENCE
	EXISTING ROAD
	PROPERTY LINE
118	PROPOSED MINOR GRADE CONTOUR
120	PROPOSED MAJOR GRADE CONTOUR
	LANDFILL GAS HEADER
	LANDFILL GAS LATERAL
EW-12	LANDFILL GAS EXTRACTION WELL
CS-02	CONDENSATE SUMP
LP	LOW POINT
HP	HIGH POINT
	CONDENSATE KNOCKOUT
	GAS CONTROL/ ISOLATION VALVE

NOTES:

1. CONTOURS SHOWN REPRESENT TOP OF WASTE GRADES.
2. IN LOCATIONS WHERE THE PROPERTY BOUNDARY IS NOT APPARENT, THE SITE BOUNDARY AND PROPERTY BOUNDARY ARE COINCIDENTAL.

FOR REVIEW PURPOSES ONLY
DESIGN DRAWINGS - NOT FOR CONSTRUCTION

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TOLSON AND ASSOCIATES, LLC
24024 FREDERICK ROAD
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TITLE: LANDFILL GAS MANAGEMENT SYSTEM PLAN

PROJECT: **VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL**

SITE: **TOLSON RUBBLE LANDFILL**

SIGNATURE

DATE

DRAFT

DESIGN BY:	SS	DATE:	JULY 2020
DRAWN BY:	ANA	PROJECT NO.:	ME1606
CHECKED BY:	SS	FILE:	ME1606-021
REVIEWED BY:	---	DRAWING NO.:	
APPROVED BY:	CHP	15 OF 18	

Appendix I.4: Estimate of Condensate Volume

Geosyntec
consultants

COMPUTATION COVER SHEET

Client: Tolson & Associates **Project:** TRL Expansion **Project #:** ME1606 **Task #:** 03

TITLE OF COMPUTATIONS ESTIMATE OF LANDFILL GAS CONDENSATE VOLUME

COMPUTATIONS BY: Signature — 01/17/2020 DATE

Printed Name and Title: Andrew Stallings, Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY: (Peer Reviewer) Signature — 02/14/2020 DATE

Printed Name and Title: Jennifer M. Padgett, Project Engineer

COMPUTATIONS CHECKED BY: Signature — 02/14/2020 DATE

Printed Name and Title: Jennifer M. Padgett, Project Engineer

COMPUTATIONS BACKCHECKED BY: (Originator) Signature — 02/25/2020 DATE

Printed Name and Title: Andrew Stallings, Engineer

APPROVED BY: (PM or Designate) Signature — 02/20/2020 DATE

Printed Name and Title: Jeremy Morris, Principal

APPROVAL NOTES:

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

ESTIMATE OF LANDFILL GAS CONDENSATE VOLUME

PURPOSE

The objective of this calculation package is to calculate the volume of condensate that may form in the landfill gas (LFG) transmission pipes installed as components of the LFG collection system at the proposed Tolson Rubble Landfill (TRL) Expansion, a construction and demolition (C&D) debris landfill located in Crofton, Anne Arundel County, Maryland.

METHODOLOGY

To calculate the volume of condensate that may form in the LFG transmission piping, it is first necessary to estimate the temperature of the gas at different points in the system. Based on Geosyntec's previous experience, the following temperatures are expected:

- 110°F (maximum) at gas wells
- 40°F (minimum) at knockout tanks/condensate sump

Based on Figure 1, the water content of a hydrocarbon gas (LFG is typically 50 percent methane, a simple hydrocarbon) can be estimated at a given temperature [GPSA, 2004]. From the figure, the water content of LFG was estimated at each of the two temperatures above. The estimates are as follows:

$$110°F \xrightarrow{yields} 4{,}000\,\frac{lb\ H_2O}{10^6\ ft^3\ gas}$$

$$40°F \xrightarrow{yields} 400\,\frac{lb\ H_2O}{10^6\ ft^3\ gas}$$

CALCULATIONS

Assuming that the maximum change in temperature will be from 110°F to 40°F, the maximum expected change in water content is:

$$4{,}000\,\frac{lb\ H_2O}{10^6\ ft^3\ gas} - 400\,\frac{lb\ H_2O}{10^6\ ft^3\ gas} = 3{,}600\,\frac{lb\ H_2O}{10^6\ ft^3\ gas}$$

The estimated maximum LFG generation rate at the landfill is used to estimate the maximum amount of condensate that will be generated in any one year. The selected peak flow rate used for this calculation is 1,270 cubic feet per minute at standard temperature and pressure (scfm) which was determined in the *Landfill Gas Generation Estimate* calculation package (Appendix I.1). Using this value, the maximum total condensate generated at the landfill is calculated as follows:

$$3{,}600\,\frac{lb\ H_2O}{10^6\ ft^3\ gas} \times 1{,}270\,\frac{ft^3}{min} = 4.57\,\frac{lb}{min}$$

$$4.57\,\frac{lb}{min} \times 1{,}440\,\frac{min}{day} \div 62.4\,\frac{lb}{ft^3} \times 7.48\,\frac{gal}{ft^3} = 789.2\,\frac{gal}{day} \approx 800\,\frac{gal}{day}$$

Approximately 800 gallons of condensate will be produced per day based on the maximum predicted generation rate.

RESULTS AND CONCLUSIONS

A conceptual plan for installation of vertical LFG wells, lateral and header piping, condensate sumps, and a blower/flare station is illustrated in Attachment 1. The conceptual plan shows four condensate sumps located along the perimeter LFG header loop. During final design of the LFG collection system, the sumps on the header loop should be located such that approximately equal volumes of condensate drain to them, with each sump designed to handle about 200 gallons per day. For conservatism, the sump closest to the blower/flare station should be designed to handle the full expected condensate load of 800 gallons per day.

REFERENCES

Gas Processors Suppliers Association (GPSA) [2004]. "Engineering Data Book, FPS Version," 12th Edition, Gas Processors Suppliers Association, Tulsa, Oklahoma.

FIGURE

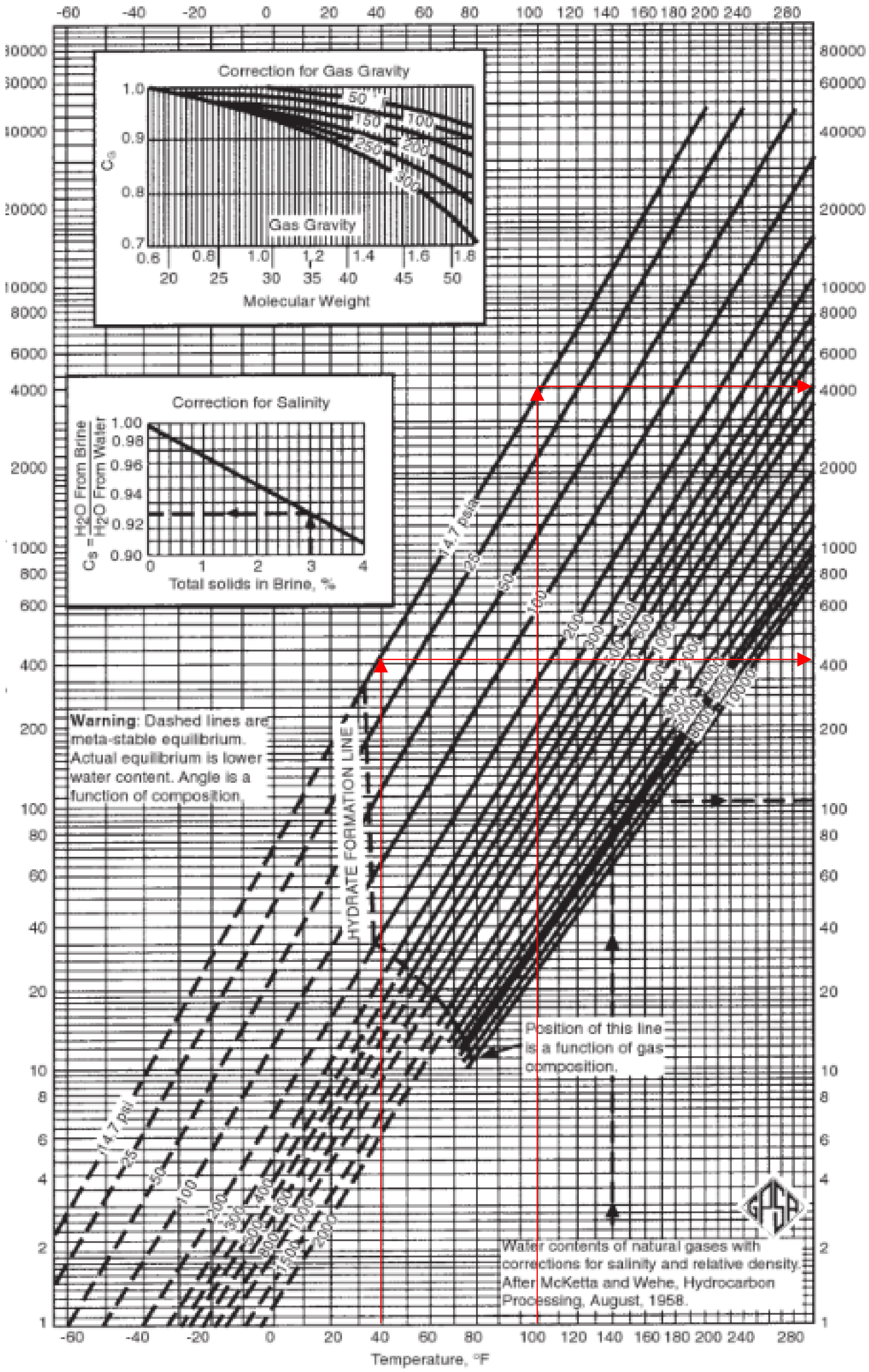
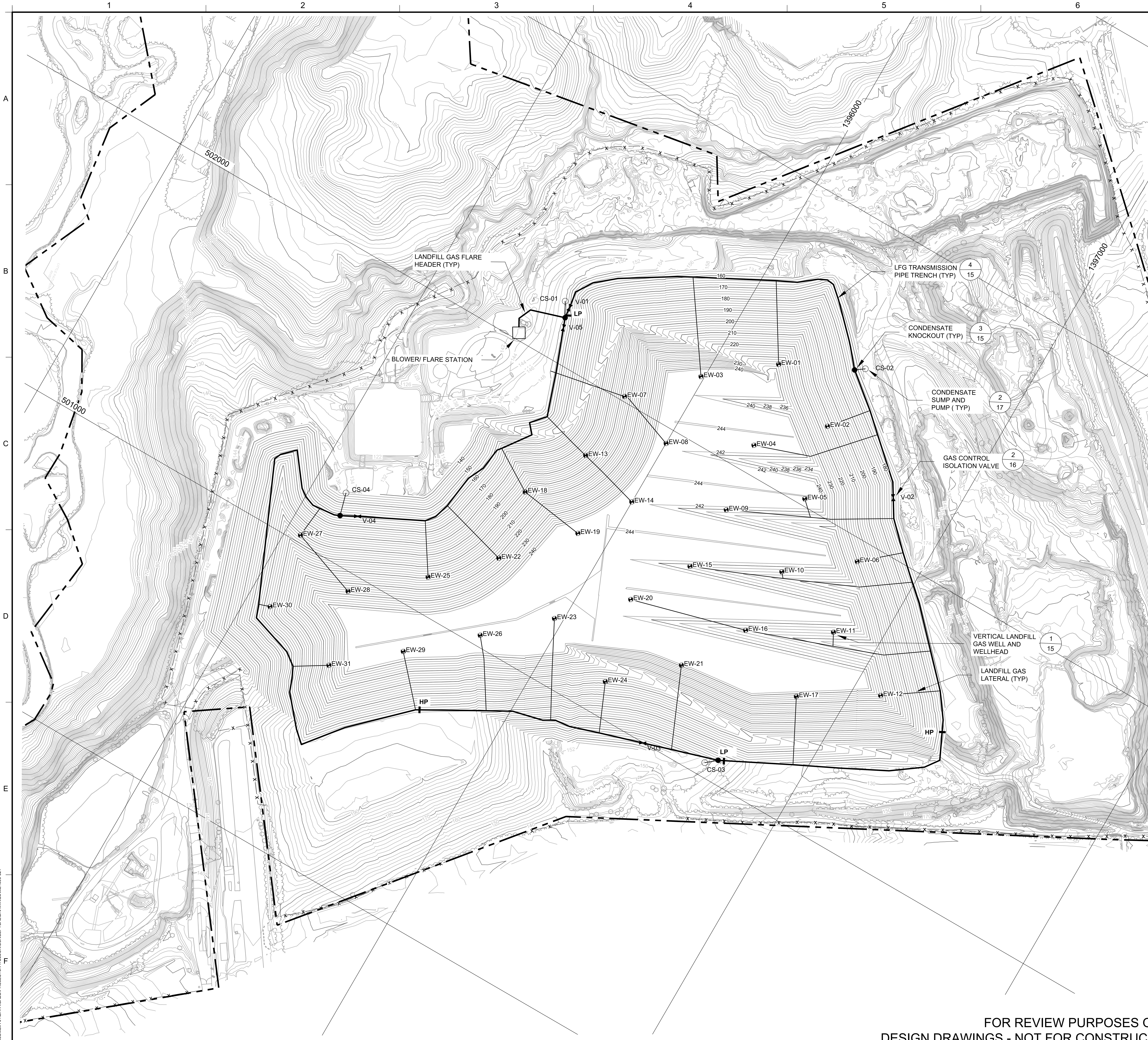


Figure 1. Water Content of Natural Gas Pressure-Temperature Correlation [GPSA, 2004]

ATTACHMENT 1

Conceptual LFG Collection System Design



N

0 160 320
SCALE IN FEET

LEGEND

55	EXISTING MINOR GRADE CONTOUR
50	EXISTING MAJOR GRADE CONTOUR
	EXISTING TREE LINE
x x x	EXISTING FENCE
	EXISTING ROAD
	PROPERTY LINE
118	PROPOSED MINOR GRADE CONTOUR
120	PROPOSED MAJOR GRADE CONTOUR
	LANDFILL GAS HEADER
	LANDFILL GAS LATERAL
EW-12	LANDFILL GAS EXTRACTION WELL
CS-02	CONDENSATE SUMP
LP	LOW POINT
HP	HIGH POINT
●	CONDENSATE KNOCKOUT
	GAS CONTROL/ ISOLATION VALVE

NOTES:

1. CONTOURS SHOWN REPRESENT TOP OF WASTE GRADES.
2. IN LOCATIONS WHERE THE PROPERTY BOUNDARY IS NOT APPARENT, THE SITE BOUNDARY AND PROPERTY BOUNDARY ARE COINCIDENTAL.

FOR REVIEW PURPOSES ONLY
DESIGN DRAWINGS - NOT FOR CONSTRUCTION

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24024 FREDERICK ROAD
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TITLE: LANDFILL GAS MANAGEMENT SYSTEM PLAN

PROJECT: **VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL**

SITE: **TOLSON RUBBLE LANDFILL**

DRAFT

SIGNATURE

DATE

DESIGN BY:	SS	DATE:	JULY 2020
DRAWN BY:	ANA	PROJECT NO.:	ME1606
CHECKED BY:	SS	FILE:	ME1606-021
REVIEWED BY:	---	DRAWING NO.:	
APPROVED BY:	CHP	15 OF 18	

Appendix I.5: Landfill Gas Overlay Pipe Strength

Geosyntec consultants

COMPUTATION COVER SHEET

Client: Tolson & Associates **Project:** TRL Vertical Expansion **Project/Proposal #:** ME1606 **Task:** 03

TITLE OF COMPUTATIONS: Landfill Gas Overlay Pipe Strength

COMPUTATIONS BY: Signature Simone Smith DATE 11/5/2020

Printed Name and Title: Simone Smith, P.E. Senior Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY: (Peer Reviewer) Signature Andrew Stallings DATE 11/6/2020

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COMPUTATIONS CHECKED BY: Signature Andrew Stallings DATE 11/6/2020

Printed Name and Title: Andrew Stallings, P.E. Engineer

COMPUTATIONS BACKCHECKED BY: (Originator) Signature Simone Smith DATE 11/10/2020

Printed Name and Title: Simone Smith, P.E. Senior Engineer

APPROVED BY: (PM or Designate) Signature DATE 11/12/2020

Printed Name and Title: David Espinoza, P.E. Principal

APPROVAL NOTES:

REVISIONS: (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

LANDFILL GAS OVERLAY PIPE STRENGTH

1. PURPOSE

The purpose of this calculation is to evaluate the structural stability of the landfill gas (LFG) pipes to be used in the overlay of the closed Cunningham Rubble Landfill (CRL) as part of the proposed Tolson Rubble Landfill (TRL) vertical expansion, located in Crofton, Anne Arundel County, Maryland. The LFG pipes are evaluated for structural stability based on resistance to wall crushing, buckling, and excessive ring deflection.

2. BACKGROUND

The proposed LFG pipes will be high-density polyethylene (HDPE) pipe with a nominal diameter of 6 inches (in.) and a standard dimension ratio (SDR) of 11. SDR is the ratio of outer diameter of the pipe to wall thickness. The parameters used for the design of the HDPE pipe are based on the *Plastic Pipe Institute® Handbook of Polyethylene Pipe* and provided in Attachment 1. The basic properties of the proposed LFG pipes are given below:

Parameter *	LFG Overlay Pipe
Nominal Diameter	6 in.
Standard Dimension Ratio (SDR)	11
Outer Diameter	6.625 in.
Inner Diameter	5.35 in.
Wall Thickness	0.602 in

* Parameter references are provided in Attachment 1-1.

The LFG pipes will be placed above the capping system of the CRL and beneath the overlay liner shown in Figure 1. The proposed final grades for TRL and the overlay gas pipes for CRL are shown in Figure 2 (maximum elevation 244 ft-msl). The maximum waste thickness at TRL is expected to be approximately 140 ft, however the maximum waste thickness above the overlay gas pipes is less than 80 ft, as shown in Figure 2.

3. INDUCED PIPE STRESSES

Evaluation of the stability of the LFG pipes is done based on engineering procedures described in *Plastic Pipe Institute® Handbook of Polyethylene Pipe*. To ensure the stability of the pipe, loads imposed on the pipe must be limited to stresses which will not cause failure of the pipe. Two typical loading conditions are analyzed:

- *During Construction*: The maximum pressure on the pipe induced by equipment during construction of the vertical expansion.
- *After Closure*: The maximum pressure exerted on the pipe due to overburden loads of the landfill waste and cover material after the final grades have been achieved.

3.1 <u>During Construction</u>

The initial condition assumes that the pipe is buried under 6 in structural fill plus the liner system consisting of 2 ft of prepared subbase and 1 ft drainage layer before construction equipment will cross the pipe. For the calculations, a concentrated load of 30,000 lbs from one tire is assumed to be applied above the crown of the pipe (based on Caterpillar 730 Articulated Haul Vehicle). The stress on the pipe induced by the construction equipment is calculated as follows:

$$\sigma_{equipment} = C_H \frac{IW_l}{LD} \tag{1}$$

where:

$\sigma_{equipment}$	=	stress induced on the pipe by construction equipment (psf)
I	=	impact factor
L	=	pipe length (ft)
C_H	=	load coefficient
D	=	pipe outer diameter (ft)
W_l	=	wheel load (pounds)

The *Handbook of Polyethylene Pipe* suggests an impact factor of 1.5 be used for calculations of highway vehicles traveling at low speeds over pipes which are 3 feet or longer. The load coefficient (C_H) is a function of the pipe burial depth (H), length (L), and outer diameter (D).

$$C_H = f\left(\frac{L}{2H}, \frac{D}{2H}\right)$$

The stress on the pipe induced by the overlying soil of unit weight (γ) is calculated as follows:

$$\sigma_{soil} = \gamma H \qquad (2)$$

The vertical stresses due to construction can then be calculated as:

$$\sigma_{construction} = (\sigma_{equipment} + \sigma_{soil}) \qquad (4)$$

3.2 <u>During Closure</u>

During post closure conditions, the LFG overlay pipes will be subjected to overburden stresses due to the materials above the pipe (i.e., waste and final cover soils). The vertical stresses for a the pipe can be calculated as follows:

$$\sigma_{closure} = I_s(\gamma H) \qquad (5)$$

where:

γ	=	unit weight of waste (pcf)
H	=	maximum depth of waste in the landfill (ft)
I_s	=	influence factor for vertical stress

4. FACTOR OF SAFETY

4.1 Case 1: Pipes installed with overburden soil less than 50 ft

For pipes installed within a trench or underneath an embankment with an overburden soil thickness less than 50 ft, the following calculation procedure can be used:

4.1.1 Wall Crushing

Wall crushing can occur when the stresses in the pipe wall due to external vertical pressure exceed the compressive strength of the pipe material. The pipe wall compressive stress can be calculated as:

$$\sigma_{compressive} = \frac{\sigma_{max} \cdot (SDR)}{2} \tag{6}$$

where:

$\sigma_{compressive}$	=	compressive design strength of the pipe (psi)
SDR	=	standard dimension ratio of the pipe (i.e., outer diameter/wall thickness)
σ_{max}	=	maximum stress applied to the pipe (psi)

The calculated pipe wall compressive stress should be less than the allowable compressive stress shown in Attachment 1-2.

4.1.2 Wall Buckling

Wall buckling, a longitudinal wrinkling in the pipe wall, can occur when the external vertical pressure exceeds the critical buckling pressure of the pipe/bedding aggregate system. The factor of safety against pipe wall buckling can be calculated using the following equation adapted from the *Plastic Pipe Institute® Handbook of Polyethylene Pipe.*

$$FS_{wb} = \frac{5.65}{\sigma_{max}}\left[\frac{RB'E'E}{12(SDR-1)^3}\right]^{1/2} \tag{7}$$

where:

FS_{wb}	=	factor of safety against pipe wall buckling
σ_{max}	=	maximum stress applied to the pipe (psi)
E'	=	modulus of soil reaction for pipe bedding (Attachment 1-3) (psi)
E	=	modulus of elasticity of the pipe material (Attachment 1-4) (psi)
SDR	=	standard dimension ratio of the pipe
B'	=	support factor, $B' = [1 + 4e^{-0.065H}]^{-1}$
R	=	buoyancy reduction factor, $R = 1 - 0.33\, H_{GW}/H$
H_{GW}	=	height of ground water above pipe

4.1.3 Ring Deflection

Ring deflection is the change in vertical diameter of the pipe as the pipe/bedding aggregate system deforms under the external vertical pressure. The pipe ring deflection may be estimated by the following equation, according to the *Plastic Pipe Institute® Handbook of Polyethylene Pipe*:

$$\frac{\Delta X}{D_M} = \frac{1}{144}\left(\frac{KL_{DL}P_E + KP_L}{2\frac{E}{3}\left(\frac{1}{SDR-1}\right)^3 + 0.061F_sE'}\right) \tag{8}$$

where:

ΔX	=	horizontal deflection (in.)
D_M	=	mean diameter (in.) ($D_o - t$)
P_E	=	pressure induced by earth (psf)
P_L	=	pressure induced by live load (psf)
F_s	=	soil support factor (Attachment 1-5)
K	=	bedding factor, typically 0.1
L_{DL}	=	deflection lag factor, typically between 1.0 and 1.5 (1.0 often chosen for soil column loads, 1.5 conservatively used)
E'	=	modulus of soil reaction for pipe bedding (Attachment 1-3) (psi)
E	=	modulus of elasticity of the pipe material (Attachment 1-4) (psi)

According to *Plastic Pipe Institute® Handbook of Polyethylene Pipe*, the safe deflection limit for non-pressurized pipe ($\Delta X/D_M$) is 7.5 percent, which contains a factor of safety greater than 3 (Attachment 1-6).

4.2 Case 2: Pipes installed with overburden soil greater than 50 ft

For pipes installed with overburden soil thickness greater than 50 ft, significant arching effect will occur, and the following calculation procedures are recommended by the *Plastic Pipe Institute® Handbook of Polyethylene Pipe*.

4.2.1 Earth Pressure due to Arching Effect

A vertical arching factor (VAF) defined as follows can be used to account for the arching effect.

$$VAF = 0.88 - 0.71\frac{S_A - 1}{S_A + 2.5} \tag{9}$$

where S_A is the hoop thrust stiffness ratio, which can be calculated as follows:

$$S_A = \frac{1.43 M_s r_{cent}}{EA} \tag{10}$$

where:

r_{cent}	=	radius to centroidal axis of the pipe
M_s	=	one-dimensional modulus of soil (Attachment 1-9)
E	=	elastic modulus of pipe material
A	=	wall thickness of solid-wall pipes (in.)

The radial-directed pressure induced on the pipe can then be calculated as:

$$p_{rd} = VAF\sigma_{max} \tag{11}$$

where σ_{max} is the overburden calculated without consideration of arching effect.

4.2.2 Wall Crushing

$$\sigma = \frac{p_{rd} SDR}{2} \tag{12}$$

where p_{rd} is the radial-directed earth pressure (psi).

The calculated pipe wall compressive stress should be less than the allowable compressive stress shown in Attachment 1-2.

4.2.3 Wall Buckling

The Moore-Selig equation can be used to estimate the critical earth pressure (P_{cr}) at which wall buckling may occur:

$$P_{cr} = \frac{2.4\varphi R_H}{D_M}(EI)^{1/3}\left(\frac{E_s}{1-\mu}\right)^{2/3} \tag{13}$$

where:

φ	=	calibration factor (0.55 for granular soil)
R_H	=	geometry factor (1.0 for deep uniform fill)
I	=	pipe wall moment of inertia ($t^3/12$ for solid wall pipe, t = wall thickness)

E_s = secant modulus of the soil
M = Poisson's ratio

The secant modulus (E_s) can be calculated as:

$$E_s = \frac{M_s(1+\mu)(1-2\mu)}{1-\mu} \quad (14)$$

The factor of safety against wall buckling can be calculated as:

$$FS_{wb} = \frac{P_{CR}}{\sigma_{max}} \quad (15)$$

4.2.4 Ring Deflection

The ring deflection of pipe buried under deep fill can be calculated using the Watkins-Gaube Graph. To use the Watkins-Gaube Graph, first determine the relative stiffness between the pipe and soil, which is given by the Rigidity Factor, defined as follows:

$$R_F = \frac{12E_s(SDR-1)^3}{E} \quad (16)$$

With the calculated rigidity factor, a deformation factor (D_F) can be determined from the Watkins Gaube Graph (Attachment 1-7). The deflection ratio can be calculated as follows:

$$\frac{\Delta X}{D_M} = \frac{\sigma_{max}}{E_s} D_F \quad (17)$$

5. CALCULATIONS

The stresses induced by the loading are calculated as follows.

5.1 During Construction – LFG Overlay Pipes

The load coefficient is taken from Attachment 1-8 for this calculation. The tire width of Caterpillar 730 haul trucks is approximately 2 ft. The analysis conservatively assumes the tire width of 1.5 ft and a 1H:2V load distribution. Therefore, for a depth (H) of 3.5 ft (6 in structural fill plus 3 ft of subbase and protective cover) and a pipe outer diameter of 6.625 in. (0.552 ft):

$$L = 1.5\,ft + (2 \times 3.5\,ft \times 1H{:}\,2V) = 5\,ft$$

$$L/2H = \frac{5\,ft}{2 \times 3.5\,ft} = 0.714$$

$$D/2H = \frac{0.552\,ft}{2 \times 3.5\,ft} = 0.079$$

The corresponding C_H = 0.098 (Attachment 1-8).

Stress induced by construction equipment:

$$\sigma_{equipment} = \left(0.098 \times \frac{1.5 \times 30{,}000\,lbs}{(3.5\,ft)\left(\frac{6.625}{12}ft\right)}\right) \times \left(\frac{ft^2}{144\,in^2}\right) = 15.8\,psi$$

Stress induced by overlying soil (e.g., fill surrounding the LFG pipes and liner above):

$$\sigma_{soil} = (135\,pcf \times 3.5\,ft) \times \left(\frac{1\,ft^2}{144\,in.^2}\right) = 3.3\,psi$$

Thus, total stress induced on pipes during construction:

$$\sigma_{construction} = 1\ \times (23.4 + 3.3) = 19.1\,psi$$

5.2 After Closure – LFG Overlay

The assumed unit weight of the waste is 50 pcf and the maximum thickness of waste above the liner for the proposed final grade is approximately 80 ft. Based on the design chart (Figure 3: x/H = 0; $L/H = \infty$; z/H = 1) for the given embankment stress, the influence factor is estimated to be approximately 1.0 for the pipe buried under the maximum height of the landfill. The maximum stress after closure is:

$$\sigma_{closure} = 50\,pcf \times 80\,ft \times \left(\frac{1\,ft^2}{144\,in.^2}\right) = 27.8\,psi$$

5.3 Pipe Structural Capacity Calculations

The modulus of soil reaction, *E'*, for the pipe bedding material is based on information provided in *Handbook of Polyethylene Pipe*. Values range from 1,000 to 2,500 psi based on 95 percent compaction and cover soil thickness (Attachment 1-3). For this analysis, the value of *E'* is conservatively selected to be 1,000 psi for construction conditions. For post-closure conditions, the value of M_s is selected to be 3,850 psi (Attachment 1-9).

The modulus of elasticity of the pipe varies based on the load duration. For this analysis, the short-term modulus (2-hr duration) of 71,000 psi is used during construction stage and a long-term modulus (100 years duration) of 27,000 psi is used for post-closure conditions (Attachment 1-4). Poisson's ratio is assumed to be 0.2.

The structural capacity calculation results are shown in Tables 1 and 2. A summary of the calculated values and allowable values for the pipe under these conditions is provided below:

Design Parameters	During Construction – LFG Overlay Pipes	After Closure – LFG Overlay	Requirement
Pipe Wall Compressive Stress	105.1 psi	133.8 psi	< 1,000 psi
F.S. Wall Buckling	11.12	16.54	> 2.0
Ring Deflection Ratio	2.50 %	1.12 %	< 7.5 %

6. CONCLUSION

The pipe wall compressive stresses and ring deflection ratios computed for this calculation are less than the allowable values, and the calculated factor of safety against wall buckling is greater than 2.0. The selected LFG overlay pipes will withstand the anticipated loads that may be imposed during construction and after closure of the landfill.

REFERENCES

Plastic Pipe Institute, "Handbook of Polyethylene Pipe," Second Edition, http://plasticpipe.org/publications/pe_handbook.html.

Perloff, W. H., G. Y. Baladi, and M. E. Harr [1967]. "Stress Distribution within and under Long Elastic Embankments: Research Paper," Publication FHWA/IN/JHRP-67/14. Joint Highway Research Project, Indiana Department of Transportation and Purdue University, West Lafayette, Indiana.

TABLES

Geosyntec consultants

Table 1. Landfill Gas Overlay Pipe Structural Capacity Calculation
Tolson Rubble Landfill Expansion
Crofton, Anne Arundel County, MD

During Construction - LFG Overlay

General Input Parameters												
σ_{max} =	19.1	psi	SDR =	11		t =	0.602	in.				
D_i =	5.35	in.	D_o =	6.625	in.							
Wall Crushing												
σ_y =	1,000	psi	σ =	105.1	psi				**OK**	$\sigma < \sigma_y$		
Ring Deflection												
K =	0.1		L_{DL} =	1.5		F_s =	1.1		**OK**	$\Delta X/D_M$ =	2.50%	< 7.5%
E_N =	1,500	psi	E_N/E' =	1.5								
Wall Buckling												
E' =	1,000	psi	E =	71,000	psi	B' =	0.239		**OK**	FS_{wb} =	11.12	> 2
H =	3.5	ft	H_{GW} =	0.0	ft	R =	1.0					

Geosyntec consultants

Table 2. Landfill Gas Overlay Pipe Structural Capacity Calculation
Tolson Rubble Landfill Expansion
Crofton, Anne Arundel County, MD

After Closure - LFG Overlay Pipes

General Input Parameters

σ_{max} =	27.8	psi	SDR =	11		t =	0.602	in.
D_i =	5.35	in.	D_o =	6.625	in.			

Wall Crushing

σ_y =	1,000	psi	M_s =	3,850	psi	r_{cent} =	3.01	in.	**OK**	$\sigma < \sigma_y$
E =	27,000	psi	S_A =	1.020		VAF =	0.876			
p_{rd} =	24.3	psi	σ =	133.8	psi					

Ring Deflection

								OK			
μ =	0.2		E_s =	3,465	psi	R_F =	1,540	**OK**	$\Delta X/D_M$ =	1.12%	< 7.5%
D_F =	1.4										

Wall Buckling

P_{cr} =	459.4	psi	**OK**	FS_{wb} =	16.54	> 2

FIGURES

Geosyntec consultants

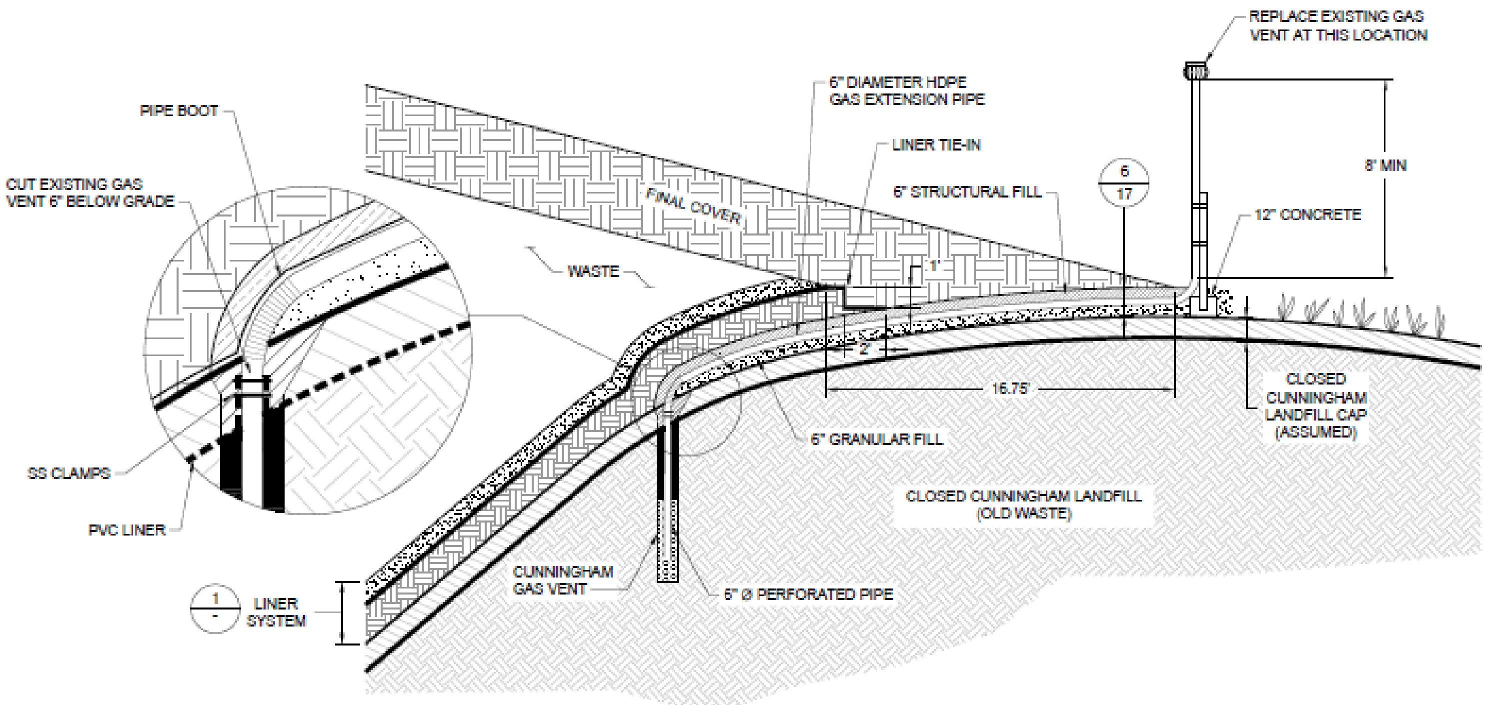

Figure 1. LFG Pipe Overlay

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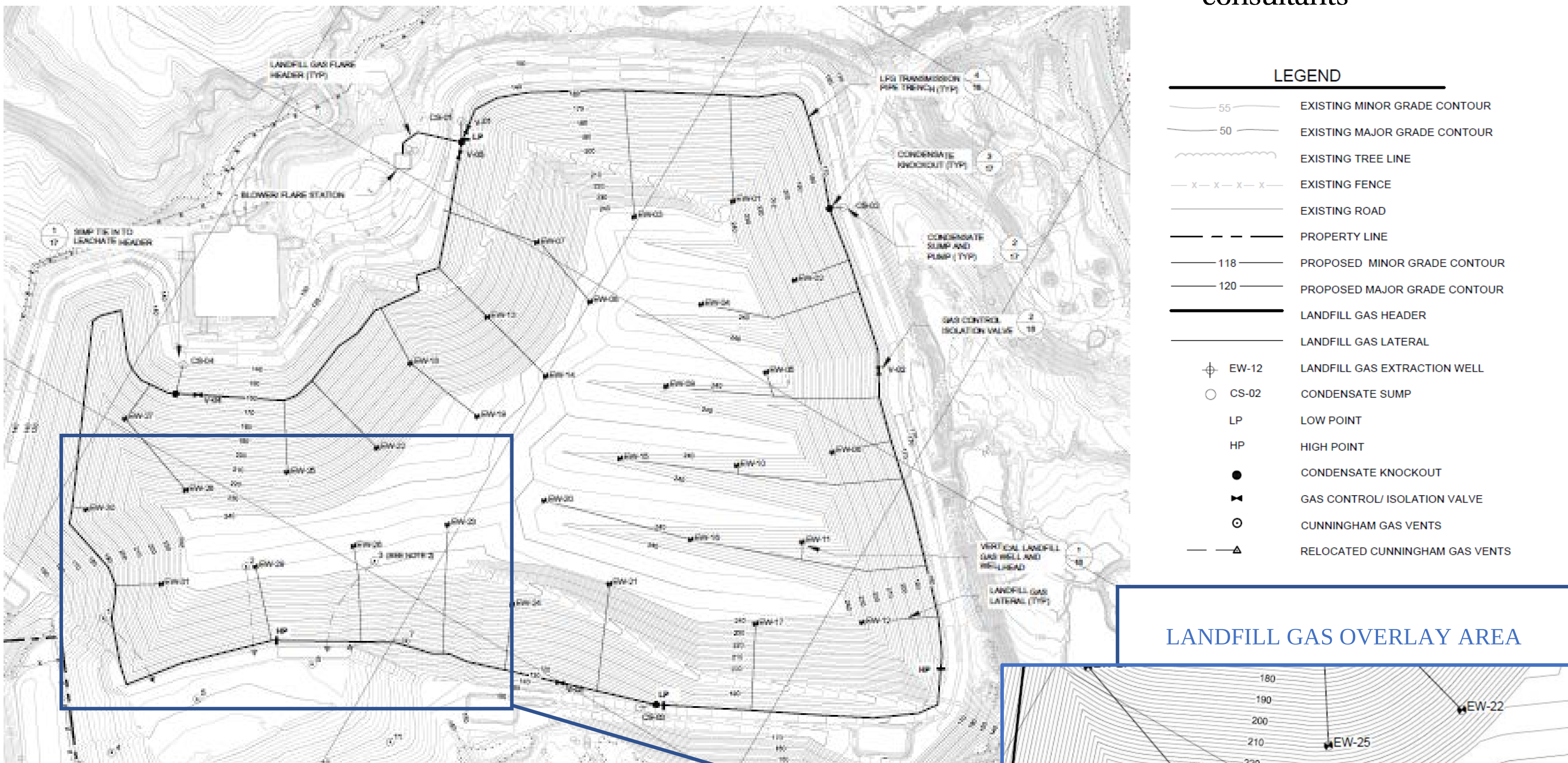
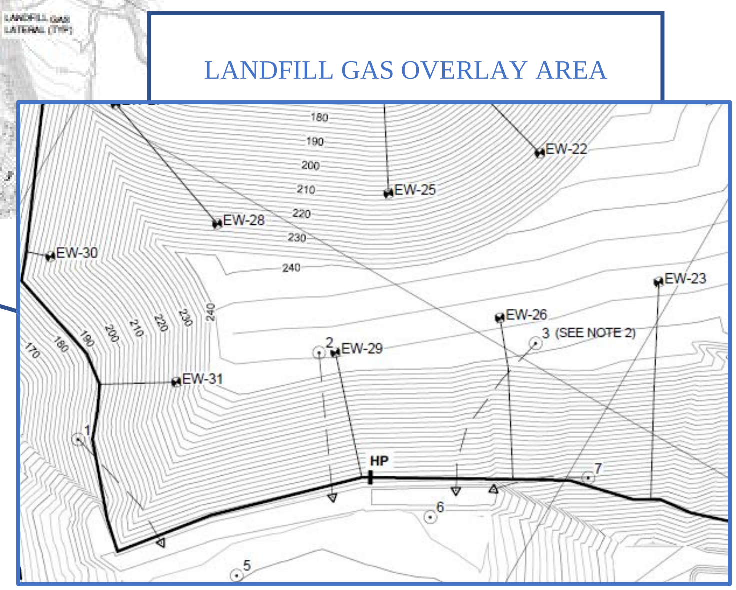




CRL Gas Well	Surface Elevation (Existing) (ft msl)	Final Grade Elevation (ft msl)	Thickness of Waste (ft)
CRL Gas Well 1	161	185	24
CRL Gas Well 2	173	242	69
CRL Gas Well 3	164	240	76
CRL Gas Well 7	160	189	29

Figure 2. Final Grading and Gas Overlay Plan.

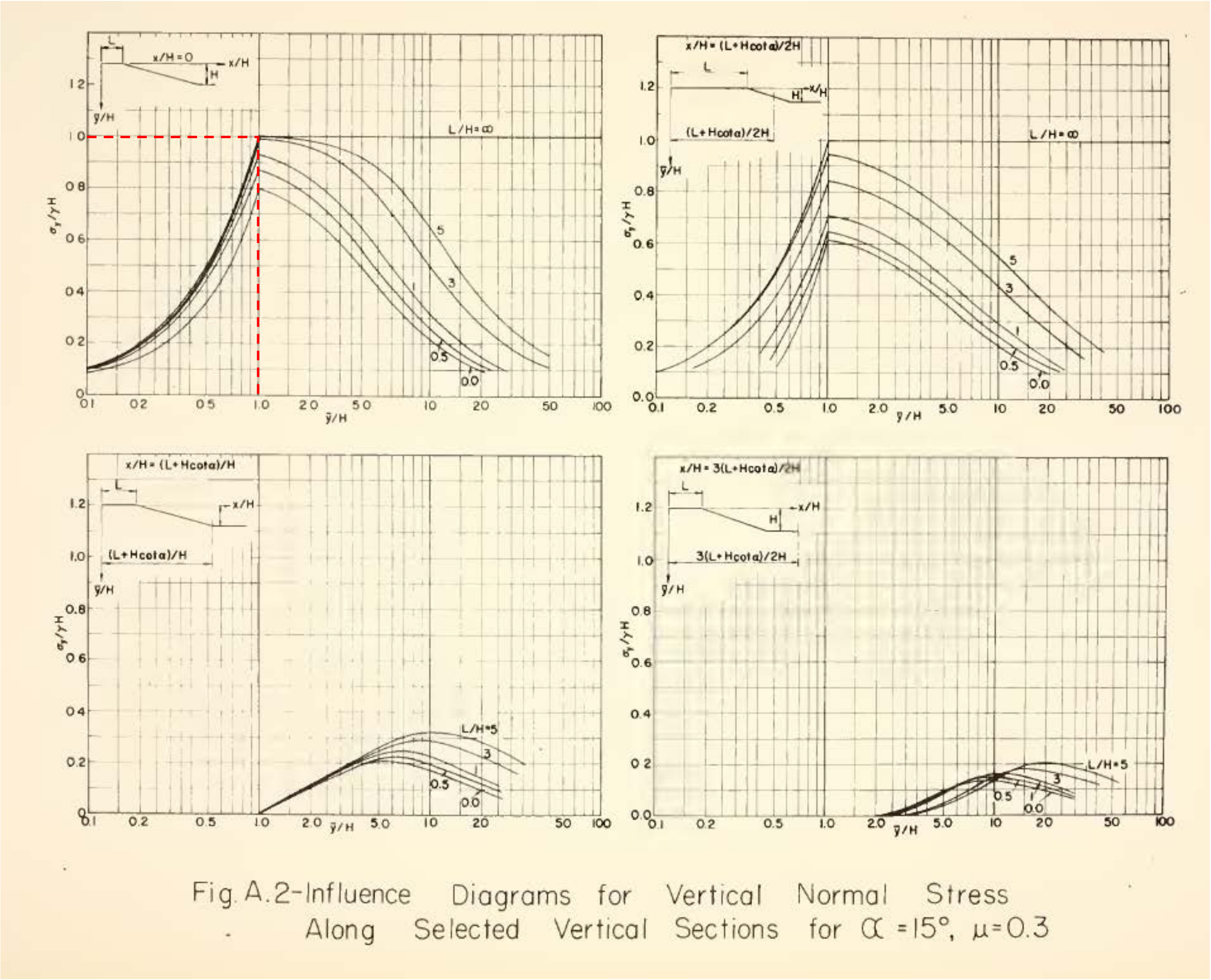


Figure 3. Vertical Stress Distribution Underneath an Embankment (Perloff et al., 1967).

ATTACHMENT 1

Pipe Performance Literature

Attachment 1-1

HDPE IRON PIPE SIZE (IPS) PRESSURE PIPE PE4710

		DR 7 (333 psi)			DR 7.3 (318 psi)			DR 9 (250 psi)			DR 9.3 (241 psi)			DR 11 (200 psi)			DR 13.5 (160 psi)		
Pipe Size	Avg OD	Min Wall	Avg ID	Weight lb/ft	Min Wall	Avg ID	Weight lb/ft	Min Wall	Avg ID	Weight lb/ft	Min Wall	Avg ID	Weight lb/ft	Min Wall	Avg ID	Weight lb/ft	Min Wall	Avg ID	Weight lb/ft
1/2	0.840	0.120	0.59	0.12	0.115	0.60	0.11	0.093	0.64	0.10	0.090	0.65	0.09	0.076	0.68	0.08	0.062	0.71	0.07
3/4	1.050	0.150	0.73	0.19	0.144	0.75	0.18	0.117	0.80	0.15	0.113	0.81	0.15	0.095	0.85	0.12	0.078	0.88	0.10
1	1.315	0.188	0.92	0.29	0.180	0.93	0.28	0.146	1.01	0.23	0.141	1.02	0.23	0.120	1.06	0.20	0.097	1.11	0.16
2	2.375	0.339	1.66	0.95	0.325	1.69	0.91	0.264	1.82	0.77	0.255	1.83	0.74	0.216	1.92	0.64	0.176	2.00	0.53
3	3.500	0.500	2.44	2.06	0.479	2.48	1.98	0.389	2.68	1.66	0.376	2.70	1.61	0.318	2.83	1.39	0.259	2.95	1.16
4	4.500	0.643	3.14	3.40	0.616	3.19	3.28	0.500	3.44	2.75	0.484	3.47	2.67	0.409	3.63	2.30	0.333	3.79	1.91
5 3/8	5.375	0.768	3.75	4.85	0.736	3.81	4.68	0.597	4.11	3.92	0.578	4.15	3.81	0.489	4.34	3.29	0.398	4.53	2.73
5	5.563	0.795	3.88	5.20	0.762	3.95	5.02	0.618	4.25	4.20	0.598	4.29	4.08	0.506	4.49	3.52	0.412	4.69	2.92
6	6.625	0.946	4.62	7.36	0.908	4.70	7.12	0.736	5.06	5.96	0.712	5.11	5.79	0.602	5.35	4.99	0.491	5.58	4.15
7	7.125	0.976	5.06	8.23	0.976	5.06	8.23	0.792	5.45	6.89	0.766	5.50	6.70	0.648	5.75	5.78	0.528	6.01	4.80
8	8.625	1.232	6.01	12.48	1.182	6.12	12.06	0.958	6.59	10.09	0.927	6.66	9.81	0.784	6.96	8.46	0.639	7.27	7.03
10	10.750	1.536	7.49	19.40	1.473	7.63	18.74	1.194	8.22	15.68	1.156	8.30	15.24	0.977	8.68	13.14	0.796	9.06	10.92
12	12.750	1.821	8.89	27.28	1.747	9.05	26.36	1.417	9.75	22.07	1.371	9.84	21.44	1.159	10.29	18.49	0.944	10.75	15.36
14	14.000	2.000	9.76	32.90	1.918	9.93	31.78	1.556	10.70	26.61	1.505	10.81	25.85	1.273	11.30	22.30	1.037	11.80	18.52
16	16.000	2.286	11.15	42.97	2.192	11.35	41.51	1.778	12.23	34.75	1.720	12.35	33.76	1.455	12.92	29.12	1.185	13.49	24.19
18	18.000	2.571	12.55	54.37	2.466	12.77	52.53	2.000	13.76	43.97	1.935	13.90	42.73	1.636	14.53	36.84	1.333	15.17	30.61
20	20.000	2.857	13.94	67.13	2.740	14.19	64.85	2.222	15.29	54.28	2.151	15.44	52.77	1.818	16.15	45.49	1.481	16.86	37.79
24	24.000	3.429	16.73	96.68	3.288	17.03	93.39	2.667	18.35	78.18	2.581	18.53	75.98	2.182	19.37	65.52	1.778	20.23	54.44
26	26.000							2.889	19.88	91.75	2.796	20.07	89.17	2.364	20.99	76.89	1.926	21.92	63.89
28	28.000							3.111	21.40	106.40	3.011	21.62	103.42	2.545	22.60	89.15	2.074	23.60	74.09
30	30.000							3.333	22.93	122.13	3.226	23.16	118.72	2.727	24.22	102.35	2.222	25.29	85.04
32	32.000													2.909	25.83	116.46	2.370	26.98	96.76
34	34.000													3.091	27.45	131.48	2.519	28.66	109.26
36	36.000													3.273	29.06	147.41	2.667	30.35	122.49

Attachment 1-2

Appendix C

Allowable Compressive Stress

Table C.1 lists allowable compressive stress values for 73°F (23°C). Values for allowable compressive stress for other temperatures may be determined by application of the same multipliers that are used for pipe pressure rating (See Table A.2).

TABLE C.1
Allowable Compressive Stress for 73°F (23°C)

	Pe Pipe Material Designation Code (1)					
	PE 2406 PE 2708		PE3408 PE 3608 PE 3708 PE 3710 PE 4708		PE 4710	
	psi	MPa	psi	MPa	psi	MPa
Allowable Compressive Stress	800	5.52	1000	6.90	1150	7.93

(1) See Chapter 5 for an explanation of the PE Pipe Material Designation Code.

Attachment 1-3

TABLE 3-8
Values of E' for Pipe Embedment (See Duncan and Hartley[10])

Type of Soil	Depth of Cover, ft	E' for Standard AASHTO Relative Compaction, lb/in^2			
		85%	90%	95%	100%
Fine-grained soils with less than 25% sand content (CL, ML, CL-ML)	0-5	500	700	1000	1500
	5-10	600	1000	1400	2000
	10-15	700	1200	1600	2300
	15-20	800	1300	1800	2600
Coarse-grained soils with fines (SM, SC)	0-5	600	1000	1200	1900
	5-10	900	1400	1800	2700
	10-15	1000	1500	2100	3200
	15-20	1100	1600	2400	3700
Coarse-grained soils with little or no fines (SP, SW, GP, GW)	0-5	700	1000	1600	2500
	5-10	1000	1500	2200	3300
	10-15	1050	1600	2400	3600
	15-20	1100	1700	2500	3800

Attachment 1-4

Appendix B
Apparent Elastic Modulus

B.1 – Apparent Elastic Modulus for the Condition of Either a Sustained Constant Load or a Sustained Constant Deformation

B.1.1 – Design Values for the Base Temperature of 73°F (23°C)

TABLE B.1.1
Apparent Elastic Modulus for 73°F (23°C)

During Construction

After Construction

Duration of Sustained Loading	Design Values For 73°F (23°C) (1,2,3)					
	PE 2XXX		PE3XXX		PE4XXX	
	psi	MPa	psi	MPa	psi	MPa
0.5hr	62,000	428	78,000	538	82,000	565
1hr	59,000	407	74,000	510	78,000	538
2hr	57,000	393	71,000	490	74,000	510
10hr	50,000	345	62,000	428	65,000	448
12hr	48,000	331	60,000	414	63,000	434
24hr	46,000	317	57,000	393	60,000	414
100hr	42,000	290	52,000	359	55,000	379
1,000hr	35,000	241	44,000	303	46,000	317
1 year	30,000	207	38,000	262	40,000	276
10 years	26,000	179	32,000	221	34,000	234
50 years	22,000	152	28,000	193	29,000	200
100 years	21,000	145	27,000	186	28,000	193

(1) Although there are various factors that determine the exact apparent modulus response of a PE, a major factor is its ratio of crystalline to amorphous content – a parameter that is reflected by a PE's density. Hence, the major headings PE2XXX, PE3XXX and, PE4XXX, which are based on PE's Standard Designation Code. The first numeral of this code denotes the PE's density category in accordance with ASTM D3350 (An explanation of this code is presented in Chapter 5).

(2) The values in this table are applicable to both the condition of sustained and constant loading (under which the resultant strain increases with increased duration of loading) and that of constant strain (under which an initially generated stress gradually relaxes with increased time).

(3) The design values in this table are based on results obtained under uni-axial loading, such as occurs in a test bar that is being subjected to a pulling load. When a PE is subjected to multi-axial stressing its strain response is inhibited, which results in a somewhat higher apparent modulus. For example, the apparent modulus of a PE pipe that is subjected to internal hydrostatic pressure – a condition that induces bi-axial stressing – is about 25% greater than that reported by this table. Thus, the Uni-axial condition represents a conservative estimate of the value that is achieved in most applications.

It should also be kept in mind that these values are for the condition of continually sustained loading. If there is an interruption or a decrease in the loading this, effectively, results in a somewhat larger modulus.

In addition, the values in this table apply to a stress intensity ranging up to about 400psi, a value that is seldom exceeded under normal service conditions.

Attachment 1-5

TABLE 3-9

Values of E'_N, Native Soil Modulus of Soil Reaction, Howard [3]

Native In Situ Soils				
Granular		Cohesive		E'_N (psi)
Std. Pentration ASTM D1586 Blows/ft	Description	Unconfined Compressive Strength (TSF)	Description	
> 0 - 1	very, very loose	> 0 - 0.125	very, very soft	50
1 - 2	very loose	0.125 - 0.25	very soft	200
2 - 4	very loose	0.25 - 0.50	soft	700
4 - 8	loose	0.50 - 1.00	medium	1,500
8 - 15	slightly compact	1.00 - 2.00	stiff	3,000
15 - 30	compact	2.00 - 4.00	very stiff	5,000
30 - 50	dense	4.00 - 6.00	hard	10,000
> 50	very dense	> 6.00	very hard	20,000
Rock	–	–	–	50,000

Loose gravel

TABLE 3-10

Soil Support Factor, F_S

E'_N/E'	B_d/D_o 1.5	B_d/D_o 2.0	B_d/D_o 2.5	B_d/D_o 3.0	B_d/D_o 4.0	B_d/D_o 5.0
0.1	0.15	0.30	0.60	0.80	0.90	1.00
0.2	0.30	0.45	0.70	0.85	0.92	1.00
0.4	0.50	0.60	0.80	0.90	0.95	1.00
0.6	0.70	0.80	0.90	0.95	1.00	1.00
0.8	0.85	0.90	0.95	0.98	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00
1.5	1.30	1.15	1.10	1.05	1.00	1.00
2.0	1.50	1.30	1.15	1.10	1.05	1.00
3.0	1.75	1.45	1.30	1.20	1.08	1.00
5.0	2.00	1.60	1.40	1.25	1.10	1.00

Attachment 1-6

crown may completely reverse its curvature inward and collapse. See Figure 3-1A. A deflection limit of 7.5% provides at least a 3 to 1 safety factor against reverse curvature.

Bending strain occurs in the pipe wall as a result of ring deflection—outer-fiber tensile strain at the pipe springline and outer-fiber compressive strain at the crown and invert. While strain limits of 5% have been proposed, Jansen [12] reported that, on tests of PE pipe manufactured from pressure-rated resins and subjected to soil pressure only, "no upper limit from a practical design point of view seems to exist for the bending strain." In other words, as deflection increases, the pipe's performance limit will not be overstraining but reverse curvature collapse.

Thus, for non-pressure applications, a 7.5 percent deflection limit provides a large safety factor against instability and strain and is considered a safe design deflection. Some engineers will design profile wall pipe and other non-pressure pipe applications to a 5% deflection limit, but allow spot deflections up to 7.5% during field inspection.

The deflection limits for pressurized pipe are generally lower than for non-pressurized pipe. This is primarily due to strain considerations. Hoop strain from pressurization adds to the outer-fiber tensile strain. But the internal pressure acts to reround the pipe and, therefore, Eq. 3-10 overpredicts the actual long-term deflection for pressurized pipe. Safe allowable deflections for pressurized pipe are given in Table 3-11. Spangler and Handy [13] give equations for correcting deflection to account for rerounding.

Attachment 1-7

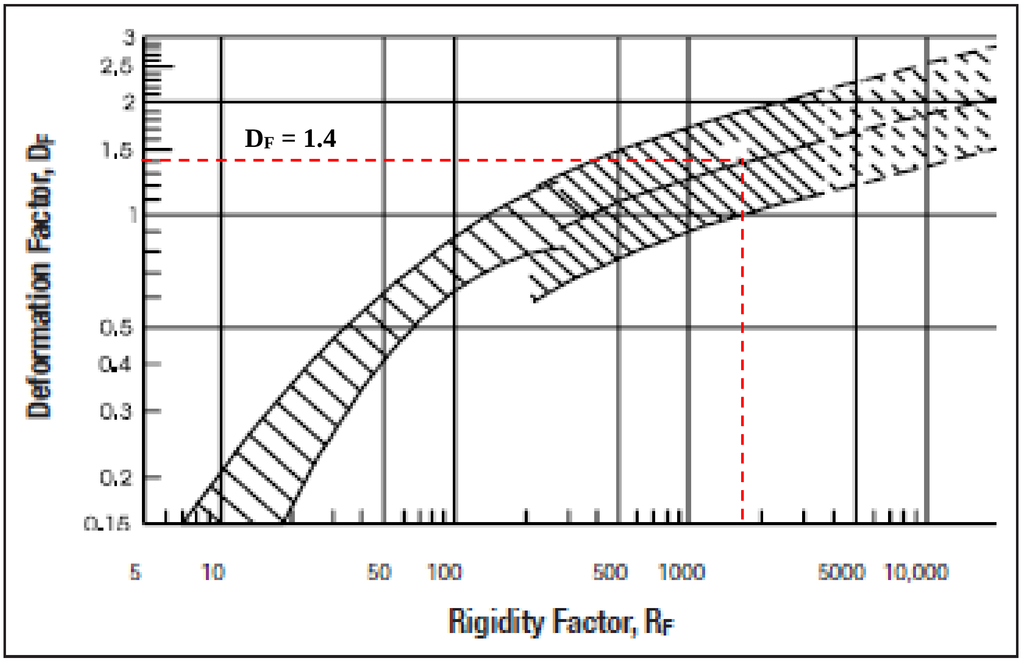
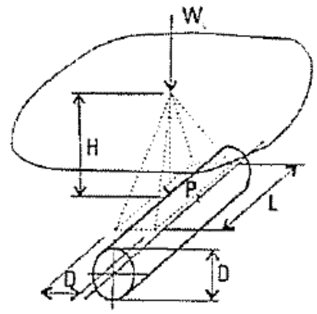


Figure 3-6 Watkins-Gaube Graph

Attachment 1-8

Table 7-4 Load Coefficient, C_H, for Holl's Integration of Boussinesq's Equation



D/2H	L/2H													
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.5	2.0	20.0
0.1	0.019	0.037	0.053	0.067	0.079	0.089	0.097	0.103	0.108	0.112	0.117	0.121	0.124	0.127
0.2	0.037	0.072	0.103	0.131	0.155	0.174	0.189	0.202	0.211	0.219	0.229	0.238	0.244	0.248
0.3	0.053	0.103	0.149	0.190	0.224	0.252	0.274	0.292	0.306	0.318	0.333	0.346	0.355	0.361
0.4	0.067	0.131	0.190	0.241	0.284	0.320	0.349	0.373	0.391	0.405	0.425	0.442	0.454	0.462
0.5	0.079	0.155	0.224	0.284	0.336	0.379	0.414	0.441	0.463	0.481	0.505	0.525	0.540	0.550
0.6	0.089	0.174	0.252	0.320	0.379	0.428	0.467	0.499	0.524	0.544	0.572	0.596	0.613	0.625
0.7	0.097	0.189	0.274	0.349	0.414	0.467	0.511	0.546	0.574	0.597	0.628	0.655	0.674	0.688
0.8	0.103	0.202	0.292	0.373	0.441	0.499	0.546	0.584	0.615	0.639	0.674	0.703	0.725	0.740
0.9	0.108	0.211	0.306	0.391	0.463	0.524	0.574	0.615	0.647	0.673	0.711	0.743	0.766	0.783
1.0	0.112	0.219	0.318	0.405	0.481	0.544	0.597	0.639	0.673	0.701	0.740	0.775	0.800	0.818
1.2	0.117	0.229	0.333	0.425	0.505	0.572	0.628	0.674	0.711	0.740	0.783	0.821	0.849	0.871
1.5	0.121	0.238	0.346	0.422	0.525	0.596	0.655	0.703	0.743	0.775	0.821	0.863	0.895	0.920
2.0	0.124	0.244	0.355	0.454	0.540	0.613	0.674	0.725	0.766	0.800	0.849	0.895	0.930	0.960
20.0	0.127	0.248	0.361	0.462	0.550	0.625	0.688	0.740	0.783	0.818	0.871	0.920	0.960	1.000

C_H linearly interpolated:
L/2H = 0.714
D/2H = 0.079
C_H = 0.098

Attachment 1-9

TABLE 3-12
Typical Values of M_S, One-Dimensional Modulus of Soil

Vertical Soil Stress[1] (psi)	Gravelly Sand/Gravels 95% Std. Proctor (psi)	Gravelly Sand/Gravels 90% Std. Proctor (psi)	Gravelly Sand/Gravels 85% Std. Proctor (psi)
10	3000	1600	550
20	3500	1800	650
40	4200	2100	800
60	5000	2500	1000
80	6000	2900	1300
100	6500	3200	1450

* Adapted and extended from values given by McGrath[20]. For depths not shown in McGrath[20], the MS values were approximated using the hyperbolic soil model with appropriate values for K and n where n=0.4 and K=200, K=100, and K=45 for 95% Proctor, 90% Proctor, and 85% Proctor, respectively.

[1] Vertical Soil Stress (psi) = [soil depth (ft) x soil density (pcf)]/144

Appendix J: Environmental Monitoring Plan

Geosyntec consultants

engineers | scientists | innovators

ENVIRONMENTAL MONITORING PLAN

Tolson Rubble Landfill
Crofton, Maryland

Prepared for

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1. INTRODUCTION

1.1 Purpose and Scope

On behalf of Tolson and Associates, LLC (Tolson), Geosyntec Consultants (Geosyntec) has prepared this *Environmental Monitoring Plan* (Plan) for the Tolson Rubble Landfill (TRL or the Site) located at the end of Capitol Raceway Road, Crofton, Maryland (**Figure 1**). This Plan was prepared in accordance with Part III Section F.1 of the *Refuse Disposal Permit No. 2019*-WRF-0580 (the Permit) issued by the Maryland Department of the Environment (MDE), which requires submittal of an updated groundwater monitoring plan. This Plan: (i) identifies the groundwater and landfill gas locations that will be monitored; (ii) provides a description of the procedures and techniques used to collect and analyze samples; and (iii) presents the plan for evaluating the data in accordance with applicable regulatory and permit requirements described in Section 1.2 below. This Plan supersedes the *Monitoring Plan* dated 3 August 2016 prepared by Environmental Resources Management (ERM, 2016)

1.2 Regulatory Requirements for Water Quality Monitoring

Groundwater monitoring at the Site is required to be conducted in accordance with: (i) the Permit (Permit No. 2019-WRF-0580); (ii) the Code of Federal Regulations (CFR) as set forth in 40 CFR§257 Subpart B; and (iii) the Code of Maryland Regulations (COMAR) 26.04.07.

Accordingly, this Plan was prepared to develop a groundwater monitoring program consisting of:

- an adequate number and sampling frequency of groundwater monitoring points to monitor water quality downgradient of the waste limit boundary prior to the property boundary;
- sampling locations that are representative of the background groundwater quality not affected by past or present disposal operations on the property;
- groundwater sampling and analytical procedures that are intended to provide representative and defensible water quality data;
- chemical constituents to be monitored;
- frequency of sample collection, analysis, and reporting; and
- response actions should significant changes in groundwater quality changes be detected that are attributable to the Site.

1.3 Plan Organization

The remainder of this Plan is organized as follows:

- A summary of site conditions is presented in Section 2;
- The water quality monitoring program is presented in Section 3;
- Methods for water quality data evaluation are given in Section 4;

- The landfill gas monitoring program is presented in Section 5;
- Response actions based on changes in water quality and landfill gas data are presented in Section 6;
- The reporting schedule and components are described in Section 7; and
- References are provided in Section 8.

Supporting tables, figures, and appendices are attached to this Plan.

2. SITE CONDITIONS

The following sections summarize the Site's location, relevant features, disposal history, topography and surface water hydrology, geology, hydrogeology, and groundwater quality. Much of this information is further detailed in the *Phase II Site Geology Report* (ERM, 2006).

2.1 Site Overview and Disposal History

The TRL facility is located in Anne Arundel County, Maryland, approximately one mile northwest of Maryland Route 3, and accessed via Capitol Raceway Road. TRL currently comprises a permitted waste footprint of approximately 72.4 acres with one constructed active waste disposal cell (Phase 1 Cell A) that began accepting waste on 12 December 2016. TRL receives rubble and other acceptable wastes (e.g., construction debris, land clearing debris, demolition debris) from primarily Anne Arundel County and surrounding areas. The disposal cell (Phase I Cell A) is underlain by a leachate collection system, 60-mil thick high-density polyethylene (HDPE) geomembrane, and a 24-inch prepared subbase. Operations ancillary to disposal of waste within Phase I Cell A include: composting, natural wood waste recycling, concrete crushing, and soil blending which occur at the areas shown on **Figure 2**.

The remaining property is occupied by an active sand and gravel mining operation, washing and distribution quarry, and the previously closed, unlined Cunningham Landfill (Maryland State Permit 89-02-04-09A) shown on **Figure 2**. Sand and gravel mining operations have been conducted at the Site since the late 1970s. Disposal at the approximately 20-acre unlined Cunningham Landfill ceased in 1991. The Cunningham Landfill was subsequently capped in 1997 with a 20-mil thick polyvinyl chloride (PVC) geomembrane and covered with a vegetated soil cover. The Cunningham Landfill accepted nonhazardous and inert construction and demolition debris, including concrete and asphalt, and to a lesser degree lumber, trees, stumps, brush and miscellaneous demolition debris during the period it operated.

2.2 Topography and Surface Water Hydrology

The site is located in rolling terrain which ranges in topographic elevation from approximately 60 feet above mean sea level (amsl) NAVD88 in the Little Patuxent River valley to 230 feet amsl NAVD88 near the northern quarry boundary. The majority of the Site is currently being mined or has been recently mined and is open space. The site topography is shown on **Figure 2**.

Ephemeral water bodies are present in the mining area, a stormwater basin is located on the northwest corner of the Site, and a wash pond is present southwest of the Site, outside of the TRL boundary. The Little Patuxent River is located to the west and southwest of the site and flows north to south. An unnamed tributary to the Little Patuxent River is located along the northwestern property boundary. This tributary flows to the southwest.

2.3 Geology

As summarized in the Phase III Engineering Report dated May 31, 2016, the local geology at the Site is comprised of the upper sediments representing deposits associated with the Patuxent River Terrace, and some similar deposits of the Magothy Formation and the Potomac Group. The shallow soils include silts, medium to coarse sands, and gravels comprising the upper unconfined aquifer in the area. Carbonaceous layers have also been observed at the Site and within the surrounding areas as darkened or "black" soils. The black soils have been observed on-Site along the northern and eastern walls of the open mine excavation at the northern end of the property. Iron sulfides (arsenopyrite) and iron oxides are present in the sand. Both the native orange-buff silty sands and black soils contain naturally occurring metals, including aluminum, arsenic, chromium, iron, manganese, vanadium, and others to a much lesser degree. The extensive continuous confining unit underlies the entire Site and is interpreted as a confining bed of the Potomac Group.

2.4 Hydrogeology

As summarized in previous environmental monitoring reports (Geosyntec, 2019), groundwater at the Site consists of two aquifers: an upper, unconfined aquifer and a deeper, confined aquifer beneath a dense confining layer that is continuous across the Site. Groundwater potentiometric surface maps for the shallow and deep aquifers are provided as **Figures 3 and 4**, respectively. As shown on those maps, potentiometric surface elevations in the shallow aquifer are approximately 40 feet higher than those in the deep aquifer system. Groundwater in the shallow aquifer generally flows southwesterly toward, and discharges into the Little Patuxent River. The deep aquifer also flows generally toward the south southwest, in the direction of the Little Patuxent River.

2.5 Summary of Groundwater Quality

The chemical water quality of the upper and lower aquifers has been measured at the Site on a semiannual basis from 1989 to the present for the closed unlined Cunningham Landfill. Prior to waste disposal at TRL, metals constituents including iron, manganese, mercury, arsenic, beryllium, cadmium, chromium, lead, nickel, thallium and vanadium were detected in groundwater above Site Groundwater Quality Standards (GWQSs). Additionally, low concentrations of volatile organic compounds (VOCs) that include acetone, chloroethane, toluene, and vinyl chloride were detected in groundwater samples collected at the Site, but the concentrations did not exceed GWQSs.

A focused groundwater investigation was performed in November and December 2010 to evaluate potential groundwater quality affects associated with the Cunningham Landfill. The investigation concluded that reducing conditions in the groundwater beneath the landfill may be contributing to mobilization of naturally-occurring metals in the native soils at the Site (ERM, 2011), leading to slightly elevated concentrations of specific metals in groundwater downgradient of the Site. Subsequent monitoring has verified continued exceedances of total (unfiltered) concentrations of arsenic, cadmium, iron, manganese, mercury, nickel and thallium above action levels. Cadmium, lead, mercury and thallium contamination are addressed through continued long-term monitoring and natural attenuation. To address concerns regarding arsenic contamination, a barrier of seven sparge wells was installed immediately downgradient of the landfill to oxidize and precipitate the dissolved arsenic concentrations observed at MW-20A. The air sparge system construction was completed in 2017.

Detection groundwater monitoring has been performed at TRL since March 2017 and reported in the semiannual reports. Those monitoring results indicate groundwater quality at the Site has been consistent with background levels and patterns that occurred prior to disposal, except for a few locations where possible increasing trends for select constituents were identified. Semiannual monitoring is ongoing to evaluate if the apparent increases persist.

3. WATER QUALITY MONITORING PROGRAM

This section describes the water quality monitoring program for the Site, which is intended to be consistent with the regulatory requirements outlined in Section 1. Groundwater monitoring for the closed unlined Cunningham Landfill is performed separately by others. Please note, upon evaluation of future groundwater quality data, the monitoring program may require revisions. Approval of any such revisions will be requested from MDE prior to implementation.

3.1 Monitoring Network

As summarized in **Table 1** and shown on **Figure 2**, a total of 43 groundwater monitoring wells are present at the Site. Twenty of the 43 monitoring wells are part of the current TRL monitoring network as shown on **Figure 5**. Note that several monitoring wells (e.g., MW-21A/B, MW26A, MW-27A, MW-28A, and MW-29A) are located along the northeastern and northwestern boundary of the Cunningham Landfill and are within the permitted TRL disposal area. These wells will be abandoned prior to construction of the disposal cell in that area. Other monitoring wells present at the Site are used to monitor groundwater quality related to the Cunningham Landfill. Additionally, six monitoring wells (MW-32A, MW-33A, MW-34A, MW-35A, MW-36A, and MW-37A) were installed in early 2019 to collect geologic, hydrogeologic, and aquifer geochemical data for a proposed lateral expansion of TRL. Those six monitoring wells will be added to the monitoring network in the future if the lateral expansion is approved. Monitoring wells identified with an “A” are wells installed in the shallow unconfined aquifer and monitoring wells identified with a “B” are wells installed in the lower confined aquifer, with the exception of monitoring wells MW-2A (deep aquifer) and MW-2B (shallow aquifer). The upgradient wells in monitoring program are identified as MW-17A and MW-23A for the shallow aquifer and MW-17B for the deep aquifer.

A leachate sump is present at the Phase 1 disposal area. Leachate from the sump is sampled, if present, concurrent with the collection of groundwater quality samples.

Surface water monitoring is not performed under the Permit and is not part of this Plan.

3.2 Groundwater Elevation Measurements

As required by Part III Section E of the Refuse Disposal Permit, groundwater levels will be measured monthly at the locations indicated on **Table 1.** During months when groundwater samples are collected, depth to water measurements will be measured at each monitoring location immediately prior to the sampling event. Depth to water readings will be collected within as short a period of time as reasonably possible. The purpose of collecting the measurements within a short time period is to avoid temporal variations in groundwater flow direction which could preclude accurate determination of groundwater flow rate and direction, and groundwater quality characteristics.

The depth to water at each location will be measured from the top of the riser pipe, or other predetermined point of reference, using a water level indicator capable of measuring water levels to a precision of 0.01 ft. The depth to water and reference point of measurement at each well will be recorded in the field logbook or on a field form. The water level indicator will be decontaminated immediately after use in each monitoring well in accordance with the procedures described in Section 3.5.2.2.

3.3 Sample Collection

3.3.1 Monitoring Well Sampling

Groundwater samples will be collected from each monitoring well location (see **Table 1**) on a semiannual (i.e., two times per year) basis. Groundwater samples will be collected from each monitoring well using low-flow sampling techniques and equipment in accordance with the guidance presented in **Appendix A**. Dedicated bladder pumps and tubing, specifically designed for low-flow sampling applications, are installed in most monitoring wells and will be used to collect samples.

3.3.2 Leachate Sampling

One leachate sample will be collected from the Phase 1 disposal area leachate sump during each semiannual monitoring event. A grab sample of the leachate will be collected from the leachate sump with a bailer.

3.4 Analytical Program

The analytical program at each monitoring location is summarized in **Table 1**. The specific analytical methods, containers, preservatives, and holding times for each analysis are summarized in **Table 2**. The laboratory performing the analyses will be an independent laboratory certified by the State of Maryland and qualified to perform the required analyses. They will be informed of the specifics of the sampling event as their involvement is imperative to the coordination of the sampling event. The laboratory will provide the coolers, pre-preserved sample bottles, sample labels, and chain-of-custody forms.

The analytical program for the Site will include analyses of water quality samples for constituents specified by the Permit and Appendix I of 40 CFR §258. A detailed listing of the constituents that will be analyzed are presented in **Table 3**.

Table 3 also provides typical method detection limits (MDLs) achievable by the laboratory for each analyte and present the practical quantitation limits (PQLs) required by the Permit. MDLs for most analytes are lower than the PQLs, except for trans-1,4-dichloro-2-butene, calcium, iron, magnesium, sodium, alkalinity, specific conductance, and turbidity. Except for trans-1,4-dichloro-2-butene, those analytes have historically been detected in most samples collected at the Site. Although above the Permit PQL, the MDL for trans-1,4-dichloro-2-butene is below the intrawell background upper tolerance limits established for each monitoring well (see **Appendix B**). Therefore, the laboratory MDLs are sufficient for detection groundwater monitoring activities at the Site. Results measured by the laboratory above the MDL and below the reporting limit (RL) will be reported as estimated.

3.5 Documentation. Equipment, and Sample Handling Procedures

3.5.1 Documentation

The field-sampling personnel are responsible for maintaining the field log forms, labeling the bottles correctly, and preparing the chain-of-custody forms. All field records will be kept in an organized, legible, and up-to-date form and must be recorded with an indelible ballpoint pen.

3.5.1.1 Field Forms

The field log forms are permanent records of the water quality sampling activities conducted at the Site. Therefore, the data entered on the field log forms will be neatly and concisely written. Before beginning a sampling event, the sampling personnel will review the field notes from previous sampling events. By reviewing the information pertaining to sampling at each location in the groundwater monitoring network, the sampling personnel will be aware of the range of field parameter values expected at a particular well, and will be able to collect water-quality data in a timely manner.

The field log forms will be labeled with the Site name, the date of field activities, and field personnel conducting the work. Errors must be corrected by drawing a single line through the mistake and initialing the correction.

3.5.1.2 Sample Identification

Groundwater samples will be properly labeled. Information that will be written on the label includes:

- Site name;
- Sample identification number (e.g., M-06);
- Date and time of sample collection;
- Preservatives used; and
- Initials of field sampling personnel.

Labels will be filled out using an indelible ballpoint pen or marker. Pre-printed labels from the laboratory should be acquired prior to the sampling event when possible. If pre-printed labels are used, the sampler will complete the label immediately after filling.

3.5.1.3 Chain-of-Custody Form

A chain-of-custody form is documentation for tracking sample possession from the time of sample collection through analysis and final disposition. The chain-of-custody form must list all sample bottles shipped in a single cooler or set of coolers. The chain-of-custody form will be placed in a sealed plastic bag and packed in the cooler with the sample bottles. Typically, the laboratory performing the analysis will provide the sampling personnel with the chain-of-custody forms.

Information that will be recorded on the chain-of-custody form includes:

- Name and address of the Site;
- Identification of the sample bottles contained in the cooler;
- Date and time of sample collection;
- Number of sample bottles contained in the shipment and identification of the any preservatives contained in the bottles;
- Constituent groups (including method codes) requested for analyses;
- Laboratory and Geosyntec project manager;
- Specified turnaround time (i.e., normal); and
- Release signature of each person involved in the possession of the samples with the date and time listed below the signature.

3.5.2 Equipment

3.5.2.1 Requirements

Equipment needed to conduct groundwater sampling at the Site is detailed in **Appendix A**. The groundwater sampling equipment list and equipment needed to conduct surface water sampling will be reviewed when preparing for a sampling event and updated as necessary. All field equipment (e.g., water level tapes, water quality probes, pumps) shall receive routine testing, inspection, and maintenance checks to limit equipment breakdown. The field personnel will be responsible for field equipment maintenance. Routine daily maintenance to be conducted in the field is listed below:

- Remove surface dirt and debris from the exposed surfaces of all equipment;
- Clean equipment in accordance with appropriate cleaning procedures, summarized in Section 3.5.2.2;
- Store equipment away from the elements and in a safe and secure location;
- Inspect equipment and instruments daily for possible problems, including cracked or clogged lines or tubing, weak batteries, and worn pump heads;
- Check the instrument calibrations as recommended by the equipment manufacturer; and
- Charge any equipment battery packs when not in use.

Spare and replacement parts stored in the field to minimize down time will include:

- Appropriately sized batteries;
- Extra sample containers and preservatives;

- Extra coolers and packing materials; and
- Extra supply of health and safety equipment.

3.5.2.2 Cleaning and Decontamination

The groundwater quality sampling equipment that includes the water-level indicators must be cleaned prior to use and between each monitoring well. Non-dedicated down-hole equipment intended for re-use will be decontaminated as follows:

- Wash with a non-phosphate detergent (e.g., Alconox® or Liquinox®) and potable water solution to remove potential contaminants and sediment;
- Rinse with potable water;
- Rinse with distilled water; and
- Allow the equipment to air-dry or dry with a clean absorbent (e.g. paper towel) before next use.

3.5.2.3 Calibration

This section presents general procedures for calibration and use of the water quality meter(s). At a minimum, the calibration of the water quality meter(s) will be performed at the beginning and end of each day of sampling day. Additional calibration cycles may be conducted at the discretion of field personnel, if thought necessary to maintain meter accuracy. The calibration will be recorded on field calibration log forms. The sampling personnel should refer to the manufacturer's instruction manuals that are included with the calibration fluids and meter(s) for detailed, product-specific instructions.

Calibration solutions are available from many manufacturers and laboratory supply vendors. The sampling personnel will reference the instructions that are included with the calibration solutions for specific information regarding shelf life, storage conditions, and the effects of temperature on the solutions.

Only small bottles of calibration fluids should be ordered since they expire and are susceptible to contamination once opened. Calibration fluids should not be used after the expiration date written on the bottles. Expired fluids will be discarded according to applicable law. The date that a calibration solution is opened should be recorded on the bottle.

3.5.3 Sample Handling Procedures

After each sample (groundwater or leachate) is collected, the bottles will be labeled, tightly closed, and placed in a cooler containing enough ice to maintain an internal temperature below approximately 6° Celsius (C). The ice will be enclosed in re-sealable (i.e., "zipper") plastic bags. The maximum holding time for each analysis is presented in **Table 2**.

The coolers will be packed in such a manner to avoid breakage of the bottles, or leakage of melted ice. It is recommended that the bottles be placed on the bottom of the cooler, with fresh ice sealed in heavy plastic zipper bags, placed on top of the bottles. A cooler liner will be utilized to help prevent leakage during shipment. The original, complete, and executed chain-of-custody form will be sealed in a plastic bag and placed on top of the contents in the cooler. The cooler will then be sealed, and the appropriate steps taken to have the samples delivered to the laboratory by the next morning.

Samples will be received at the analytical laboratory by personnel who will inspect the integrity of the sample bottles, compare the sample identification numbers on the sample labels to the sample numbers listed on the chain-of-custody forms, and record the field sample numbers and unique laboratory identification numbers. Sample bottles received broken, improperly labeled, or at temperatures out of range will be noted, and the project manager must be immediately notified. Once the sample bottles are inspected and laboratory numbers are assigned, samples will be refrigerated at approximately 6°C until the appropriate analyses are performed.

3.6 Waste Management

Purge water and decontamination water generated during monitoring well sampling will be discharged to the ground surface in the vicinity of the monitoring well where it was generated. Disposables such as paper towels, tubing, and other miscellaneous trash will be properly disposed with other solid waste generated at the Site.

3.7 Quality Assurance and Quality Control Protocols

The objective of the quality assurance/quality control (QA/QC) program is to ensure the generation of defensible and scientifically valid analytical data. The QA/QC program includes both sampling and laboratory quality control, which are further described below.

3.7.1 Field Quality Control

All field equipment must be checked, calibrated, and maintained prior to a sampling event to prevent equipment malfunction which could affect data quality. Vital components of the QA/QC program are the manufacturers' instruction manuals which accompany the field equipment. These instructions should be consulted prior to equipment maintenance and calibration. Equipment QC should include the following:

- Operator training at the various manufacturers' training classes or in-house instruction by supervisory personnel as appropriate;
- Systematic instrument calibration and verification of the calibration results; and
- Routine preventative maintenance.

Sampling procedures should be conducted to minimize sample handling and transfer. During sampling, a specified individual of the sampling team will record all field entries. This individual will check, sign, and date all field log forms and chain-of-custody forms.

3.7.2 Quality Assurance/Quality Control Samples

During each sampling event, event blind duplicate and matrix spike/matrix spike duplicate (MS/MSD) sample sets will be collected and analyzed as detailed in **Table 4**. The results of those analyses will be evaluated to assess the precision of the analytical procedures and potential matrix interferences. A trip blank sample provided by the laboratory will be included in any cooler that is shipped to the laboratory with samples for VOCs analysis. The trip blank will used to evaluate if contamination was introduced during sample handling or transport. A complete record of all QC samples collected will be maintained as a part of the field sampling documentation.

3.7.3 Laboratory Quality Assurance/Quality Control

An in-house QA/QC program will be in-place and operating for the analytical laboratory. The laboratory QA/QC program will include the following types of activities: daily calibration of analytical instruments, analysis of QA samples (i.e., method blanks, matrix-spike/matrix-spike duplicates, surrogate spike samples, etc.), chain-of-custody handling procedures, chain-of-custody documentation, laboratory protocols for sample identification, and analytical data reporting.

3.7.4 Data Quality Assessment

Following receipt of the data from the laboratory, a data quality assessment will be conducted which will consist of: (i) an evaluation of the analytical data for duplicate, MS/MSD, and trip blank samples, (ii) an evaluation of the laboratory's method precision; and (iii) a review of constituent detection limits, analytical methods, hold-times, and temperature requirements to assess whether the data were properly qualified and meet the data quality objectives. Based on that evaluation, the data will be qualified in accordance with the National Functional Guidelines for Data Review (USEPA, 2014).

In addition to reviewing the QA/QC results, data will also be evaluated by qualitatively comparing them to historical data to identify unusual or anomalous concentrations.

4. GROUNDWATER AND LEACHATE DATA EVALUATION

4.1 Groundwater Monitoring Data

Groundwater data generated from each monitoring event at the Site will be evaluated by: (i) constructing a potentiometric surface map to assess groundwater flow patterns; (ii) comparing the analytical results from each monitoring event to applicable water quality standards; (iii) statistically comparing the data for upgradient and downgradient groundwater monitoring wells (inter-well evaluation); (iv) statistically comparing the long-term monitoring results at each location to applicable water quality standards; and (v) assessing trends at each location (intra-well evaluation). Those evaluations are further described in the sections below.

4.1.1 Static Groundwater Elevations

Piezometric heads measured in the groundwater monitoring wells and piezometers prior to each sampling event (see Section 3.2) will be evaluated by plotting the head elevation on a Site map and constructing a potentiometric surface map for both the shallow and deep aquifers. A potentiometric surface map shows lines of equal groundwater elevations to assess the direction of groundwater flow. The potentiometric surface maps will be submitted to MDE as figures in each groundwater monitoring report (see Section 6). The potentiometric maps will depict the monitoring well locations used for interpolation, as well as the available Site topography at the time of measurement.

The potentiometric surface data in the shallow aquifer will be compared to the elevation of the cell floor to assess if the groundwater surface encroached within 3 feet of the cell floor.

If the potentiometric maps shows that the upgradient and/or downgradient well permit requirements are no longer satisfied, installation of new groundwater monitoring wells may be proposed to maintain compliance with the applicable regulations.

4.1.2 Comparison to Groundwater Quality Standards

As required by Part III Section F.2.h of the Permit, the analytical results generated to comply with the Permit will be compared to the GWQSs. The GWQSs for the Site are summarized on **Table 5** and were established using the following hierarchy:

i) USEPA Maximum Contaminant Level (MCL), if one has been established;

ii) USEPA Secondary MCL, if one has been established;

iii) MDE Groundwater Standards for Type I and II aquifers (MDE, 2018); and

iv) USEPA Region III Tapwater Risk-based Screening Level (RSL) November 2019.

Please note the RSL values are periodically updated by USEPA. If an USEPA update affects the RSL for a monitored constituent, the GWQS used for that constituent will be revised to match the revised RSL.

As detailed in the Permit, if a water quality standard is exceeded for the first-time, MDE will be notified in writing within 24 hours of receipt of the laboratory report detecting the occurrence (Part III Section F.2.j) and the monitoring location will be resampled within 30 days (Part III Section F.2.k).

4.1.3 Statistical Evaluation

Consistent with historical practice, detection monitoring statistical analyses will be performed to evaluate whether constituent concentrations have increased at statistically significant levels above intrawell and/or interwell background groundwater quality. Statistical analyses expected to be conducted on groundwater quality data generated under this Plan are detailed below. Statistical analyses other than those described below may be performed, if needed. Those analyses will be performed consistent with the Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance ([Unified Guidance] USEPA, 2009).

4.1.3.1 Intrawell Analysis

Baseline monitoring has been completed for all monitoring wells within the network. Baseline for wells installed prior to 2016 began with the date of 24 and 25 March 2010 and included data through 2015. These data were collected prior to construction and operation of the Tolson Rubble Landfill. For monitoring wells installed in September-October 2016, baseline monitoring consisted of at least six monitoring events (four events prior to waste being placed into the landfill, and two events directly after waste was placed), and included quarterly sampling for the first year thereafter. Therefore, baseline for those monitoring wells was established after September 2017.

The baseline data were previously used by ERM to calculate the upper tolerance limit (UTL) for each downgradient monitoring well, which was defined as the average of the background results at the well plus two times the standard deviation for the background period. The UTL calculations for each constituent at each downgradient monitoring well are presented in **Appendix B**.

To evaluate if there has been a statistically significant increase (SSI) above intrawell background, constituent results collected during the most recent monitoring event will be directly compared to the respective UTL. The constituent will be considered an intrawell SSI for that compliance monitoring event if the result is greater than the UTL.

4.1.3.2 Interwell Analysis

Interwell background analysis will performed for each constituent and monitoring well pair where an intrawell SSI was detected by the analysis outlined in Section 4.1.3.1. The interwell analysis will consist of comparing the compliance well data to monitoring results at upgradient monitoring wells MW-17A and MW-23A for the shallow aquifer and MW-17B for the deep aquifer. Based on the historical distribution of data, a Tolerance Interval test is expected to be selected for the evaluation. Accordingly, a UTL will be calculated using the background monitoring well data in accordance with the Unified Guidance (USEPA, 2009). The downgradient well compliance data will then be compared to the background UTL to evaluate for an interwell SSI. An interwell SSI will be concluded if the result is greater than the UTL.

4.1.3.3 Trend Analysis

To assist in evaluating long-term data trends, upward and/or downward statistical trend analyses (e.g., Mann-Kendal trend test) may be conducted for select constituents and monitoring wells. Those evaluations will be conducted consistent with the Unified Guidance (USEPA, 2009).

4.2 Leachate Monitoring Data

Leachate data will be evaluated by qualitatively comparing key constituents present in the leachate (e.g., leachate indicators) to groundwater sample results. Additionally, the data collected will be tabulated and compared to historical leachate results to assess is changes in leachate quality have occurred.

5. LANDFILL GAS MONITORING

5.1 Landfill Gas Monitoring Probe Network

Of the 20 proposed monitoring points, 13 soil-gas monitoring wells have been installed to-date and used to monitor gas migration around Phase I of the landfill. These locations are identified as landfill gas monitoring points GP-1 through GP-10, GP-21, GP-22, and GP-23 as shown on **Figure 2**. GP-21, GP-22, and GP-23 are interim probes that are located within the future landfill footprint and will be relocated as necessary when the footprint is expanded. The interim gas monitoring probes installed to-date serve as early warning of any gas migration in the vicinity of Phase 1, prior to reaching the perimeter of the landfill footprint.

5.2 Landfill Gas Probe Monitoring

The soil gas monitoring probes will be monitored quarterly using a multi-gas meter (e.g. Landtec-GEM2000, or equivalent) to measure the percentage of methane present with respect to the LEL for methane, and for the concentration of hydrogen sulfide gas. A sample will be obtained at each soil gas monitoring probe both prior to purging the probe and after approximately three probe volumes are purged. In addition to recording methane and hydrogen sulfide concentrations, water levels, if present, gas probe pressure, ambient temperature, barometric pressure and the occurrence of precipitation during sampling will be recorded.

5.3 Landfill Gas Monitoring in Onsite Structures

Methane concentrations within the scale house will be monitored in two locations that include the conference room and kitchen to confirm concentrations are below 25 percent of the Lower Explosive Limit (LEL). Monitoring will be performed on a quarterly basis and the results will be recorded in the operating record.

Leachate collection system structures, such as the wet well and vault will be screened for the presence of methane and oxygen before entry will be allowed. Entry will not be permitted without respiratory protection until methane is non-detectable and the oxygen concentration exceeds 20 percent.

5.4 Evaluation of Landfill Gas Monitoring Data

Landfill gas monitoring data will be evaluated as it is obtained in the field by monitoring personnel. If the compliance levels (i.e., 25 percent of the LEL in structures at the facility, and/or 100 percent of the LEL at the facility boundary) are exceeded, then response actions, described in Section 6, will be taken immediately.

6. RESPONSE ACTIONS

6.1 Groundwater

In accordance with 40 CFR §257 and the Permits, response actions will be implemented in the event that significant changes in groundwater quality are observed during the life of the TRL water quality monitoring program. **Table 6** presents the observations requiring response and the appropriate response actions.

6.2 Landfill Gas - Elevated Gas Level Response

If methane concentrations exceed the LEL in a monitoring probe (i.e., concentrations are greater than 100%), or if methane concentrations exceed 25 percent of the LEL in the scale house/landfill office building, the following steps will be initiated in order:

- The monitoring instrument will be brought to an area with fresh air and recalibrated;
- Remeasure the gas concentrations at the exceedance location;
- If and exceedance is confirmed, ensure the protection of human health by ordering evacuation of the building, if in a structure, and the removal of all possible ignition sources;
- Notify MDE within 24 hours of a first-time exceedance of a response level in a gas probe or structure;
- Within seven days of detection above a response level, report the methane gas levels and the action initiated to protect human health to MDE and place the report in the operating record; and
- Within 60 days of detection, submit a gas remediation plan to MDE for approval.

7. REPORTING

A environmental monitoring report detailing the results of the groundwater and landfill gas monitoring events will be submitted to MDE within 90 calendar days of the close of every first (March 31) and third (September 30) calendar quarters. The reports will be prepared by a qualified groundwater scientist and are expected to include: (i) a Site map; (ii) a potentiometric surface map; (iii) tables summarizing the monitoring data and statistical evaluations; (iv) copies of the field forms, laboratory analytical results, and chain-of-custody forms, (v) tables summarizing available historical data at each groundwater monitoring point, (vi) time-series concentration plots; (vii) a summary of the methods used during the monitoring event; (vii) and a discussion of the results and interpretative findings.

As required by Part III Section D.8 of the Permit, each semiannual report will also contain information pertaining to the handling, storage, and disposal of leachate and other liquid wastes at the Site. This will include:

- The volume of leachate collected monthly;
- The method used to measure the quantities of leachate from the leachate collection systems;
- The volume of liquid disposed at an offsite disposal facility; and
- The estimated total amount of cumulative precipitation received at the landfill based on local climatological data.

Reports will include supporting tables, figures, and appendices.

8. REFERENCES

MDE, 2008. State of Maryland Department of the Environment Cleanup Standards for Soil and Groundwater, Interim Final Guidance (Update No. 2.1). June 2008.

Maryland Department of the Environment (MDE), 2015. Refuse Disposal Permit No. 2019-WRF-0580.

USEPA, 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance. United States Environmental Protection Agency. March 2009. Available: http://www.epa.gov/osw/hazard/correctiveaction/resources/guidance/sitechar/gwstats/

USEPA, 2014. National Functional Guidelines for Inorganic Superfund Data Review, OSWER 9355.0-131, EPA 540-R-13-001, August 2014.

TABLES

TABLE 1
MONITORING WELL NETWORK AND ANALYTICAL PROGRAM

Tolson Rubble Landfill
Crofton, Maryland

Monitoring Location	Top of Casing Elevation (feet amsl)	Total Depth (feet bgs)	Date Installed	Gradient	Aquifer	Monthly Water Level Measurements	Analytical Program Semiannual Analytes				
							Volatile Organic Compounds	Total Metals	General Chemistry [1]	Nitrite-Nitrogen, TOC, and Phosphorous [2]	Field Parameters [3]
MW-1A	155.82	83	1/6/186	up	Shallow	X					
MW-1B	154.59	148	1/20/1986	up	Deep	X					
MW-2A	145.41	148	12/30/1985	cross	Deep	X					
MW-2B	147.33	58	1/14/1986	cross	Shallow	X					
MW-4A	149.38	61	12/30/1985	down	Shallow	X	X	X	X	X	X
MW-4B	151.17	146	1/13/1986	down	Deep	X					
MW-5A	80.01	25	1/15/1986	down	Shallow	X	X	X	X	X	X
MW-5B	78.27	60	1/15/1986	down	Deep	X	X	X	X	X	X
MW-6A	91.70	35	12/24/1995	down	Shallow	X					
MW-7A	96.12	48	1/22/1986	down	Shallow	X					
MW-7B	95.43	112	1/22/1986	down	Deep	X					
MW-8A	144.22	50	1/4/1995	down	Shallow	X	X	X	X		X
MW-8B	148.5	150	1/4/1995	down	Deep	X	X	X	X		X
MW-12AR	152.48	54	9/22/2016	cross	Shallow	X	X	X	X		X
MW-15A	143.59	56	9/5/2006	cross	Shallow	X	X	X	X	X	X
MW-15B	143.98	172	9/8/2006	cross	Deep	X	X	X	X		X
MW-16A	157.79	68	8/29/2006	down	Shallow	X	X	X	X	X	X
MW-16B	157.96	150	8/31/2006	down	Deep	X	X	X	X		X
MW-17A	183.8	73	6/8/2007	up	Shallow	X	X	X	X		X
MW-17B	185.4	201	6/13/2007	up	Deep	X	X	X	X		X
MW-18A	186.9	68	6/15/2007	up	Shallow	X					
MW-18B	189.6	180	8/31/2007	up	Deep	X					
MW-19A	159.90	95	6/26/2007	down	Shallow	X					
MW-19B	159.50	160	6/28/2007	down	Deep	X					
MW-20A	158.7	95	7/2/2007	down	Shallow	X					
MW-20B	158.3	138	7/6/2007	down	Deep	X					
MW-21A	145.7	43	7/9/2007	down	Shallow	X	X	X	X		X
MW-21B	146.1	130	7/13/2007	down	Deep	X	X	X	X		X
MW-23A	173.09	63	9/23/2016	up	Shallow	X	X	X	X		X
MW-26A	151.92	75	10/31/2016	down	Shallow	X	X	X	X		X
MW-27A	158.22	73	10/27/2016	down	Shallow	X	X	X	X		X
MW-28A	160.77	70	9/30/2016	down	Shallow	X	X	X	X		X
MW-29A	161.17	72	10/20/2016	down	Shallow	X	X	X	X		X
MW-31A	158.11	66	10/24/2016	cross	Shallow	X	X	X	X		X
MW-32A	139.26	45	3/13/2019	cross	Shallow						
MW-33A	198.89	95	3/14/2019	up	Shallow						
MW-34A	141.11	30	3/11/2019	up	Shallow						
MW-35A	132.08	35	3/12/2019	up	Shallow						
MW-36A	124.13	30	3/19/2019	cross	Shallow						
MW-37A	125.54	25	3/15/2019	cross	Shallow						
Leachate	NA	NA	NA	NA	NA	NA	X	X	X		X

Notes:

bgs - below ground surface

amsl - above mean sea level

NA - Not Applicable

[1] General chemistry parameters include alkalinity, ammonia, chloride, chemical oxygen demand, hardness, specific conductance, nitrate, sulfate, total dissolved solids, and turbidity.

[2] Nitrite-Nitrogen, Total Organic Carbon (TOC), and Phosphorous were added to the monitoring program in Spring 2019.

[3] Field parameters include dissolved oxygen, specific conductance, pH, oxidation reduction potential, and turbidity measured with a field water quality meter.

X- indicates monitoring is performed, monitoring is not performed if blank.

TABLE 2
SUMMARY OF ANALTYICAL METHODS, PRESERVATIVES, AND HOLDING TIMES

Tolson Rubble Landfill
Crofton, Maryland

Constituent/Constituent Group	Container	Preservative	Holding Time	Analytical Method
Volatile Organic Compounds	glass vials	HCL to pH < 2, cool to 6^{o}C	14 days	SW846 8260C/8011
Total Metals	poly	HNO_3 to pH < 2, cool to 6^{o}C	6 months	SW846 6010C/6020A
Mercury	poly	HNO_3 to pH < 2, cool to 6^{o}C	28 days	SW846 7470A
Alkalinity	poly	Cool to 6°C	14 days	SM 2320B-2011
Hardness	poly	HNO_3 to pH <2	6 months	SM 2340 B-2011
Chloride	poly	Cool to 6°C	28 days	EPA 300.0
Nitrate	glass vial	H_2SO_4 to pH<2, cool to 6° C	28 days	EPA 353.2
Nitrite-Nitrogen	poly	Cool to 6°C	48 hours	EPA 353.2
Phosphorous	poly	H_2SO_4 to pH<2, cool to 6° C	28 days	EPA 365.1
Total Organic Carbon	amber glass vials	H_3PO_4 to pH<2, cool to 6° C	28 days	SM 5310 C-2011
Chemical Oxygen Demand	poly	H_2SO_4 to pH<2, cool to 6° C	28 days	EPA 410.4
Ammonia	poly	HNO_3 to pH < 2, cool to 6^{o}C	28 days	SM 4500-NH3 B/C-2011
Sulfate	poly	Cool to 6°C	28 days	EPA 300.0
Total Dissolved Solids	poly	Cool to 6°C	7 days	SM 2540 C-2011
Turbidity	poly	Cool to 6°C	48 hours	SM 2130 B-2011
Specific Conductivity	poly	Cool to 6°C	28 days	SM 2510 B-2011
pH	poly	Cool to 6°C	Immediately	SM 4500-H+ B-2011

Notes:
HCL - Hydrochloric acid
HNO_3 - Nitric acid
H_2SO_4 - Sulfuric acid
H_3PO_4 - Phosphoric acid
SW-846 - Test methods for evaluating solid waste, physical/chemical methods", third edition, November 1986 and subsequent updates
SM - Standard methods for the examination of water and wastewater.
EPA - Methods for chemical analysis of water and wastes, EPA-600-4-79-020, March 1983 and subsequent updates.

TABLE 3
CONSTITUENT LIST

Tolson Rubble Landfill
Crofton, Maryland

Constituent	Analytical Method	Units	Laboratory Method Detection Limit	Permit Required PQL
Volatile Organic Compounds				
1,1,1,2-Tetrachloroethane	SW-846 8260C	µg/L	0.2	1.00
1,1,1-Trichloroethane	SW-846 8260C	µg/L	0.3	1.00
1,1,2,2-Tetrachloroethane	SW-846 8260C	µg/L	0.2	1.00
1,1,2-Trichloroethane	SW-846 8260C	µg/L	0.2	1.00
1,1-Dichloroethane	SW-846 8260C	µg/L	0.2	1.00
1,1-Dichloroethene	SW-846 8260C	µg/L	0.2	1.00
1,2,3-Trichloropropane	SW-846 8260C	µg/L	0.2	1.00
1,2-Dibromo-3-Chloropropane	SW-846 8011	µg/L	0.010	1.00
1,2-Dibromoethane	SW-846 8011	µg/L	0.010	1.00
1,2-Dichlorobenzene	SW-846 8260C	µg/L	0.2	1.00
1,2-Dichloroethane	SW-846 8260C	µg/L	0.3	1.00
1,2-Dichloropropane	SW-846 8260C	µg/L	0.2	1.00
1,4-Dichlorobenzene	SW-846 8260C	µg/L	0.2	1.00
2-Butanone (MEK)	SW-846 8260C	µg/L	0.3	5.00
2-Hexanone	SW-846 8260C	µg/L	0.3	5.00
4-Methyl-2-pentanone (MIBK)	SW-846 8260C	µg/L	0.5	5.00
Acetone	SW-846 8260C	µg/L	0.7	5.00
Acrylonitrile	SW-846 8260C	µg/L	0.3	5.00
Benzene	SW-846 8260C	µg/L	0.2	1.00
Bromoform	SW-846 8260C	µg/L	1	1.00
Bromomethane	SW-846 8260C	µg/L	0.3	1.00
Carbon disulfide	SW-846 8260C	µg/L	0.2	1.00
Carbon tetrachloride	SW-846 8260C	µg/L	0.2	1.00
Chlorobenzene	SW-846 8260C	µg/L	0.2	1.00
Chlorobromomethane	SW-846 8260C	µg/L	0.2	1.00
Chlorodibromomethane	SW-846 8260C	µg/L	0.2	1.00
Chloroethane	SW-846 8260C	µg/L	0.2	1.00
Chloroform	SW-846 8260C	µg/L	0.2	1.00
Chloromethane	SW-846 8260C	µg/L	0.2	1.00
cis-1,2-Dichloroethene	SW-846 8260C	µg/L	0.2	1.00
cis-1,3-Dichloropropene	SW-846 8260C	µg/L	0.2	1.00
Dibromomethane	SW-846 8260C	µg/L	0.2	1.00
Dichlorobromomethane	SW-846 8260C	µg/L	0.2	1.00
Ethylbenzene	SW-846 8260C	µg/L	0.4	1.00
Iodomethane	SW-846 8260C	µg/L	0.2	1.00
Methylene Chloride	SW-846 8260C	µg/L	0.3	1.00
Methyl tert-butyl ether (MTBE)	SW-846 8260C	µg/L	0.2	2.00
Styrene	SW-846 8260C	µg/L	0.2	1.00
Tetrachloroethene	SW-846 8260C	µg/L	0.2	1.00
Toluene	SW-846 8260C	µg/L	0.2	1.00
trans-1,2-Dichloroethene	SW-846 8260C	µg/L	0.2	1.00
trans-1,3-Dichloropropene	SW-846 8260C	µg/L	0.2	1.00
trans-1,4-Dichloro-2-butene	SW-846 8260C	µg/L	**6**	5.00
Trichloroethene	SW-846 8260C	µg/L	0.2	1.00
Trichlorofluoromethane	SW-846 8260C	µg/L	0.2	1.00
Vinyl acetate	SW-846 8260C	µg/L	0.7	1.00
Vinyl chloride	SW-846 8260C	µg/L	0.2	1.00
Xylenes, Total	SW-846 8260C	µg/L	1	1.00

TABLE 3
CONSTITUENT LIST

Tolson Rubble Landfill
Crofton, Maryland

Constituent	Analytical Method	Units	Laboratory Method Detection Limit	Permit Required PQL
Metals, Total				
Antimony	SW-846 6020A	mg/L	0.00041	0.002
Arsenic	SW-846 6020A	mg/L	0.00068	0.002
Barium	SW-846 6010C	mg/L	0.001	0.010
Beryllium	SW-846 6010C	mg/L	0.001	0.002
Cadmium	SW-846 6010C	mg/L	0.001	0.004
Calcium	SW-846 6010C	mg/L	**0.10**	0.080
Chromium	SW-846 6010C	mg/L	0.0016	0.010
Cobalt	SW-846 6010C	mg/L	0.0015	0.010
Copper	SW-846 6020A	mg/L	0.00036	0.010
Iron	SW-846 6020A	mg/L	**0.0228**	0.005
Lead	SW-846 6020A	mg/L	0.000071	0.002
Magnesium	SW-846 6010C	mg/L	**0.04**	0.004
Manganese	SW-846 6010C	mg/L	0.003	0.010
Mercury	SW-846 7470A	mg/L	0.00005	0.0002
Nickel	SW-846 6010C	mg/L	0.0021	0.011
Potassium	SW-846 6010C	mg/L	0.204	0.390
Selenium	SW-846 6010C	mg/L	0.016	0.035
Silver	SW-846 6010C	mg/L	0.005	0.010
Sodium	SW-846 6010C	mg/L	**0.24**	0.200
Thallium	SW-846 6020A	mg/L	0.00013	0.002
Vanadium	SW-846 6010C	mg/L	0.0019	0.010
Zinc	SW-846 6010C	mg/L	0.0037	0.010
General Chemistry Parameters Analyzed by Laboratory				
Alkalinity	SM 2320 B-2011	mg/L as $CaCO_3$	**2.6**	1
Ammonia Nitrogen	SM 4500-NH3 B/C-2011	mg/L	0.25	1
Chloride	EPA 300.0	mg/L	0.2	0.39
Chemical Oxygen Demand	EPA 410.4	mg/L	5	10
Specific Conductance	SM 2510 B-2011	µS/cm	**1.7**	1
Nitrate	EPA 353.2	mg/L	0.04	0.06
Nitrite-Nitrogen	EPA 353.2	mg/L	0.015	NA
Phosphorous	EPA 365.1	mg/L	0.05	NA
pH	SM 4500-H+ B-2011	Std Units	0.01	0.1
Total Organic Carbon	SM 5310 C-2011	mg/L	0.5	NA
Hardness	SM 2340 B-2011	mg/L	0.033	0.5
Sulfate	EPA 300.0	mg/L	0.3	0.38
Total Dissolved Solids	SM 2540 C-2011	mg/L	10	10
Turbidity	SM 2130 B-2011	NTU	**0.14**	0.11

Notes:
PQL - Practical Quantitation Limit
Bold - Laboratory method detection limit does not meet permit required PQL value.
mg/L - milligrams per liter
µg/L - micrograms per liter
µS/cm - microsiemens per centimeter
NTU - nephelometric turbidity units

TABLE 4
QUALITY ASSURANCE/QUALITY CONTROL SAMPLING SUMMARY

Tolson Rubble Landfill
Crofton, Maryland

QA/QC Sample	Collection Frequency	Constituent/Consituent Group												
		VOCs	Total Metals	Anions	Ammonia	COD	Alkalinity	Hardness	Nitrite Nitrogen	Phosphorous	TOC	TDS	Turbidity	Specific Conductivity
Blind Duplicate - Groundwater	1 per sampling event	X	X	X	X	X	X	X	X	X	X	X	X	X
Matrix Spike/Matrix Spike Duplicate - Groundwater	1 set per sampling event	X	X	X	X									
Trip Blank	1 per cooler containing VOC samples	X												

Notes:
See Table 3 for complete list of consituents included in each analytical group.
Anions include chloride, sulfate, and nitrate
VOCs - Volatile Organic Compounds
COD - Chemical Oxygen Demand
TDS - Total Dissolved Solids
TOC - Total Organic Carbon

TABLE 5
GROUNDWATER QUALITY STANDARDS

Tolson Rubble Landfill
Crofton, Maryland

Constituent	GWQS	GWQS Basis
Volatile Organic Compounds (µg/L)		
1,1,1,2-Tetrachloroethane	0.57	RSL
1,1,1-Trichloroethane	200	MCL
1,1,2,2-Tetrachloroethane	0.076	MDE
1,1,2-Trichloroethane	5	MCL
1,1-Dichloroethane	2.8	MDE
1,1-Dichloroethene	7	MCL
1,2,3-Trichloropropane	0.00075	RSL
1,2-Dibromo-3-Chloropropane	0.2	MCL
1,2-Dibromoethane	0.05	MDE
1,2-Dichlorobenzene	600	MCL
1,2-Dichloroethane	5	MCL
1,2-Dichloropropane	5	MCL
1,4-Dichlorobenzene	75	MCL
2-Butanone (MEK)	560	MDE
2-Hexanone	38	RSL
4-Methyl-2-pentanone (MIBK)	630	MDE
Acetone	1,400	MDE
Acrylonitrile	0.052	RSL
Benzene	5	MCL
Bromoform	80	MDE
Bromomethane	0.75	MDE
Carbon disulfide	81	MDE
Carbon tetrachloride	5	MCL
Chlorobenzene	100	MCL
Chlorobromomethane	83	RSL
Chlorodibromomethane	80	MDE
Chloroethane	2,100	MDE
Chloroform	80	MDE
Chloromethane	19	MDE
cis-1,2-Dichloroethene	70	MCL
cis-1,3-Dichloropropene	0.47	RSL
Dibromomethane	8.3	RSL
Dichlorobromomethane	80	MDE
Ethylbenzene	700	MCL
Iodomethane	NS	NS
Methylene Chloride	5	MDE
Methyl-tert-butyl-ether (MTBE)	20	MDE
Styrene	100	MCL
Tetrachloroethene	5	MCL
Toluene	1,000	MCL
trans-1,2-Dichloroethene	100	MCL
trans-1,3-Dichloropropene	0.47	RSL
trans-1,4-Dichloro-2-butene	0.0013	RSL
Trichloroethene	5	MCL
Trichlorofluoromethane	5,200	RSL
Vinyl acetate	410	RSL
Vinyl chloride	2	MCL
Xylenes, Total	10,000	MCL

TABLE 5
GROUNDWATER QUALITY STANDARDS

Tolson Rubble Landfill
Crofton, Maryland

Constituent	GWQS	GWQS Basis
Metals, Total (mg/L)		
Antimony	0.006	MCL
Arsenic	0.010	MCL
Barium	2.0	MCL
Beryllium	0.004	MCL
Cadmium	0.005	MCL
Calcium	NS	NS
Chromium	0.1	MCL
Cobalt	0.006	RSL
Copper	1.3	MCL
Iron	0.3	SMCL
Lead	0.015	MCL
Magnesium	NS	NS
Manganese	0.050	SMCL
Mercury	0.002	MCL
Nickel	0.039	MDE
Potassium	NS	NS
Selenium	0.05	MCL
Silver	0.10	SMCL
Sodium	NS	NS
Thallium	0.002	MCL
Vanadium	0.0037	MDE
Zinc	5.0	SMCL
Other Constituents (mg/L)		
Chloride	250	SMCL
Nitrate	10	MCL
Sulfate	250	SMCL
Total Dissolved Solids	500	SMCL

Notes:

GWPS - Groundwater Protection Standard, hierarchy for GWPS was MCL, SMCL, MDE, and RSL.

MCL - USEPA Maximum Contaminant Level

SMCL - USEPA Secondary Maximum Contaminant Level

MDE - MDE Clean-up Standards For Soil and Groundwater, October 2018, Interim Final Guidance (Update No. 3)

RSL - USEPA Region III Regional Screening Level, November 2019

NS - No Standard, no MCL, SMCL, MDE, or RSL values are published

mg/L - milligrams per liter

µg/L - micrograms per liter

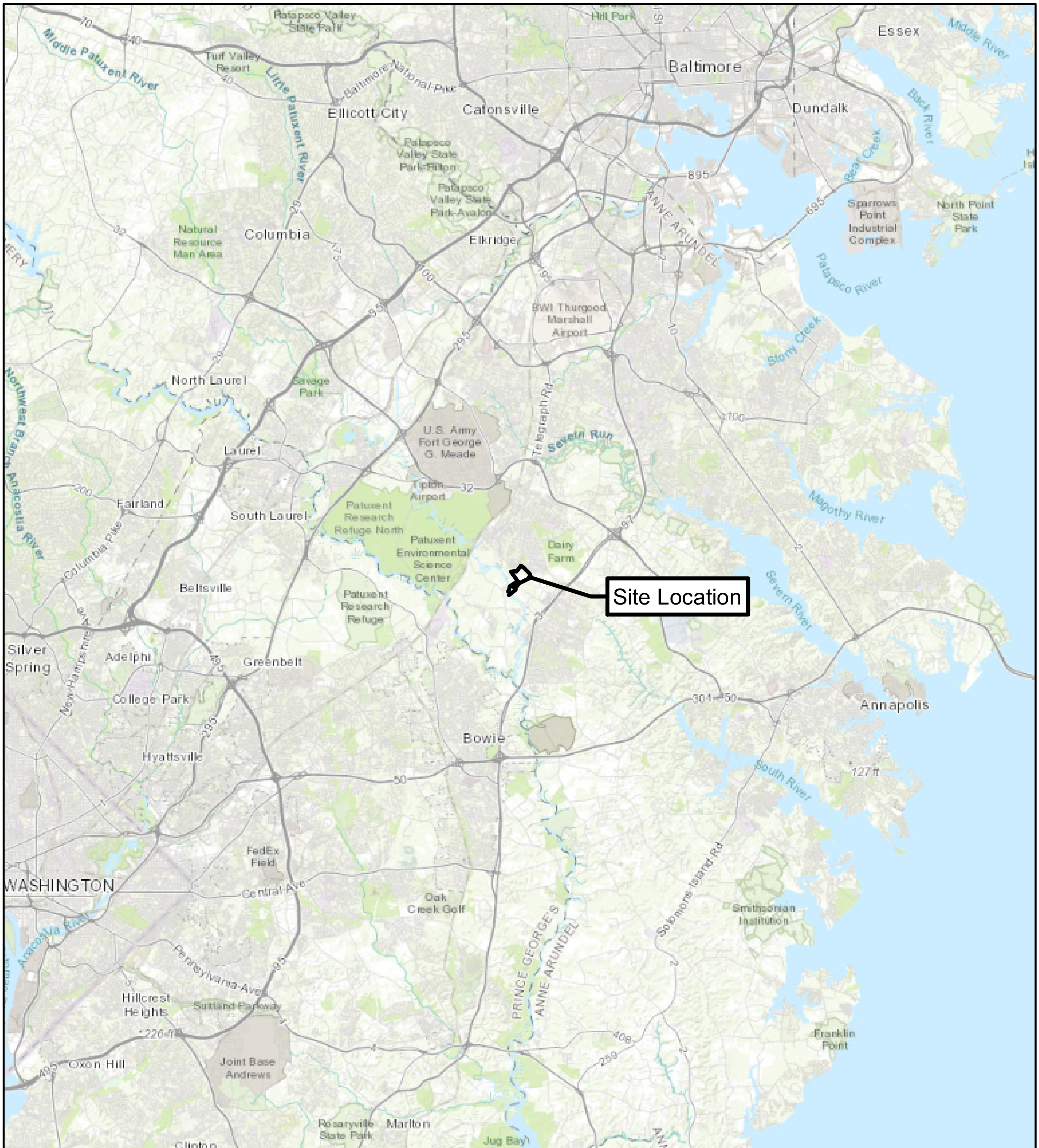
TABLE 6
GROUNDWATER QUALITY RESPONSE ACTIONS

Tolson Rubble Landfill
Crofton, Maryland

Observation	Response Action
Groundwater Quality Standard Exceedances	
Concentrations of a permit required constituent exceeds the GWQS for the first time.	- Notify MDE within 24 hours of receipt of the laboratory report; and - Resample monitoring location(s) with first time excedances within 30 days to verify the intitial exceedance or accept the intial result.
Constituent concentration from the second resampling event indicates an exceedance of the GWQS.	- Evaluate exceedance(s) in terms of potential release from the fill area.
Statistically Significant Increases Above Background Groundwater Quality	
Statistical evaluations indicate a statististically significant increase (SSI) above background water quality for a consituent listed in Appenidix I of 40 CFR 258.	- Assess if the SSI is from a potential alternate source.
Alternate source assessment demontrates the SSI may be related to a source other than the landfill.	- Continue detection monitoring program in accordance with this Plan and assess future groundwater quality.
Alternate source assessment does not identify a source for SSI other than the landfill.	- Prepare an Assessment Monitoring Plan and submit to MDE for approval within 90 days; and - Upon approval, implement Assessment Monitoring Plan.

Notes:
Applicable groundwater quality standards are presented on Table 5.
CFR - United States Code of Federal Regulations.
MDE - Maryland Department of the Environment

FIGURES



Legend

Site Location

N

0 24,000 Feet

Sources: Esri, HERE, Garmin, Intermap, increment P Corp.,

Site Location Map

Tolson Rubble Landfill
Tolson & Associates
Capitol Raceway Road, Crofton, Maryland

Geosyntec consultants

Columbia, Maryland | May 2020

Figure

1

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LEGEND

- EXISTING CONTOURS (FEET, MSL)
- PROPERTY BOUNDARY
- MW-26A MONITORING WELL
- TREE LINE
- CURRENT PERMITTED WASTE BOUNDARY
- EXISTING WASH POND
- EXISTING WASTE DISPOSAL CELL
- —x—x—x— SECURITY FENCE
- SECURITY FENCE AND GATE
- ELECTRIC POLES
- —E—E—E— ELECTRIC LINE
- —UE— UNDERGROUND ELECTRIC LINE
- SURFACE WATER
- CUNNINGHAM LANDFILL (CLOSED)
- GP-10 LANDFILL GAS WELL

NOTES:

1. EXISTING TOPOGRAPHY IS FROM AN AERIAL SURVEY BY QUANTUM SPATIAL, DULLES, VA, PERFORMED ON 11 JANUARY 2019.
2. PROPERTY AND PARCEL BOUNDARIES FROM BAY ENGINEERING *"FILENAME TO GEOSYNTEC 06-01-2018 15-5132 EXHIBITS FOR ZONING 1-3"*.
3. LIMIT OF PHASE 1 CELL A BOUNDARY OBTAINED FROM CONSTRUCTION COMPLETION REPORT TOLSON RUBBLE LANDFILL PHASE I CELL A CROFTON, MARYLAND, 13 MARCH 2017, APPENDIX C, AS-BUILT DRAWINGS.

0 300 600
SCALE IN FEET

SITE PLAN

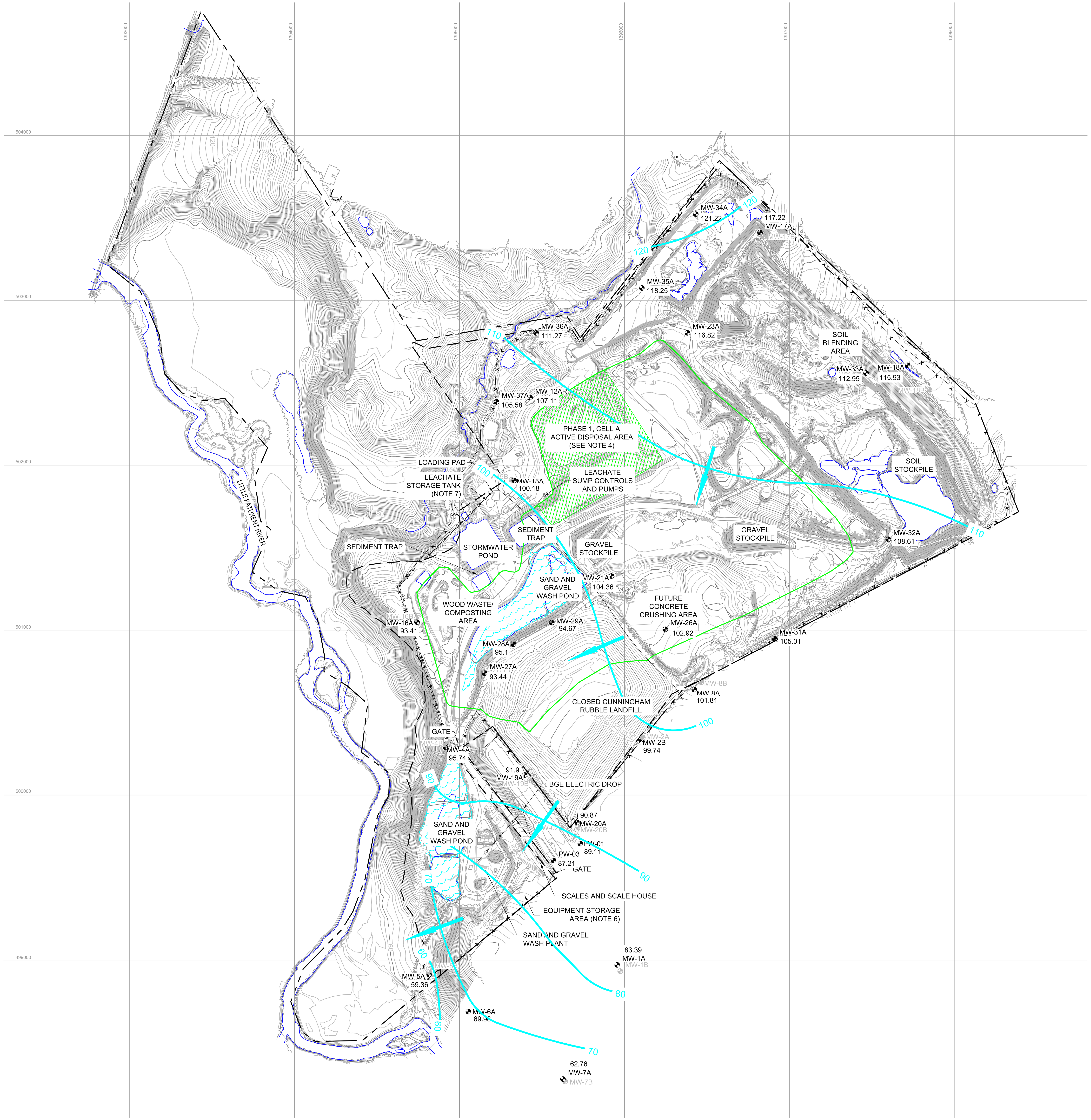
TOLSON & ASSOCIATES RUBBLE LANDFILL
TOLSON AND ASSOCIATES, LLC
CAPITOL RACEWAY ROAD, CROFTON, MARYLAND

Geosyntec consultants

PROJECT NO: ME1606 | MAY 2020

FIGURE 2

P:\CADD\PROJECTS\TOLSON\CONCEPTUAL\FIGURES\ME1606F001A



LEGEND

- EXISTING CONTOURS (FEET, MSL)
- PROPERTY BOUNDARY
- MW-26A MONITORING WELL
- TREE LINE
- CURRENT PERMITTED WASTE BOUNDARY
- EXISTING WASH POND
- EXISTING WASTE DISPOSAL CELL
- SECURITY FENCE
- SECURITY FENCE AND GATE
- ELECTRIC POLES
- ELECTRIC LINE
- UNDERGROUND ELECTRIC LINE
- SURFACE WATER
- GROUNDWATER CONTOUR
- GROUNDWATER FLOW DIRECTION

NOTES:

1. EXISTING TOPOGRAPHY IS FROM AN AERIAL SURVEY BY QUANTUM SPATIAL, DULLES, VA, PERFORMED ON 11 JANUARY 2019.
2. PROPERTY AND PARCEL BOUNDARIES FROM BAY ENGINEERING *"FILENAME TO GEOSYNTEC 06-01-2018 15-5132 EXHIBITS FOR ZONING 1-3"*.
3. LIMIT OF PHASE 1 CELL A BOUNDARY OBTAINED FROM CONSTRUCTION COMPLETION REPORT TOLSON RUBBLE LANDFILL PHASE I CELL A CROFTON, MARYLAND, 13 MARCH 2017, APPENDIX C, AS-BUILT DRAWINGS.
4. PIEZOMETER PW-02 IS UNDER AIR SPARGING PRESSURE AND NOT CONSIDERED IN THE INTERPOLATION OF THE SHOWN POTENTIOMETRIC SURFACE.

0 300 600
SCALE IN FEET

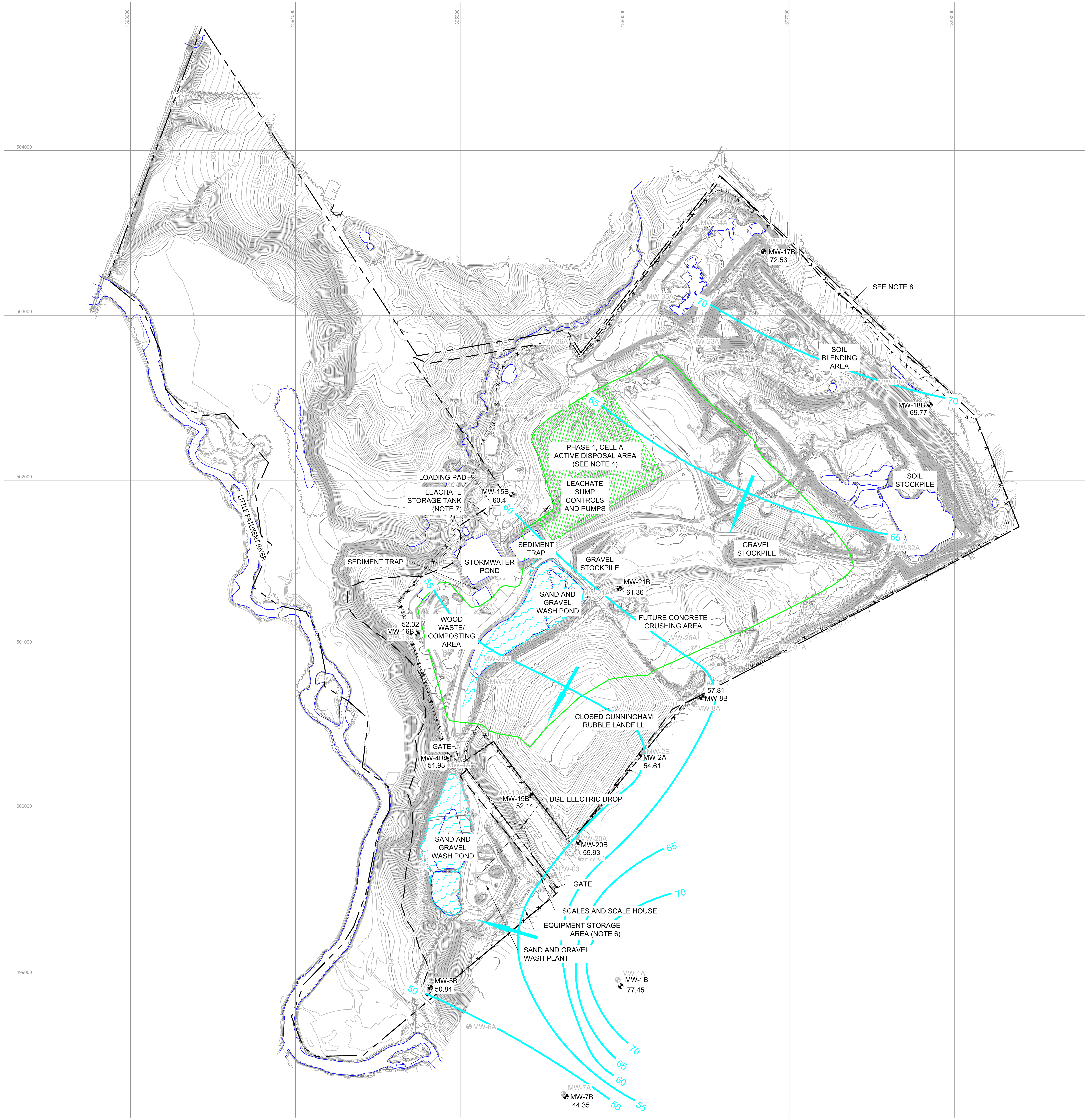
SHALLOW AQUIFER POTENTIOMETRIC SURFACE AUGUST 2019

TOLSON & ASSOCIATES RUBBLE LANDFILL
TOLSON AND ASSOCIATES, LLC
CAPITOL RACEWAY ROAD, CROFTON, MARYLAND

Geosyntec consultants

FIGURE 3

PROJECT NO: ME1606 | MAY 2020



LEGEND

- EXISTING CONTOURS (FEET, MSL)
- PROPERTY BOUNDARY
- MW-26B MONITORING WELL
- TREE LINE
- CURRENT PERMITTED WASTE BOUNDARY
- EXISTING WASH POND
- EXISTING WASTE DISPOSAL CELL
- SECURITY FENCE
- SECURITY FENCE AND GATE
- ELECTRIC POLES
- ELECTRIC LINE
- UNDERGROUND ELECTRIC LINE
- SURFACE WATER
- GROUNDWATER CONTOUR
- GROUNDWATER FLOW DIRECTION

NOTES:

1. EXISTING TOPOGRAPHY IS FROM AN AERIAL SURVEY BY QUANTUM SPATIAL, DULLES, VA, PERFORMED ON 11 JANUARY 2019.
2. PROPERTY AND PARCEL BOUNDARIES FROM BAY ENGINEERING *"FILENAME TO GEOSYNTEC 06-01-2018 15-5132 EXHIBITS FOR ZONING 1-3".*
3. LIMIT OF PHASE 1 CELL A BOUNDARY OBTAINED FROM CONSTRUCTION COMPLETION REPORT TOLSON RUBBLE LANDFILL PHASE I CELL A CROFTON, MARYLAND, 13 MARCH 2017, APPENDIX C, AS-BUILT DRAWINGS.
4. WELL MW-21B WAS DRAWN DOWN DURING A RECENT SAMPLING EVENT AND NOT CONSIDERED IN THE INTERPOLATION OF THE SHOWN POTENTIOMETRIC SURFACE.

0 300 600
SCALE IN FEET

DEEP AQUIFER POTENTIOMETRIC SURFACE AUGUST 2019

TOLSON & ASSOCIATES RUBBLE LANDFILL
TOLSON AND ASSOCIATES, LLC
CAPITOL RACEWAY ROAD, CROFTON, MARYLAND

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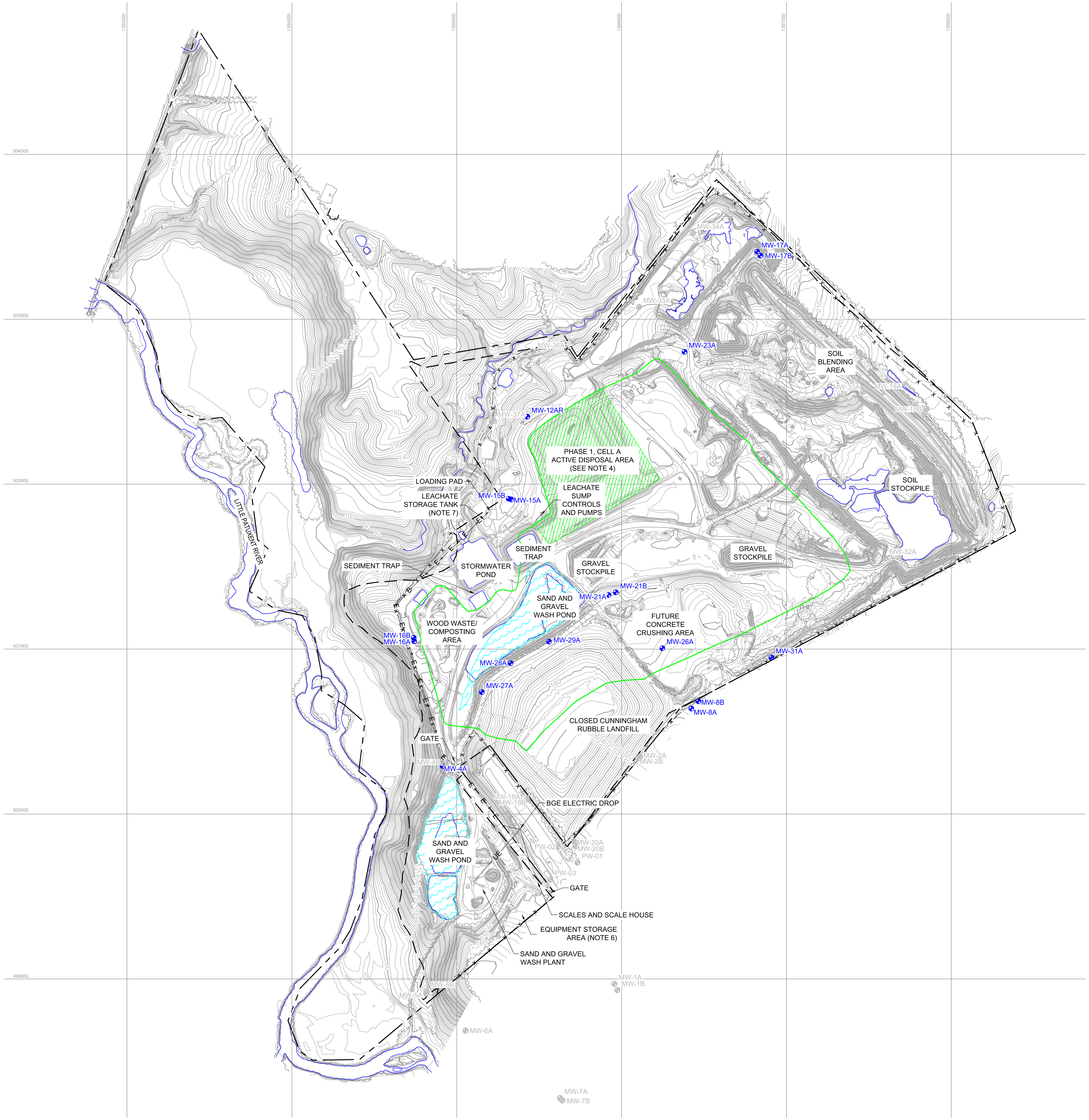
FIGURE 4

PROJECT NO: ME1606 | MAY 2020



LEGEND

170	EXISTING CONTOURS (FEET, MSL)
	PROPERTY BOUNDARY
MW-26A	MONITORING WELL NOT INCLUDED IN MONITORING PROGRAM
MW-26A	MONITORING WELL INCLUDED IN MONITORING PROGRAM
	TREE LINE
	CURRENT PERMITTED WASTE BOUNDARY
	EXISTING WASH POND
	EXISTING WASTE DISPOSAL CELL
x — x — x	SECURITY FENCE
	SECURITY FENCE AND GATE
	ELECTRIC POLES
E — E — E	ELECTRIC LINE
UE	UNDERGROUND ELECTRIC LINE
	SURFACE WATER

NOTES:

1. EXISTING TOPOGRAPHY IS FROM AN AERIAL SURVEY BY QUANTUM SPATIAL, DULLES, VA, PERFORMED ON 11 JANUARY 2019.
2. PROPERTY AND PARCEL BOUNDARIES FROM BAY ENGINEERING *"FILENAME TO GEOSYNTEC 06-01-2018 15-5132 EXHIBITS FOR ZONING 1-3"*.
3. LIMIT OF PHASE 1 CELL A BOUNDARY OBTAINED FROM CONSTRUCTION COMPLETION REPORT TOLSON RUBBLE LANDFILL PHASE I CELL A CROFTON, MARYLAND, 13 MARCH 2017, APPENDIX C, AS-BUILT DRAWINGS.

0 300 600
SCALE IN FEET

GROUNDWATER MONITORING NETWORK

TOLSON & ASSOCIATES RUBBLE LANDFILL
TOLSON AND ASSOCIATES, LLC
CAPITOL RACEWAY ROAD, CROFTON, MARYLAND

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FIGURE 5

PROJECT NO: ME1606 | MAY 2020

P:\CADD\PROJECTS\TOLSON\CONCEPTUAL\FIGURES\ME1606F002A

APPENDIX A
Sampling and Analysis Procedure

APPENDIX A

STANDARD OPERATING PROCEDURE

GROUNDWATER SAMPLING USING THE LOW-FLOW PROTOCOL

TOLSON RUBBLE LANDFILL

TABLE OF CONTENTS

Section **Page**

STANDARD OPERATING PROCEDURE
GROUNDWATER SAMPLING USING THE LOW-FLOW PROTOCOL
TOLSON RUBBLE LANDFILL

1. INTRODUCTION

1.1 Overview

This Standard Operating Procedure (SOP) was prepared to provide instructions to the field sampler for groundwater sampling using the United States Environmental Protection Agency (USEPA) low-flow/low-stress well purging protocol during semi-annual groundwater monitoring events at the Tolson Rubble Landfill located in Crofton, Maryland (the Site). Included in this SOP are a list of equipment and supplies needed to conduct the sampling and the specific procedures to be used for monitoring well purging and sample collection, and example field forms for sampling and water quality meter calibration documentation.

1.2 Objective

The objective of low-flow sampling techniques is to collect a representative groundwater sample from a monitoring well.

1.3 Equipment and Supplies

Dedicated purging and sampling equipment consisting of a QED Environmental Systems (QED) MicroPurge bladder pump, discharge tubing, and other miscellaneous sampling accessories are installed most wells. The pump intakes are set at either the approximate middle of screen section of the middle of the water column (if the water table is below the top of screen). The dedicated equipment is intended to remain in each monitoring well and will not be removed between sampling events. Sampling will require the following (or similar) re-usable or disposable equipment and/or supplies:

- Water quality meter and flow-through cell (e.g., YSI) for measuring pH, temperature, conductivity (and/or specific conductance), dissolved oxygen (DO), and oxidation-reduction potential (ORP) of groundwater, and a turbidity meter (e.g. Lamotte 2020);
- Calibration solutions for the water quality meter probes, per manufacturer's requirements;
- Water level meter;
- QED pressure controller and air compressor;
- Portable car battery;

- Tubing and air line connectors;
- Graduated cylinder and stopwatch;
- Paper towels, plastic bags, and miscellaneous sampling supplies;
- Personal Protective Equipment (PPE) as specified in the health and safety plan;
- Pre-preserved and laboratory-provided sample containers, sample labels, and coolers with ice;
- Field forms for meter calibration and groundwater sample collection (included in SOP); and
- Chain of custody documentation.

2. PROCEDURES

2.1 Pre-Mobilization Activities

The following is a list of activities will be completed prior to each sampling event:

- Obtain the well construction construction details (i.e., diameter, depth, well material, and screened interval) and map showing location of each monitoring well to be sampled.
- Obtain a list of parameters that will be measured in the field or laboratory as part of the sampling program including the required analytical method, sample volume, and holding time for each parameter. The parameters that will be measured in the field are the low-flow stabilization parameters including temperature, pH, specific conductance, ORP, DO, and turbidity. Those parameters will be recorded during low flow purging and immediately prior to collection of samples for laboratory analysis. Refer to the Environmental Monitoring Plan for a list of the laboratory analytical parameters
- Verify that all necessary equipment (see Section 1.3) has been ordered or is available and is being shipped to the Site or field sampler's office

2.2 Pre-Sampling Procedures

Several steps are required before sampling any of the wells. Those steps are described below and help ensure that instruments are functioning and properly calibrated and that the necessary equipment has been supplied for efficient and accurate sampling. All sampling procedures will be conducted consistent with the health and safety measures specified in the health and safety plan.

2.2.1 Inventory

Verify that the correct field equipment has been received and that it is clean (decontaminated). Inventory sample containers to verify that the laboratory has provided the correct number of containers of the proper size and containing the correct preservative if required. To the extent possible, pre-label/tag and bundle sample containers for each well to avoid confusion during sample collection.

Verify that appropriate PPE and ancillary supplies (e.g., paper towels, trash bags) have been received by the field staff. The appropriate protective equipment, as specified in the health and safety plan will be reviewed during a morning tailgate meeting. Contact the field manager or project manager immediately if there are discrepancies.

2.2.2 Calibration

Calibrate the field probes consistent with the manufacturer's specifications before sampling and at the start of each field day. Record the calibration data on the field calibration form. A check of the calibration shall be performed at least once more during the field day. Instruments will be recalibrated as necessary (e.g., when calibration checks indicate incorrect operation) to ensure accurate measurements, and all checks and recalibrations will be recorded on field calibration forms. Calibration will also be checked if any readings during sampling are suspect.

2.2.3 Well Inspection

Inspect the well for the presence of lock and cap, surface seal integrity, obstructions, evidence of tampering, debris, or surface water collecting in flush mounts. Note any irregularities in the groundwater sampling field form.

2.3 Well Purging and Sampling

Sampling will be performed using a five-step procedure that will be followed upon arrival at each well. Those steps include:

1. set-up;
2. purging;
3. measurement of field parameters and field testing;
4. sampling; and
5. clean-up.

Detailed procedures for performing each of these steps are provided in the following subsections.

2.3.1 Set-up

All necessary equipment for purging, sampling, and storage will be brought to the well before the well is opened. Inspect the well for the presence of lock and cap, surface seal integrity, obstructions, evidence of tampering, debris, or surface water collecting in flush mounts. Note any irregularities in the groundwater sampling field form. PPE, as required by the health and safety plan, will be donned prior to opening well. Open the monitoring well. The tubing, field probe and other above-ground purging equipment are then set up.

2.3.2 Purging (Low Flow Protocol)

Wells will be purged using the low flow/minimum drawdown protocol as described by Puls and Barcelona (1996) and summarized below. The general procedural requirements for low-flow purging using dedicated bladder pumps are listed below The pumps and tubing are intened to remain in each well between sampling events and should not be removed unless the tubing or pump is thought to be damaged or malfunctions.

- Measure the static depth to water. This measurement will be used to calculate drawdown during purging and sampling.
- Connect the pump discharge tubing to the flowthrough cell and multiparameter probe. Connect the air line from the air compressor output to the pressure controller input, if separate devices. Connect the air line from pressure controller output to the pump air line.
- Begin pumping at a steady rate of 100 mL/min and measure the depth to water frequently (e.g., every minute for the first few minutes). Purge water will be discharged to the groundwater surface in the vincinity of the monitoring well. The pumping rate may be increased if drawdown stabilizes at less than 0.33 ft, but the pumping rate will not exceed 500 mL/min. Drawdown may exceed 0.33 ft if the water level stabilizes above the top of the well screen. If the intial water level is within the screened interval, drawdown to the top of the pump is acceptable. In some silty and/or clayey formations, drawdown may not stabilize when pumping at 100 mL/min. If this occurs, refer to the Section 2.3.3 below for alternatives to the low flow/minimum drawdown protocol.
- Field parameters and depth to water will be recorded on field data sheets every three to five minutes while purging. Purging will continue until three consecutive water quality readings (i.e., pH, temperature, specific

conductance, ORP, DO, and turbidity) are within the stabilization criteria defined in the table below:

Parameter	Stabilization Criteria	Reference
pH	± 0.1 units	Groundwater Sampling Guidelines for Superfund and RCRA Project Managers, 2002
Specific Conductance	± 3%	
ORP	± 10 mV	
Turbidity	± 10% when > 10 NTU or three consecutive readings < 10 NTU	
DO	± 10% when > 0.5 mg/L or three consecutive readings < 0.5 mg/L	USEPA Region I: Low Stress Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells, 2010

- Samples will be collected after field parameters have stabilized and measurements recorded. Samples are to be obtained from the influent line (prior) to the flow-through cell (i.e., field parameters cannot be measured during sampling). Properly label each sample container.

- In the case that the above stabilization criteria are not met before three well volumes have been purged, samples may be collected. Also, if stabilization has not occurred after two hours of purging regardless of well volume status, samples may be collected.

- Demobilize from the well. Lock outer well casing and leave work area neat and orderly.

2.3.3 Variations from Low Flow Protocol

Wells in low-yielding formations such as poorly fractured bedrock and silt or clay soils may not yield sufficient water for purging (e.g., 100 mL/min) to allow drawdown stabilization above the monitoring well screen. In those cases, the modified low-flow methods described below will be used.

Alternative Method 1: Initial water level above top of screened interval

Purge the well at a rate not greater than 500 mL/min to one foot above the top of the screened interval. Measure and record the field parameters and water depth at a minimum of five-minute intervals. Cease pumping and allow the water level to recover until the standing water column in the well (length from water level to bottom of well) equilibrates to at least 90% of the original water column. Repeat the purging and cessation cycle until a minimum of one casing volume is removed from the well. The well will then be allowed to recover sufficient volume for sample collection within 24 hours of the last purging event, but no sooner than two hours.

Alternative Method 2: Initial water level within the screened interval

Purge the well at a rate not greater than 500 mL/min to the top of the pump. Cease pumping and allow the water level to recover until the standing water column in the well (length from water level to bottom of well) equilibrates to at least 90% of the original water column. Repeat the purging and cessation cycle until a minimum of one casing volume is removed from the well. The well will then be allowed to recover sufficient volume for sample collection within 24 hours of the last purging event, but no sooner than two hours.

Other Modifications to Low Flow Sampling

Other deviations the low-flow protocol may be required. Any methods that are not described in this SOP will be discussed with the project manager before implementing in the field. Data from low-yielding wells that require any alternative methods may need to be qualified to indicate potential for sample bias.

2.3.4 Observations During Sampling

Field sampling staff will identify and log any observations that may be considered unusual into a field notebook or on the groundwater sampling field form for each well. Those observations include, but are not limited to: excessive bubbling within the tubing or in the sample containers as they are filled; odors; excessive turbidity, solids, or formation of precipitates in the samples; color changes in the water; and unusual sounds made by the equipment.

2.3.5 Storage and Shipping

All samples will be immediately placed on ice (preferably bagged wet ice packs) to remain at <6°C prior to and during shipment to the laboratory. The sample containers will be stored in a cooler until further processing. The chain of custody forms for each sample suite will be sealed inside ziplock bags (double bagged if necessary) and placed in the cooler with corresponding samples, if possible. Fragile materials (glass or other breakable sample vials) are to be wrapped with bubble wrap or a similar material.

3. REFERENCES

Puls, R.W. and Barcelona, M.J. 1996. Low-flow (minimal drawdown) Ground-Water Sampling Procedures. USEPA/540/S-95/504, ORD, Robert S. Kerr Environmental Research Center, Ada, OK.

USEPA. 2010. Low Stress (low flow) Purging and Sampling Procedures for the Collection of Groundwater Samples from Monitoring Wells. U.S. Environmental Protection Agency – Region 1. Revised, January 2010.

Yeskis, D. and Zavala, B. 2002. Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers. May 2002. EPA 542-S-02-001.

METER CALIBRATION REPORT

Geosyntec consultants
engineers | scientists | innovators

Geosyntec Consultants
10220 Old Columbia Road
Columbia, MD 21046
PHONE (410)381-4333 FAX (410) 381-4499

Project Name: ______ Date: ______
Project Number: ______ Primary Activities:
Field Personnel: ______ Initial Calibration Completed at:
Recorded By: ______ Midday Calibration Completed at:
Weather: Final Calibration Check Completed at:

1. Specific Conductance Calibration	1413 µS / cm		
	Temp.	Initial	Cal to.
Initial			
Midday			
Final			

2. pH Calibration		Buffer Solution		
		pH 7.0	pH 4.0	pH 10.0
Initial	temperature (°C)			
	instrument reading			
	should read/calibrated			
Midday	temperature (°C)			
	instrument reading			
	should read/calibrated			
Final	temperature (°C)			
	instrument reading			

4. Dissolved Oxygen Calibration		Saturation	
		100%	0%
Initial	Barometer		
	temperature (°C)		
	instrument reading		
	calibrated to		
Midday	Barometer		
	temperature (°C)		
	instrument reading		
	calibrated to		
Final	Barometer		
	temperature (°C)		
	instrument reading		

3. ORP Calibration	+240 mv Zobell		
	Temp.	Initial	Cal to.
Initial			
Midday			
Final			

5. Turbidity	1 NTU Initial	1 NTU Final	10 NTU Initial	10 NTU Final
Initial				
Midday				
Final				

pH 7 Calibration Solution – Lot Number:	Expiration Date:
pH 4 Calibration Solution – Lot Number:	Expiration Date:
pH 10 Calibration Solution – Lot Number:	Expiration Date:
Specific Conductance Calibration Solution – Lot Number:	Expiration Date:
ORP Calibration Solution – Lot Number:	Expiration Date
1 NTU Turbidity Calibration Solution – Lot Number:	Expiration Date:
10 NTU Turbidity Calibration Solution – Lot Number:	Expiration Date:
Multiparameter Probe – Model: PES #:	SN:
Turbidity Meter - Model: PES #:	SN:

Comments: (rental, condition, problems):

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Columbia Maryland 21046
Tel (410) 381-4333 Fax (410) 381-4499

GROUNDWATER SAMPLING LOG

Project Name ______________________ Date ____ / ____ / ____

Project Number __________ Phase __________ Task __________

Location ______________________ Personnel __________

Sample Type __________ Location Type __________ DTW (feet) __________

Depth Measurement Location __________ DTB (feet) from prior data __________

Location ID __________

Screen Interval (ft) __________ Pump Setting (feet) __________

Duplicate ID __________ Well Diameter (inches) __________

Purge Method **Low Flow** Rate (mL/min) Time - Start Time-End

Time	*DTW (ft)*	*pH (S.U.)*	*Conductivity (µS/cm)*	*Temp. (°C)*	*Turbidity (NTU)*	*ORP (mV)*	*DO (mg/L)*	*Flow rate (mL/min)*

Sample Method **Low Flow** Rate (mL/min) Date Time

Final/Sample Field Parameters		***Stabilization Guidance***		**NOTES:**
pH		*0.1*	met? Y / N	
Conductivity (uS)		*3%*	met? Y / N	
Temp. (°C)		*none*		
Turbidity (NTU)		*10%*	met? Y / N	
ORP (mV)		*10*	met? Y / N	
DO (mg/L)		*10%*	met? Y / N	**SAMPLE COLOR:**

Constituent	*Method*	*Container*	*Preservative*	*Filtered?*

COMMENTS:

APPENDIX B
Intrawell Upper Tolerance Limits

APPENDIX B
INTRAWELL UPPER TOLERANCE LIMITS FOR VOLATILE ORGANIC COMPOUNDS

Tolson Rubble Landfill
Crofton, Maryland

Well	Date	1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2,3-Trichloropropane	1,2-Dibromo-3-Chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloropropane	trans-1,4-Dichloro-2-Butene	1,4-Dichlorobenzene	2-Butanone	2-Hexanone	4-Methyl-2-Pentanone	Acetone	Acrylonitrile	Benzene	Bromochloromethane	Bromodichloromethane	Bromoform	Bromomethane
MW-4A	3/25/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	8/30/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	2/21/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/15/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	3/6/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/13/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	3/7/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/23/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	3/24/2014	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	6.0	10.0	1.0	1.0	1.0	5.0	1.0
	12/16/2014	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	4/27/2015	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	Mean (x)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.3	1.0	1.0	1.0	1.0	2.5	1.0	6.8	6.8	5.0	6.5	6.8	1.0	1.0	1.0	2.5	1.0
	SD (σ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.0	0.0	0.0	0.0	2.0	0.0	2.5	2.5	0.0	2.3	2.5	0.0	0.0	0.0	2.0	0.0
	x + σ	1.0	1.0	1.0	1.0	1.0	1.0	1.0	8.8	1.0	1.0	1.0	1.0	4.5	1.0	9.3	9.3	5.0	8.8	9.3	1.0	1.0	1.0	4.5	1.0
	x + 2*σ (UTL)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	13.4	1.0	1.0	1.0	1.0	6.5	1.0	11.9	11.9	5.0	11.0	11.9	1.0	1.0	1.0	6.5	1.0
MW-8A	3/25/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	8/30/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	33.5	5.0	1.0	1.0	1.0	1.0	1.0
	2/17/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/13/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	2/28/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/10/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	3/4/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/18/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	3/24/2014	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	12/15/2014	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	4/23/2015	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	Mean (x)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.3	1.0	1.0	1.0	1.0	2.5	1.0	6.8	6.8	5.0	9.4	6.8	1.0	1.0	1.0	2.5	1.0
	SD (σ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.0	0.0	0.0	0.0	2.0	0.0	2.5	2.5	0.0	8.4	2.5	0.0	0.0	0.0	2.0	0.0
	x + σ	1.0	1.0	1.0	1.0	1.0	1.0	1.0	8.8	1.0	1.0	1.0	1.0	4.5	1.0	9.3	9.3	5.0	17.8	9.3	1.0	1.0	1.0	4.5	1.0
	x + 2*σ (UTL)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	13.4	1.0	1.0	1.0	1.0	6.5	1.0	11.9	11.9	5.0	26.1	11.9	1.0	1.0	1.0	6.5	1.0
MW-8B	3/25/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	8/30/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	2/17/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/13/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	2/28/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/10/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	3/4/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/18/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	3/24/2014	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	12/15/2014	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	4/23/2015	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	Mean (x)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.3	1.0	1.0	1.0	1.0	2.5	1.0	6.8	6.8	5.0	6.8	6.8	1.0	1.0	1.0	2.5	1.0
	SD (σ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.0	0.0	0.0	0.0	2.0	0.0	2.5	2.5	0.0	2.5	2.5	0.0	0.0	0.0	2.0	0.0
	x + σ	1.0	1.0	1.0	1.0	1.0	1.0	1.0	8.8	1.0	1.0	1.0	1.0	4.5	1.0	9.3	9.3	5.0	9.3	9.3	1.0	1.0	1.0	4.5	1.0
	x + 2*σ (UTL)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	13.4	1.0	1.0	1.0	1.0	6.5	1.0	11.9	11.9	5.0	11.9	11.9	1.0	1.0	1.0	6.5	1.0

APPENDIX B
INTRAWELL UPPER TOLERANCE LIMITS FOR VOLATILE ORGANIC COMPOUNDS

Tolson Rubble Landfill
Crofton, Maryland

Well	Date	Carbon Disulfide	Carbon Tetrachloride	Chlorobenzene	Dibromochloromethane	Chloroethane	Chloroform	Chloromethane	cis-1,2-Dichloroethene	cis-1,3-Dichloropropene	Dibromomethane	Methylene Chloride*	Methyl Iodide	Methyl-tert-butyl ether	Styrene	Trichloroethene	Tetrachloroethene	Toluene	Ethylbenzene	trans-1,2-Dichloroethene	trans-1,3-Dichloropropene	Trichlorofluoromethane	Vinyl Acetate	Vinyl Chloride	Total Xylenes
	3/25/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	8/30/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	2/21/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	9/15/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	3/6/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
MW-4A	9/13/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0
	3/7/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0
	9/23/2013	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	3/24/2014	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	12/16/2014	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	4/27/2015	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	Mean (x)	2.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.5	1.0	1.0	1.5
	SD (σ)	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.5
	x + σ	4.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.5	1.0	1.0	2.1
	x + 2*σ (UTL)	6.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	6.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	6.5	1.0	1.0	2.6
	3/25/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	8/30/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	2/17/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	9.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	9/13/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	2/28/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
MW-8A	9/10/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0
	3/4/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0
	9/18/2013	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	3/24/2014	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	12/15/2014	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	4/23/2015	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	Mean (x)	2.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.5	1.0	1.0	1.0	1.0	1.8	1.0	1.0	1.0	2.5	1.0	1.0	1.5
	SD (σ)	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	2.0	0.0	0.0	0.5
	x + σ	4.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.5	1.0	1.0	1.0	1.0	4.3	1.0	1.0	1.0	4.5	1.0	1.0	2.1
	x + 2*σ (UTL)	6.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	6.5	1.0	1.0	1.0	1.0	6.8	1.0	1.0	1.0	6.5	1.0	1.0	2.6
	3/25/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	8/30/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	2/17/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	9/13/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	2/28/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
MW-8B	9/10/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0
	3/4/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0
	9/18/2013	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	3/24/2014	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	12/15/2014	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	4/23/2015	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	Mean (x)	2.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.5	1.0	1.0	1.5
	SD (σ)	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.5
	x + σ	4.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.5	1.0	1.0	2.1
	x + 2*σ (UTL)	6.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	6.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	6.5	1.0	1.0	2.6

APPENDIX B
INTRAWELL UPPER TOLERANCE LIMITS FOR VOLATILE ORGANIC COMPOUNDS

Tolson Rubble Landfill
Crofton, Maryland

Well	Date	1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2,3-Trichloropropane	1,2-Dibromo-3-Chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloropropane	trans-1,4-Dichloro-2-Butene	1,4-Dichlorobenzene	2-Butanone	2-Hexanone	4-Methyl-2-Pentanone	Acetone	Acrylonitrile	Benzene	Bromochloromethane	Bromodichloromethane	Bromoform	Bromomethane
	11/7/2016	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	11/14/2016	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	11/21/2016	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	11/28/2016	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
MW-12AR	12/15/2016	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	12/28/2016	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	3/27/2017	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	6/14/2017	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	9/28/2017	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	Mean (x)	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	SD (σ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	x + σ	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	x + 2*σ (UTL)	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	3/24/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	8/30/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	2/23/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/15/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	3/6/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
MW-15A	9/12/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	3/7/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/20/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	3/26/2014	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	12/16/2014	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	4/30/2015	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	Mean (x)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.3	1.0	1.0	1.0	1.0	2.5	1.0	6.8	6.8	5.0	6.8	6.8	1.0	1.0	1.0	2.5	1.0
	SD (σ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.0	0.0	0.0	0.0	2.0	0.0	2.5	2.5	0.0	7.0	2.5	0.0	0.0	0.0	2.0	0.0
	x + σ	1.0	1.0	1.0	1.0	1.0	1.0	1.0	8.8	1.0	1.0	1.0	1.0	4.5	1.0	9.3	9.3	5.0	13.8	9.3	1.0	1.0	1.0	4.5	1.0
	x + 2*σ (UTL)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	13.4	1.0	1.0	1.0	1.0	6.5	1.0	11.9	11.9	5.0	20.8	11.9	1.0	1.0	1.0	6.5	1.0
	3/24/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	8/30/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	2/23/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/15/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	3/6/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
MW-15B	9/12/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	3/7/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/24/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	3/26/2014	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	12/16/2014	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	4/29/2015	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	Mean (x)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.3	1.0	1.0	1.0	1.0	2.5	1.0	6.8	6.8	5.0	6.8	6.8	1.0	1.0	1.0	2.5	1.0
	SD (σ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.0	0.0	0.0	0.0	2.0	0.0	2.5	2.5	0.0	2.5	2.5	0.0	0.0	0.0	2.0	0.0
	x + σ	1.0	1.0	1.0	1.0	1.0	1.0	1.0	8.8	1.0	1.0	1.0	1.0	4.5	1.0	9.3	9.3	5.0	9.3	9.3	1.0	1.0	1.0	4.5	1.0
	x + 2*σ (UTL)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	13.4	1.0	1.0	1.0	1.0	6.5	1.0	11.9	11.9	5.0	11.9	11.9	1.0	1.0	1.0	6.5	1.0

APPENDIX B
INTRAWELL UPPER TOLERANCE LIMITS FOR VOLATILE ORGANIC COMPOUNDS

Tolson Rubble Landfill
Crofton, Maryland

Well	Date	Carbon Disulfide	Carbon Tetrachloride	Chlorobenzene	Dibromochloromethane	Chloroethane	Chloroform	Chloromethane	cis-1,2-Dichloroethene	cis-1,3-Dichloropropene	Dibromomethane	Methylene Chloride*	Methyl Iodide	Methyl-tert-butyl ether	Styrene	Trichloroethene	Tetrachloroethene	Toluene	Ethylbenzene	trans-1,2-Dichloroethene	trans-1,3-Dichloropropene	Trichlorofluoromethane	Vinyl Acetate	Vinyl Chloride	Total Xylenes
MW-12AR	11/7/2016	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	11/14/2016	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	11/21/2016	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	11/28/2016	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	12/15/2016	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.50	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	12/28/2016	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.50	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	3/27/2017	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.50	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	6/14/2017	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.50	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	9/28/2017	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.50	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	Mean (x)	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	SD (σ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	x + σ	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	x + 2*σ (UTL)	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
MW-15A	3/24/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	8/30/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	2/23/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	9/15/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	3/6/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	9/12/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0
	3/7/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0
	9/20/2013	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	3/26/2014	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	12/16/2014	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	4/30/2015	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	Mean (x)	2.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.5	1.0	1.0	1.5
	SD (σ)	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.5
	x + σ	4.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.5	1.0	1.0	2.1
	x + 2*σ (UTL)	6.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	6.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	6.5	1.0	1.0	2.6
MW-15B	3/24/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	8/30/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	2/23/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	9/15/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	3/6/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	9/12/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0
	3/7/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0
	9/24/2013	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	3/26/2014	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	12/16/2014	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	4/29/2015	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	Mean (x)	2.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.5	1.0	1.0	1.5
	SD (σ)	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.5
	x + σ	4.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.5	1.0	1.0	2.1
	x + 2*σ (UTL)	6.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	6.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	6.5	1.0	1.0	2.6

APPENDIX B
INTRAWELL UPPER TOLERANCE LIMITS FOR VOLATILE ORGANIC COMPOUNDS

Tolson Rubble Landfill
Crofton, Maryland

Well	Date	1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2,3-Trichloropropane	1,2-Dibromo-3-Chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloropropane	trans-1,4-Dichloro-2-Butene	1,4-Dichlorobenzene	2-Butanone	2-Hexanone	4-Methyl-2-Pentanone	Acetone	Acrylonitrile	Benzene	Bromochloromethane	Bromodichloromethane	Bromoform	Bromomethane
MW-16A	3/24/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	8.1	5.0	1.0	1.0	1.0	1.0	1.0
	8/30/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	2/23/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/14/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	3/1/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/11/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	3/5/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/17/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	3/20/2014	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	12/10/2014	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	4/27/2015	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	Mean (x)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.3	1.0	1.0	1.0	1.0	2.5	1.0	6.8	6.8	5.0	7.1	6.8	1.0	1.0	1.0	2.5	1.0
	SD (σ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.0	0.0	0.0	0.0	2.0	0.0	2.5	2.5	0.0	2.5	2.5	0.0	0.0	0.0	2.0	0.0
	x + σ	1.0	1.0	1.0	1.0	1.0	1.0	1.0	8.8	1.0	1.0	1.0	1.0	4.5	1.0	9.3	9.3	5.0	9.6	9.3	1.0	1.0	1.0	4.5	1.0
	x + 2*σ (UTL)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	13.4	1.0	1.0	1.0	1.0	6.5	1.0	11.9	11.9	5.0	12.0	11.9	1.0	1.0	1.0	6.5	1.0
MW-16B	3/24/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	8/30/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	2/23/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/14/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	3/1/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/11/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	3/5/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/19/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	3/20/2014	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	12/10/2014	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	4/27/2015	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	Mean (x)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.3	1.0	1.0	1.0	1.0	2.5	1.0	6.8	6.8	5.0	6.8	6.8	1.0	1.0	1.0	2.5	1.0
	SD (σ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.0	0.0	0.0	0.0	2.0	0.0	2.5	2.5	0.0	2.5	2.5	0.0	0.0	0.0	2.0	0.0
	x + σ	1.0	1.0	1.0	1.0	1.0	1.0	1.0	8.8	1.0	1.0	1.0	1.0	4.5	1.0	9.3	9.3	5.0	9.3	9.3	1.0	1.0	1.0	4.5	1.0
	x + 2*σ (UTL)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	13.4	1.0	1.0	1.0	1.0	6.5	1.0	11.9	11.9	5.0	11.9	11.9	1.0	1.0	1.0	6.5	1.0
MW-17A	3/25/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	8/30/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	2/21/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/13/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	3/2/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/11/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	3/5/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/19/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	3/20/2014	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	12/11/2014	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	4/27/2015	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	Mean (x)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.3	1.0	1.0	1.0	1.0	2.5	1.0	6.8	6.8	5.0	6.8	6.8	1.0	1.0	1.0	2.5	1.0
	SD (σ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.0	0.0	0.0	0.0	2.0	0.0	2.5	2.5	0.0	2.5	2.5	0.0	0.0	0.0	2.0	0.0
	x + σ	1.0	1.0	1.0	1.0	1.0	1.0	1.0	8.8	1.0	1.0	1.0	1.0	4.5	1.0	9.3	9.3	5.0	9.3	9.3	1.0	1.0	1.0	4.5	1.0
	x + 2*σ (UTL)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	13.4	1.0	1.0	1.0	1.0	6.5	1.0	11.9	11.9	5.0	11.9	11.9	1.0	1.0	1.0	6.5	1.0

APPENDIX B
INTRAWELL UPPER TOLERANCE LIMITS FOR VOLATILE ORGANIC COMPOUNDS

Tolson Rubble Landfill
Crofton, Maryland

Well	Date	Carbon Disulfide	Carbon Tetrachloride	Chlorobenzene	Dibromochloromethane	Chloroethane	Chloroform	Chloromethane	cis-1,2-Dichloroethene	cis-1,3-Dichloropropene	Dibromomethane	Methylene Chloride*	Methyl Iodide	Methyl-tert-butyl ether	Styrene	Trichloroethene	Tetrachloroethene	Toluene	Ethylbenzene	trans-1,2-Dichloroethene	trans-1,3-Dichloropropene	Trichlorofluoromethane	Vinyl Acetate	Vinyl Chloride	Total Xylenes
MW-16A	3/24/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	8/30/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	2/23/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	9/14/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	3/1/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	9/11/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0
	3/5/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0
	9/17/2013	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	3/20/2014	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	0.51	2.0
	12/10/2014	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	4/27/2015	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	Mean (x)	2.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.5	1.0	1.0	1.5
	SD (σ)	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.1	0.5
	x + σ	4.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.5	1.0	1.1	2.1
	x + 2*σ (UTL)	6.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	6.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	6.5	1.0	1.3	2.6
MW-16B	3/24/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	8/30/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	2/23/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	9/14/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	3/1/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	9/11/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0
	3/5/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0
	9/19/2013	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	3/20/2014	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	12/10/2014	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	4/27/2015	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	Mean (x)	2.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.5	1.0	1.0	1.5
	SD (σ)	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.5
	x + σ	4.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.5	1.0	1.0	2.1
	x + 2*σ (UTL)	6.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	6.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	6.5	1.0	1.0	2.6
MW-17A	3/25/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	8/30/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	2/21/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	9/13/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	3/2/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	9/11/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0
	3/5/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0
	9/19/2013	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	3/20/2014	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	12/11/2014	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	4/27/2015	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	Mean (x)	2.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.5	1.0	1.0	1.5
	SD (σ)	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.5
	x + σ	4.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.5	1.0	1.0	2.1
	x + 2*σ (UTL)	6.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	6.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	6.5	1.0	1.0	2.6

APPENDIX B
INTRAWELL UPPER TOLERANCE LIMITS FOR VOLATILE ORGANIC COMPOUNDS

Tolson Rubble Landfill
Crofton, Maryland

Well	Date	1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2,3-Trichloropropane	1,2-Dibromo-3-Chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloropropane	trans-1,4-Dichloro-2-Butene	1,4-Dichlorobenzene	2-Butanone	2-Hexanone	4-Methyl-2-Pentanone	Acetone	Acrylonitrile	Benzene	Bromochloromethane	Bromodichloromethane	Bromoform	Bromomethane
MW-17B	3/25/2010	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	8/30/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	2/21/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/12/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	3/2/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/11/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	3/5/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/19/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	3/20/2014	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	12/11/2014	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	4/28/2015	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	Mean (x)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.6	1.0	1.0	1.0	1.0	2.6	1.0	7.0	7.0	5.0	7.0	7.0	1.0	1.0	1.0	2.6	1.0
	SD (σ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	0.0	0.0	0.0	0.0	2.1	0.0	2.6	2.6	0.0	2.6	2.6	0.0	0.0	0.0	2.1	0.0
	x + σ	1.0	1.0	1.0	1.0	1.0	1.0	1.0	9.2	1.0	1.0	1.0	1.0	4.7	1.0	9.6	9.6	5.0	9.6	9.6	1.0	1.0	1.0	4.7	1.0
	x + 2*σ (UTL)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	13.9	1.0	1.0	1.0	1.0	6.7	1.0	12.2	12.2	5.0	12.2	12.2	1.0	1.0	1.0	6.7	1.0
MW-21A	3/25/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	8/30/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	2/17/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/14/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	3/5/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/10/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	3/4/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/18/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	3/19/2014	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	12/15/2014	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	4/29/2015	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	Mean (x)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.3	1.0	1.0	1.0	1.0	2.5	1.0	6.8	6.8	5.0	6.8	6.8	1.0	1.0	1.0	2.5	1.0
	SD (σ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.0	0.0	0.0	0.0	2.0	0.0	2.5	2.5	0.0	2.5	2.5	0.0	0.0	0.0	2.0	0.0
	x + σ	1.0	1.0	1.0	1.0	1.0	1.0	1.0	8.8	1.0	1.0	1.0	1.0	4.5	1.0	9.3	9.3	5.0	9.3	9.3	1.0	1.0	1.0	4.5	1.0
	x + 2*σ (UTL)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	13.4	1.0	1.0	1.0	1.0	6.5	1.0	11.9	11.9	5.0	11.9	11.9	1.0	1.0	1.0	6.5	1.0
MW-21B	3/25/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	8/30/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	2/17/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/14/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	3/5/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/10/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	3/4/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	1.0	1.0	1.0	1.0	1.0
	9/18/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	3/19/2014	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	12/15/2014	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	5/28/2015	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	5.0	1.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0	1.0	5.0	1.0
	Mean (x)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.3	1.0	1.0	1.0	1.0	2.5	1.0	6.8	6.8	5.0	6.8	6.8	1.0	1.0	1.0	2.5	1.0
	SD (σ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.0	0.0	0.0	0.0	2.0	0.0	2.5	2.5	0.0	2.5	2.5	0.0	0.0	0.0	2.0	0.0
	x + σ	1.0	1.0	1.0	1.0	1.0	1.0	1.0	8.8	1.0	1.0	1.0	1.0	4.5	1.0	9.3	9.3	5.0	9.3	9.3	1.0	1.0	1.0	4.5	1.0
	x + 2*σ (UTL)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	13.4	1.0	1.0	1.0	1.0	6.5	1.0	11.9	11.9	5.0	11.9	11.9	1.0	1.0	1.0	6.5	1.0

APPENDIX B
INTRAWELL UPPER TOLERANCE LIMITS FOR VOLATILE ORGANIC COMPOUNDS

Tolson Rubble Landfill
Crofton, Maryland

Well	Date	Carbon Disulfide	Carbon Tetrachloride	Chlorobenzene	Dibromochloromethane	Chloroethane	Chloroform	Chloromethane	cis-1,2-Dichloroethene	cis-1,3-Dichloropropene	Dibromomethane	Methylene Chloride*	Methyl Iodide	Methyl-tert-butyl ether	Styrene	Trichloroethene	Tetrachloroethene	Toluene	Ethylbenzene	trans-1,2-Dichloroethene	trans-1,3-Dichloropropene	Trichlorofluoromethane	Vinyl Acetate	Vinyl Chloride	Total Xylenes
	3/25/2010	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	8/30/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	2/21/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	9/12/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	3/2/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
MW-17B	9/11/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0
	3/5/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0
	9/19/2013	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	3/20/2014	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	12/11/2014	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	4/28/2015	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	Mean (x)	2.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.6	1.0	1.0	1.6
	SD (σ)	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	0.0	0.0	0.5
	x + σ	4.7	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.7	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.7	1.0	1.0	2.1
	x + 2*σ (UTL)	6.7	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	6.7	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	6.7	1.0	1.0	2.6
	3/25/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	8/30/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	2/17/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	9/14/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	3/5/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
MW-21A	9/10/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0
	3/4/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0
	9/18/2013	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	3/19/2014	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	12/15/2014	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	4/29/2015	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	Mean (x)	2.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.5	1.0	1.0	1.5
	SD (σ)	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.5
	x + σ	4.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.5	1.0	1.0	2.1
	x + 2*σ (UTL)	6.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	6.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	6.5	1.0	1.0	2.6
	3/25/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	8/30/2010	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	2/17/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	9/14/2011	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	3/5/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
MW-21B	9/10/2012	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0
	3/4/2013	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0
	9/18/2013	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	3/19/2014	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	12/15/2014	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	5/28/2015	5.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	1.0	1.0	1.0	1.00	1.0	1.0	1.0	1.0	5.0	1.0	1.0	2.0
	Mean (x)	2.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.5	1.0	1.0	1.5
	SD (σ)	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.5
	x + σ	4.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.5	1.0	1.0	2.1
	x + 2*σ (UTL)	6.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	6.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	6.5	1.0	1.0	2.6

APPENDIX B
INTRAWELL UPPER TOLERANCE LIMITS FOR VOLATILE ORGANIC COMPOUNDS

Tolson Rubble Landfill
Crofton, Maryland

Well	Date	1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2,3-Trichloropropane	1,2-Dibromo-3-Chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloropropane	trans-1,4-Dichloro-2-Butene	1,4-Dichlorobenzene	2-Butanone	2-Hexanone	4-Methyl-2-Pentanone	Acetone	Acrylonitrile	Benzene	Bromochloromethane	Bromodichloromethane	Bromoform	Bromomethane
	11/7/2016	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	11/15/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	11/21/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	11/28/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
MW-23A	12/15/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	12/27/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	3/27/2017	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	6/14/2017	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	9/28/2017	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	Mean (x)	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	SD (σ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	x + σ	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	x + 2*σ (UTL)	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	11/9/2016	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	11/14/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	11/21/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	11/28/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
MW-26A	12/16/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	12/28/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	3/29/2017	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	6/16/2017	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	9/27/2017	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	Mean (x)	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	SD (σ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	x + σ	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	x + 2*σ (UTL)	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	11/8/2016	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	11/15/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	11/22/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	11/28/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
MW-27A	12/16/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	12/27/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	3/28/2017	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	6/15/2017	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	9/27/2017	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	Mean (x)	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	SD (σ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	x + σ	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	x + 2*σ (UTL)	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5

APPENDIX B
INTRAWELL UPPER TOLERANCE LIMITS FOR VOLATILE ORGANIC COMPOUNDS

Tolson Rubble Landfill
Crofton, Maryland

Well	Date	Carbon Disulfide	Carbon Tetrachloride	Chlorobenzene	Dibromochloromethane	Chloroethane	Chloroform	Chloromethane	cis-1,2-Dichloroethene	cis-1,3-Dichloropropene	Dibromomethane	Methylene Chloride*	Methyl Iodide	Methyl-tert-butyl ether	Styrene	Trichloroethene	Tetrachloroethene	Toluene	Ethylbenzene	trans-1,2-Dichloroethene	trans-1,3-Dichloropropene	Trichlorofluoromethane	Vinyl Acetate	Vinyl Chloride	Total Xylenes
	11/7/2016	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	11/15/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	11/21/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	11/28/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
MW-23A	12/15/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	12/27/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	3/27/2017	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	6/14/2017	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	9/28/2017	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	Mean (x)	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	SD (σ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	x + σ	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	x + 2*σ (UTL)	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	11/9/2016	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	2	0.6	0.5	0.5	4	2.0	0.5	2
	11/14/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.7	0.5	0.5	0.5	2	2	0.5	1
	11/21/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.9	2	0.5	0.5
	11/28/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
MW-26A	12/16/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	12/28/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	3/29/2017	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	6/16/2017	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	9/27/2017	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	Mean (x)	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.7	0.5	0.5	0.5	1.1	2.0	0.5	0.7
	SD (σ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	1.2	0.0	0.0	0.5
	x + σ	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	1.2	0.5	0.5	0.5	2.3	2.0	0.5	1.2
	x + 2*σ (UTL)	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	1.7	0.6	0.5	0.5	3.5	2.0	0.5	1.7
	11/8/2016	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	11/15/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	11/22/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	11/28/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
MW-27A	12/16/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	12/27/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	3/28/2017	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	6/15/2017	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	9/27/2017	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	Mean (x)	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	SD (σ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	x + σ	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	x + 2*σ (UTL)	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5

APPENDIX B
INTRAWELL UPPER TOLERANCE LIMITS FOR VOLATILE ORGANIC COMPOUNDS

Tolson Rubble Landfill
Crofton, Maryland

Well	Date	1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2,3-Trichloropropane	1,2-Dibromo-3-Chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloropropane	trans-1,4-Dichloro-2-Butene	1,4-Dichlorobenzene	2-Butanone	2-Hexanone	4-Methyl-2-Pentanone	Acetone	Acrylonitrile	Benzene	Bromochloromethane	Bromodichloromethane	Bromoform	Bromomethane
MW-28A	11/8/2016	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	11/15/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	11/22/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	11/29/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	12/16/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	12/27/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	3/28/2017	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	6/15/2017	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	9/27/2017	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	Mean (x)	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	SD (σ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	x + σ	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	x + 2*σ (UTL)	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
MW-29A	11/9/2016	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	11/15/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	11/22/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	11/29/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	12/16/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	12/27/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	3/28/2017	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	6/15/2017	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	9/27/2017	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	Mean (x)	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	SD (σ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	x + σ	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
	x + 2*σ (UTL)	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	3.0	3.0	3.0	6.0	4.0	0.5	1.0	0.5	0.5	0.5
MW-31A	11/8/2016	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	12	3.0	3.0	16.0	4.0	0.5	1.0	0.5	0.5	0.5
	11/14/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	4	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	11/21/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	11/28/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	12/15/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	12/28/2016	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	3/27/2017	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	6/14/2017	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	9/28/2017	0.5	0.5	0.5	0.5	0.5	0.5	1	2	0.5	1	0.5	0.5	15	1	3	3	3	6.0	4	0.5	1	0.5	0.5	0.5
	Mean (x)	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	4.1	3.0	3.0	7.1	4.0	0.5	1.0	0.5	0.5	0.5
	SD (σ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0
	x + σ	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	7.1	3.0	3.0	10.4	4.0	0.5	1.0	0.5	0.5	0.5
	x + 2*σ (UTL)	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	0.5	1.0	0.5	0.5	15.0	1.0	10.1	3.0	3.0	13.8	4.0	0.5	1.0	0.5	0.5	0.5

NOTES:

The upper tolerence limit (UTL) (gray shaded cell) is defined as the mean plus twice the standard deviation established by Environmental Resources Management, Inc.

For non-detect chemicals, the detection limit is used in the statistical analysis.

All conentrations in micrograms per liter.

NS: Not Sampled. Well was not sampled for analyte.

* Methylene Chloride data were not available, statistics were conservatively calculated using the analytical method reporting limits of 1.0

APPENDIX B
INTRAWELL UPPER TOLERANCE LIMITS FOR VOLATILE ORGANIC COMPOUNDS

Tolson Rubble Landfill
Crofton, Maryland

Well	Date	Carbon Disulfide	Carbon Tetrachloride	Chlorobenzene	Dibromochloromethane	Chloroethane	Chloroform	Chloromethane	cis-1,2-Dichloroethene	cis-1,3-Dichloropropene	Dibromomethane	Methylene Chloride*	Methyl Iodide	Methyl-tert-butyl ether	Styrene	Trichloroethene	Tetrachloroethene	Toluene	Ethylbenzene	trans-1,2-Dichloroethene	trans-1,3-Dichloropropene	Trichlorofluoromethane	Vinyl Acetate	Vinyl Chloride	Total Xylenes
	11/8/2016	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	11/15/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	11/22/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	11/29/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
MW-28A	12/16/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	12/27/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	3/28/2017	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	6/15/2017	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	9/27/2017	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	Mean (x)	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	SD (σ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	x + σ	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	x + 2*σ (UTL)	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	11/9/2016	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	11/15/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	11/22/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	11/29/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
MW-29A	12/16/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	12/27/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	3/28/2017	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	6/15/2017	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	9/27/2017	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	Mean (x)	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	SD (σ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	x + σ	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	x + 2*σ (UTL)	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	11/8/2016	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	11/14/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	11/21/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	11/28/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
MW-31A	12/15/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	12/28/2016	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	3/27/2017	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	6/14/2017	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	9/28/2017	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5
	Mean (x)	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	SD (σ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	x + σ	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5
	x + 2*σ (UTL)	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	0.5	0.5

NOTES:

The upper tolerence limit (UTL) (gray shaded cell) is defined as the mean plus twice the standard deviation established by Environmental Resources Management, Inc.

For non-detect chemicals, the detection limit is used in the statistical analysis.

All conentrations in micrograms per liter.

NS: Not Sampled. Well was not sampled for analyte.

* Methylene Chloride data were not available, statistics were conservatively calculated using the analytical method reporting limits of 1.0

APPENDIX B
INTRAWELL UPPER TOLERANCE LIMITS FOR METALS

Tolson Rubble Landfill
Crofton, Maryland

Well	Date	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
	3/25/2010	2	2	34	1.000	4	3,920	16	282	57	1,880	5	2,750	70	0	331	1,550	2	2	3,730	2	10	1,840
	8/30/2010	2	2	40	1.000	4	960	10	130	54	6,700	11	1,580	46	0	138	1,300	2	2	4,170	2	10	805
	2/21/2011	2	2	35	1.000	4	1,360	10	114	10	1,380	2	1,640	42	0	120	1,230	2	2	4,240	2	10	611
	9/15/2011	1	2	35	1.000	4	777	10	122	10	442	2	1,630	45	0	123	1,250	2	2	4,050	2	10	657
	3/6/2012	2	2	47	1.000	4	2,010	10	230	10	11,200	2	2,570	54	0	232	1,670	2	2	4,410	2	10	1,260
MW-4A	9/13/2012	2	2	41.9	1	4	1,230	10	143	10	1,240	2	2,280	58.3	0	139	1,230	2	2	4,330	2	10	798
	3/7/2013	1	2	48.3	1	4	1,300	10	171	10	285	2	2,390	64.6	0	166	1,350	2	2	4,130	2	10	926
	9/23/2013	5	0.57	44	1	1	1,400	0.93	160	1.0	220	0.93	2,300	61	0	150	1,300	1	1	4,400	1	1	780
	3/24/2014	5	1	46	1	1	7,400	0.84	160	2.2	3,900	1.5	3,900	55	0.16	160	1,500	1	1	4,000	1	1	840
	12/16/2014	5	0.63	51	0.68	0.50	1,400	0.78	160	1.4	320	0.53	2,600	65	0	160	1,500	1	1	4,000	1	1	830
	4/27/2015	5	1.4	66	0.53	1	8,000	1.1	300	2.6	13,000	1.1	4,600	100	0	300	1,800	1	1	4,300	0.80	1	1,700
	Mean (x)	2.9	1.6	44.4	0.9	2.9	2,705	7.2	179.3	15.3	3,688	2.7	2,567	60.1	0.2	183.5	1,425	1.6	1.6	4,160	1.6	6.7	1,004.3
	SD (σ)	1.7	0.6	9.2	0.2	1.6	2,611	5.3	63.4	20.3	4,608	3.0	940	16.0	0.0	72.1	193	0.5	0.5	206	0.5	4.5	414.6
	x + σ	4.6	2.2	53.6	1.1	4.4	5,316	12.6	242.7	35.6	8,296	5.7	3,508	76.1	0.2	255.6	1,618	2.1	2.1	4,366	2.2	11.3	1,418.9
	x + 2*σ (UTL)	6.3	2.8	62.8	1.3	6.0	7,927	17.9	306.0	55.8	12,904	8.7	4,448	92.1	0.2	327.7	1,811	2.6	2.6	4,572	2.7	15.8	1,833.5
	3/25/2010	2	5	40	1	4	46,500	10	16	10	50	2	14,600	981	0.20	18	4,410	2	2	3,840	2	10	38
	8/30/2010	2	6	45	1	4	26,800	10	10	10	219,000	2	7,400	623	0.20	10	4,270	2	2	3,050	2	10	29
	2/17/2011	2	8	47	1	4	26,400	10	10	10	262,000	2	8,020	588	0.20	10	4,920	2	2	3,420	2	10	40
	9/13/2011	1	7	37	1	4	38,000	10	10	10	232,000	2	14,700	703	0.20	10	3,520	2	2	3,090	2	10	20
	2/28/2012	2	11	32	1	4	28,200	10	10	10	290,000	2	8,700	566	0.20	10	2,900	2	2	1,950	2	10	37
MW-8A	9/10/2012	2	8.20	34.4	1	4	34,000	10	10	10	245,000	2	10,700	610	0.20	10	3,100	2	2	2,500	2	10	16.0
	3/4/2013	5.7	21.7	39.3	2.9	4.7	44,900	10	10	10	214,000	5.9	15,700	744	0.20	10	3,600	10.3	2.6	4,050	6.1	28.3	33.7
	9/18/2013	5	7.5	44	1	4	61,000	1	10	1	210,000	1	16,000	750	0.20	0.61	4,300	1	1	8,200	1	1	20
	3/24/2014	5	5.5	44	1	4	41,000	1	2.0	1	140,000	1	18,000	760	0.20	1.0	3,300	1	1	4,900	1	1	11
	12/15/2014	5	5.2	41	1	4	28,000	1	16	1.1	210,000	1	11,000	690	0.20	6.2	3,000	0.58	1	2,900	1	1	19
	4/23/2015	5	5.8	39	1	4	36,000	1	11	0.83 J	250,000	1	13,000	810	0.20	4.3	2,900	0.61	1	2,900	1	1	20
	Mean (x)	3.3	8.3	40.2	1.2	4.1	37,345	6.7	10.5	7.3	206,550	2.0	12,529	711.4	0.2	8.2	3,656	2.3	1.7	3,709	2.0	8.4	25.8
	SD (σ)	1.8	4.8	4.6	0.6	0.2	10,626	4.5	3.7	4.3	78,331	1.4	3,581	119.3	0.0	4.9	706	2.7	0.6	1,688	1.4	7.9	10.1
	x + σ	5.1	13.1	44.9	1.7	4.3	47,972	11.3	14.1	11.6	284,881	3.4	16,110	830.7	0.2	13.1	4,363	5.0	2.3	5,397	3.5	16.3	35.8
	x + 2*σ (UTL)	6.9	17.8	49.5	2.3	4.5	58,598	15.8	17.8	16.0	363,213	4.8	19,691	950.0	0.2	18.1	5,069	7.7	2.8	7,085	4.9	24.3	45.9
	3/25/2010	2	2	10	1	4	960	10	10	11	421	3	335	18	0.2	15	552	2	2	1,630	2	10	41
	8/30/2010	2	2	10	1	4	835	10	10	157	319	24	331	10	0.2	10	612	2	2	1,900	2	10	202
	2/17/2011	2	2	10	1	4	821	10	10	19	84	2	320	10	0.2	11	554	2	2	1,810	2	10	32
	9/13/2011	2	2	10	1	4	820	10	10	10	50	2	341	10	0.2	10	582	2	2	1,990	2	10	17
	2/28/2012	2	2	10	1	4	791	10	10	10	50	2	343	10	0.2	10	502	2	2	1,920	2	10	20
MW-8B	9/10/2012	2	2	10	1	4	894	10	10	10	66	2	346	11.1	0.2	10	534	2	2	2,000	2	10	10
	3/4/2013	2	4	10	1	4	690	10	10	10	83	2.2	346	10	0.2	10	500	2.8	2	1,460	2	10	28
	9/18/2013	5	1	4.7	1	1	680	1	7.0	0.85	100	1	320	9.9	0.2	8.1	520	1	1	1,900	1	1	24
	3/24/2014	5	1	5.4	1	1	760	1	7.3	0.99	100	1	320	11	0.2	9.4	520	1	1	1,800	1	1	29
	12/15/2014	5	1	5.8	1	1	710	1	7.1	1.5	100	1	320	12	0.2	8.7	520	1	1	1,900	1	1	32
	4/23/2015	5	1	6.6	1	1	810	1	7.5	1.5	100	0.52	330	11	0.2	8.6	530	1	1	1,800	1	1	34
	Mean (x)	3.1	1.8	8.4	1.0	2.9	797	6.7	9.0	21.1	134	3.7	332	11.2	0.2	10.1	539	1.7	1.6	1,828	1.6	6.7	42.6
	SD (σ)	1.5	0.9	2.2	0.0	1.5	85	4.5	1.4	45.4	120	6.8	11	2.4	0.0	1.8	34	0.6	0.5	160	0.5	4.5	53.6
	x + σ	4.6	2.7	10.7	1.0	4.4	883	11.3	10.4	66.5	254	10.5	343	13.5	0.2	11.9	573	2.3	2.1	1,988	2.1	11.3	96.2
	x + 2*σ (UTL)	6.1	3.6	12.9	1.0	5.9	968	15.8	11.8	112.0	375	17.2	354	15.9	0.2	13.7	607	2.9	2.6	2,148	2.6	15.8	149.7
	11/7/2016	0.48	0.91	44.6	0.67	0.49	36,900	1.8	11	4.1	75	0.48	3,260	171	0.05	12.7	1,330	9.7	1.9	1,850	0.16	1.6	19
	11/14/2016	0.48	0.8	43.1	0.68	0.49	36,900	1.8	10.7	4.1	75	0.35	3,080	58.8	0.05	11.1	1,180	9.7	1.9	1,710	0.16	1.6	17.6
	11/21/2016	0.48	0.68	46.1	0.67	0.49	36,700	1.8	11.9	4.1	75	0.35	3,180	63.2	0.05	13.9	1,220	9.7	1.9	1,680	0.16	1.6	20.7
	11/28/2016	0.48	0.79	44.1	0.86	0.49	38,200	1.8	11.2	4.1	75	0.39	3,250	65.2	0.05	13	1,310	9.7	1.9	1,760	0.16	1.6	22.0
MW-12AR	12/15/2016	0.48	0.68	45.7	0.67	0.49	38,000	1.8	11.1	4.1	75	0.38	3,060	69.0	0.05	12.8	1,120	9.7	1.9	1,660	0.16	1.6	21.9
	12/28/2016	0.48	1.2	49.7	0.67	0.49	42,300	1.8	13.1	4.1	75	0.31	3,460	78.1	0.05	13.8	1,290	9.7	1.9	1,700	0.16	1.6	23.0
	3/27/2017	0.48	1.2	42.9	0.67	0.50	38,400	1.8	14.2	4.1	961	0.69	2,730	81.7	0.05	13.2	1,380	9.7	1.9	1,540	0.16	2.6	26.1
	6/14/2017	0.48	0.68	29.2	0.67	0.49	43,200	1.8	12.9	4.1	75	0.38	2,320	87.9	0.05	12.7	1,190	9.7	1.9	1,480	0.16	1.6	35.0
	9/28/2017	0.45	0.72	24.4	2.0	1.8	31,000	3.3	10.6	4.0	81	0.44	1,980	68.6	0.05	10.5	1,100	9.3	2.4	1,520	0.12	1.6	29.1
	Mean (x)	0.5	0.9	41.1	0.8	0.6	37,956	2.0	11.9	4.1	174	0.4	2,924	82.6	0.1	12.6	1,236	9.7	2.0	1,656	0.2	1.7	23.8
	SD (σ)	0.0	0.2	8.4	0.4	0.4	3,515	0.5	1.3	0.0	295	0.1	488	34.4	0.0	1.1	97	0.1	0.2	121	0.0	0.3	5.4
	x + σ	0.5	1.1	49.5	1.3	1.1	41,470	2.5	13.1	4.1	469	0.5	3,413	117.1	0.1	13.8	1,333	9.8	2.1	1,776	0.2	2.0	29.3
	x + 2*σ (UTL)	0.5	1.3	58.0	1.7	1.5	44,985	3.0	14.4	4.2	764	0.6	3,901	151.5	0.1	14.9	1,430	9.9	2.3	1,897	0.2	2.4	34.7

APPENDIX B
INTRAWELL UPPER TOLERANCE LIMITS FOR METALS

Tolson Rubble Landfill
Crofton, Maryland

Well	Date	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
	3/24/2010	2	2	63	1	4	7,772	10	20	10	473	2	4,660	109	0.2	30	1,760	2	2	2,030	2	10	74
	8/30/2010	2	2	61	1	4	7,870	10	24	10	2,700	2	3,830	64	0.2	27	1,880	2	2	2,130	2	10	52
	2/23/2011	2	2	68	1	4	7,850	10	35	10	977	2	5,080	82	0.2	39	1,950	2	2	2,750	2	10	68
	9/15/2011	1	2	64	1	4	6,550	10	10	10	974	2	4,960	147	0.2	12	1,880	2	2	1,480	2	10	24
	3/6/2012	2	2	82	1	4	8,610	10	28	10	964	2	5,010	101	0.2	32	2,210	2	2	3,190	2	10	61
MW-15A	9/12/2012	2	12.4	1,220	9.70	20	42,600	585	200	561	373,000	159	19,700	1,600	6.10	244	11,100	10	2	3,680	2	367	1,040
	3/7/2013	2	2	64.9	1	4	9,770	10	64.3	10	1,650	2	4,640	102	0.2	83	1,810	2	2	2,400	2	10	122
	9/20/2013	5	1	80	1	0.65	16,000	0.71	28	1.3	230	1	4,700	99	0.59	32	1,700	0.88	1	1,900	1	1	78
	3/26/2014	5	1	72	1	1.0	13,000	0.90	65	1.5	410	1	4,400	120	0.2	75	1,900	1.2	1	3,600	1	0.52	110
	12/16/2014	5	0.50	68	1	0.75	16,000	0.92	31	1.8	580	1	4,800	93	0.28	29	1,700	0.85	1	4,900	1	0.60	72
	4/30/2015	5	1	67	1	1.5	10,000	1	69	1.4	90	1	5,700	130	0.91	75	1,900	0.89	1	2,400	1	1	150
	Mean (x)	3.0	2.5	173.6	1.8	4.4	13,275	59.0	52.2	57.0	34,732	15.9	6,135	240.6	0.8	61.6	2,708	2.3	1.6	2,769	1.6	39.1	168.3
	SD (σ)	1.6	3.3	347.1	2.6	5.4	10,266	174.5	52.9	167.2	112,193	47.5	4,523	451.4	1.8	64.9	2,787	2.6	0.5	994	0.5	108.8	291.2
	x + σ	4.6	5.9	520.7	4.4	9.8	23,540	233.5	105.1	224.2	146,925	63.4	10,657	692.0	2.6	126.5	5,495	4.9	2.1	3,763	2.1	147.9	459.5
	x + 2*σ (UTL)	6.2	9.2	867.8	7.0	15.2	33,806	408.0	158.0	391.4	259,118	110.8	15,180	1,143.5	4.4	191.4	8,282	7.5	2.6	4,757	2.6	256.8	750.7
	3/24/2010	2	2	11	1	4	8,820	10	17	10	71	2	292	41	0.2	22	903	2	2	2,160	2	10	44
	8/30/2010	2	2	14	1	4	10,200	10	16	10	457	2	272	79	0.2	20	945	2	2	2,700	2	10	55
	2/23/2011	2	2	14	1	4	11,500	10	15	10	5	2	320	67	0.2	20	1,180	2	2	2,780	2	10	30
	9/15/2011	1	2	11	1	4	6,510	10	15	10	143	2	207	49	0.2	20	1,180	2	2	2,030	2	10	36
	3/6/2012	2	2	17	1	4	9,100	10	26	10	711	2	405	104	0.2	33	836	2	2	2,470	2	10	50
MW-15B	9/12/2012	2	4.10	36.7	2.10	4	9,920	23.2	72.3	57.2	8,750	10.1	544	165	0.2	101	1,570	2	2	2,100	2	38.9	225
	3/7/2013	2	2	25.5	1	4	9,760	11.2	28.1	17.5	3,670	4.2	428	92.7	0.2	36.5	1,330	2	2	2,030	2	17.2	75.2
	9/24/2013	5	1	11	1	1	6,200	1.3	12	3.1	150	1	370	47	0.2	15	900	1	1	1,900	1	0.88	43
	3/26/2014	5	1	7.4	1	1	3,100	1	9.8	2.7	100	1	270	22	0.2	12	620	1	1	1,600	1	1	23
	12/26/2014	5	1	7.6	1	1	1,900	0.84	11	3.5	110	1	300	27	0.2	14	680	1	1	1,600	1	0.63	38
	4/29/2015	5	1.1	11	1	1	1,800	1.6	13	3.7	540	0.86	310	43	0.2	15	810	1	1	1,600	1	4.4	39
	Mean (x)	3.0	1.8	15.1	1.1	2.9	7,165	8.1	21.4	12.5	1,337	2.6	338	67.0	0.2	28.0	996	1.6	1.6	2,088	1.6	10.3	59.8
	SD (σ)	1.6	0.9	8.7	0.3	1.5	3,510	6.7	17.9	15.5	2,673	2.7	93	41.7	0.0	25.4	288	0.5	0.5	420	0.5	10.8	56.5
	x + σ	4.6	2.7	23.8	1.4	4.4	10,675	14.8	39.2	28.0	4,010	5.2	431	108.7	0.2	53.4	1,284	2.1	2.1	2,508	2.1	21.1	116.3
	x + 2*σ (UTL)	6.2	3.6	32.6	1.8	5.9	14,184	21.5	57.1	43.5	6,683	7.9	524	150.3	0.2	78.8	1,572	2.6	2.6	2,928	2.6	31.9	172.8
	3/24/2010	2	5	99	1	4	60,000	617	28	71	27,300	16	21,000	500	3.1	480	6,200	2	2	14,700	2	27	98
	8/30/2010	2	2	71	1	4	44,100	10	20	10	4,090	2	17,000	371	0.3	13	5,250	4	2	10,800	2	10	23
	2/23/2011	2	2	75	1	4	35,100	10	28	10	4,290	2	14,400	341	0.2	21	5,030	3	2	14,400	2	10	12
	9/14/2011	1	2	85	1	4	39,500	10	39	10	2,380	2	15,500	431	0.2	44	4,640	2	2	14,100	2	10	23
	3/1/2012	2	2	93	1	4	45,500	10	32	10	8,690	2	16,700	373	0.40	45	5,110	2	2	13,800	2	10	23
MW-16A	9/11/2012	2	5.50	91.9	1	4	37,400	77.1	22.3	15.2	34,600	3.40	13,100	266	1.80	86.4	4,350	3.40	2	11,100	2	10	45.9
	3/5/3013	2	2	61.2	1	4	27,000	10	17.1	10	10,100	2	9,720	185	0.43	34.4	3,670	2	2	9,800	2	10	35.7
	9/17/2013	5	0.88	89	1	0.73	55,000	0.72	24	0.69	8,300	1	20,000	380	0.47	37	4,700	1.0	1	16,000	1	1	31
	3/20/2014	5	0.53	79	1	0.58	66,000	0.59	58	1.2	2,800	1	24,000	670	0.33	27	5,400	0.57	1	16,000	0.50	1	27
	12/10/2014	5	0.75	61	1	0.89	34,000	1.0	28	0.67	13,000	1	11,000	300	0.64	25	4,000	1.1	1	8,600	1	1	27
	4/27/2015	5	0.63	57	1	0.64	27,000	1	15	0.87	11,000	1	9,100	170	0.13 J	21	3,800	1.4	1	8,300	1	1	27
	Mean (x)	3.0	2.1	78.4	1.0	2.8	42,782	67.9	28.3	12.7	11,505	3.0	15,593	362.5	0.8	75.8	4,741	2.0	1.6	12,509	1.6	8.3	33.9
	SD (σ)	1.6	1.7	14.5	0.0	1.7	12,915	183.4	12.0	20.0	10,352	4.4	4,774	141.7	0.9	135.5	761	1.1	0.5	2,867	0.6	7.6	22.9
	x + σ	4.6	3.8	92.9	1.0	4.5	55,697	251.3	40.3	32.7	21,856	7.4	20,367	504.2	1.7	211.3	5,502	3.1	2.1	15,376	2.2	15.9	56.8
	x + 2*σ (UTL)	6.2	5.5	107.3	1.0	6.1	68,612	434.7	52.3	52.7	32,208	11.8	25,141	645.9	2.7	346.8	6,262	4.2	2.6	18,243	2.8	23.5	79.7

APPENDIX B
INTRAWELL UPPER TOLERANCE LIMITS FOR METALS

Tolson Rubble Landfill
Crofton, Maryland

Well	Date	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
MW-16B	3/24/2010	2	2	20	1	4	1,930	37	14	43	3,230	5	693	39	0.2	54	1,100	2	2	2,180	2	10	129
	8/30/2010	2	2	16	1	4	1,240	10	16	16	1,040	2	564	34	0.2	25	971	2	2	2,340	2	10	61
	2/23/2011	2	2	10	1	4	1,310	10	13	10	54	2	566	18	0.2	18	780	2	2	2,450	2	10	32
	9/14/2011	1	2	15	1	4	1,180	10	17	10	862	2	581	29	0.2	24	982	2	2	2,420	2	10	41
	3/1/2012	2	2	15	1	4	1,140	10	16	12	1,040	2	616	27	0.2	23	1,050	2	2	2,420	2	10	40
	9/11/2012	2	2	11.7	1	4	1,600	10	15.0	10	316	2	555	28.7	0.2	20.1	721	2	2	2,320	2	10	51.0
	3/5/2013	2	4.5	67	1.7	4	1,260	55.7	18.2	39.2	22,200	19.1	999	77.9	0.2	42.5	2,060	2	2	2,130	2	27.9	83.4
	9/19/2013	5	1	10	1	1	1,000	0.54	14	3.6	180	0.65	500	18	0.2	18	720	1	1	2,300	1	1	38
	3/20/2014	5	1	10	1	1	860	0.88	13	2.6	250	0.89	480	18	0.2	15	740	1	1	2,100	1	1	42
	12/10/2014	5	1	13	1	0.75	1,000	1.5	14	3.9	770	1.2	550	24	0.2	18	800	1	1	2,100	1	1.0	41
	4/27/2015	5	1	12	1	1	1,100	0.92 J	14	3.2	410	1.2	530	19	0.2	16	800	1	1	2,800	1	0.51 J	45
	Mean (x)	3.0	1.9	18.2	1.1	2.9	1,238	14.6	14.9	14.0	2,759	3.5	603	30.2	0.2	24.9	975	1.6	1.6	2,324	1.6	9.1	54.9
	SD (σ)	1.6	1.0	16.5	0.2	1.5	301	17.8	1.7	14.1	6,507	5.3	143	17.3	0.0	12.3	385	0.5	0.5	205	0.5	7.9	28.4
	x + σ	4.6	2.9	34.6	1.3	4.4	1,539	32.4	16.6	28.1	9,266	8.8	746	47.5	0.2	37.1	1,360	2.1	2.1	2,529	2.1	16.9	83.2
	x + 2*σ (UTL)	6.2	3.9	51.1	1.5	6.0	1,839	50.2	18.3	42.2	15,773	14.1	889	64.8	0.2	49.4	1,745	2.6	2.6	2,734	2.6	24.8	111.6
MW-17A	3/25/2010	2	2	29	1	4	2,370	11	10	10	2,180	2	2,750	15	0.2	16	1,420	2	2	5,340	2	10	33
	8/30/2010	2	2	29	1	4	2,140	10	10	41	2,260	22	2,720	12	0.2	10	1,510	2	2	6,380	2	10	63
	2/21/2011	2	2	30	1	4	2,180	10	10	10	698	2	2,910	11	0.2	10	1,540	2	2	6,820	2	10	10
	9/13/2011	1	2	40	1	4	2,430	10	10	10	3,430	2	3,260	14	0.2	10	1,830	2	2	7,420	2	10	16
	3/1/2012	2	2	36	1	4	2,600	10	10	10	1,270	2	3,440	11	0.2	10	1,850	2	2	8,170	2	10	10
	9/11/2012	2	2	10	1	4	500	10	10	10	120	2	10	10	0.2	10	500	2	2	500	2	10	10
	3/5/2013	2	2	30.7	1	4	2,100	10	10	10	2,440	2	2,930	11.1	0.2	10	1,600	2	2	6,790	2	10	24.5
	9/19/2013	5	1	30	1	1	2,400	0.67	6.7	6.7	300	1	3,000	9.7	0.2	7.7	1,600	1	1	7,600	1	1	31
	3/20/2014	5	1	31	1	1	2,100	0.84	6.9	6.9	300	1	3,000	7.5	0.2	7.5	1,500	1	1	7,400	1	0.75	22
	12/10/2014	5	1	32	1	0.51	2,300	0.54	5.8	5.8	270	1	3,000	9.3	0.2	6.5	1,600	1	1	8,000	1	1	17
	4/23/2015	5	1	35	1	1	2,700	1	7.9	2.0	160	1	3,600	11	0.2	8.3	1,800	1	1	8,900	1	1	21
	Mean (x)	3.0	1.6	30.2	1.0	2.9	2,165	6.7	8.8	11.1	1,221	1.6	2,784	11.1	0.2	9.6	1,523	1.6	1.6	7,282	1.6	6.7	23.4
	SD (σ)	1.6	0.5	7.5	0.0	1.6	587	4.7	1.7	10.2	1,165	0.5	959	2.1	0.0	2.5	368	0.5	0.5	1,005	0.5	4.6	15.4
	x + σ	4.6	2.1	37.8	1.0	4.4	2,752	11.5	10.5	21.4	2,386	2.1	3,743	13.1	0.2	12.1	1,891	2.1	2.1	8,287	2.1	11.3	38.8
	x + 2*σ (UTL)	6.2	2.6	45.3	1.0	6.0	3,339	16.2	12.2	31.6	3,551	2.6	4,702	15.2	0.2	14.6	2,259	2.6	2.6	9,293	2.6	15.9	54.1
MW-17B	3/25/2010	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	8/30/2010	2	2	44	1	4	13,700	10	20	20	87	2	543	33	0.2	27	2,030	2	2	5,720	2	10	59
	2/21/2011	2	2	37	1	4	9,960	10	31	10	5	2	537	34	0.2	41	947	2	2	2,900	2	10	85
	9/12/2011	1	2	30	1	4	7,510	10	32	22	160	2	553	28	0.2	43	1,110	2	2	2,900	2	10	90
	3/1/2012	2	2	33	1	4	9,490	10	34	13	50	2	537	25	0.2	45	992	2	2	2,740	2	10	78
	9/11/2012	2	2	27.5	1	4	7,760	10	32.1	12.8	59	2	465	21.1	0.2	42.1	793	2	2	2,500	2	10	86.1
	3/5/2013	2	2	26.4	1	4	8,770	10	30.3	11.6	50	2	467	18.7	0.2	41.1	835	2	2	2,490	2	10	78.7
	9/19/2013	5	1	28	0.51	1	7,700	1	33	15	100	0.65	450	18	0.2	43	820	1	1	2,600	1	1	75
	3/20/2014	5	1	29	1	1	11,000	1	30	12	100	1	410	17	0.2	36	760	1	1	2,100	1	1	72
	12/11/2014	5	1	25	1	1	8,000	1	26	12	100	1	370	12	0.2	32	710	1	1	2,100	1	1	56
	4/28/2015	5	1.5	15	1	1	1,500	3.1	16	22	890	3.2	380	12	0.2	20	970	1	1	2,000	1	6.0	45
	Mean (x)	3.1	1.7	29.5	1.0	2.8	8,539	6.6	28.4	15.0	160	1.8	471	21.9	0.2	37.0	997	1.6	1.6	2,805	1.6	6.9	72.5
	SD (σ)	1.7	0.5	7.6	0.2	1.5	3,125	4.4	6.0	4.6	260	0.7	69	7.9	0.0	8.2	383	0.5	0.5	1,075	0.5	4.3	14.7
	x + σ	4.8	2.1	37.1	1.1	4.3	11,664	11.0	34.4	19.6	420	2.5	541	29.8	0.2	45.3	1,380	2.1	2.1	3,880	2.1	11.2	87.1
	x + 2*σ (UTL)	6.4	2.6	44.8	1.3	5.9	14,789	15.4	40.4	24.1	680	3.2	610	37.7	0.2	53.5	1,763	2.6	2.6	4,955	2.6	15.4	101.8

APPENDIX B
INTRAWELL UPPER TOLERANCE LIMITS FOR METALS

Tolson Rubble Landfill
Crofton, Maryland

Well	Date	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
MW-21A	3/25/2010	2	2	46	1	4	33,800	11	10	10	9,680	2	8,070	172	0.2	16	2,430	2	2	11,500	2	10	29
	8/30/2010	2	4	63	1	4	42,900	10	10	10	18,700	2	10,900	227	0.2	10	3,170	2	2	25,800	2	10	19
	2/17/2011	2	3	63	1	4	46,600	10	10	10	18,500	2	11,700	217	0.2	10	3,500	2	2	34,100	2	10	18
	9/14/2011	1	6	99	1	4	66,600	10	15	45	24,600	9	16,500	300	0.2	12	4,620	2	2	81,700	2	10	178
	3/5/2012	2	4	99	1	4	74,100	10	12	38	25,200	2	19,200	327	0.2	46	5,060	2	2	90,600	2	10	17
	9/10/2012	2	4.0	150	1	4	120,000	10	22.3	8.4	30,800	2.2	28,500	593	0.2	16.9	6,160	2	2	238,000	2	10	38.6
	3/4/2013	2.4	8.7	97.1	1.2	4	115,000	10	27.2	10	43,900	2.9	26,900	573	0.2	18.3	6,250	2	2	283,000	2.3	12.7	34.4
	5/16/2013	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	2	NS	NS
	9/18/2013	5	3.1	51	1	1	83,000	1	17	3.4	46,000	0.72	19,000	360	0.2	6.2	3,400	1	1	120,000	1	1	16
	3/19/2014	5	2.4	50	1	1	68,000	1	15	1.0	32,000	1	17,000	280	0.2	6.7	3,500	1	1	87,000	1	1	16
	12/15/2014	5	2.5	46	1	1	26,000	1	6.2	6.9	25,000	1.5	6,500	140	0.2	3.0	2,000	1	1	26,000	1	1	20
	4/29/2015	5	1.9	46	1	1	26,000	1	6.6	1.3	21,000	1	6,400	160	0.2	1.9	2,400	1	1	24,000	1	1	13
	Mean (x)	3.0	3.8	73.6	1.0	2.9	63,818	6.8	13.8	13.1	26,853	2.4	15,515	317.7	0.2	13.4	3,863	1.6	1.6	92,882	1.7	7.0	36.3
	SD (σ)	1.6	2.0	33.6	0.1	1.5	32,818	4.6	6.5	14.5	10,844	2.3	7,634	156.1	0.0	12.1	1,470	0.5	0.5	90,499	0.5	4.8	47.7
	x + σ	4.6	5.8	107.2	1.1	4.4	96,636	11.4	20.2	27.6	37,697	4.7	23,149	473.8	0.2	25.5	5,333	2.1	2.1	183,381	2.2	11.8	84.0
	x + 2*σ (UTL)	6.2	7.8	140.7	1.1	5.9	129,455	16.1	26.7	42.2	48,541	7.0	30,783	630.0	0.2	37.6	6,802	2.6	2.6	273,880	2.7	16.6	131.7
MW-21B	3/25/2010	2	2	43	2	4	7,710	12	16	19	3,070	2	3,090	354	0.2	211	2,020	2	2	7,580	2	10	297
	8/30/2010	2	2	48	1	4	7,540	10	13	50	2,870	13	3,070	367	0.2	140	2,070	2	2	7,840	2	10	299
	2/16/2011	2	2	42	1	4	5,380	10	10	10	11,100	2	2,650	300	0.2	45	1,930	2	2	6,130	2	10	163
	9/14/2011	1	6	282	13	4	14,400	1,410	79	382	120,000	74	5,620	524	0.2	1,470	4,530	2	2	6,290	2	117	609
	3/5/2012	2	2	54	1	4	5,020	14	10	25	18,000	4	2,780	297	0.2	26	2,180	2	2	5,250	2	10	141
	9/10/2012	2	2	43.4	1	4	3,700	10	10	10	14,300	2	2,420	282	0.2	18.4	1,750	2	2	4,870	2	10	152
	3/4/2013	2.1	5.1	42.4	1.8	4	4,000	10	10	10	12,100	2.8	2,500	275	0.2	22.8	1,990	2	2	4,660	2.00	11.9	159
	9/18/2013	5	1	42	1.3	2.6	5,800	2.2	6.4	12	620	1.2	2,700	280	0.2	32	1,900	1	1	5,700	1	1	190
	3/19/2014	5	1	42	0.97	2.0	4,000	0.68	5.0	8.1	6,100	1.0	2,400	250	0.2	21	1,800	1	1	4,400	1	1	170
	12/15/2014	5	1	42	0.99	3.0	4,600	2.3	5.5	9.5	3,000	1.1	2,400	290	0.2	25	1,800	1	1	4,700	1	1	190
	5/28/2015	5	1	49	0.93	1.0	8,000	0.66	20	35	350	0.56	3,200	250	0.2	25	1,900	1	1	4,400	1	1	240
	Mean (x)	3.0	2.3	66.3	2.3	3.3	6,377	134.7	16.8	51.9	17,410	9.4	2,985	315.4	0.2	185.1	2,170	1.6	1.6	5,620	1.6	16.6	237.3
	SD (σ)	1.6	1.7	71.6	3.6	1.0	3,081	423.0	21.1	110.3	34,537	21.7	921	78.4	0.0	430.6	793	0.5	0.5	1,222	0.5	33.6	135.2
	x + σ	4.6	4.0	138.0	5.8	4.4	9,458	557.7	37.9	162.2	51,947	31.1	3,906	393.7	0.2	615.7	2,963	2.1	2.1	6,842	2.1	50.2	372.5
	x + 2*σ (UTL)	6.2	5.7	209.6	9.4	5.4	12,539	980.7	59.0	272.5	86,485	52.8	4,827	472.1	0.2	1,046.4	3,756	2.6	2.6	8,064	2.6	83.8	507.6
MW-23A	11/7/2016	0.48	0.68	66.9	0.67	1.5	8,420	1.8	33.9	4.1	191	0.41	4,290	97.9	0.05	34.9	2,500	9.7	1.9	7,660	0.16	1.6	24.1
	11/15/2016	0.48	0.68	62.3	0.67	2.0	6,650	1.8	34.0	4.1	75	0.40	4,070	72.9	0.05	35.6	2,210	9.7	1.9	7,230	0.16	1.6	23.8
	11/21/2016	0.48	0.68	85.5	1	1.5	6,070	1.8	35.0	4	75	0.39	4,160	68.9	0.05	35.3	2,310	9.7	1.9	7,530	0.16	1.6	25.0
	11/28/2016	0.48	0.68	61.7	0.88	1.5	5,510	1.8	32.6	8.1	75	0.36	4,070	59.2	0.05	214	2,330	9.7	1.9	7,190	0.16	1.6	25.8
	12/15/2016	0.48	0.68	57.8	0.67	1.4	4,940	1.8	31.3	4.1	75	0.32	4,000	56.2	0.05	32.5	2,150	9.7	1.9	6,940	0.16	1.6	22.4
	12/27/2016	0.48	0.68	53.8	0.67	1.2	4,680	1.8	29.0	4.1	75	0.30	3,800	49.7	0.05	30.4	2,100	9.7	1.9	6,710	0.16	1.6	20.7
	3/27/2017	0.48	0.68	54.4	0.67	1.4	4,480	1.8	31.8	4.1	75	0.36	4,110	48.1	0.05	31.4	2,190	9.7	1.9	6,820	0.16	1.6	23.3
	6/14/2017	0.48	0.68	66.7	0.67	1.3	5,740	1.8	30.5	4.1	75	0.36	5,020	49.5	0.05	31.0	2,630	9.7	1.9	11,400	0.16	1.6	25.2
	9/28/2017	0.45	0.72	51.7	2.0	1.8	4,550	3.3	29.1	4.0	91	0.44	4,270	43.6	0.05	28.4	2,190	9.3	2.4	6,630	0.12	1.6	29.1
	Mean (x)	0.48	0.68	62.3	0.8	1.5	5,671	2.0	31.9	4.5	89	0.4	4,199	60.7	0.05	52.6	2,290	9.7	2.0	7,568	0.2	1.6	24.4
	SD (σ)	0.01	0.01	10.3	0.4	0.2	1,270	0.5	2.2	1.3	38	0.0	341	17.0	0.00	60.6	175	0.1	0.2	1,480	0.0	0.0	2.4
	x + σ	0.49	0.70	72.6	1.3	1.8	6,941	2.5	34.1	5.9	128	0.4	4,540	77.7	0.05	113.2	2,465	9.8	2.1	9,048	0.2	1.6	26.7
	x + 2*σ (UTL)	0.50	0.71	82.9	1.7	2.0	8,210	3.0	36.2	7.2	166	0.5	4,880	94.7	0.05	173.8	2,639	9.9	2.3	10,528	0.2	1.6	29.1
MW-26A	11/9/2016	0.48	4.4	49.5	0.67	2.9	42,700	1.8	81.6	4.1	6,760	2.1	13,500	471	0.05	96.8	3,020	9.7	1.9	6,630	0.16	1.6	128
	11/14/2016	0.48	3.9	47.1	0.89	4.3	38,500	1.8	95.6	6.6	5,420	2.1	13,400	449	0.05	114	3,100	9.7	1.9	6,770	0.16	1.6	153
	11/21/2016	0.48	3.4	84.8	0.67	5.4	34,100	3.2	109	13.9	4,760	2.1	13,900	455	0.05	128	3,190	9.7	1.9	7,150	0.16	1.6	167
	11/28/2016	0.48	3.4	43.3	1.1	6.8	31,200	1.8	101	14.7	4,420	2.4	13,600	413	0.05	127	3,310	9.7	1.9	7,020	0.16	1.6	143
	12/16/2016	0.48	3.5	47.5	0.67	10.5	28,300	1.9	108	19.9	4,220	4.2	12,600	420	0.071	126	3,010	9.7	1.9	6,820	0.19	1.6	153
	12/28/2016	0.48	5.5	43.7	0.67	7.6	27,000	1.8	107	17.1	3,310	3.2	12,600	403	0.33	123	3,060	9.7	1.9	7,210	0.23	1.8	129
	3/29/2017	0.48	3.6	42.8	0.67	10.1	25,000	1.8	124	19.6	3,500	2.3	13,200	415	0.17	136	3,070	9.7	1.9	7,350	0.25	1.6	161
	6/16/2017	0.48	3.5	41.6	0.67	9.2	23,600	1.8	116	20.9	2,730	1.9	11,800	381	0.48	130	2,900	9.7	1.9	7,520	0.28	1.6	149
	9/27/2017	0.45	3.5	44.1	2.0	9.9	22,900	3.3	124.0	53.8	2,170	2.7	13,200	390	0.39	140	2,910	9.3	2.4	7,350	0.24	1.6	172
	Mean (x)	0.48	3.9	49.4	0.9	7.4	30,367	2.1	107.4	19.0	4,143	2.6	13,089	421.9	0.18	124.5	3,063	9.7	2.0	7,091	0.2	1.6	150.6
	SD (σ)	0.01	0.7	13.5	0.4	2.8	6,881	0.6	13.6	14.3	1,412	0.7	647	30.5	0.17	12.8	129	0.1	0.2	302	0.0	0.1	15.3
	x + σ	0.49	4.6	62.9	1.3	10.2	37,248	2.8	120.9	33.3	5,555	3.3	13,736	452.3	0.35	137.3	3,192	9.8	2.1	7,393	0.3	1.7	165.9
	x + 2*σ (UTL)	0.50	5.2	76.4	1.8	12.9	44,130	3.4	134.5	47.6	6,966	4.0	14,383	482.8	0.53	150.1	3,321	9.9	2.3	7,695	0.3	1.8	181.2

APPENDIX B
INTRAWELL UPPER TOLERANCE LIMITS FOR METALS

Tolson Rubble Landfill
Crofton, Maryland

Well	Date	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
MW-27A	11/8/2016	0.48	0.68	53	0.67	0.62	14,600	2.3	15.2	4.1	191	0.65	4,350	106	0.78	20.9	2,950	9.7	1.9	4,980	0.31	1.6	28.1
	11/15/2016	0.48	3	43.7	0.67	0.87	9,600	1.8	16.3	4.1	192	1.3	3,560	92.3	0.59	21.7	2,070	9.7	1.9	4,460	0.33	1.6	29.0
	11/22/2016	0.48	0.68	52.5	0.67	0.71	8,940	1.8	16	4.9	75	0.72	3,730	95.8	0.58	21.7	2,190	9.7	1.9	4,710	0.28	1.6	29.7
	11/28/2016	0.48	0.68	41.4	0.73	0.72	9,150	1.8	14.6	4.1	102	0.38	3,930	92.1	0.48	22.3	2,340	9.7	1.9	5,030	0.30	1.6	28.9
	12/16/2016	0.48	0.68	46.7	0.67	0.78	9,120	1.8	16.5	4.1	148	0.48	3,870	94.0	0.69	22.6	2,580	9.7	1.9	5,170	0.28	1.6	33.6
	12/27/2016	0.48	0.68	43.5	0.67	0.41	8,620	1.8	16.8	4.1	78	0.35	3,760	87.4	0.55	21.5	2,280	9.7	1.9	5,260	0.31	1.6	27.0
	3/28/2017	0.48	0.68	49.7	0.67	0.68	9,790	1.9	20.3	4.4	184	0.41	4,350	89.1	1.80	26.0	2,400	9.7	1.9	5,820	0.35	1.6	37.3
	6/15/2017	0.48	0.68	52.3	0.67	0.82	10,700	1.8	20.1	4.1	75	0.46	4,600	83.5	1.20	26.4	2,620	9.7	1.9	6,810	0.36	1.6	39.7
	9/272017	0.45	0.72	46.8	2.0	1.8	9,970	3.3	20.9	4.0	3,830	0.40	4,590	86.9	0.36	29.1	2,230	9.3	2.4	4,750	3.30	1.6	46.2
	Mean (x)	0.48	0.9	47.7	0.8	0.8	10,054	2.0	17.4	4.2	542	0.6	4,082	91.9	0.8	23.6	2,407	9.7	2.0	5,221	0.6	1.6	33.3
	SD (σ)	0.01	0.8	4.4	0.4	0.4	1,815	0.5	2.4	0.3	1,234	0.3	393	6.5	0.5	2.9	270	0.1	0.2	711	1.0	0.0	6.5
	x + σ	0.49	1.7	52.1	1.3	1.2	11,869	2.5	19.8	4.5	1,776	0.9	4,476	98.4	1.23	26.4	2,677	9.8	2.1	5,932	1.6	1.6	39.8
	x + 2*σ (UTL)	0.50	2.5	56.4	1.7	1.6	13,684	3.0	22.2	4.8	3,010	1.2	4,869	105.0	1.68	29.3	2,946	9.9	2.3	6,643	2.6	1.6	46.3
MW-28A	11/7/2016	0.48	0.68	42	0.67	0.49	11,200	1.8	12.8	4.1	353	0.36	3,890	63.7	0.20	18.1	2,350	9.7	1.9	4,220	0.30	1.6	25.2
	11/15/2016	0.48	0.68	39.2	0.67	0.54	9,780	1.8	13.3	4.1	331	0.29	3,560	60.3	0.13	18.2	2,140	9.7	1.9	3,900	0.31	1.6	24.3
	11/22/2016	0.48	0.68	55.3	0.67	0.49	9,890	1.8	12.9	4.1	273	0.25	3,830	65.9	0.23	17.8	2,300	9.7	1.9	4,260	0.31	1.6	26.0
	11/29/2016	0.48	0.68	37.1	0.77	0.49	9,290	1.8	12.4	4.1	336	0.20	3,670	59.0	0.14	17.4	2,310	9.7	1.9	4,140	0.33	1.6	24.2
	12/16/2016	0.48	0.68	40.4	0.67	0.49	9,250	1.8	11.9	4.1	156	0.20	3,580	59.6	0.24	17.2	2,210	9.7	1.9	4,020	0.29	1.6	24.4
	12/27/2016	0.48	0.68	38.0	0.67	0.49	8,850	1.8	11.8	4.1	133	0.21	3,440	56.1	0.22	16.7	2,320	9.7	1.9	4,040	0.32	1.6	22.7
	3/28/2017	0.48	0.68	42.4	0.67	0.49	9,650	1.8	12.4	4.1	75	0.27	3,670	52.5	0.81	17.1	2,240	9.7	1.9	4,370	0.40	1.6	25.3
	6/15/2017	0.48	0.68	42.4	0.67	0.76	10,500	1.8	11.7	4.1	75	0.19	3,750	48.2	1.80	15.1	2,520	9.7	1.9	4,250	0.35	1.6	22.7
	9/27/2017	0.45	0.72	43.2	2.0	1.8	10,500	3.3	12.4	4.0	81	0.38	4,190	53.8	0.20	16.6	2,510	9.3	2.4	4,290	0.38	1.6	30.1
	Mean (x)	0.48	0.68	42.2	0.83	0.67	9,879	2.0	12.4	4.1	201	0.3	3,731	57.7	0.44	17.1	2,322	9.7	2.0	4,166	0.3	1.6	25.0
	SD (σ)	0.01	0.01	5.3	0.44	0.43	740	0.5	0.5	0.0	121	0.1	221	5.6	0.55	0.9	127	0.1	0.2	152	0.0	0.0	2.2
	x + σ	0.49	0.70	47.6	1.27	1.10	10,619	2.5	12.9	4.1	322	0.3	3,952	63.3	0.99	18.1	2,449	9.8	2.1	4,317	0.4	1.6	27.2
	x + 2*σ (UTL)	0.50	0.71	52.9	1.71	1.54	11,359	3.0	13.5	4.2	443	0.4	4,173	68.9	1.54	19.0	2,576	9.9	2.3	4,469	0.4	1.6	29.4
MW-29A	11/9/2016	0.48	3.1	21.7	0.67	0.49	31,000	1.8	7.7	4.1	75,500	0.09	8,490	285	0.05	2.8	2,090	9.7	1.9	7,370	0.16	1.6	5.4
	11/15/2016	0.48	2.7	19.1	0.67	0.49	30,000	1.8	6.1	4.1	72,200	0.11	7,880	263	0.05	2.8	1,880	9.7	6.1	6,630	0.16	1.7	5.4
	11/22/2016	0.48	2.5	21.3	0.67	0.65	28,900	1.8	3.8	4.1	71,400	0.11	8,140	263	0.05	2.8	2,040	9.7	1.9	7,260	0.16	1.6	5.4
	11/29/2016	0.48	3.1	17.2	0.67	0.49	30,900	1.8	3.6	4.1	78,800	0.09	8,540	268	0.05	2.8	2,210	9.7	1.9	6,910	0.16	1.6	5.4
	12/16/2016	0.48	3.6	18.0	0.67	0.49	30,500	1.8	2.9	4.1	79,900	0.18	8,420	272	0.05	2.8	2,080	18.4	2.0	6,670	0.16	1.6	5.4
	12/27/2016	0.48	3.1	16.8	0.67	1.8	29,900	1.8	4.0	4.1	76,900	0.09	8,270	254	0.05	2.8	2,050	9.7	1.9	6,550	0.16	1.6	5.4
	3/28/2017	0.48	3.1	16.7	0.67	0.49	29,600	1.8	4.3	4.1	67,300	0.09	7,850	241	0.05	2.8	1,970	9.7	1.9	5,910	0.16	1.6	5.4
	6/15/2017	0.48	2.3	13.4	0.67	1.1	26,700	1.8	1.9	4.1	55,300	0.09	6,370	186	0.05	2.8	1,960	9.7	1.9	4,770	0.16	1.6	5.4
	9/272017	0.45	3.4	13.7	2.0	1.8	23,500	3.3	2.5	4.0	52,100	0.11	5,820	189	0.05	4.0	1,880	9.3	2.4	4,640	0.12	1.6	6.5
	Mean (x)	0.48	3.0	17.5	0.82	0.87	29,000	2.0	4.1	4.1	69,933	0.1	7,753	246.8	0.05	2.9	2,018	10.6	2.4	6,301	0.2	1.6	5.5
	SD (σ)	0.01	0.4	2.9	0.44	0.56	2,439	0.5	1.8	0.0	10,024	0.0	981	35.7	0.00	0.4	107	2.9	1.4	1,000	0.0	0.0	0.4
	x + σ	0.49	3.4	20.4	1.26	1.43	31,439	2.5	5.9	4.1	79,957	0.1	8,734	282.5	0.05	3.3	2,125	13.5	3.8	7,301	0.2	1.6	5.9
	x + 2*σ (UTL)	0.50	3.8	23.3	1.70	2.00	33,877	3.0	7.7	4.2	89,982	0.2	9,715	318.2	0.05	3.7	2,231	16.5	5.2	8,301	0.2	1.7	6.3
MW-31A	11/8/2016	0.48	2.2	20.5	0.67	3.7	6,360	3.6	28.9	4.1	1,310	0.53	3,340	87.6	0.87	35	1,260	9.7	1.9	3,740	0.16	1.6	97.9
	11/14/2016	0.48	2.2	15.9	1.1	3.4	5,750	2.1	26.6	4.6	771	0.33	3,200	72.9	0.88	30.6	1,220	9.7	1.9	3,470	0.16	1.6	85.3
	11/21/2016	0.48	1.6	16.0	0.89	3.2	5,960	3.2	27.9	5.6	587	0.35	3,440	78.7	1.1	32.2	1,260	9.7	1.9	3,560	0.16	1.6	93.8
	11/28/2016	0.48	1.9	13.7	1.2	3.2	6,590	1.8	26.5	5.6	534	0.30	3,910	78.9	0.87	32.4	1,360	9.7	1.9	3,700	0.16	1.6	82.9
	12/15/2016	0.48	1.5	14.1	0.67	3.1	6,770	1.8	32.1	4.1	239	0.25	4,110	97.0	1.4	36.1	1,190	9.7	1.9	3,740	0.21	1.6	81.8
	12/28/2016	0.48	2.3	13.9	0.67	2.9	7,910	1.8	37.8	4.1	156	0.23	4,920	124	1.20	42.9	1,250	9.7	1.9	3,880	0.26	1.6	81.2
	3/27/2017	0.48	2.5	24.3	0.67	6.7	10,700	2.0	94.1	7.4	157	0.50	6,580	253	1.7	109	1,830	9.7	1.9	3,870	0.43	1.6	225
	6/14/2017	0.48	4.5	17.3	0.67	6.4	8,150	1.8	66.2	6.4	75	0.42	5,000	162	2.3	75.2	1,590	9.7	1.9	3,750	0.40	1.6	193
	9/28/2017	0.45	9.5	32.8	2.0	12.1	15,000	1.7	150	8.1	81	0.67	10,000	395	1.4	169	1,940	9.3	2.4	3,660	0.62	1.6	433
	Mean (x)	0.48	3.1	18.7	0.9	5.0	8,132	2.2	54.5	5.6	434	0.4	4,944	149.9	1.30	62.5	1,433	9.7	2.0	3,708	0.3	1.6	152.7
	SD (σ)	0.01	2.5	6.3	0.4	3.0	2,991	0.7	42.6	1.5	412	0.1	2,176	108.5	0.47	47.9	283	0.1	0.2	133	0.2	0.0	118.0
	x + σ	0.49	5.7	25.0	1.4	8.0	11,123	2.9	97.1	7.0	847	0.5	7,121	258.4	1.77	110.4	1,717	9.8	2.1	3,840	0.4	1.6	270.7
	x + 2*σ (UTL)	0.50	8.2	31.4	1.8	11.0	14,115	3.6	139.7	8.5	1,259	0.7	9,297	367.0	2.24	158.3	2,000	9.9	2.3	3,973	0.6	1.6	388.7

NOTES:

The upper tolerence limit (UTL) (gray shaded cell) is defined as the mean plus twice the standard deviation established by Environmental Resources Management

For non-detect chemicals, the detection limit is used in the statistical analysis.

All conentrations in micrograms per liter

J Value is an estimated concentration below the Limit of Quantitation (LOQ) but above the Method Detection Limit (MDL).

NS: Not Sampled. Well was not sampled for analyte.

APPENDIX B
INTRAWELL UPPER TOLERANCE LIMITS FOR GENERAL CHEMISTRY

Tolson Rubble Landfill
Crofton, Maryland

Well	Date	Alkalinity (mg/l)	Ammonia, Nitrogen (mg/l)	Chloride (mg/l)	COD (mg/l)	Hardness (mg/l)	Specific Conductivity (µS/cm)	Nitrate, Nitrogen (mg/l)	Sulfate (mg/l)	Total Dissolved Solids (mg/l)	Turbity (NTU)
MW-4A	3/25/2010	1.0	0.20	3.97	10	21.1	487	0.97	265.0	156	61
	8/30/2010	1.0	0.20	4.59	10	8.9	229	0.06	51.6	83	77
	2/21/2011	1.0	0.20	4.45	10	10.2	232	0.06	53.9	80	7.0
	9/15/2011	1.0	0.20	5.01	10	8.6	180	0.06	39.2	70	420
	3/6/2012	1.0	0.20	5.31	18	15.6	369	0.06	97.6	107	3.8
	9/13/2012	1.0	0.20	4.58	10	12.5	225.7	0.05	64.1	85.0	1.24
	3/7/2013	1.0	0.20	4.8	10	13.1	251.7	0.05	58.5	65.0	2.29
	9/23/2013	10.0	0.20	5.00	5	13	230	0.14	89	70	1.5
	3/24/2014	10.0	0.20	5.1	5	35	300	0.34	95	140	0.87
	12/16/2014	10.0	0.20	5.5	5	14	200	0.10	83	120	6.3
	4/27/2015	10.0	0.2	5	7.0	39	32	0.14	5.0	200	2.8
	Mean (x)	4.3	0.2	4.8	9.1	17.4	248.8	0.2	82.0	106.9	53.1
	SD (σ)	4.5	0.0	0.4	3.7	10.3	113.8	0.3	66.6	43.1	124.6
	x + σ	8.8	0.2	5.3	12.8	27.7	362.6	0.5	148.5	150.0	177.6
	x + 2*σ (UTL)	13.4	0.2	5.7	16.5	38.0	476.4	0.7	215.1	193.2	302.2
MW-8A	3/25/2010	226	1.72	6.76	54	176	461	0.06	6.4	450	300
	8/30/2010	183	2.06	3.19	105	97.4	707	0.16	36.4	225	250
	2/17/2011	269	3.99	5.99	61	98.9	712	0.06	1.22	485	310
	9/13/2011	135	2.54	10.2	57	155	495	0.73	22.7	468	360
	2/28/2012	310	2.39	3.15	61	106	645	0.06	9.54	443	250
	9/10/2012	388	3.84	1.00	54.6	129	547	0.05	3.97	470	855
	3/4/2013	174	1.99	9.45	50.1	177	898	0.05	4.2	425	300
	9/18/2013	180	1.8	13	54	220	760	0.10	51	400	490
	3/24/2014	70	0.82	9.2	31	180	500	1.80	130	490	170
	12/15/2014	240	1.4	5.00	49	120	760	0.10	24	470	100
	4/23/2015	380	2.1	5.4	56	140	780	0.10	10	470	530
	Mean (x)	232.3	2.2	6.6	57.5	145.4	660.5	0.3	27.2	436.0	355.9
	SD (σ)	99.0	1.0	3.6	17.7	39.7	141.9	0.5	37.5	74.8	206.9
	x + σ	331.2	3.2	10.2	75.3	185.1	802.4	0.8	64.7	510.8	562.8
	x + 2*σ (UTL)	430.2	4.1	13.7	93.0	224.8	944.3	1.4	102.1	585.7	769.8
MW-8B	3/25/2010	1.0	0.20	2.25	10	3.8	36	0.62	10.10	10	3.1
	8/30/2010	2.3	0.20	2.50	10	3.4	34.0	0.64	6.31	25	5.8
	2/17/2011	1.0	0.20	2.76	10	3.4	29.0	0.71	8.24	16	0.79
	9/13/2011	1.0	0.20	2.77	10	3.4	38.0	0.80	3.63	39	0.31
	2/28/2012	1.0	0.20	2.64	10	3.4	36	0.77	9.34	26	0.69
	9/10/2012	1.0	0.20	2.79	10	3.66	34.9	0.791	6.31	35.0	1.14
	3/4/2013	1.0	0.20	2.78	10	3.15	38.9	0.768	5.81	33.0	0.317
	9/18/2013	10.0	0.20	5.00	5	3.0	40	0.35	7.7	24	0.29
	3/24/2014	10.0	0.20	5.00	5	3.2	40	0.65	5.0	43	1.9
	12/15/2014	10.0	0.20	5.00	5	3.1	51	0.30	5.0	53	0.83
	4/23/2015	10.0	0.2	5	5	3.4	37	0.29	6.4	21	0.53
	Mean (x)	4.4	0.2	3.5	8.2	3.4	37.7	0.6	6.7	29.5	1.4
	SD (σ)	4.5	0.0	1.2	2.5	0.2	5.4	0.2	2.0	12.5	1.7
	x + σ	8.9	0.2	4.7	10.7	3.6	43.1	0.8	8.7	42.1	3.1
	x + 2*σ (UTL)	13.3	0.2	5.9	13.2	3.8	48.5	1.0	10.6	54.6	4.8

APPENDIX B
INTRAWELL UPPER TOLERANCE LIMITS FOR GENERAL CHEMISTRY

Tolson Rubble Landfill
Crofton, Maryland

Well	Date	Alkalinity (mg/l)	Ammonia, Nitrogen (mg/l)	Chloride (mg/l)	COD (mg/l)	Hardness (mg/l)	Specific Conductivity (µS/cm)	Nitrate, Nitrogen (mg/l)	Sulfate (mg/l)	Total Dissolved Solids (mg/l)	Turbity (NTU)
MW-12AR	11/7/2016	2.5	0.20	3.8	2.6	106	245	0.16	102	163	0.27
	11/14/2016	1.7	0.20	3.50	2.6	105	247	0.14	105	172	1.7
	11/21/2016	1.7	0.20	4.0	2.6	105	256	0.12	112	166	0.71
	11/28/2016	1.7	0.20	3.9	2.6	109	249	0.14	106	162	4.4
	12/15/2016	1.7	0.20	3.6	2.6	108	263	0.14	107	177	0.71
	12/28/2016	1.7	0.20	4.4	2.6	120	276	0.14	123	181	0.20
	3/27/2017	1.7	0.20	3.8	3.0	107	267	0.17	102	174	19.0
	6/14/2017	1.7	0.20	4.1	3.0	117	259	0.04	138	168	0.18
	9/28/2017	1.7	0.25	3.2	3.0	86	214	0.18	75	159	0.20
	Mean (x)	1.8	0.2	3.8	2.7	106.9	252.9	0.1	107.7	169.1	3.0
	SD (σ)	0.3	0.0	0.4	0.2	9.7	17.7	0.0	17.1	7.4	6.1
	x + σ	2.1	0.2	4.2	2.9	116.6	270.6	0.2	124.8	176.5	9.2
	x + 2*σ (UTL)	2.3	0.2	4.5	3.1	126.2	288.3	0.2	141.9	183.9	15.3
MW-15A	3/24/2010	2.3	0.20	2.28	10	38.5	120	0.57	43.4	67	6.1
	8/30/2010	1.4	0.20	3.18	10	35.5	149	0.41	33.4	70	78
	2/23/2011	1.7	0.20	4.30	10	40.5	127	0.47	38.5	57	15
	9/15/2011	1.6	0.20	2.04	10	36.8	125	0.54	36.7	70	48
	3/6/2012	1.5	0.20	5.76	16	42.1	134	0.42	40.3	91	31
	9/12/2012	1.0	0.20	3.35	1,780	187	244.9	0.725	83.6	103	650
	3/7/2013	1.8	0.20	3.79	10	43.5	171.6	0.585	48.2	76.0	63.5
	9/20/2013	10.0	0.20	5.00	5	59	160	0.39	61	77.0	10
	3/26/2014	10.0	0.20	6.2	5	51	170	0.43	59	140	31
	12/16/2014	1.3	0.20	7.8	5	60	150	0.33	53	110	23
	4/30/2015	10.0	0.2	5	6.0	48	130	0.20	48	100	5.8
	Mean (x)	3.9	0.2	4.4	8.7	58.4	152.9	0.5	49.6	87.4	87.4
	SD (σ)	4.0	0.0	1.7	3.5	43.5	35.5	0.1	14.4	24.2	188.1
	x + σ	7.8	0.2	6.2	12.2	101.8	188.4	0.6	63.9	111.6	275.5
	x + 2*σ (UTL)	11.8	0.2	7.9	15.7	145.3	223.8	0.7	78.3	135.8	463.6
MW-15B	3/24/2010	8.4	0.20	2.18	10	23.2	70	0.61	15.8	42	0.35
	8/30/2010	8.8	0.20	2.57	10	26.6	97.0	0.64	18.5	62	0.61
	2/23/2011	7.6	0.20	4.28	10.0	30.0	91.0	0.50	35.9	44	4.6
	9/15/2011	4.8	0.20	2.97	10	17.2	53	0.79	8.7	32	13
	3/6/2012	4.6	0.20	2.53	34	24.4	66	0.56	17.0	49	29
	9/12/2012	5.52	0.20	2.58	14.3	27.0	78.9	0.579	21.2	50.0	432
	3/7/2013	4.96	0.20	2.64	10	26.1	81.1	0.537	21.9	44.0	268
	9/24/2013	10.0	0.20	5	5	17	50	0.39	5.0	44	22
	3/26/2014	10.0	0.20	5	5	8.9	37	0.67	5.0	86	1.4
	12/16/2014	1.0	0.20	5	5	6.0	28	0.31	5.0	63	16
	4/29/2015	10.0	0.2	5	5	5.8	28	0.21	5.9	39	66
	Mean (x)	6.9	0.2	3.6	10.8	19.3	61.8	0.5	14.5	50.5	77.5
	SD (σ)	2.9	0.0	1.2	8.3	8.9	24.4	0.2	9.8	14.9	140.9
	x + σ	9.8	0.2	4.8	19.1	28.2	86.2	0.7	24.3	65.4	218.4
	x + 2*σ (UTL)	12.7	0.2	6.1	27.3	37.1	110.6	0.9	34.1	80.3	359.3

APPENDIX B
INTRAWELL UPPER TOLERANCE LIMITS FOR GENERAL CHEMISTRY

Tolson Rubble Landfill
Crofton, Maryland

Well	Date	Alkalinity (mg/l)	Ammonia, Nitrogen (mg/l)	Chloride (mg/l)	COD (mg/l)	Hardness (mg/l)	Specific Conductivity (µS/cm)	Nitrate, Nitrogen (mg/l)	Sulfate (mg/l)	Total Dissolved Solids (mg/l)	Turbity (NTU)
MW-16A	3/24/2010	161.0	0.64	18.4	127	236	629	0.08	170	344	150
	8/30/2010	87.0	0.57	12.3	19	180	486	0.07	91.6	273	9.7
	2/23/2011	45.0	0.27	27.1	10.00	147	441	0.06 J	89.5	208	3.7
	9/14/2011	42	0.23	19.5	10	162	444	0.28	108	252	15
	3/1/2012	82	0.31	15.4	18	183	470	0.33	92	263	26
	9/11/2012	66.2	0.36	14.3	12.9	147	378	0.364	72.0	251	115
	3/5/2013	32.8	0.20	15.5	10	107	340	0.401	73.5	159	60.8
	9/17/2013	160	0.35	35	23	220	560	0.21	72	290	7.9
	3/20/2014	120	0.63	23	18	260	590	0.10	75	390	16
	12/10/2014	110	0.63	13	14	130	360	0.18	54	250	57
	4/27/2015	63	0.26	13	8.0	100	280	0.29	58	190	6.2
	Mean (x)	88.1	0.4	18.8	24.5	170.2	452.5	0.2	86.9	260.9	42.5
	SD (σ)	44.9	0.2	7.1	34.3	51.8	109.4	0.1	31.8	65.6	49.2
	x + σ	133.0	0.6	25.9	58.8	222.0	562.0	0.4	118.6	326.5	91.7
	x + 2*σ (UTL)	177.9	0.8	32.9	93.2	273.7	671.4	0.5	150.4	392.2	140.8
MW-16B	3/24/2010	1.0	0.20	3.34	34	7.7	87.6	3.67	12.20	35	140
	8/30/2010	1.0	0.20	3.59	13	5.4	56.0	1.37	6.26	21	44
	2/23/2011	1.0	0.20	3.75	10	5.6	52.0	1.43	7.38	10	1.4
	9/14/2011	1.0	0.20	3.53	13	5.3	61	1.04	5.93	31	110
	3/1/2012	1.0	0.20	3.58	18	5.4	56	1.42	8.49	38	22
	9/11/2012	1.0	0.20	3.48	10	5.18	48.5	1.19	5.74	61.0	19.8
	3/5/2013	1.0	0.20	3.69	18.4	7.26	48.5	1.18	5.09	11.0	413
	9/19/2013	1.0	0.20	5	5	4.6	50	0.61	9.0	22	7.4
	3/20/2014	1.0	0.20	5	5	4.1	49	0.81	5.0	21	25
	12/10/2014	1.0	0.20	5	5	4.8	44	0.34	7.3	16	88
	4/27/2015	10.0	0.2	5	5	4.9	45	0.61	5.0	20	33
	Mean (x)	1.8	0.2	4.1	12.4	5.5	54.3	1.2	7.0	26.0	82.1
	SD (σ)	2.7	0.0	0.7	8.7	1.1	12.1	0.9	2.2	14.7	118.5
	x + σ	4.5	0.2	4.8	21.1	6.6	66.5	2.1	9.2	40.7	200.6
	x + 2*σ (UTL)	7.2	0.2	5.5	29.9	7.6	78.6	3.0	11.4	55.4	319.1
MW-17A	3/25/2010	5.2	0.20	16.1	10	17.2	80.0	0.06	1.71	54	97
	8/30/2010	5.0	0.20	14.8	10	16.5	81.0	0.89	2.29	49	100
	2/21/2011	24.0	0.20	17.3	10	17.4	90.0	0.99	1	58	20
	9/13/2011	4.8	0.20	18.4	10	19.5	96	1.08	1.5	69	150
	3/2/2012	5.3	0.20	18.3	10	20.7	94	1.1	2.1	66	46
	9/11/2012	6.00	0.20	15.0	100	0.5	75.9	0.841	1.0	76.0	89.5
	3/5/2013	6.04	0.20	15.5	100	17.3	84.2	0.893	1.5	53.0	79.5
	9/19/2013	10.0	0.20	18	5	18	87	0.81	5.0	53	15
	3/20/2014	10.0	0.20	18	5	18	87	0.82	5.0	63	27
	12/11/2014	10.0	0.20	21	5	18	96	0.51	5.0	33	19
	4/23/2015	10.0	0.2	23	5	22	110	0.65	5.0	77	5.9
	Mean (x)	8.8	0.2	17.8	24.5	16.8	89.2	0.8	2.8	59.2	59.0
	SD (σ)	5.5	0.0	2.5	37.4	5.7	9.6	0.3	1.8	12.9	46.7
	x + σ	14.3	0.2	20.3	61.9	22.5	98.7	1.1	4.6	72.0	105.7
	x + 2*σ (UTL)	19.9	0.2	22.8	99.3	28.1	108.3	1.4	6.4	84.9	152.4

APPENDIX B
INTRAWELL UPPER TOLERANCE LIMITS FOR GENERAL CHEMISTRY

Tolson Rubble Landfill
Crofton, Maryland

Well	Date	Alkalinity (mg/l)	Ammonia, Nitrogen (mg/l)	Chloride (mg/l)	COD (mg/l)	Hardness (mg/l)	Specific Conductivity (µS/cm)	Nitrate, Nitrogen (mg/l)	Sulfate (mg/l)	Total Dissolved Solids (mg/l)	Turbity (NTU)
MW-17B	3/25/2010	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	8/30/2010	37.0	0.20	2.61	10	36.4	143	0.61	7.88	64	4.0
	2/21/2011	24	0.20	2.60	10	27.1	82.0	0.64	6.96	72	4.1
	9/12/2011	14	0.20	2.92	10	21.1	61	0.81	5.6	44	0.84
	3/2/2012	19	0.20	2.81	11	25.9	66	0.80	5.9	59	0.81
	9/11/2012	15.0	0.20	2.84	10	21.3	59.2	0.858	4.7	57.0	0.519
	3/15/2013	17.8	0.20	2.88	10	23.8	65.1	0.873	5.2	24.0	0.409
	9/19/2013	13	0.20	5	5	21	58	0.50	5	24	0.36
	3/20/2014	26	0.20	5	5	29	75	0.59	5	76	2.1
	12/11/2014	14	0.20	5	5	21	61	0.50	5	12	0.76
	4/28/2015	10.0	0.2	5	5	5	31	0.36	5.0	34	210
	Mean (x)	19.0	0.2	3.7	8.1	23.2	70.1	0.7	5.6	46.6	22.4
	SD (σ)	8.0	0.0	1.2	2.7	8.0	28.8	0.2	1.0	22.3	65.9
	x + σ	27.0	0.2	4.8	10.8	31.1	99.0	0.8	6.6	68.9	88.3
	x + 2*σ (UTL)	35.1	0.2	6.0	13.5	39.1	127.8	1.0	7.7	91.1	154.3
MW-21A	3/25/2010	59.0	0.20	32.9	12	118.0	366	0.06	66.6	229	19
	8/30/2010	97.0	0.31	44.7	20	152.0	519	0.06	66.8	316	4.7
	2/17/2011	61.0	0.30	81.1	13	164	603	0.06	85.8	331	5.0
	9/14/2011	44	0.28	198	17	234	962	0.06	109	506	200.0
	3/5/2012	65	0.61	213	30	264	1190	0.06	118	557	8.4
	9/10/2012	26.0	0.361	612	19.9	417	2153	0.05	175	1310	109
	3/4/2013	122	0.661	560	15.1	398	2424	0.05	165	1250	8.22
	5/16/2013	NS	NS	NS	NS	NS	NS	NS	NS	NS	8.02
	9/18/2013	150	0.44	220	23	290	1200	0.10	110	680	15
	3/19/2014	97	0.48	180	13	240	990	0.10	110	600	4.5
	12/15/2014	77	0.053	37	6.0	92	360	0.10	35	210	29
	4/29/2015	75	0.56	42	7.0	91	310	0.10	41	190	3.1
	Mean (x)	79.4	0.4	201.9	16.0	223.6	1,007.0	0.1	98.4	561.7	34.5
	SD (σ)	35.4	0.2	204.4	7.0	113.6	714.9	0.0	45.3	392.2	59.8
	x + σ	114.7	0.6	406.3	23.0	337.2	1,721.9	0.1	143.7	954.0	94.3
	x + 2*σ (UTL)	150.1	0.8	610.8	30.0	450.8	2,436.8	0.1	189.0	1,346.2	154.1
MW-21B	3/25/2010	1.0	0.20	3.00	10	32.0	252	0.06	85.9	111	33
	8/30/2010	1.0	0.20	2.60	10	31.4	263	0.18	61.1	102	33
	2/17/2011	1.0	0.20	2.35	10	24.3	243	0.06	91.2	64	40
	9/14/2011	1.0	0.20	3	149	59.1	155	0.10	43.6	87	3,400
	3/5/2012	1.0	0.20	2	25	23.9	146	0.06	51.2	93	85
	9/10/2012	1.72	0.20	2	10	19.2	165.2	0.0526	52.3	89.0	24.8
	3/4/2013	1	0.20	2	10	20.3	173.6	0.05	50.4	87.0	10.6
	9/18/2013	10	0.20	5	5	26	140	0.10	66	55.0	8.6
	3/19/2014	10	0.20	5	5	20	120	0.10	51	100	15
	12/15/2014	10	0.20	5	5	21	140	0.10	55	97	4.0
	5/28/2015	10	0.57	5	6.0	33	110	0.10	32	80	NS
	Mean (x)	4.3	0.2	3.4	22.3	28.2	173.4	0.1	58.2	87.7	365.4
	SD (σ)	4.5	0.1	1.3	42.4	11.4	54.1	0.0	17.4	16.5	1,066.5
	x + σ	8.8	0.3	4.7	64.7	39.6	227.6	0.1	75.6	104.2	1,431.9
	x + 2*σ (UTL)	13.3	0.5	5.9	107.1	51.0	281.7	0.2	93.0	120.6	2,498.4

APPENDIX B
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Tolson Rubble Landfill
Crofton, Maryland

Well	Date	Alkalinity (mg/l)	Ammonia, Nitrogen (mg/l)	Chloride (mg/l)	COD (mg/l)	Hardness (mg/l)	Specific Conductivity (µS/cm)	Nitrate, Nitrogen (mg/l)	Sulfate (mg/l)	Total Dissolved Solids (mg/l)	Turbity (NTU)
MW-23A	11/7/2016	11.3	0.20	18.0	2.6	38.7	130	0.53	18.4	86	9.5
	11/15/2016	5.1	0.20	19.4	2.6	33.4	126	0.51	20.3	79	2.5
	11/21/2016	6.7	0.20	18.3	2.6	32.3	127	0.50	19.1	73	1.7
	11/28/2016	4.4	0.20	18.3	2.6	30.5	127	0.51	19.7	83.5	0.40
	12/15/2016	2.7	0.20	17.5	2.6	28.8	120	0.55	20.0	78.5	0.18
	12/27/2016	1.7	0.20	16.3	2.6	27.4	119	0.56	18.5	71	0.36
	3/27/2017	2.20	0.20	17.1	3.0	28.1	118	0.56	16.9	78	0.20
	6/14/2017	1.7	0.20	30.1	3.0	35.0	159	0.39	15.0	97	0.20
	9/28/2017	2.6	0.31	12.3	ND (3.0)	28.9	122	0.55	20.4	88.5	0.15
	Mean (x)	4.3	0.21	18.6	2.7	31.5	127.6	0.5	18.7	81.6	1.7
	SD (σ)	3.1	0.04	4.8	0.2	3.7	12.5	0.1	1.8	8.1	3.0
	x + σ	7.4	0.25	23.4	2.9	35.2	140.1	0.6	20.5	89.7	4.7
	x + 2*σ (UTL)	10.5	0.29	28.1	3.1	38.9	152.6	0.6	22.3	97.8	7.8
MW-26A	11/9/2016	50.7	0.20	13.0	3.8	162	400	0.30	120	265	16.1
	11/14/2016	34.1	0.20	13.9	9.7	151	370	0.22	128	269	17.4
	11/21/2016	23.4	0.20	13.4	2.6	142	361	0.23	135	282	9.5
	11/28/2016	12.6	0.20	13.4	2.6	134	5.4	0.13	134	251	6.0
	12/16/2016	8.0	0.20	13.8	2.6	123	326	0.20	124	231	25.3
	12/28/2016	2.2	0.28	14.8	2.6	119	320	0.24	127	216	9.9
	3/29/2017	2.3	0.20	13.9	3.0	117	315	0.19	116	232	8.6
	6/16/2017	1.7	0.20	16.1	3.0	108	304	0.17	112	210	2.4
	9/27/2017	1.7	0.25	15.7	4.2	112	319	0.16	117	227	5.7
	Mean (x)	15.2	0.21	14.2	3.8	129.8	302.3	0.2	123.7	242.6	11.2
	SD (σ)	17.5	0.03	1.1	2.3	18.6	115.7	0.1	8.0	25.2	7.1
	x + σ	32.7	0.24	15.3	6.1	148.4	417.9	0.3	131.7	267.8	18.3
	x + 2*σ (UTL)	50.1	0.27	16.4	8.4	167.0	533.6	0.3	139.8	293.0	25.5
MW-27A	11/8/2016	5.6	0.20	7.4	2.6	54.4	135	0.51	37.3	106	1.6
	11/15/2016	2.3	0.20	6.9	2.6	38.6	134	0.51	36.8	79.5	74.6
	11/22/2016	1.7	0.20	7.8	2.6	37.7	132	0.54	35.7	81.5	1.2
	11/28/2016	3.5	0.20	8.1	2.6	39.0	134	0.54	38.2	75.5	3.2
	12/16/2016	3.6	0.20	8.7	2.6	38.7	140	0.62	39.6	88.5	3.7
	12/27/2016	1.9	0.20	9.1	2.6	37.0	140	0.64	38.7	84.5	1.2
	3/28/2017	1.7	0.20	10.0	3.0	42.4	147	0.62	40.4	108	1.3
	6/15/2017	1.7	0.20	10.4	3.0	45.6	156	0.48	41.5	100	0.15
	9/27/2017	1.7	0.20	8.9	3.0	43.8	161	0.30	50.7	110	0.20
	Mean (x)	2.6	0.20	8.6	2.7	41.9	142.1	0.5	39.9	92.6	9.7
	SD (σ)	1.4	0.00	1.2	0.2	5.5	10.4	0.1	4.4	13.4	24.4
	x + σ	4.0	0.20	9.7	2.9	47.4	152.5	0.6	44.3	106.0	34.1
	x + 2*σ (UTL)	5.3	0.20	10.9	3.1	53.0	162.9	0.7	48.8	119.5	58.4

APPENDIX B
INTRAWELL UPPER TOLERANCE LIMITS FOR GENERAL CHEMISTRY

Tolson Rubble Landfill
Crofton, Maryland

Well	Date	Alkalinity (mg/l)	Ammonia, Nitrogen (mg/l)	Chloride (mg/l)	COD (mg/l)	Hardness (mg/l)	Specific Conductivity (µS/cm)	Nitrate, Nitrogen (mg/l)	Sulfate (mg/l)	Total Dissolved Solids (mg/l)	Turbity (NTU)
MW-28A	11/7/2016	1.7	0.20	8.0	2.6	44.0	133	0.74	36.3	86	0.17
	11/15/2016	2.9	0.20	7.8	2.6	39.1	134	0.66	37.2	59.5	2.6
	11/22/2016	1.7	0.20	8.5	2.6	40.5	134	0.63	35.8	83	0.76
	11/29/2016	1.7	0.20	10.3	2.6	38.3	144	0.63	37.1	82	0.23
	12/16/2016	1.7	0.20	8.2	2.6	37.8	133	0.62	37.3	87.5	0.25
	12/27/2016	1.7	0.20	8.3	2.6	36.3	131	0.58	36.2	81	0.65
	3/28/2017	1.7	0.20	8.2	3.0	39.2	133	0.51	37.1	81.5	0.15
	6/15/2017	1.7	0.20	7.5	3.0	41.7	138	0.49	38.9	92.5	0.15
	9/27/2017	1.7	0.25	7.5	3.0	43.3	146	0.54	43.1	95.5	0.20
	Mean (x)	1.8	0.21	8.3	2.7	40.0	136.2	0.6	37.7	83.1	0.6
	SD (σ)	0.4	0.02	0.8	0.2	2.6	5.3	0.1	2.2	10.2	0.8
	x + σ	2.2	0.22	9.1	2.9	42.6	141.6	0.7	39.9	93.3	1.4
	x + 2*σ (UTL)	2.6	0.24	9.9	3.1	45.2	146.9	0.8	42.1	103.6	2.2
MW-29A	11/9/2016	114	0.57	8.3	2.6	112	257	0.04	3.3	134	251
	11/15/2016	118	0.43	8.4	13.2	107	255	0.076	3.6	191	127
	11/22/2016	107	0.20	9.3	2.6	106	238	0.04	4.4	131	104
	11/29/2016	113	11.5	8.3	5.8	112	252	0.04	3.5	152	92
	12/16/2016	127	0.43	7.5	11.9	111	259	0.04	2.4	144	190
	12/27/2016	122	0.31	8.3	17.1	109	244	0.04	3.3	149	239
	3/28/2017	108	0.58	6.5	3.0	106	242	0.04	1.5	149	73
	6/15/2017	109	0.61	7.5	8	93	227	0.04	2.6	114	57.6
	9/27/2017	77	0.55	13.1	15.1	83	204	0.04	1.5	124	260.0
	Mean (x)	110.5	1.7	8.6	8.8	104.3	242.0	0.04	2.9	143.1	154.8
	SD (σ)	14.3	3.7	1.9	5.7	10.0	17.6	0.01	1.0	22.0	80.7
	x + σ	124.8	5.4	10.4	14.5	114.3	259.6	0.06	3.9	165.1	235.5
	x + 2*σ (UTL)	139.1	9.1	12.3	20.2	124.3	277.2	0.07	4.9	187.2	316.2
MW-31A	11/8/2016	1.7	0.20	5.9	2.6	29.6	158	0.18	52.7	114	1.3
	11/14/2016	1.7	0.20	5.9	2.6	27.5	160	0.14	57.2	92.5	1.4
	11/21/2016	1.7	0.20	5.8	2.6	29.0	168	0.14	56.4	112	0.20
	11/28/2016	1.7	0.20	5.9	2.6	32.6	170	0.14	60.5	115	0.57
	12/15/2016	1.7	0.20	6.0	2.6	33.8	182	0.15	63.2	118	0.78
	12/28/2016	1.7	0.20	5.8	2.6	40.0	190	0.17	76.2	125	0.17
	3/27/2017	1.7	0.20	5.7	3.0	53.9	302	0.25	119.0	241	0.25
	6/14/2017	1.7	0.20	5.6	3.0	40.9	266	0.18	113.0	192	0.19
	9/28/2017	1.7	0.25	4.6	3.7	78.6	552	0.16	256.0	499	0.15
	Mean (x)	1.7	0.21	5.7	2.8	40.7	238.7	0.2	94.9	178.7	0.6
	SD (σ)	0.0	0.02	0.4	0.4	16.4	127.9	0.0	65.3	129.1	0.5
	x + σ	1.7	0.22	6.1	3.2	57.1	366.6	0.2	160.2	307.8	1.1
	x + 2*σ (UTL)	1.7	0.24	6.5	3.6	73.5	494.5	0.2	225.5	436.9	1.6

NOTES:
mg/l = miligrams per liter.
µS/cm = microSiemens per centimeter.
NTU = Nephologmetric Turbidity Units.
NA = Not analyzed.
COD = Chemical Oxygen Demand.
Blank = not analyzed.

The upper tolerence limit (UTL) (gray shaded cell) is defined as the mean plus twice the standard deviation established by Environmental Resources Management, Inc.
For non-detect chemicals, the detection limit was used in the statistical analysis.

Geosyntec consultants

Appendix K: Final Cover System Design

Appendix K.1: Soil Requirements

APPENDIX K.1 – SOIL REQUIREMENTS

In this appendix, an estimate of the soil volume requirements for the following items is calculated:

- periodic and intermediate cover soils for TRL (Cells 1-7); and
- final cover system for TRL.

Periodic and Intermediate Cover

The periodic (6" thick) and intermediate (12" thick) cover soil required for TRL operation is based on the disposal volume calculations presented in Appendix C of the Phase III Report and assumes that these cover soils will account for 10 % of the total disposal volume. Based on the calculated disposal volume of 9,440,000 cubic yards, approximately 944,000 cubic yards of soil will be required for periodic and intermediate cover soils.

Final Cover System

As shown on Drawing 12, the soil components of the final cover system (from bottom to top) are:

- 24" grading layer (of which 12" comprises intermediate cover which will already be in place when the final cover is installed);
- 18" protective cover soil; and
- 6" topsoil.

Based on a landfill area of 72.1 acres, approximately 233,000 cubic yards of soil will be required to make up the grading layer (consisting of 116,300 cubic yards for intermediate cover and 116,300 for final cover), 175,000 cubic yards of protective cover soil will be required, and 58,000 cubic yards of topsoil will be required.

Total Cover Soil Requirements

In summary, the total volume of soil needed for TRL operation and final closure of the entire landfill is 1,409,000 cubic yards.

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Appendix K.2: Final Cover System Design (HELP Model)

Geosyntec consultants

COMPUTATION COVER SHEET

Client: Tolson & Associates **Project:** TRL Vertical Expansion **Project/Proposal #:** ME1606 **Task:** 03

TITLE OF COMPUTATIONS: FINAL COVER SYSTEM DESIGN (HELP MODEL)

COMPUTATIONS BY: Signature ______ February 7, 2020
DATE
Printed Name Sean O'Donnell
and Title Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY: (Peer Reviewer) Signature ______ August 3, 2020
DATE
Printed Name Simone Smith
and Title Senior Engineer

COMPUTATIONS CHECKED BY: Signature ______ August 3, 2020
DATE
Printed Name Simone Smith
and Title Senior Engineer

COMPUTATIONS BACKCHECKED BY: (Originator) Signature ______ August 3, 2020
DATE
Printed Name Sean O'Donnell
and Title Engineer

APPROVED BY: (PM or Designate) Signature ______ August 3, 2020
DATE
Printed Name David Espinoza
and Title Senior Principal

APPROVAL NOTES: ______

REVISIONS: (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

FINAL COVER SYSTEM DESIGN (HELP MODEL)

1. OBJECTIVE

The objective of this calculation package is to design the final cover system such that water is expediently removed from the cap and conveyed to the stormwater management system. The objective is also to evaluate the water head above the geomembrane component of the final cover system for the proposed expanded Tolson Rubble Landfill (TRL) located in Anne Arundel County, Maryland.

2. METHOD

The Hydrologic Evaluation of Landfill Performance (HELP) Version 3.07 [USEPA, 1994] computer program is used to perform this analysis. Figure 1 shows the proposed final grades and Figure 2 shows the cover system components. The assumptions summarized in the following paragraphs are made.

3. INPUT DATA

3.1 Introduction

The input data in the HELP model is classified into site/design specific data such as the layering configuration and material properties, and location specific data such as climatic data. For both types of input data properties, HELP offers the option of using default values or user defined values. Each set of input data is described in the following sections.

3.2 Weather Data

The HELP model requires the following weather-related input data: (i) evapotranspiration, (ii) precipitation, (iii) temperature, and (iv) solar radiation data. The HELP model provides default values and synthetically generated weather data for specific cities in the United States. The closest city available in HELP, Baltimore, Maryland, was selected for weather data input. Weather data were synthetically generated for a 30-year period.

The HELP default values for evaporation zone depths are used. The final cover condition of the landfill is assumed to support a fair stand of grass, leading to a default evaporation zone depth of 21 inches. Maximum leaf area indices (LAI) are used. An LAI value of 2 is used for final condition, which corresponds to a fair stand of grass.

3.3 Soil, Waste, and Geosynthetic Material Data

The final cover system is assumed to be comprised of the following layers (Figure 2):

- 6" topsoil;
- 18" final cover soil with hydraulic conductivity of 1×10^{-5} cm/sec.;
- 200-mil geocomposite drainage layer;
- 40-mil HDPE geomembrane; and
- 24" compacted clay subgrade with hydraulic conductivity of 1×10^{-5} cm/sec.

The soil layers below the final cover system have an insignificant effect on the performance of the final cover system; therefore, the layers below the final cover system are not simulated.

Final Cover Soils

The final cover soil layer is assumed to be approximately 24 inches in thickness, including 6-inches of topsoil and 18-inches of clay soil with hydraulic conductivity of 1×10^{-5} cm/s or higher. The default soil texture number chosen for the final cover soil is 13 (clayey sand) and a hydraulic conductivity of 1×10^{-5} cm/s is assumed.

Geocomposite Drainage Layer* (*Cover System)

The chosen final cover system drainage layer is a geocomposite. This layer is modeled as a drainage net with a thickness of 0.2 in. To appropriately model the anticipated hydraulic conductivity of the geocomposite drainage layer, manufacturer-provided hydraulic properties of a typical geocomposite drainage product are modified based on the methodology presented by Koerner [1998]. For this analysis the following geocomposite products were reviewed as the basis of model analysis (manufacturer data sheet is provided as Attachment 1):

- GSE Lining Technology - FabriNet UF Geocomposite

- SKAPS Industries – Transnet TN-270 Double-sided geocomposite

The following presents the approach used to modify the manufacturer-provided transmissivity values into hydraulic conductivity values required for the HELP model input.

The hydraulic conductivity of a geocomposite drainage layer is related to the hydraulic transmissivity (θ) and the thickness of the geocomposite drainage layer (t) as follows:

$$k = \frac{\theta}{t} \quad (1)$$

where:

k = hydraulic conductivity (cm/sec)
θ = hydraulic transmissivity (cm^2/sec); and
t = drainage layer thickness (cm).

The following equations proposed by Giroud et al. [2000] are used to estimate an appropriate transmissivity design value for the geocomposite drainage layer.

$$\theta_{LTIS} = \frac{\theta_{measured}}{\prod(\mathrm{RF})} = \frac{\theta_{measured}}{\mathrm{RF_{IMCO}} \times \mathrm{RF_{IMIN}} \times \mathrm{RF_{CR}} \times \mathrm{RF_{IN}} \times \mathrm{RF_{CD}} \times \mathrm{RF_{PC}} \times \mathrm{RF_{CC}} \times \mathrm{RF_{BC}}} \quad (2)$$

where:

θ_{LTIS} = long-term-in-soil hydraulic transmissivity of the geocomposite;

$\theta_{measured}$ = value of hydraulic transmissivity measured in laboratory tests (ASTM D 4716);

Π(RF) = product of all reduction factors;

RF_{IMCO} = reduction factor for immediate compression, i.e. decrease of hydraulic transmissivity due to compression of the geocomposite core immediately following the application of stress;

RF_{IMIN} = reduction factor for immediate intrusion, i.e. decrease hydraulic transmissivity due to geotextile intrusion into the geocomposite core immediately following the application of stress;

RF_{CR} = reduction factor for creep, i.e. time-dependent hydraulic transmissivity reduction due to creep of the geocomposite core under the applied stress;

RF_{IN} = reduction factor for delayed intrusion, i.e. decrease of hydraulic transmissivity over time due to geotextile intrusion into the geocomposite core resulting from time-dependent deformation of the geotextile;

RF_{CD} = reduction factor for chemical degradation, i.e. decrease of hydraulic transmissivity due to chemical degradation of the polymeric compound(s) used to make the geocomposite;

RF_{PC} = reduction factor for particulate clogging, i.e. decrease of hydraulic transmissivity due to clogging by particles migrating into the geocomposite core;

RF_{CC} = reduction factor for chemical clogging, i.e. decrease of hydraulic transmissivity due to chemical clogging of the geocomposite core; and

RF_{BC} = reduction factor for biological clogging, i.e. decrease of hydraulic transmissivity due to biological clogging of the geocomposite core.

$$\theta_{design} = \frac{\theta_{LTIS}}{FS} \tag{3}$$

where:

θ_{design} = geocomposite transmissivity appropriate for use in design; and

FS = overall factor of safety to account for all possible uncertainties.

The values of measured hydraulic transmissivity and material thickness are obtained from the manufacturer literature for the modeled material (Attachment 1). Selection of the remaining reduction factors is based on the following factors: (i) uncertainty regarding a specific parameter; and (ii) the degree to which the laboratory test mimics the condition being evaluated. A typical range of values for the reduction factors are provided in Koerner [1998].

Because the stormwater volume percolated through the final cover system is relatively small, reduction factors different from those used for the liner system were assumed, which are summarized below:

Reduction Factor		Typical Value(s)	Selected Value	Reasoning
RF_{IMCO}	reduction factor for immediate compression	1.0	1.0	Manufacturer laboratory testing conditions mimic this mechanism
RF_{IMIN}	reduction factor for immediate intrusion	1.5	1.0	Manufacturer laboratory testing conditions mimic this mechanism
RF_{CR}	reduction factor for creep	1.4-2.0	1.7	Use median value of recommended range
RF_{IN}	reduction factor for delayed intrusion	1.0-1.2	1.1	Use median value of recommended range
RF_{CD}	reduction factor for chemical degradation	1.5	1.5	Selected as recommended value
RF_{PC}	reduction factor for particulate clogging	1.2	1.2	Selected as recommended value
RF_{CC}	reduction factor for chemical clogging	1.5-2.0	1.0	Selected considering water percolated from the final cover soil is relatively clean.
RF_{BC}	reduction factor for biological clogging	1.5-2.0	1.5	Selected considering water percolated from the final cover soil is relatively clean.

The product of the reduction factors is 5.05. The transmissivity of the candidate product (GSE Fabrinet UF) is tested as 1×10^{-4} m^2/sec (Attachment 1). Based on the reduction factors described above, θ_{LTIS} and k_{design} values were calculated based on the $\theta_{measured}$ and using Equations (1) through (3). The following presents a summary of the calculation of k_{design}.

Using the reduction factors as described above and a factor of safety (FS) of 1.1, the long-term hydraulic conductivity of the final cover geocomposite drainage layer is estimated as below.

Step 1. Convert $\theta_{measured}$ from manufacturer provided units of meters squared per second to units of centimeters squared per second:

$$\theta_{measured} = 1.0\times10^{-4}\ \text{m}^2/\text{s} \times (100\text{cm/m})^2 = 1.0\ \text{cm}^2/\text{s}$$

Step 2. Calculate θ_{LTIS} using equations 2 and 3.

$$\theta_{\text{LTIS}} = \theta_{measured} \ /\ \Pi(\text{RF}) = 1.0\ \text{cm}^2/\text{s}\ \ /\ \ 5.05 = 0.198\ \text{cm}^2/\text{s}$$

$$\theta_{design} = 0.198\ \text{cm}^2/\text{s} \ /\ 1.1 = 0.180\ \text{cm}^2/\text{s}$$

Based on the manufacturer provided thickness of the geocomposite drainage layer and the modified transmissivity value, the hydraulic conductivity value required for the HELP model input can be calculated as follows:

Step 3. Calculate k_{design} using equation 1.

$$k_{design} = 0.180\ \text{cm}^2/\text{s} \ /\ [0.2\ \text{in} \ /\ (2.54\text{in/cm})] = 2.28\ \text{cm/s}$$

The 2.28 cm/sec designed hydraulic conductivity was assumed to account for the decreased transmissivity under long-term condition.

Geomembrane Liner

The 40-mil (0.04 in) high density polyethylene (HDPE) geomembrane is assumed to be used for the base liner and cover barrier, respectively. The geosynthetic material number chosen for the HELP simulations is 35. The geomembrane liner is modeled as having a pinhole density of 2 per acre, a defect density of 2 per acre, and is assumed conservatively to have a poor placement quality.

Subgrade Soils

Before placing the final cover system, the 24-inch subgrade will be prepared. The soil anticipated to be used for the cover soil at the landfill is the daily/intermediate cover soils representing the soils or other materials that are placed over the waste between periods of waste placement. The default soil texture number chosen for the subgrade soils is 13 (clayey sand).

3.4 Surface Drainage Distance and Slope

Figure 1 shows the proposed final grades of the landfill. The proposed final grade will reach a maximum elevation of 244 ft above mean sea level (ft-msl). Drainage distances along the sideslopes will be limited to 165 feet (drainage terraces will be spaced every 40 vertical feet with a 4:1 H:V slope).

HELP models the surface runoff using the Soil Conservation Service (SCS) curve number method. HELP uses the surface slopes, lengths, soil type, and vegetative cover to determine a runoff curve number, which is used for runoff calculations. The surface characteristics vary depending upon the cell condition. For final cover, runoff is generated from 100% of the total area (i.e., no water ponding is allowed).

Table 1 summarizes the surface drainage distances and slopes assumed in the analysis. The final cover slope on the majority of the landfill is designed at a slope of 4 percent with a maximum drainage length of 1,000 ft. The drainage slope of the final cover at the plateau is assumed to be 3.0 percent to account for slope change due to differential settlement. The sideslopes are designated with a 4 horizontal: 1 vertical (4H:1V) slope with terraces spaced at 165 feet along the length of the sideslope.

4. HELP MODEL RESULTS

HELP simulation output for the four cell conditions are included as Attachments 2 and 3. The average calculated head above the cover system is summarized in Table 2. As shown in Table 2, because the plateau is relatively flat, the peak average daily head above the cover system is greater than the thickness of the geocomposite. However, slope failure is not expected at the flat plateau area. At sideslopes, the average head above the cover system is less than 0.2 inches (the thickness of the geocomposite) at all times.

REFERENCES

Schroeder, P. Rs., Aziz, N. M., Lloyd, C. M. and Zappi, P. A. (1994). "The Hydrologic Evaluationa of Landfill Performance (HELP) Model: User's Guide for Version 3," EPA/600/R-94/168a, September 1994, U.S. Environmental Protection Agency Office of Research and Development, Washington, DC.

Koerner, R.M. (1998). "Designing with Geosynthetics," 4th ed. New Jersey: Prentice Hall, Inc.

TABLES

Table 1. Surface Condition and Runoff Curve Numbers

Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Case	Surface Slope (%)	Slope Length (ft)	Soil Texture	Vegetative Cover	Percent Possible Runoff	Runoff Curve Numbers
Plateau*	3 *	1000	13	Fair Stand of Grass	100	87.6
Sideslope	25	165 **	13	Fair Stand of Grass	100	89.3

Note: * Surface slope reduced to account for differential settlement, design plateau slope of 4 percent.
** Terraces spaced every 40 vertical feet at 4:1 H:V. Maximum sideslope length is approximately 165-ft

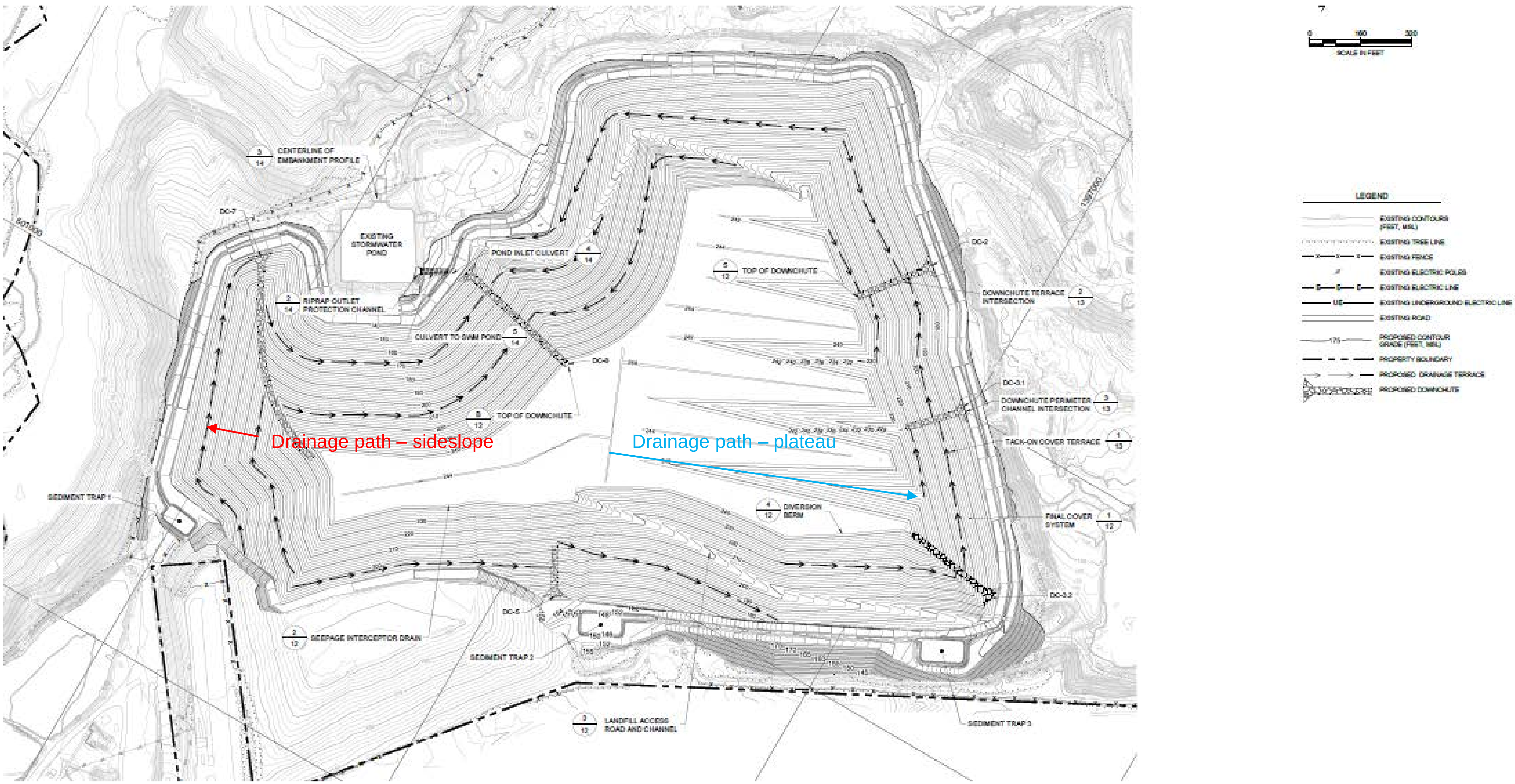
Table 2. Leachate Head above Cover Geomembrane

Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Case	Drainage Slope (%)	Drainage Distance (ft)	Average Leachate Head above Geomembrane (in.)	
			Annual	Peak Daily
Plateau	3 *	1000	1.503	24.132
Sideslope	25	165	0.001	0.095

Note: * Surface slope reduced to account for differential settlement, design plateau slope of 4 percent.

FIGURES

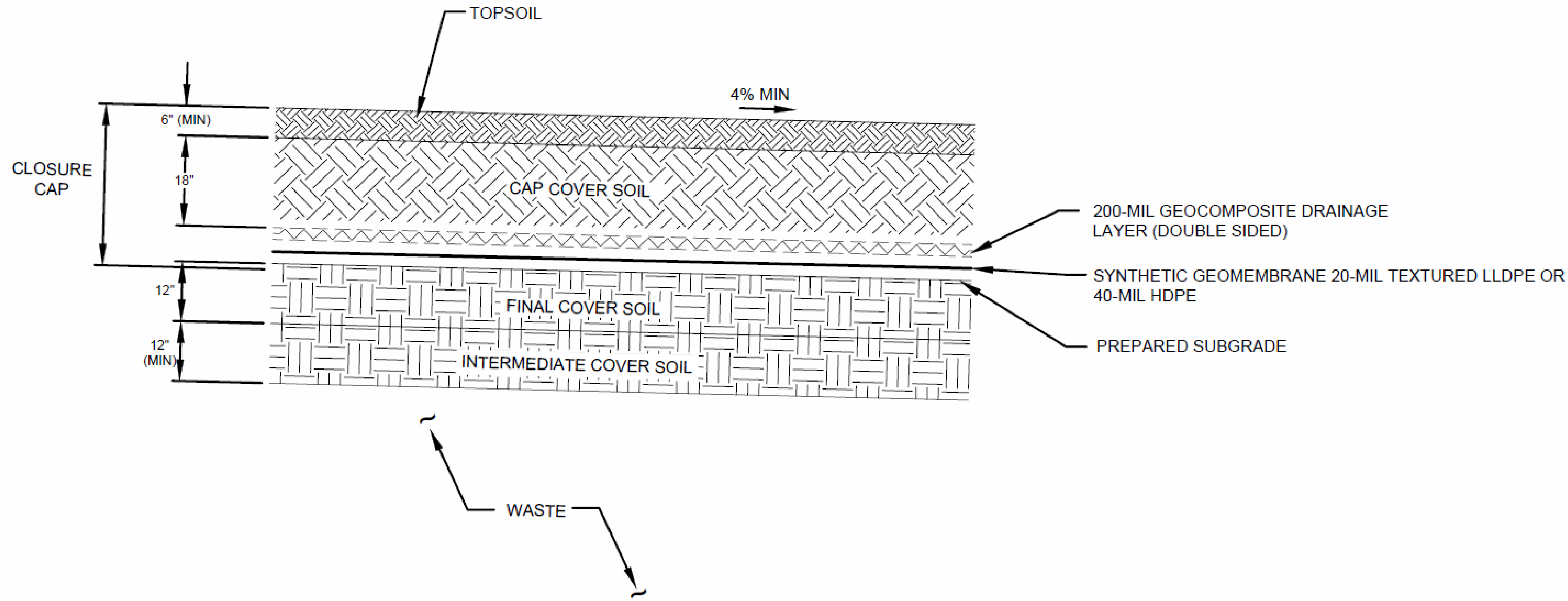


FINAL GRADING PLAN
Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Geosyntec consultants

Columbia, Maryland | July 2020

Figure K.2-1



FINAL COVER SYSTEM
Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Geosyntec consultants

Columbia, Maryland | July 2020

Figure

K-2.2

ATTACHMENT 1

GSE FABRINET GEOCOMPOSITE DATA SHEET

GSE FabriNet 200 mil Geocomposite

GSE FabriNet geocomposite consists of a 200 mil thick GSE HyperNet geonet heat-laminated on one or both sides with a GSE nonwoven needle-punched geotextile. The geotextile is available in mass per unit area range of 6 oz/yd² to 16 oz/yd². The geocomposite is designed and formulated to perform drainage function under a range of anticipated site loads, gradients and boundary conditions.

[*]

AT THE CORE:
A 200 mil thick HyperNet geonet heat-laminated on one or both sides with a nonwoven needlepunched geotextile.

Product Specifications

Tested Property	Test Method	Frequency	Minimum Average Roll Value[1]		
Geocomposite			6 oz/yd²	8 oz/yd²	10 oz/yd²
Transmissivity[2], gal/min/ft, (m²/sec) Double-Sided Composite Single-Sided Composite	ASTM D 4716	1/540,000 ft²	0.5 (1×10^{-4}) 4.8 (1×10^{-3})	0.5 (1×10^{-4}) 4.8 (1×10^{-3})	0.4 (9×10^{-5}) 4.3 (9×10^{-4})
Ply Adhesion, lb/in	ASTM D 7005	1/50,000 ft²	1.0	1.0	1.0
Geonet Core[1,3] – GSE HyperNet					
Geonet Core Thickness, mil	ASTM D 5199	1/50,000 ft²	200	200	200
Transmissivity[2], gal/min/ft (m²/sec)	ASTM D 4716		9.6 (2×10^{-3})	9.6 (2×10^{-3})	9.6 (2×10^{-3})
Density, g/cm³	ASTM D 1505	1/50,000 ft²	0.94	0.94	0.94
Tensile Strength (MD), lb/in	ASTM D 7179	1/50,000 ft²	45	45	45
Carbon Black Content, %	ASTM D 4218	1/50,000 ft²	2.0	2.0	2.0
Geotextile[1,3]					
Mass per Unit Area, oz/yd²	ASTM D 5261	1/90,000 ft²	6	8	10
Grab Tensile Strength, lb	ASTM D 4632	1/90,000 ft²	160	220	260
Grab Elongation	ASTM D 4632	1/90,000 ft²	50%	50%	50%
CBR Puncture Strength, lb	ASTM D 6241	1/540,000 ft²	435	575	725
Trapezoidal Tear Strength, lb	ASTM D 4533	1/90,000 ft²	65	90	100
AOS, US sieve[1], (mm)	ASTM D 4751	1/540,000 ft²	70 (0.212)	80 (0.180)	100 (0.150)
Permittivity, sec^{-1}	ASTM D 4491	1/540,000 ft²	1.5	1.3	1.0
Water Flow Rate, gpm/ft²	ASTM D 4491	1/540,000 ft²	110	95	75
UV Resistance, % retained	ASTM D 4355 (after 500 hours)	per formulation	70	70	70
NOMINAL ROLL DIMENSIONS[4]					
Roll Width, ft			14.75	14.75	14.75
Roll Length, ft	Double-Sided Composite Single-Sided Composite		270 300	260 300	230 290
Roll Area, ft²	Double-Sided Composite Single-Sided Composite		3,982 4,425	3,835 4,425	3,392 4,277

NOTES:
- [1] All geotextile properties are minimum average roll values except AOS which is maximum average roll value and UV resistance is typical value. Geonet core thickness is nominal value.
- [2] Gradient of 0.1, normal load of 10,000 psf, water at 70°F between steel plates for 15 minutes. Contact GSE for performance transmissivity value for use in design.
- [3] Component properties prior to lamination.
- [4] Roll widths and lengths have a tolerance of ±1%.

GSE is a leading manufacturer and marketer of geosynthetic lining products and services. We've built a reputation of reliability through our dedication to providing consistency of product, price and protection to our global customers.

Our commitment to innovation, our focus on quality and our industry expertise allow us the flexibility to collaborate with our clients to develop a custom, purpose-fit solution.

[DURABILITY RUNS DEEP] For more information on this product and others, please visit us at GSEworld.com, call 800.435.2008 or contact your local sales office.

GSE ENVIRONMENTAL™

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Fax: (706) 336-7007
E-Mail: contact@skaps.com

SKAPS TRANSNET™ HDPE GEOCOMPOSITE WITH TN 220 GEONET

SKAPS TRANSNET™ Geocomposite consists of SKAPS Geonet made from HDPE resin with nonwoven polypropylene geotextile fabric heat bonded on one side or both sides of Geonet.

PROPERTY	TEST METHOD	UNIT	VALUE		QUALIFIER
GEONET					
Thickness	ASTM D 5199	mil	200	200	MAV(3)
Carbon Black	ASTM D 4218	%	2.0	2.0	MAV
Tensile Strength	ASTM D 7179	lb/in	45	45	MAV
Melt Flow	ASTM D 1238(2)	g/10 min	1.0	1.0	Maximum
Density	ASTM D 1505	g/cm^3	0.94	0.94	MAV
Transmissivity(1)	ASTM D 4716	gal/min/ft (m^2/sec)	9.67 (2.0 x 10^{-3})	9.67 (2.0 x 10^{-3})	MAV
GEOCOMPOSITE			**6 oz/yd^2**	**8 oz/yd^2**	
Ply Adhesion	ASTM D 7005	lb/in	1.00	1.00	MAV
Transmissivity(1) DS	ASTM D 4716	gal/min/ft (m^2/sec)	**TN 220-2-6**	**TN 220-2-8**	
			0.48 (1.0 x 10^{-4})	0.48 (1.0 x 10^{-4})	MAV
Transmissivity(1) SS	ASTM D 4716	gal/min/ft (m^2/sec)	**TN 220-1-6**	**TN 220-1-8**	
			4.83 (1.0 X 10^{-3})	4.83 (1.0 X 10^{-3})	MAV
GEOTEXTILE					
Fabric Weight	ASTM D 5261	oz/yd^2	6	8	MARV(4)
Grab Tensile	ASTM D 4632	lb	160	225	MARV
Grab Elongation	ASTM D 4632	%	50	50	MARV
Trapezoid Tear	ASTM D 4533	lb	65	90	MARV
CBR Puncture	ASTM D 6241	lb	450	600	MARV
Water Flow(5)	ASTM D 4491	gpm/ft^2	125	100	MARV
Permittivity(5)	ASTM D 4491	sec^{-1}	1.63	1.26	MARV
Permeability(5)	ASTM D 4491	cm/sec	0.30	0.30	MARV
AOS	ASTM D 4751	US Sieve	70	80	MaxARV

Notes:

(1) Transmissivity measured using water at 21 $\pm$ 2 °C (70 $\pm$ 4 °F) with a gradient of 0.1 and a confining pressure of 10000 psf between steel plates after 15 minutes. Values may vary with individual labs.
DS - Double Sided, SS - Single Sided

(2) Condition 190/2.16

(3) Minimum average value.

(4) MARV is statistically defined as mean minus two standard deviations and it is the value which is exceeded by 97.5% of all the test data.

(5) At the time of manufacturing. Handling may change these properties.

This information is provided for reference purposes only and is not intended as a warranty or guarantee.

SKAPS assumes no liability in connection with the use of this information. Geotextile and Geonet properties are prior to lamination.

ATTACHMENT 2

HELP MODEL OUTPUT
FOR PLATEAU

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    C:\HELP3\M2_4_1.D4
TEMPERATURE DATA FILE:      C:\HELP3\M2_7_1.D7
SOLAR RADIATION DATA FILE:  C:\HELP3\M2_13_1.D13
EVAPOTRANSPIRATION DATA:    C:\HELP3\M2_11_1.D11
SOIL AND DESIGN DATA FILE:  C:\HELP3\M2_10_1.D10
OUTPUT DATA FILE:           C:\HELP3\M2_OUT_1.OUT


TIME:   9:22     DATE:   8/28/2019


******************************************************************************

     TITLE:  TRL CAP DESIGN EVALUATION PLATEAU

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
```



```
                       MATERIAL TEXTURE NUMBER  13
         THICKNESS                  =     24.00   INCHES
         POROSITY                   =      0.4300 VOL/VOL
         FIELD CAPACITY             =      0.3210 VOL/VOL
         WILTING POINT              =      0.2210 VOL/VOL
         INITIAL SOIL WATER CONTENT =      0.4077 VOL/VOL
         EFFECTIVE SAT. HYD. COND.  =  0.330000003000E-04 CM/SEC
       NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
                FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                  LAYER  2
                                  --------

                       TYPE 2 - LATERAL DRAINAGE LAYER
                       MATERIAL TEXTURE NUMBER   0
         THICKNESS                  =      0.20   INCHES
         POROSITY                   =      0.8500 VOL/VOL
         FIELD CAPACITY             =      0.0100 VOL/VOL
         WILTING POINT              =      0.0050 VOL/VOL
         INITIAL SOIL WATER CONTENT =      0.8500 VOL/VOL
         EFFECTIVE SAT. HYD. COND.  =   2.27999997000     CM/SEC
         SLOPE                      =      3.00   PERCENT
         DRAINAGE LENGTH            =   1000.0    FEET


                                  LAYER  3
                                  --------

                       TYPE 4 - FLEXIBLE MEMBRANE LINER
                       MATERIAL TEXTURE NUMBER  35
         THICKNESS                  =      0.04   INCHES
         POROSITY                   =      0.0000 VOL/VOL
         FIELD CAPACITY             =      0.0000 VOL/VOL
         WILTING POINT              =      0.0000 VOL/VOL
         INITIAL SOIL WATER CONTENT =      0.0000 VOL/VOL
         EFFECTIVE SAT. HYD. COND.  =  0.199999996000E-12 CM/SEC
         FML PINHOLE DENSITY        =      2.00   HOLES/ACRE
         FML INSTALLATION DEFECTS   =      2.00   HOLES/ACRE
         FML PLACEMENT QUALITY      =  3 - GOOD
```

LAYER 4

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 13

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4300 VOL/VOL
FIELD CAPACITY	=	0.3210 VOL/VOL
WILTING POINT	=	0.2210 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3212 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.330000003000E-04 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #13 WITH A FAIR STAND OF GRASS, A SURFACE SLOPE OF 3.% AND A SLOPE LENGTH OF 1000. FEET.

SCS RUNOFF CURVE NUMBER	=	87.60
FRACTION OF AREA ALLOWING RUNOFF	=	100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000 ACRES
EVAPORATIVE ZONE DEPTH	=	21.0 INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	8.494 INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	9.030 INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	4.641 INCHES
INITIAL SNOW WATER	=	0.000 INCHES
INITIAL WATER IN LAYER MATERIALS	=	17.663 INCHES
TOTAL INITIAL WATER	=	17.663 INCHES
TOTAL SUBSURFACE INFLOW	=	0.00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM BALTIMORE MARYLAND

STATION LATITUDE	=	39.18 DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	102

END OF GROWING SEASON (JULIAN DATE)	=	300
EVAPORATIVE ZONE DEPTH	=	21.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	9.30 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	62.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	65.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	68.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR BALTIMORE MARYLAND

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.00	2.98	3.72	3.35	3.44	3.76
3.89	4.62	3.46	3.11	3.11	3.40

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR BALTIMORE MARYLAND

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
32.70	34.70	43.30	54.00	63.40	72.20
76.80	75.60	68.90	56.90	46.30	36.50

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR BALTIMORE MARYLAND AND STATION LATITUDE = 39.18 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.50	3.30	3.36	3.35	3.77	3.77
	3.77	5.57	3.38	2.65	2.96	3.00
STD. DEVIATIONS	1.25	1.51	1.27	1.69	1.70	2.29
	1.76	2.71	2.41	1.41	1.46	1.56
RUNOFF						
TOTALS	0.563	1.149	0.628	0.092	0.153	0.300
	0.347	0.570	0.452	0.220	0.160	0.346
STD. DEVIATIONS	0.855	1.200	1.033	0.148	0.296	0.474
	0.652	0.683	0.630	0.383	0.217	0.829
EVAPOTRANSPIRATION						
TOTALS	1.090	1.036	2.484	2.851	3.618	4.071
	3.587	3.935	2.512	1.376	1.341	1.045
STD. DEVIATIONS	0.337	0.426	0.407	0.859	0.840	1.478
	1.489	1.487	0.840	0.424	0.276	0.179
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	1.1143	0.7505	1.3712	0.5718	0.4225	0.2694
	0.1111	0.2017	0.3653	0.3308	0.7965	1.1001
STD. DEVIATIONS	0.8916	0.6840	0.6590	0.6126	0.5143	0.4986
	0.2454	0.3513	0.6261	0.4703	0.6921	0.8346
PERCOLATION/LEAKAGE THROUGH LAYER 3						
TOTALS	0.0134	0.0067	0.0150	0.0026	0.0016	0.0014
	0.0003	0.0015	0.0030	0.0012	0.0063	0.0116
STD. DEVIATIONS	0.0196	0.0134	0.0182	0.0070	0.0037	0.0044
	0.0010	0.0054	0.0075	0.0032	0.0096	0.0173
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0133	0.0065	0.0146	0.0028	0.0023	0.0017
	0.0005	0.0016	0.0035	0.0014	0.0074	0.0118
STD. DEVIATIONS	0.0164	0.0106	0.0132	0.0071	0.0052	0.0052
	0.0016	0.0050	0.0087	0.0037	0.0103	0.0155

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3						
AVERAGES	3.7192	2.0006	4.1521	0.7077	0.4197	0.3818
	0.0751	0.4242	0.8445	0.3316	1.7814	3.1994
STD. DEVIATIONS	5.4932	4.0300	5.1089	2.0101	0.9988	1.2575
	0.2532	1.5136	2.1534	0.8740	2.7607	4.8617

****

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.37 (6.611)	150156.2	100.00
RUNOFF	4.980 (2.3527)	18078.70	12.040
EVAPOTRANSPIRATION	28.946 (3.6172)	105072.70	69.976
LATERAL DRAINAGE COLLECTED FROM LAYER 2	7.40516 (2.85223)	26880.727	17.90185
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.06448 (0.04651)	234.070	0.15588
AVERAGE HEAD ON TOP OF LAYER 3	1.503 (1.111)		
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.06731 (0.03941)	244.350	0.16273
CHANGE IN WATER STORAGE	-0.033 (1.2893)	-120.30	-0.080

****

```
******************************************************************************

            PEAK DAILY VALUES FOR YEARS     1 THROUGH   30
   ------------------------------------------------------------------------
                                               (INCHES)      (CU. FT.)
                                              ----------    -------------
      PRECIPITATION                              5.68         20618.398

      RUNOFF                                     3.039        11029.8135

      DRAINAGE COLLECTED FROM LAYER  2           0.07774        282.18137

      PERCOLATION/LEAKAGE THROUGH LAYER  3       0.002784        10.10427

      AVERAGE HEAD ON TOP OF LAYER  3           24.132

      MAXIMUM HEAD ON TOP OF LAYER  3           38.910

      LOCATION OF MAXIMUM HEAD IN LAYER  2
            (DISTANCE FROM DRAIN)              193.1 FEET

      PERCOLATION/LEAKAGE THROUGH LAYER  4       0.003534        12.82975

      SNOW WATER                                 3.90         14161.6172


      MAXIMUM VEG. SOIL WATER (VOL/VOL)                  0.4300

      MINIMUM VEG. SOIL WATER (VOL/VOL)                  0.2210


       ***  Maximum heads are computed using McEnroe's equations.  ***

            Reference:  Maximum Saturated Depth over Landfill Liner
                        by Bruce M. McEnroe, University of Kansas
                        ASCE Journal of Environmental Engineering
                        Vol. 119, No. 2, March 1993, pp. 262-270.

******************************************************************************
```



```
******************************************************************************

                   FINAL WATER STORAGE AT END OF YEAR   30
    ----------------------------------------------------------------------
                   LAYER        (INCHES)       (VOL/VOL)
                   -----        --------       ---------
                     1           8.8746         0.3698

                     2           0.1700         0.8500

                     3           0.0000         0.0000

                     4           7.6245         0.3177

                 SNOW WATER      0.000

******************************************************************************
******************************************************************************
```

ATTACHMENT 3

HELP MODEL OUTPUT
FOR SIDESLOPE

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    C:\HELP3\M2_4_2.D4
TEMPERATURE DATA FILE:      C:\HELP3\M2_7_2.D7
SOLAR RADIATION DATA FILE:  C:\HELP3\M2_13_2.D13
EVAPOTRANSPIRATION DATA:    C:\HELP3\M2_11_2.D11
SOIL AND DESIGN DATA FILE:  C:\HELP3\M2_10_2.D10
OUTPUT DATA FILE:           C:\HELP3\M2_OUT_2.OUT


TIME:  11:31     DATE:   2/ 6/2020


******************************************************************************

     TITLE:  TRL CAP DESIGN EVALUATION SIDE SLOPES

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
            COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                LAYER  1
                                --------

                   TYPE 1 - VERTICAL PERCOLATION LAYER
```



```
                        MATERIAL TEXTURE NUMBER  13
          THICKNESS                  =     24.00   INCHES
          POROSITY                   =      0.4300 VOL/VOL
          FIELD CAPACITY             =      0.3210 VOL/VOL
          WILTING POINT              =      0.2210 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.3514 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.330000003000E-04 CM/SEC
        NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
                 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                LAYER  2
                                --------

                      TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER   0
          THICKNESS                  =      0.20   INCHES
          POROSITY                   =      0.8500 VOL/VOL
          FIELD CAPACITY             =      0.0100 VOL/VOL
          WILTING POINT              =      0.0050 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.0301 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =   2.27999997000     CM/SEC
          SLOPE                      =     25.00   PERCENT
          DRAINAGE LENGTH            =    165.0    FEET


                                LAYER  3
                                --------

                      TYPE 4 - FLEXIBLE MEMBRANE LINER
                        MATERIAL TEXTURE NUMBER  35
          THICKNESS                  =      0.04   INCHES
          POROSITY                   =      0.0000 VOL/VOL
          FIELD CAPACITY             =      0.0000 VOL/VOL
          WILTING POINT              =      0.0000 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.0000 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.199999996000E-12 CM/SEC
          FML PINHOLE DENSITY        =      2.00   HOLES/ACRE
          FML INSTALLATION DEFECTS   =      2.00   HOLES/ACRE
          FML PLACEMENT QUALITY      =  3 - GOOD
```

LAYER 4

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 13

```
THICKNESS                  =     24.00   INCHES
POROSITY                   =      0.4300 VOL/VOL
FIELD CAPACITY             =      0.3210 VOL/VOL
WILTING POINT              =      0.2210 VOL/VOL
INITIAL SOIL WATER CONTENT =      0.3210 VOL/VOL
EFFECTIVE SAT. HYD. COND.  =  0.330000003000E-04 CM/SEC
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE #13 WITH A
FAIR STAND OF GRASS, A SURFACE SLOPE OF 25.%
AND A SLOPE LENGTH OF 165. FEET.

```
SCS RUNOFF CURVE NUMBER            =     89.30
FRACTION OF AREA ALLOWING RUNOFF   =    100.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE =      1.000  ACRES
EVAPORATIVE ZONE DEPTH             =     21.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE  =      7.290  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE =      9.030  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE =      4.641  INCHES
INITIAL SNOW WATER                 =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS   =     16.142  INCHES
TOTAL INITIAL WATER                =     16.142  INCHES
TOTAL SUBSURFACE INFLOW            =      0.00   INCHES/YEAR
```

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
BALTIMORE MARYLAND

```
STATION LATITUDE                       =  39.18 DEGREES
MAXIMUM LEAF AREA INDEX                =   2.00
START OF GROWING SEASON (JULIAN DATE)  =    102
```



```
END OF GROWING SEASON (JULIAN DATE)    =    300
EVAPORATIVE ZONE DEPTH                 =  21.0  INCHES
AVERAGE ANNUAL WIND SPEED              =   9.30 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY  =  62.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY  =  65.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY  =  71.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY  =  68.00 %
```

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BALTIMORE MARYLAND

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.00	2.98	3.72	3.35	3.44	3.76
3.89	4.62	3.46	3.11	3.11	3.40

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BALTIMORE MARYLAND

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
32.70	34.70	43.30	54.00	63.40	72.20
76.80	75.60	68.90	56.90	46.30	36.50

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BALTIMORE MARYLAND
AND STATION LATITUDE = 39.18 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

```
                     JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                     -------  -------  -------  -------  -------  -------
PRECIPITATION
-------------
  TOTALS               2.50     3.30     3.36     3.35     3.77     3.77
                       3.77     5.57     3.38     2.65     2.96     3.00

  STD. DEVIATIONS      1.25     1.51     1.27     1.69     1.70     2.29
                       1.76     2.71     2.41     1.41     1.46     1.56

RUNOFF
------
  TOTALS               0.538    1.196    0.668    0.182    0.277    0.435
                       0.488    0.817    0.627    0.310    0.291    0.421

  STD. DEVIATIONS      0.746    1.180    0.982    0.263    0.458    0.626
                       0.779    0.866    0.835    0.452    0.328    0.793

EVAPOTRANSPIRATION
------------------
  TOTALS               1.085    1.035    2.481    2.838    3.637    4.187
                       3.524    3.873    2.482    1.349    1.326    1.029

  STD. DEVIATIONS      0.335    0.425    0.398    0.868    0.844    1.452
                       1.441    1.473    0.818    0.420    0.262    0.180

LATERAL DRAINAGE COLLECTED FROM LAYER  2
----------------------------------------
  TOTALS               1.0169   0.6945   1.3026   0.3816   0.2808   0.1490
                       0.0255   0.0821   0.2132   0.1857   0.7759   1.1642

  STD. DEVIATIONS      1.1451   0.8692   0.8835   0.4548   0.4197   0.2751
                       0.0805   0.2808   0.5841   0.3482   0.7524   1.1625

PERCOLATION/LEAKAGE THROUGH LAYER  3
------------------------------------
  TOTALS               0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                       0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

  STD. DEVIATIONS      0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                       0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

PERCOLATION/LEAKAGE THROUGH LAYER  4
------------------------------------
  TOTALS               0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                       0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

  STD. DEVIATIONS      0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
```



```
                            0.0000   0.0000   0.0000   0.0002   0.0002   0.0000

-------------------------------------------------------------------------------
              AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


  DAILY AVERAGE HEAD ON TOP OF LAYER  3
  -------------------------------------
    AVERAGES                0.0018   0.0013   0.0023   0.0007   0.0005   0.0003
                            0.0000   0.0001   0.0004   0.0003   0.0014   0.0020

    STD. DEVIATIONS         0.0020   0.0016   0.0015   0.0008   0.0007   0.0005
                            0.0001   0.0005   0.0011   0.0006   0.0014   0.0020

*******************************************************************************


*******************************************************************************

     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH   30
-------------------------------------------------------------------------------
                                     INCHES           CU. FEET      PERCENT
                               -------------------  ------------  ---------
 PRECIPITATION                 41.37    (   6.611)     150156.2     100.00

 RUNOFF                         6.250   (  2.6009)      22686.77     15.109

 EVAPOTRANSPIRATION            28.846   (  3.5231)     104710.70     69.735

 LATERAL DRAINAGE COLLECTED     6.27200 (  2.64808)     22767.355   15.16245
   FROM LAYER  2

 PERCOLATION/LEAKAGE THROUGH    0.00008 (  0.00003)        0.293     0.00019
   LAYER  3

 AVERAGE HEAD ON TOP            0.001 (    0.000)
   OF LAYER  3

 PERCOLATION/LEAKAGE THROUGH    0.00006 (  0.00022)        0.207     0.00014
   LAYER  4

 CHANGE IN WATER STORAGE       -0.002   (  1.0722)        -8.90     -0.006

*******************************************************************************
```

****

PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	5.68	20618.398
RUNOFF	3.482	12638.0059
DRAINAGE COLLECTED FROM LAYER 2	0.75019	2723.18872
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.000008	0.02732
AVERAGE HEAD ON TOP OF LAYER 3	0.041	
MAXIMUM HEAD ON TOP OF LAYER 3	0.095	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	0.0 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000855	3.10331
SNOW WATER	3.90	14161.6172

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4100

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.2210

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

****

****

FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	8.3611	0.3484
2	0.0037	0.0183
3	0.0000	0.0000
4	7.7039	0.3210
SNOW WATER	0.000	

****
****

Geosyntec
consultants

Appendix K.3: Final Cover System Settlement Analysis

Geosyntec consultants

COMPUTATION COVER SHEET

Client: Tolson & Associates **Project:** TRL Vertical Expansion **Project #:** ME1606 **Task #:** 03

TITLE OF COMPUTATIONS FINAL COVER SYSTEM SETTLEMENT ANALYSIS

COMPUTATIONS BY: Signature ______ August 4, 2020 DATE

Printed Name and Title: Julia Roberts, Professional

ASSUMPTIONS AND PROCEDURES CHECKED BY: (Peer Reviewer) Signature ______ August 4, 2020 DATE

Printed Name and Title: Andrew Stallings, Engineer

COMPUTATIONS CHECKED BY: Signature ______ August 4, 2020 DATE

Printed Name and Title: Andrew Stallings, Engineer

COMPUTATIONS BACKCHECKED BY: (Originator) Signature ______ August 4, 2020 DATE

Printed Name and Title: Julia Roberts, Professional

APPROVED BY: (PM or Designate) Signature Jenny Ramirez ______ August 4, 2020 DATE

Printed Name and Title: Jenny Ramirez, Professional

APPROVAL NOTES: ______

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

FINAL COVER SYSTEM SETTLEMENT ANALYSIS

PURPOSE

The purpose of this calculation is to evaluate settlement of the final cover system at the Tolson Rubble Landfill (TRL), located in Crofton, Maryland. The calculations presented herein provide an estimate of settlement of the proposed cover system components largely due to secondary consolidation processes of the underlying construction and demolition (C&D) waste materials. Consolidation of various locations across the final cover system are used to calculate differential settlement which is ultimately used to estimate post-settlement grades and the development of strain in the final cover geomembrane.

METHOD OF ANALYSIS

Settlement

Total settlement of soils and waste is typically attributed to three independent mechanisms: (i) elastic settlement; (ii) primary consolidation; and (iii) secondary consolidation. The total settlement (S_t) can be calculated as follows:

$$S_t = S_i + S_p + S_s \tag{1}$$

where,

S_i = elastic settlement (immediate);

S_p = primary consolidation settlement (time and surcharge dependent); and

S_s = secondary consolidation settlement (time dependent).

The settlement of the cover system placed on top of waste is a consequence of waste consolidation. Primary consolidation settlement due to the waste self-weight is excluded from the analysis of the cover considering that primary settlement of the waste occurs within the first three months after waste placement [Fasset et al., 1994]. Similarly, primary consolidation due to the 2-ft cover self-weight is considered minimal. Therefore, the deformation of the final cover system which is constructed at the end of the landfill operation is primarily a consequence of the secondary consolidation of the waste.

Secondary consolidation settlement (S_s) is a process that begins immediately after completion of primary consolidation due to degradation of the waste, particle rearrangement, and creep. Given the expected operational lifetime of the landfill, it is expected that secondary consolidation will already have commenced in each cell prior to final cover construction. However, secondary consolidation which occurs prior to final cover construction will not affect final cover grades and geomembrane strain. Therefore, rather than using time to the end of primary consolidation as the starting point for accumulation of secondary consolidation settlement, the secondary consolidation settlement for the final cover can be calculated during the time period between the construction of the final cover and the end of post-closure care as follows:

$$S_s = H \frac{C_\alpha}{1+e_o} \log\left(\frac{t_2}{t_1}\right) \quad (2)$$

where

H = waste thickness;

C_α = secondary compression index;

e_0 = initial void ratio;

t_1 = average age of waste at construction of final cover; and

t_2 = average age of waste at end of post-closure care.

<u>Differential Settlement and Geomembrane Tensile Strain</u>

Differential settlement refers to the settlement of two separate locations relative to one another and is evaluated to determine the change in slope of the cover system due to settlement. Differential settlement (ΔS) is calculated as follows:

$$\Delta S = S_1 - S_2 \quad (3)$$

where,

S_1 = total settlement at first location; and

S_2 = total settlement at second location.

The change in grade resulting from differential settlement is calculated as follows:

$$\Delta Grade\ (\%) = \left(\frac{\Delta S}{L}\right) \times 100\% \quad (4)$$

where,

L = horizontal distance between locations of interest.

The resulting tensile strain in a geomembrane (ε) is calculated using the following equation proposed by Giroud [1977]:

$$\varepsilon\ (\%) = \frac{8}{3}\left(\frac{\Delta S}{L}\right)^2 \times 100\% \qquad (5)$$

INPUT DATA

Material Properties

Values of secondary compression ratio ($C_{\varepsilon\alpha}$) for municipal solid waste (MSW) typically range from 0.01 to 0.03 [Fasset et al., 1994]. Waste at a construction and demolition (C&D) landfill will settle less than a landfill with high organic content. In order to estimate the secondary compression of the future C&D waste to be placed at TRL, a compression ratio ($C_{\varepsilon\alpha}$) value of 0.01 is assumed because it is at the lower end of the range of typical values for MSW waste. $C_{\varepsilon\alpha}$ is related to C_α as follows:

$$C_{\varepsilon\alpha} = \frac{C_\alpha}{1+e_o} \qquad (6)$$

Cross-Sections Analyzed

Settlement of the final cover system due to waste settlement is examined along two cross-sections, namely A-A' and B-B'. These two sections were selected for analysis because they were identified as most likely to experience a reversal of slope grading due to cover settlement. Figures 1 and 2 present the plan view of the locations of the analyzed cross-sections in the proposed base liner and final cover grades, respectively. The design slope of the final cover system is 2 percent along A-A' and 2.75 percent along B-B'.

Construction Sequence and Time

The time at construction of the final cover (t_1) is assumed to be equal to the age of the waste at that point in time. The time at the end of post-closure care (t_2) is assumed to be an additional 30 years from the construction of the final cover.

The proposed construction of the TRL will provide approximately 9,440,000 cubic yards (cy) of solid waste disposal capacity. It is projected that the annual waste tonnage accepted for disposal will be about 400,000 tons starting in Year 1 of TRL, with a conservative airspace utilization factor of 0.6 tons/cy, which is approximately equivalent to 667,000 cy of landfill volume consumed per year. The expected service life of TRL is approximately 14 years.

To evaluate the age of the waste in this analysis, it is assumed that each cell will be filled completely in sequence (i.e., Cell 1, then Cell 2, then Cell 3, etc.). An average age of waste will be used for each cell, which is also equal to the value of t_1. A summary of the $C_{\varepsilon\alpha}$, t_1, and t_2 values are presented in Table 1.

RESULTS

The settlement results for cross sections A-A' and B-B' are presented in Tables 2 and 3. For each point along the cross sections, the tables summarize the cell that the point is over, the horizontal distance along the cross section, the base liner grade elevation, the final cover grade elevation, the waste thickness, settlement, differential settlement, design slope, slope change, post-settlement slope, and strain in the geomembrane.

With waste thicknesses varying from 67 to 133 ft under the final cover, the predicted magnitude of cover settlement ranged from 0.56 to 1.08 ft. The post-settlement slope of the final cover is predicted to be greater than 1.38 percent, which is sufficient for long-term drainage of water on the cover system.

The long-term strain in the geomembrane was estimated to range from 0 to 0.01 percent, which is significantly less than the maximum allowable long-term strain [maximum allowable long-term strain is 4 to 5 percent according to Berg and Bonaparte (1993)].

REFERENCES

Berg, R.R. and Bonaparte, R. (1993). Long-Term Allowable Tensile Stresses for Polyethylene Geomembranes, Geotextiles and Geomembranes, Vol. 12, No. 4, pp. 287-306.

Fasset, J.B., Leonards, G.A., and Repetto, P.C. (1994). Geotechnical Properties of Municipal Solid Wastes and their Use in Landfill Design," Proc. WasteTech 1994, Solid Waste Association of North America.

Giroud, J.P. (1977). Conception de L'etancheite des Ouvrages Hydrauliques par Geomembranes, Proceedings of 1st International Symposium on Plastic and Rubber Waterproofing in Civil Engineering, Vol. 1, Session 3, Paper 13, Liege, Belgium, June (French).

TABLES

Table 1: Cover Settlement Input Parameters
Tolson Rubble Landfill, Crofton, Maryland

Cell	Volume (cy)	Fill Time (yrs)	$C_{\varepsilon\alpha}$	t_1 (yrs)	t_2 (yrs)
Cell 1	944,000	1.42	0.01	13.4	43.4
Cell 2	1,206,222	1.81	0.01	11.8	41.8
Cell 3	1,691,333	2.54	0.01	9.7	39.7
Cell 4	1,520,889	2.28	0.01	7.3	37.3
Cell 5	1,573,333	2.36	0.01	4.9	34.9
Cell 6	891,556	1.34	0.01	3.1	33.1
Cell 7	1,612,667	2.42	0.01	1.2	31.2

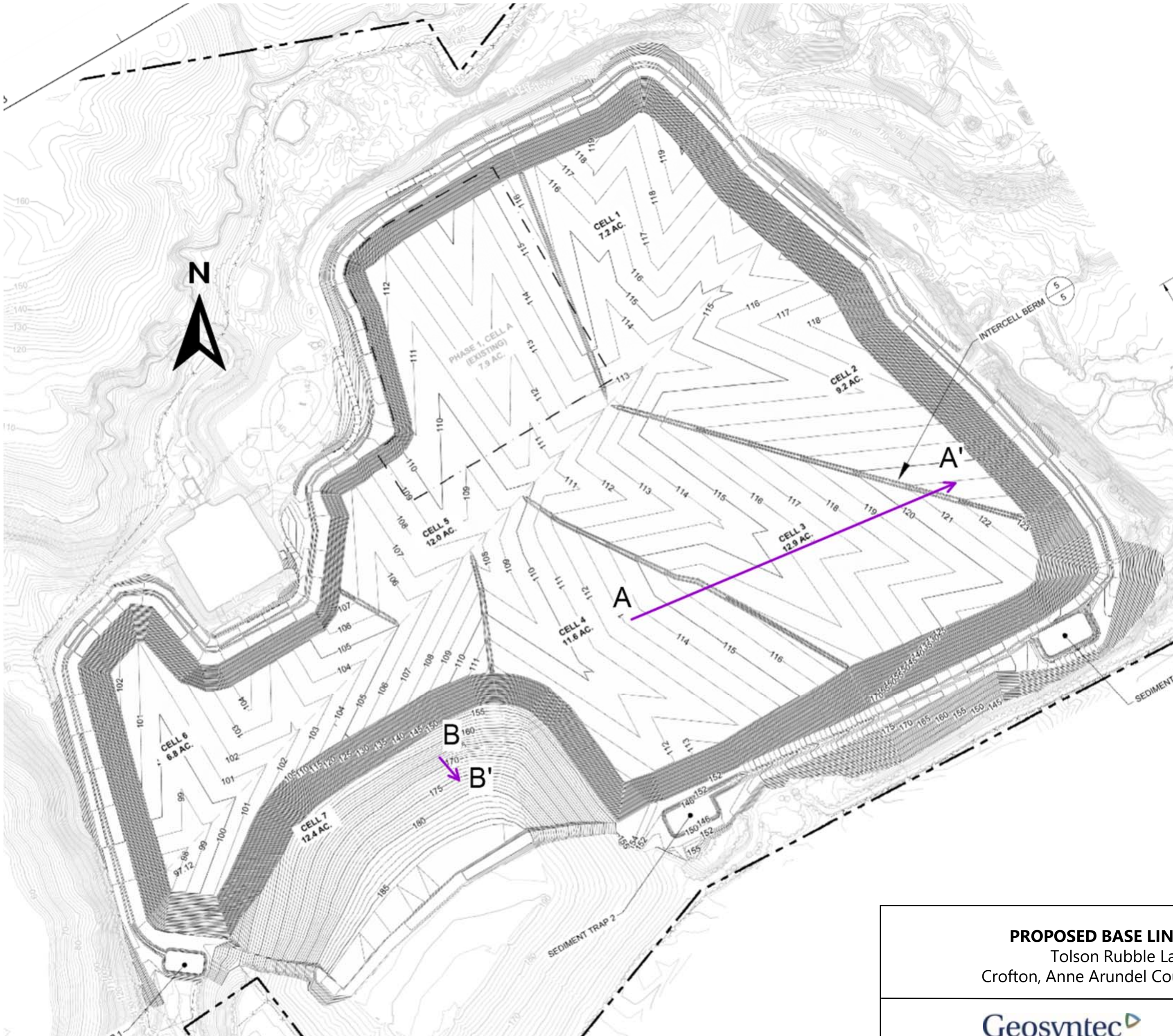
Table 2: Settlement Analysis Results for Section A-A'
Tolson Rubble Landfill, Crofton, Maryland

Point ID	Cell	Horizontal Distance (ft)	Base Grade (ft-msl)	Final Grade (ft-msl)	Waste Thickness, H (ft)	Settlement (ft)	Differential Settlement (ft)	Design Slope (%)	Slope Change (%)	Post-Settlement Slope (%)	Strain (%)
1	4	0	111.3	244.0	132.7	0.94	-	-	-	-	-
2	4	301	116.7	237.9	121.2	0.86	-0.08	2.00	-0.03	1.97	0.0000
3	3	321	116.8	237.5	120.7	0.74	-0.12	2.00	-0.62	1.38	0.0102
4	3	473	114.7	234.4	119.7	0.73	-0.01	2.00	0.00	2.00	0.0000
5	3	560	116.3	232.7	116.4	0.71	-0.02	2.00	-0.02	1.98	0.0000
6	3	619	116.0	231.5	115.5	0.71	-0.01	2.00	-0.01	1.99	0.0000
7	3	927	121.3	225.3	104.0	0.64	-0.07	2.00	-0.02	1.98	0.0000
8	2	953	121.4	224.8	103.4	0.57	-0.07	2.00	-0.28	1.72	0.0021
9	2	1004	121.1	223.8	102.7	0.56	0.00	2.00	-0.01	1.99	0.0000

Table 3: Settlement Analysis Results for Section B-B'
Tolson Rubble Landfill, Crofton, Maryland

Point ID	Cell	Horizontal Distance (ft)	Base Grade (ft-msl)	Final Grade (ft-msl)	Waste Thickness, H (ft)	Settlement (ft)	Differential Settlement (ft)	Design Slope (%)	Slope Change (%)	Post-Settlement Slope (%)	Strain (%)
1	7	0	167.2	244.0	76.8	1.08	-	-	-	-	-
2	7	66	175.0	242.2	67.2	0.95	-0.14	2.75	-0.21	2.54	0.0011

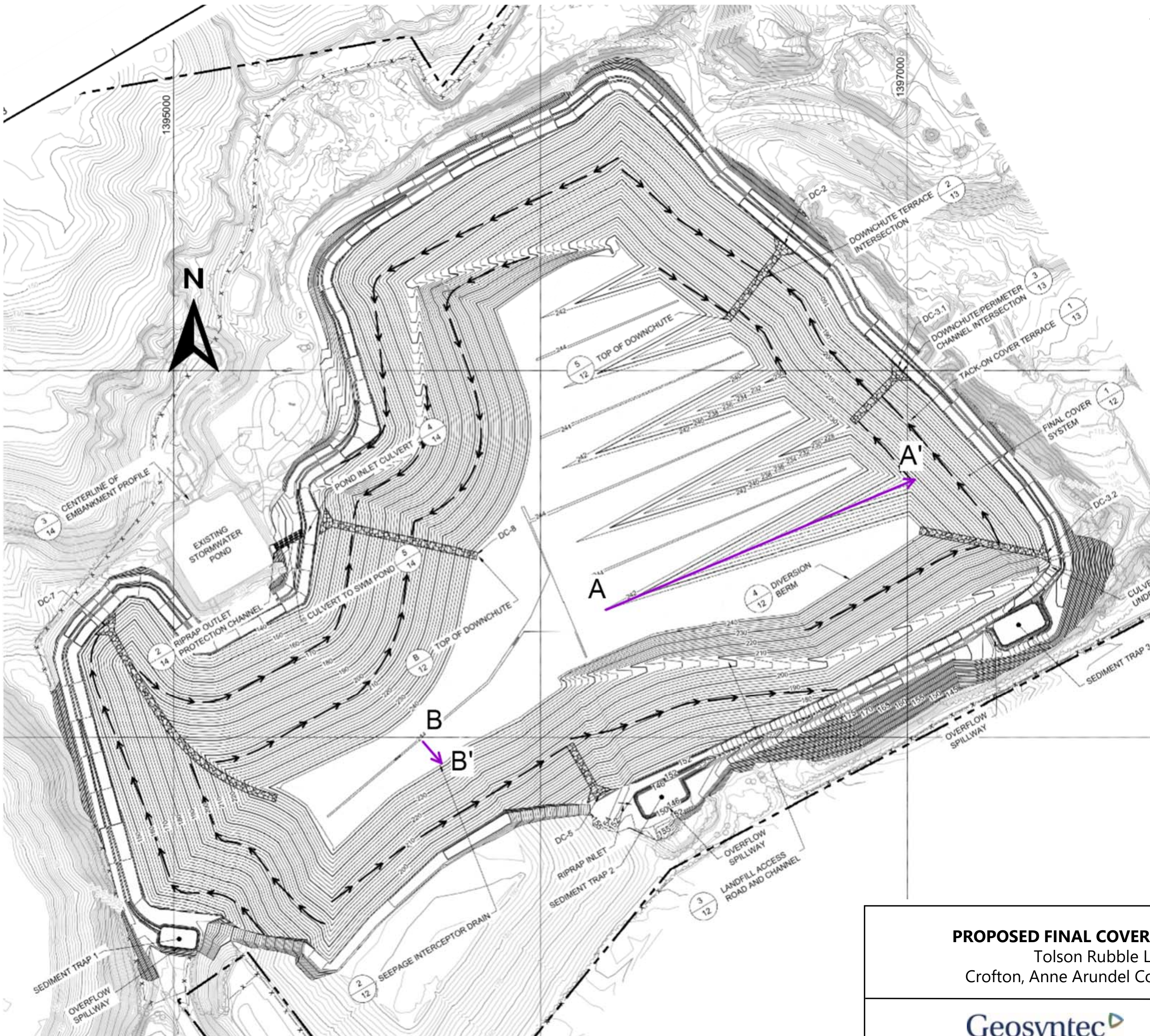
FIGURES



PROPOSED BASE LINER GRADE
Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Geosyntec consultants

Columbia, Maryland	July 2020	**Figure 1**



PROPOSED FINAL COVER SYSTEM GRADE Tolson Rubble Landfill Crofton, Anne Arundel County, Maryland		
Geosyntec consultants		**Figure 2**
Columbia, Maryland	July 2020	

Appendix K.4: Geomembrane Puncture Resistance Analysis

Geosyntec consultants

COMPUTATION COVER SHEET

Client: Tolson & Associates **Project:** TRL Vertical Expansion **Project #:** ME1606 **Task #:** 03

TITLE OF COMPUTATIONS GEOMEMBRANE PUNCTURE RESISTANCE ANALYSIS

COMPUTATIONS BY: Signature ______ DATE: February 7, 2020
Printed Name and Title: Julia Roberts, Professional

ASSUMPTIONS AND PROCEDURES CHECKED BY: (Peer Reviewer) Signature ______ DATE: February 13, 2020
Printed Name and Title: Sean O'Donnell, Engineer

COMPUTATIONS CHECKED BY: Signature ______ DATE: February 13, 2020
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COMPUTATIONS BACKCHECKED BY: (Originator) Signature ______ DATE: February 20, 2020
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APPROVED BY: (PM or Designate) Signature Jenny Ramirez ______ DATE: March 6, 2020
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APPROVAL NOTES: ______

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

GEOMEMBRANE PUNCTURE RESISTANCE ANALYSIS

PURPOSE

The purpose of this calculation is to evaluate the puncture resistance of the geomembrane component of the final cover system for the Tolson Rubble Landfill (TRL), located in Crofton, Maryland. For the geomembrane to work effectively as a barrier layer, the integrity and function of the geomembrane should not be compromised by granular materials placed either above or below the geomembrane.

METHOD OF ANALYSIS

This analysis will provide recommendations regarding construction equipment and prepared subgrade to be placed immediately beneath and above the geomembrane to provide an adequate factor of safety against puncture. The factor of safety against puncture for a given loading condition is defined as the ratio of the allowable pressure on the geomembrane (P_{allow}) to the applied pressure ($P_{applied}$), as follows:

$$FS = \frac{P_{allow}}{P_{applied}} \tag{1}$$

For this analysis, the factor of safety is calculated based on an estimate of the force acting on the geomembrane under an assumed loading condition. For the cover system, loading consists of the weight of overlying soil layers and construction traffic. The allowable force on the geomembrane surface is calculated using a modification of the design methodology proposed by Koerner [2012]. An excerpt from Koerner [2012] is included as Attachment 1 to this calculation package.

Allowable Pressure

The allowable pressure on the geomembrane is computed based on the methodology presented by Koerner [2012]. The governing equation is as follows:

$$P_{allow} = \left(50 + 0.00045 \cdot \frac{M}{H^2}\right) \cdot \left(\frac{1}{MF_S \cdot MF_{PD} \cdot MF_A}\right) \cdot \left(\frac{1}{RF_{CR} \cdot RF_{CBD}}\right) \tag{2}$$

where

P_{allow} = allowable pressure on geomembrane (kPa);
M = mass per unit area of a protective geotextile layer (g/m^2);
H = height of protrusion within adjoining soil mass (m);
MF_S = modification factor for protrusion shape;
MF_{PD} = modification factor for packing density;
MF_A = modification factor for arching in soils;
RF_{CR} = reduction factor for long-term creep; and

RF_{CBD} = reduction factor for chemical/biological degradation.

However, this method uses empirical correlations only and does not consider the membrane puncture resistance nor the testing conditions used to obtain that puncture resistance in the laboratory. A better representation is obtained by replacing the first term in Equation (2) with the ultimate puncture resistance (in pounds) of the geomembrane as measured according to ASTM D4833 (F_{lab}). This approach neglects the protection provided by a geotextile (or geocomposite) and the revised equation is as follows:

$$F_{allow} = F_{lab}\left(\frac{1}{MF_S \times MF_{PD} \times MF_A}\right)\left(\frac{1}{RF_{CR} \times RF_{CBD}}\right) \tag{3}$$

The second term in Equation (3) involves modification factors to account for shape, packing density, and arching of soils. The third term in Equation (3) represents the reduction factors to account for long-term creep and degradation of the geomembrane.

In Equation (3), F_{lab} is selected as the minimum required puncture resistance of a 40-mil HDPE textured geomembrane per GRI [2016], which is specified as 60 pounds (Attachment 2). Equation (3) calculates an allowable force on the geomembrane (F_{allow}) considering several modification and reduction factors proposed by Koerner [2012] (see Attachment 1).

Using the diameter of the test probe specified in ASTM D4833 for determining puncture resistance (8 mm diameter), the allowable pressure is calculated as follows:

$$P_{allow} = \frac{F_{allow}}{(\pi D^2/4)} \tag{4}$$

where

D = probe diameter (ASTM D4833, 2013).

Applied Pressure

The total vertical stress on the geomembrane is calculated as the sum of the overlying soil pressures and the pressure exerted by the construction equipment, as follows:

$$P_{applied} = \sum \gamma_m t_m + q_{eqp} \tag{5}$$

where,

$P_{applied}$ = applied pressure on geomembrane (kPa);
γ_m = unit weight of a given material above the geomembrane;
t_m = thickness of a given material above the geomembrane; and

q_{eqp} = equipment ground pressure (acting at the plane of the geomembrane).

Stresses induced by construction equipment at the geomembrane surface will be reduced with increasing thickness of soil cover. In order to calculate the stresses acting directly on the geomembrane liner with overlying soil cover, the stresses from construction equipment are calculated using the 1:2 load spread method. The area over which the equipment weight is distributed at the geomembrane liner is increased at a rate of 1 horizontal to 2 vertical (1H:2V) from the edge of the loaded area at the ground surface, thus reducing the induced stress on the geomembrane. The stress-distributed area (A) at the geomembrane surface is calculated as follows:

$$A = B \times L = (B_g + t) \times (L_g + t) \quad (6)$$

where,

B_g, L_g = width and length of equipment track contact at ground surface;
t = thickness of overlying soil layers; and
L, B = width and length of area under loading at geomembrane plane.

INPUT DATA

Cover System Configuration

The proposed cover system design for the TRL expansion shown in Figure 1 consists of a series of engineered layers over a prepared subgrade composed of the following layers, from top to bottom:

- *Top Soil (6-inch layer)*
- *Protective Cap Cover Soil (18-inch layer)*
- *Drainage Layer (200-mil Geocomposite)*
- *Hydraulic Barrier Layer (40-mil HDPE textured Geomembrane)*
- *Final and Intermediate Cover Soil (24-inch layer)*

The geomembrane of the cover systems is evaluated for puncture from both underlying and overlying soils. During construction of the cover system, it is assumed that the geomembrane will have a minimum soil cover of 1 ft when heavy equipment is driving over it.

Material Properties

The final and intermediate cover soil on top of the waste will be composed of clayey-silty soil with a maximum particle size of 1 inch (25 mm), proof-rolled with a smooth roller prior to placement of the geomembrane. Therefore, protrusions are not expected to be greater than 1 inch (25 mm).

The protective cap cover soil on top of the geocomposite shall also have a maximum particle size of 1 inch (25 mm). The unit weight of final cover system soil was assumed to be 120 pounds per cubic foot (pcf).

Modification and Reduction Factors

The modification and reduction factors are used when calculating allowable pressure on the geomembrane to account for protrusion shape, packing density, soil arching, long-term geomembrane creep, and chemical/biological degradation of the geomembrane. For this analysis, a value of 1.0 was conservatively used for each of the modification factors. A reduction factor of 1.5 was used for long-term creep as suggested for geomembranes with density 825 gm/m^2 and a protrusion height of 25 mm (the design geomembrane has a density of 940 gm/m^2). A reduction factor of 1.1 was used for chemical/biological degradation as suggested for a mild leachate condition (the fluids that the geomembrane in the cover system will be in contact with is clean water from rain rather than leachate generated from the waste). The table below summarizes the modification and reduction factors used in the analysis.

Factor	Value	Description
Protrusion Shape, MF_S	1.0	Angular
Packing Density, MF_{PD}	1.0	Isolated
Soil Arching, MF_A	1.0	Hydrostatic
Long-Term Creep, RF_{CR}	1.5	Geomembrane density 825 gm/m^2, protrusion height 25 mm
Chemical/Biological Degradation, RF_{CBD}	1.1	Mild Leachate

Heavy Equipment Loading

The maximum pressure acting on the geomembrane from construction vehicles is estimated assuming a typical bulldozer (CAT D6R2) and a low-ground-pressure (LGP) bulldozer (CAT D6R2 LGP) (Attachment 3). The weight and track dimensions of the vehicles are summarized in Table 1.

RESULTS AND CONCLUSION

The minimum factor of safety against puncture of the 40-mil HDPE geomembrane is 76 during construction of the cover. A summary of the evaluation is provided in Table 1. Based on the analysis presented herein, it is recommended that the final and intermediate cover soil on top of the waste as well as the protective cap cover soil on top of the geocomposite shall have a maximum particle size of 1 inch (25 mm).

If field conditions are different from those assumed herein, the Engineer shall be notified and the calculations re-evaluated.

REFERENCES

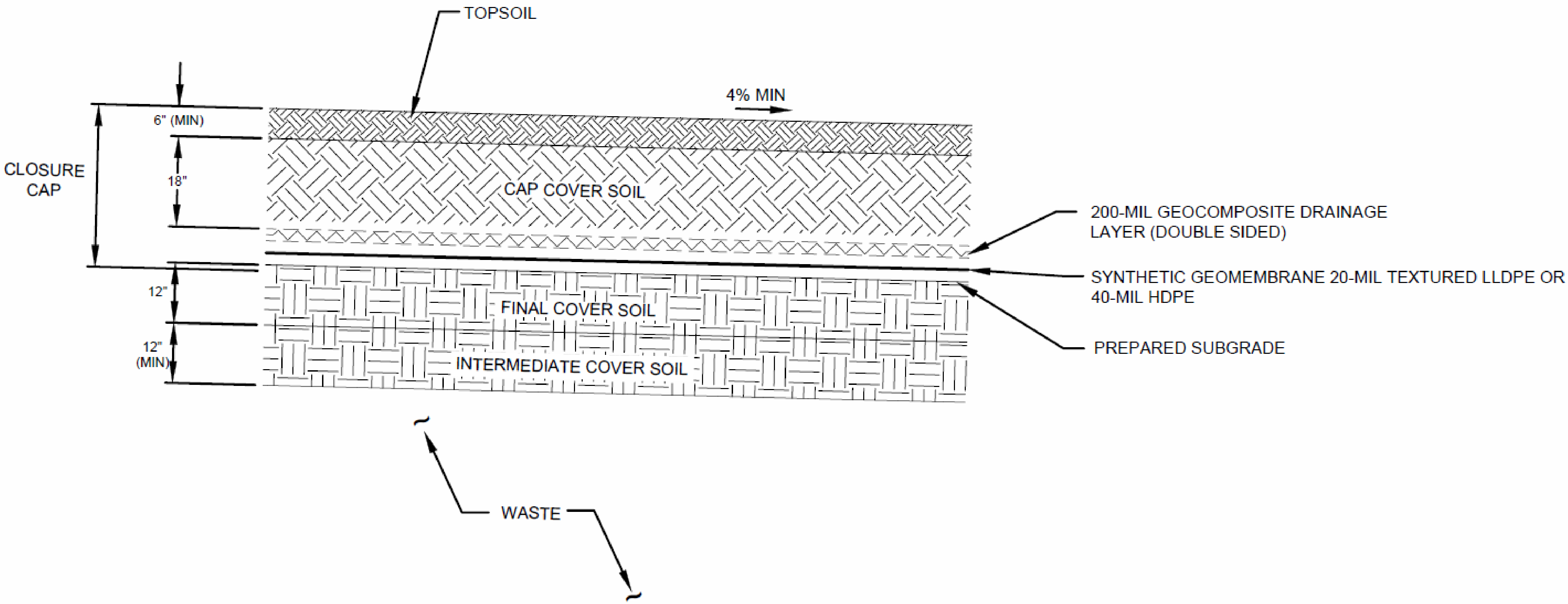
ASTM D4833 / D4833M-07(2013)e1. 2013. *Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products*, ASTM International, West Conshohocken, PA.

Caterpillar. 2017. *Caterpillar Performance Handbook*, Edition 47, Caterpillar, Peoria, Illinois, January.

Geosynthetic Research Institute (GRI). 2016. *Test Methods, Test Properties and Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes, GRI Test Method GM1*3, Revision 14, Geosynthetic Institute, Folsom, Pennsylvania, 6 January.

Koerner, R.M. 2012. *Designing with Geosynthetics*, Sixth Edition, Xlibris, USA.

FIGURES



FINAL COVER SYSTEM
Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Geosyntec consultants

Figure
1

Columbia, Maryland | February 2020

TABLES

Table 1. Cover Geomembrane Puncture Resistance

Tolson Rubble Landfill, Crofton, Maryland

Parameter		D6R2	D6R2 LGP	Final	Units
Material Properties and Loading Conditions					
Test Probe Diameter (ASTM D4833)	H	8	8	8	mm
		0.3	0.3	0.3	in.
Puncture Resistance	F_{lab}	60	60	60	lb
Thickness of Final Cover	t_{fc}	1.0	1.0	2.0	ft
Unit Weight of Final Cover	γ_{fc}	120	120	120	lb/ft^3
Equipment Operating Weight, per track	W_{eqp}	21,017	23,877	-	lbs
Standard Track Shoe Width	B_g	22	36	-	in.
Length of Track on Ground	L_g	104.9	128.9	-	in.
Track Contact Area, per track	A_g	2,308	4,640	-	in^2
Equipment Ground Pressure, per track	q_{eqp}	9.11	5.15	-	psi
Width (at Geomembrane plane), per track	B	2.8	4.0	-	ft
Length (at Geomembrane plane), per track	L	9.7	11.7	-	ft
Total Vertical Stress at Liner	$p_{applied}$	882	629	240.0	lb/ft^2
		6.13	4.37	1.67	psi
Estimated Allowable Pressure on Geomembrane					
Protrusion Shape	MF_S	1.0	1.0	1.0	-
Packing Density	MF_{PD}	1.0	1.0	1.0	-
Soil Arching	MF_A	1.0	1.0	1.0	-
Long-Term Creep	RF_{CR}	1.5	1.5	1.5	-
Chemical/Biological Degradation	RF_{CBD}	1.1	1.1	1.1	-
Geomembrane Allowable Force	F_{allow}	36	36	36	lb
Geomembrane Allowable Pressure	p_{allow}	67,209	67,209	67,209	lb/ft^2
Factor of Safety against Puncture					
Factor of Safety against Puncture	$FS_{puncture}$	76.2	106.9	280.0	-

ATTACHMENT 1

Excerpt from *Designing with Geosynthetics* [Koerner, 2012]

Modification Factors (all ≤ 1.0)					
MF_S		MF_{PD}		MF_A	
Angular	1.0	Isolated	1.0	Hydrostatic	1.0
Subrounded	0.5	Dense, 38 mm	0.83	Geostatic, shallow	0.75
Rounded	0.25	Dense, 25 mm	0.67	Geostatic, mod.	0.50
		Dense, 12 mm	0.50	Geostatic, deep	0.25

Reduction Factors (all ≥ 1.0)					
RF_{CBD}		RF_{CR}			
		Mass per unit area (gm/m^2)	Protrusion Height (mm)		
			38	25	12
Mild leachate	1.1	Geomembrane alone	N/R	N/R	N/R
Moderate leachate	1.3	270	N/R	N/R	N/R
Harsh leachate	1.5	550	N/R	N/R	1.5
		825	N/R	1.5	1.3
		≥ 1100	1.3	1.2	1.1

N/R = Not recommended

$$p_{allow} = \left(50 + 0.00045\frac{M}{H^2}\right)\left[\frac{1}{MF_S \times MF_{PD} \times MF_A}\right]\left[\frac{1}{RF_{CR} \times RF_{CBD}}\right] \qquad (5.34)$$

where

p_{allow} = allowable pressure (kPa),
M = geotextile mass per unit area (g/m^2),
H = protrusion height (m),
MF_S = modification factor for protrusion shape,
MF_{PD} = modification factor for packing density,
MF_A = modification factor for arching in solids,
RF_{CR} = reduction factor for long-term creep (note that these creep reduction factors have been increased since the previous editions of this book, see Koerner et al. [83]), and
RF_{CBD} = reduction factor for long-term chemical/ biological degradation.

ATTACHMENT 2

GSE® Geomembrane Product Data

GSE HD Textured Geomembrane

GSE HD Textured is a co-extruded textured high density polyethylene (HDPE) geomembrane available on one or both sides. It is manufactured from the highest quality resin specifically formulated for flexible geomembranes. This product is used in applications that require increased frictional resistance, excellent chemical resistance and endurance properties.

[*]

AT THE CORE:
An HDPE geomembrane used in applications that require increased frictional resistance, excellent chemical resistance and endurance properties.

Product Specifications

These product specifications meet GRI GM13

Tested Property	Test Method	Frequency	Minimum Average Value				
			30 mil	40 mil	60 mil	80 mil	100 mil
Thickness, mil Lowest individual reading	ASTM D 5994	every roll	30 27	40 36	60 54	80 72	100 90
Density, g/cm³	ASTM D 1505	200,000 lb	0.940	0.940	0.940	0.940	0.940
Tensile Properties (each direction Strength at Break, lb/in-width Strength at Yield, lb/in-width Elongation at Break, % Elongation at Yield, %	ASTM D 6693, Type IV Dumbell, 2 ipm G.L. 2.0 in G.L. 1.3 in	20,000 lb	 45 63 100 12	 60 84 100 12	 90 126 100 12	 120 168 100 12	 150 210 100 12
Tear Resistance, lb	ASTM D 1004	45,000 lb	21	28	42	56	70
Puncture Resistance, lb	ASTM D 4833	45,000 lb	45	60	90	120	150
Carbon Black Content, % (Range)	ASTM D 1603*/4218	20,000 lb	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	Note(1)	Note(1)	Note(1)	Note(1)	Note(1)
Asperity Height, mil	ASTM D 7466	second roll	16	18	18	18	18
Notched Constant Tensile Load(2), hr	ASTM D 5397, Appendix	200,000 lb	500	500	500	500	500
Oxidative Induction Time, mins	ASTM D 3895, 200°C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100	>100
TYPICAL ROLL DIMENSIONS							
Roll Length(3), ft	Double-Sided Textured Single-Sided Textured		830 1,010	700 780	520 540	400 410	330 330
Roll Width(3), ft			22.5	22.5	22.5	22.5	22.5
Roll Area, ft²	Double-Sided Textured Single-Sided Textured		18,675 22,725	15,750 17,550	11,700 12,150	9,000 9,225	7,425 7,425

NOTES:
- (1)Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- (2)NCTL for GSE HD Textured is conducted on representative smooth membrane samples.
- (3)Roll lengths and widths have a tolerance of ±1%.
- GSE HD Textured is available in rolls weighing approximately 4,000 lb.
- All GSE geomembranes have dimensional stability of ±2% when tested according to ASTM D 1204 and LTB of <-77°C when tested according to ASTM D 746.
- *Modified.

GSE is a leading manufacturer and marketer of geosynthetic lining products and services. We've built a reputation of reliability through our dedication to providing consistency of product, price and protection to our global customers.

Our commitment to innovation, our focus on quality and our industry expertise allow us the flexibility to collaborate with our clients to develop a custom, purpose-fit solution.

GSE ENVIRONMENTAL™

[DURABILITY RUNS DEEP] For more information on this product and others, please visit us at GSEworld.com, call 800.435.2008 or contact your local sales office.

ATTACHMENT 3

Excerpt from *Caterpillar Performance Handbook* [Caterpillar, 2017]

MODEL	D6R2		D6R2 XL		D6R2 LGP	
Emission Standards	Tier 3/Stage IIIA/ Japan 2006 (Tier 3) equivalent[1]		Tier 3/Stage IIIA/ Japan 2006 (Tier 3) equivalent[1]		Tier 3/Stage IIIA/ Japan 2006 (Tier 3) equivalent[1]	
Flywheel Power:						
Stage II — ISO 9249/SAE J1349	133 kW	**179 hp**	148 kW	**198 hp**	148 kW	**198 hp**
Stage IIIA — ISO 9249/SAE J1349	147 kW	**196 hp**	153 kW	**206 hp**	153 kW	**206 hp**
Operating Weight:[2]						
Power Shift Differential Steer (SU Blade)	19 066 kg	**42,033 lb**	19 914 kg	**43,903 lb**	21 661 kg	**47,754 lb**
Engine Model	**C9 ACERT**		**C9 ACERT**		**C9 ACERT**	
Rated Engine RPM:						
Stage II	**2000**		**2000**		**2000**	
Stage IIIA	**1850**		**1850**		**1850**	
No. of Cylinders	**6**		**6**		**6**	
Bore	112 mm	**4.4"**	112 mm	**4.4"**	112 mm	**4.4"**
Stroke	149 mm	**5.9"**	149 mm	**5.9"**	149 mm	**5.9"**
Displacement	8.8 L	**537 in^3**	8.8 L	**537 in^3**	8.8 L	**537 in^3**
Track Rollers (Each Side)	**6**		**7**		**8**	
Width of Standard Track Shoe	560 mm	**22"**	560 mm	**22"**	915 mm	**36"**
Length of Track on Ground	2664 mm	**104.9"**	2871 mm	**113"**	3275 mm	**128.9"**
Ground Contact Area (w/Std. Shoe)	2.98 m^2	**4625 in^2**	3.22 m^2	**4984 in^2**	5.99 m^2	**9290 in^2**
Track Gauge	1880 mm	**74"**	1880 mm	**74"**	2286 mm	**90.0"**
GENERAL DIMENSIONS:						
Height (To Top of ROPS Cab/Canopy)	3216 mm	**126.6"**	3216 mm	**126.6"**	3266 mm	**128.6"**
Height (To Exhaust Stack)	3115 mm	**122.6"**	3115 mm	**122.6"**	3165 mm	**124.6"**
Length of Basic Tractor (w/o Blade)	3860 mm	**152.0"**	3860 mm	**152.0"**	4247 mm	**167.2"**
with following attachments, add:						
S Blade	1043 mm	**41.1"**	—		1218 mm	**48.0"**
SU Blade	1235 mm	**48.6"**	1472 mm	**58.0"**	—	
Angle Blade (when Straight)	1147 mm	**45.2"**	1349 mm	**53.1"**	—	
Angle Blade (when Angled 25°)	1983 mm	**78.1"**	2185 mm	**86.0"**	—	
Rear Drawbar	366 mm	**14.4"**	366 mm	**14.4"**	251 mm	**9.9"**
Muiti-Shank Ripper (tip at ground level)	1403 mm	**55.2"**	1403 mm	**55.2"**	—	
Width of Tractor:						
Over Trunnion	2640 mm	**103.9"**	2640 mm	**103.9"**	3491 mm	**137.4"**
Without Trunnion (standard shoe width)	2440 mm	**96.1"**	2440 mm	**96.1"**	3201 mm	**126.0"**
Ground Clearance	372 mm	**14.6"**	372 mm	**14.6"**	422 mm	**16.6"**
Blade Types and Widths:						
S Blade	3360 mm	**132.3"**	—		4063 mm	**160.0"**
SU Blade	3260 mm	**128.3"**	3260 mm	**128.3"**	—	
Angle Blade	4166 mm	**164.0"**	4166 mm	**164.0"**	—	
Fuel Tank Refill Capacity	424 L	**112 U.S. gal**	424 L	**112 U.S. gal**	424 L	**112 U.S. gal**

[1] Meets Tier 2/Stage II/Japan 2001 (Tier 2) equivalent OR Tier 3/Stage IIIA/Japan 2006 (Tier 3) equivalent emission standards.
[2] Operating weight includes ROPS canopy, operator lubricants, coolants, full fuel tank, hydraulic controls and fluid, SU blades, horn, backup alarm, retrival hitch and front pull hook.

Appendix K.5: Final Cover System Veneer Stability Analysis

Geosyntec
consultants

COMPUTATION COVER SHEET

Client: Tolson & Associates **Project:** TRL Vertical Expansion **Project #:** ME1606 **Task #:** 03

TITLE OF COMPUTATIONS FINAL COVER SYSTEM VENEER STABILITY

COMPUTATIONS BY: Signature ______ February 7, 2020
DATE

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ASSUMPTIONS AND PROCEDURES CHECKED BY: (Peer Reviewer) Signature ______ February 17, 2020
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Printed Name and Title: Zichang Li, Engineer

COMPUTATIONS CHECKED BY: Signature ______ February 17, 2020
DATE

Printed Name and Title: Jenny Ramirez, Professional

COMPUTATIONS BACKCHECKED BY: (Originator) Signature ______ February 17, 2020
DATE

Printed Name and Title: Sean O'Donnell, Engineer

APPROVED BY: (PM or Designate) Signature ______ August 3, 2020
DATE

Printed Name and Title: David Espinoza, Senior Principal

APPROVAL NOTES: ______

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

ME1606/ME1606-Cover Veneer Stability_REV.docx

FINAL COVER SYSTEM VENEER STABILITY

INTRODUCTION

The purpose of this calculation package is to present the final cover veneer slope stability analysis for the landfill closure design of the Tolson Rubble Landfill, located in Crofton, Maryland. As shown in the final grading plan in Figure 1, the final cover slope on the majority of the landfill is approximately 4 percent with a maximum drainage length of 1,000 ft. The sideslopes are designated with a 4 horizontal to 1 vertical (4H:1V) slope, and the drainage slope length is 165 ft between terraces along the sideslopes. When there is no imminent danger to human life or threat of major environmental impact, the minimum slope stability factor of safety is recommended to be 1.25 in the Solid Waste Disposal Facility Criteria [USEPA, 1993]. Because veneer slope failure of the final cover system does not pose an imminent threat to human life or the environment, the target minimum calculated factor of safety is 1.25.

METHOD

An analysis of veneer stability considers noncircular wedge-type potential slip surfaces that extend parallel to the liner system components. The selected method of analysis is based on limit equilibrium and takes into account the soil buttressing effect, geosynthetic tensile forces, and seepage forces within drainage layers. The finite slope factor of safety equation, as formulated by Giroud et al. [1995], is:

$$FS = \lambda \frac{\tan\delta}{\tan\beta} + \frac{a/\sin\beta}{\gamma_t(t-t_w)+\gamma_{sat}t_w} + \frac{\gamma_t(t-t_w^*)+\gamma_b t_w^*}{\gamma_t(t-t_w)+\gamma_{sat}t_w}\frac{t}{h}\frac{\sin\phi}{\sin 2\beta\cos(\beta+\phi)} + \frac{ct/h}{\gamma_t(t-t_w)+\gamma_{sat}t_w}\frac{\cos\phi}{\sin\beta\cos(\beta+\phi)} + \frac{T/h}{\gamma_t(t-t_w)+\gamma_{sat}t_w} \qquad \text{Eq. (1)}$$

$$\lambda = \begin{cases} \dfrac{\gamma_t(t-t_w)+\gamma_b t_w}{\gamma_t(t-t_w)+\gamma_{sat}t_w} & \text{for failure surface above the geomembrane (dimensionless)} \\ 1 & \text{for failure surface below the geomembrane (dimensionless)} \end{cases}$$

where:

FS = Factor of Safety (dimensionless)
γ_t = total unit weight of soil (pcf)
γ_{sat} = saturated unit weight of soil (pcf)

γ_b	=	buoyant unit weight of soil (pcf)
t	=	thickness of soil layer (ft)
t_w	=	thickness of water flow along slope (ft)
t^*_w	=	thickness of water flow at toe of slope (ft)
β	=	slope angle (degrees)
δ	=	interface friction angle along slip surface (degrees)
a	=	interface adhesion (psf)
ϕ	=	internal friction angle of soil above critical surface (degrees)
h	=	height of slope (ft)
T	=	tension in geosynthetics (lbs/ft)
c	=	cohesion of soil above critical surface (psf)

For the analyses presented herein, the following conservative assumptions are made:

- Adhesion, a = 0 psf;
- Tension in geosynthetic, T = 0 psf; and
- Cohesion of soil above the critical surface, c = 0 psf

LINER SYSTEM MATERIALS

Liner System on Side Slopes

As shown on Figure 2, the final cover system consists of the following components from top to bottom:

- 6-inch top soil;
- 18-inch final cover soil;
- 200-mil geocomposite drainage layer;
- 40-mil thick textured high density polyethylene (HDPE) geomembrane;
- 8 oz/sy non-woven geotextile; and
- 24-inch thick compacted subgrade.

WATER FLOW ALONG SLOPE

A calculation was conducted to estimate the thickness of water flow on top of the geomembrane using the HELP3 model [USEPA, 1994].

The final cover system is assumed to have a maximum height of 40 ft between drainage terraces. The water depth for the following two scenarios was analyzed:

(1) Top Deck: Conservatively assumed 3% post-settlement top slope with an assumed drainage distance of 1,000 ft; and
(2) Sideslopes: 4H:1V sideslope with an assumed drainage distance of 165 ft (Terraces at sideslopes spaced every 40 vertical feet at 4:1 H:V).

The simulation was conducted for a 30-year period. The analysis is presented in Attachments 1 and 2, respectively . Based on the results of this calculation; the peak daily values for hydraulic head above the geomembrane are summarized below:

Slope	Peak Daily Average Head along Slope (in.)
3%	24.132
4H:1V	0.095

The average head of water in the 4H:1V slope, as estimated by HELP analysis, may be considered representative of all sections of the sideslopes, even those above the first set of drainage terraces, because a seepage interceptor drain will be constructed at the confluence of the landfill top deck and the upper sideslopes. This interceptor drain will drain seepage from the top deck of the landfill to the stormwater management system (i.e. the downchutes). However, for this analysis, it is assumed that this interceptor drain is either not built or is clogged, such that water collected in the drainage layers of the landfill top deck is force to seep into the sideslope cover drainage layer. The corrected hydraulic head on the 4H:1V most-upper slope is estimated below.

Considering two slope segments, based on the principle of continuity, the flow rate, Q, in the upper portion of the slope is equal to the flow rate in the lower portion of the slope.

$$Q_{upper} = Q_{lower}$$

$$Q = kiA$$

where:
Q = flow rate (cfs);
k = hydraulic conductivity (ft/sec);
i = hydraulic gradient (ft/ft); and
A = area of flow (ft^2).

Assuming a unit width and that the hydraulic conductivities of each segment are equal, it follows that:

$$i_{upper} \times Average\ head\ in\ upper\ slope = i_{lower} \times Average\ head\ in\ lower\ slope$$

Rearranging the terms:

$$Average\ head\ in\ lower\ slope = \frac{i_{upper}}{i_{lower}} \times Average\ head\ in\ upper\ slope$$

As can be seen in the HELP outputs, the water head at the plateau area is greater than the thickness of the geocomposite. Due to sudden increase of the drainage slope (from 3% to 4H:1V), the water flow along the sideslopes is an open channel flow. As the hydraulic conductivity of the cover soil is much lower than that of the underlaid geocomposite, the waterhead at the top of the slope is assumed to equal the thickness of the geocomposite.

The thickness of water in the lower segment is estimated as the sum of the contributions from the upper and lower segments. The average head in the 4H:1V slope segment (i.e., lower slope) is estimated from the results of HELP simulation as below:

$$\frac{3\%}{25\%} \times 0.2 + 0.095 = 0.119\ in$$

MATERIAL PROPERTIES

The typical strength properties for soils and typical interface friction values for geosynthetic liner components are presented in Table 1 and Table 2, respectively. In a veneer slope stability analysis, the unit weight and strength of the material that buttresses the veneer at the toe of the slope and the strength of the weakest interface are required to calculate the factor of safety. A discussion of the unit weight, effective stress friction angles, and interface shear friction angles for materials considered for this calculation are provided below.

Material Properties of Soils

The final cover layer will be constructed using soils typically classified as SP, SC or SM. Based on typical material parameters presented in Table 1, the final cover material is conservatively assumed to have an effective-stress friction angle of 28º and an in-place unit weight of 120 pcf, respectively. The saturated unit weight of the protective cover layer is assumed to be 130 pcf.

Interface Shear Strength

The interfaces in the liner system, from top to bottom, are:

- Final cover soil / Geocomposite, Interface #1;
- Geocomposite / textured HDPE geomembrane, Interface #2; and
- textured HDPE geomembrane / geotextile, Interface #3;
- Geotextile / Compacted subbase, Interface #4;

Peak interface friction angles for the liner system interfaces are evaluated based on the typical values as presented in Table 2.

Interface #1: The peak interface friction angle for Interface #1 for the final cover soil / geocomposite interface was determined by assuming $\tan\delta/\tan\phi = 0.8$. Assuming an effective-stress friction angle of 28º for the final cover soil, a value of $\delta = 23º$ is estimated.

Interface #2: As shown in Table 2, for textured HDPE geomembrane / geocomposite interface, $\delta = 17º$ to 29º typically. A value of $\delta = 23º$ is estimated.

Interface #3: For the textured HDPE geomembrane / non-woven geotextile the friction angle was estimated $\delta = 22º$ to 35º. A value of $\delta = 23º$ is assumed for the present analysis.

Interface #4: The peak interface friction angle for Interface #4 for the non-woven geotextile/ compacted subbase interface was determined by assuming $\tan\delta/\tan\phi = 0.8$. Assuming an effective-stress friction angle of 28º for the compacted subbase, a value of $\delta=23º$ is estimated.

Based on the results presented above, the weakest interface above and below the geomembrane both have a friction angle of 23 degree.

ANALYSIS

Following the cap geometry, interfaces and material properties described above, the Factor of Safety (FS) was calculated above and below the geomembrane as follows:

- Case 1: interface shear strengths for critical interfaces are selected based on estimated shear strength from Table 2, as detailed in the previous section;
- Case 2: The friction angle at the interface was back-calculated in order to maintain a factor of safety equal to 1.25.

The calculation was conducted using an Excel spreadsheet. The output for Cases 1 and 2 are shown as Tables 3 and 4, respectively. The results of the calculation are summarized below:

Case	Interface Shear Strength		F.S	
	Above Geomembrane	Below Geomembrane	Above Geomembrane	Below Geomembrane
1	$\delta = 23°$ a = 0 psf	$\delta = 23°$ a = 0 psf	1.35	1.35
2	$\delta = 21.4°$ a = 0 psf	$\delta = 21.4°$ a = 0 psf	1.25	1.25

CONCLUSION

The above results show that adequate factors of safety (FS = 1.35) can be obtained for the final cover system veneer slope based on the design proposed and the estimated interface shear strength. The analysis also showed that the minimum interface friction angle required to maintain a factor of safety greater than 1.25 is 21.4 degrees above the geomembrane and 21.4 degrees below the geomembrane. The interface shear strength of actual products shall be verified by laboratory testing prior to construction.

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TABLES

Table 1. Typical Properties of Compacted Soils (after NAVFAC, 1986).

Group Symbol	Soil Type	Range of Maximum Dry Unit Weight (pcf)	Range of Optimum Moisture Content (%)	Typical Strength Characteristics			
				Cohesion (as compacted) (psf)	Cohesion (saturated) (psf)	ϕ, Effective-Stress Envelope (degrees)	Tanϕ
SP	Poorly graded clean sands, sand-gravel mix.	100 - 120	12-21	0	0	37	0.74
SM	Silty sands, poorly graded sand-silt mix.	110 - 125	11 - 16	1,050	420	34	0.67
SM-SC	Sand-silt clay mix. with slightly plastic fines	110 - 130	11 - 15	1,050	300	33	0.66
SC	Clayey sands, poorly-graded sand-clay mix.	105 - 125	11 - 19	1,550	230	31	0.60
ML	Inorganic silts and clayey silts	95 - 120	12 - 24	1,400	190	32	0.62
CL	Inorganic clays of low to medium plasticity	95 - 120	12 - 24	1,800	270	28	0.54
CH	Inorganic clays of high plasticity	75 - 105	19 - 36	2,150	230	19	0.35

Table 2. Summary of Documented Interface Friction Values

GEOSYNTHETIC / GEOSYNTHETIC	δ_p[(1)] (degrees)	δ_{ld}[(1)] (degrees)
Smooth HDPE Geomembrane / Nonwoven Geotextile	7 - 12	6 - 11
Smooth LLDPE Geomembrane / Nonwoven Geotextile	10 - 12	
Textured HDPE Geomembrane / Nonwoven Geotextile	22 - 35	
Smooth HDPE Geomembrane / Geonet	7 - 15	
Textured HDPE Geomembrane / Geonet	7 - 15	
Textured HDPE Geomembrane / Geocomposite	17 - 29	13 - 20
Geonet / Nonwoven Geotextile	13 - 22	
Smooth HDPE Geomembrane / GCL (hydrated)	8 - 12	
Textured HDPE Geomembrane / GCL (hydrated)	18 - 37	6 - 10
GEOSYNTHETIC / SOIL	$\tan\delta_p/\tan\phi_p$[(2)]	$\tan\delta_{ld}/\tan\phi_{ld}$[(2)]
Smooth HDPE Geomembrane / Clay	0.4 - 0.7	0.3 - 0.7
Textured HDPE Geomembrane / Clay	0.8 - 0.9	0.6 - 0.9
Smooth HDPE Geomembrane / Sand	0.5 - 0.6	
Textured HDPE Geomembrane / Sand	0.7 - 0.8	
Needlepunched Nonwoven Geotextile / Sand	0.8 - 1.0	
Needlepunched Nonwoven Geotextile / Angular Gravel	0.7 - 0.9	
Needlepunched Nonwoven Geotextile / Rounded Gravel	0.6 - 0.8	

Notes:

(1) Adapted from tests by Martin et al. (1984), Williams and Houlihan (1986), Koerner et al. (1986), Williams and Houlihan (1987),Williams and Luna (1987), Eid and Stark (1997), Sabatini et al. (1998), Stark et al. (1998), manufacturer's literature, and unpublished results from Geosyntec Consultants.

(2) δ = interface friction angle; ϕ = soil internal friction angle; subscript p = peak and subscript ld = large displacement.

Table 3: Final Cover Veneer Slope Stability Analysis - Case 1
Tolson Rubble Landfill

Slope Height =40 ft

Factors of Safety for Slope Stability Calculated with Method Presented in Giroud, J.P., Bachus, R.C., and Bonaparte, R., "Influence of Water Flow on the Stability of Geosynthetic-Soil Layered Systems on Slopes", Geosynthetics International, Vol. 2, No. 6, 1995, pp. 1149-1180.

Input Parameters

Total γ (pcf)	120
Sat. γ (pcf)	130
Buoyant γ (pcf)	67.6
Thickness (ft)	2
t_w (ft)	0.009917
t^*_w (ft)	0.009917

β (deg)	18.4	β (rad)	0.322
δ (deg) (above)	23	δ (rad) (above)	0.401
a (psf) (above)	0		
δ (deg) (below)	23	δ (rad) (below)	0.401
a (psf) (below)	0		
slope height (ft)	30		
ϕ (deg)	28	ϕ (rad)	0.489
T	0		
c (psf)	0		

Output

Lambda (calculated) 0.997

Factor of Safety for failure surface above the geomembrane:	**1.35**
Factor of Safety for failure surface below the geomembrane:	**1.35**

Table 4: Final Cover Veneer Slope Stability Analysis - Case 2
Tolson Rubble Landfill

Slope Height =40 ft

Factors of Safety for Slope Stability Calculated with Method Presented in Giroud, J.P., Bachus, R.C., and Bonaparte, R., "Influence of Water Flow on the Stability of Geosynthetic-Soil Layered Systems on Slopes", Geosynthetics International, Vol. 2, No. 6, 1995, pp. 1149-1180.

Input Parameters

Total γ (pcf)	120
Sat. γ (pcf)	130
Buoyant γ (pcf)	67.6
thickness (ft)	2
t_w (ft)	0.009917
t^*_w (ft)	0.009917

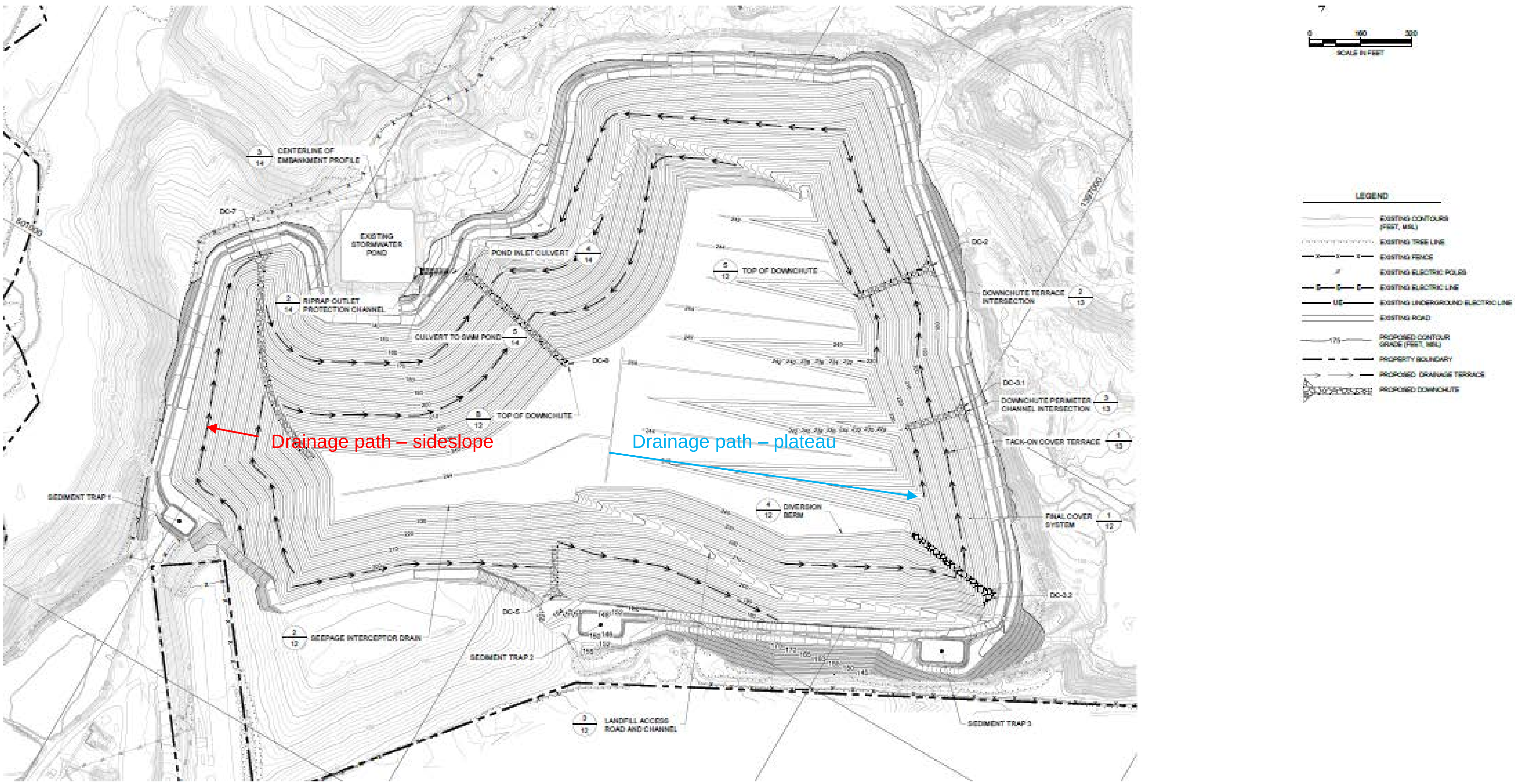
β (deg)	18.4	β (rad)	0.322
δ (deg) (above)	21.4	δ (rad) (above)	0.374
a (psf) (above)	0		
δ (deg) (below)	21.4	δ (rad) (below)	0.374
a (psf) (below)	0		
slope height (ft)	30		
ϕ (deg)	28	ϕ (rad)	0.489
T	0		
c (psf)	0		

Output

Lambda (calculated) 0.997

Factor of Safety for failure surface above the geomembrane:	**1.25**
Factor of Safety for failure surface below the geomembrane:	**1.25**

FIGURES



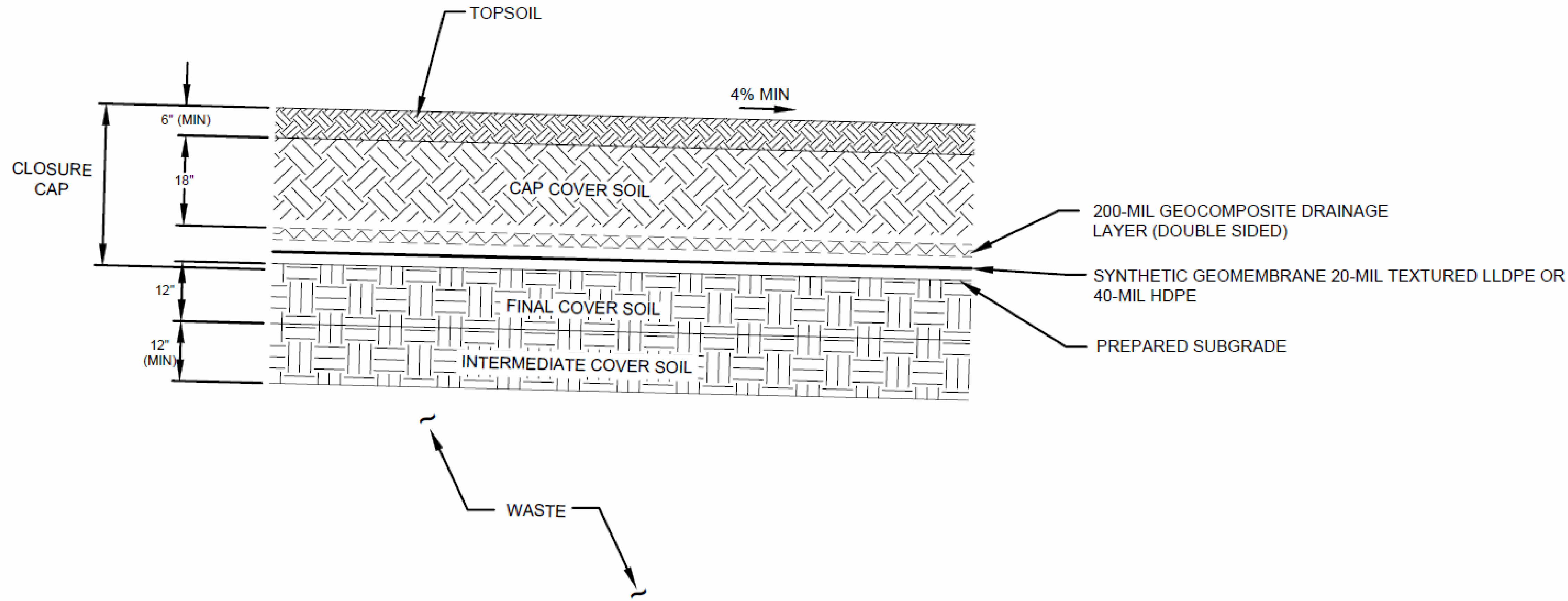
FINAL GRADING PLAN
Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Geosyntec consultants

Columbia, Maryland | July 2020

Figure

K.5-1



FINAL COVER SYSTEM
Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

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Figure
K-5.2

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ATTACHMENT 1

CALCULATION OF WATER DEPTH ABOVE GEOMEMBRANE – TOP DECK

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    C:\HELP3\M2_4_1.D4
TEMPERATURE DATA FILE:      C:\HELP3\M2_7_1.D7
SOLAR RADIATION DATA FILE:  C:\HELP3\M2_13_1.D13
EVAPOTRANSPIRATION DATA:    C:\HELP3\M2_11_1.D11
SOIL AND DESIGN DATA FILE:  C:\HELP3\M2_10_1.D10
OUTPUT DATA FILE:           C:\HELP3\M2_OUT_1.OUT


TIME:   9:22     DATE:   8/28/2019


******************************************************************************

     TITLE:  TRL CAP DESIGN EVALUATION PLATEAU

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
```


M2_OUT_1

```
                         MATERIAL TEXTURE NUMBER  13
   THICKNESS                   =     24.00   INCHES
   POROSITY                    =      0.4300 VOL/VOL
   FIELD CAPACITY              =      0.3210 VOL/VOL
   WILTING POINT               =      0.2210 VOL/VOL
   INITIAL SOIL WATER CONTENT  =      0.4077 VOL/VOL
   EFFECTIVE SAT. HYD. COND.   =  0.330000003000E-04 CM/SEC
 NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
          FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                   LAYER  2
                                   --------

                        TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER   0
   THICKNESS                   =      0.20   INCHES
   POROSITY                    =      0.8500 VOL/VOL
   FIELD CAPACITY              =      0.0100 VOL/VOL
   WILTING POINT               =      0.0050 VOL/VOL
   INITIAL SOIL WATER CONTENT  =      0.8500 VOL/VOL
   EFFECTIVE SAT. HYD. COND.   =   2.27999997000     CM/SEC
   SLOPE                       =      3.00   PERCENT
   DRAINAGE LENGTH             =   1000.0    FEET


                                   LAYER  3
                                   --------

                        TYPE 4 - FLEXIBLE MEMBRANE LINER
                         MATERIAL TEXTURE NUMBER  35
   THICKNESS                   =      0.04   INCHES
   POROSITY                    =      0.0000 VOL/VOL
   FIELD CAPACITY              =      0.0000 VOL/VOL
   WILTING POINT               =      0.0000 VOL/VOL
   INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
   EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
   FML PINHOLE DENSITY         =      2.00   HOLES/ACRE
   FML INSTALLATION DEFECTS    =      2.00   HOLES/ACRE
   FML PLACEMENT QUALITY       =  3 - GOOD
```

LAYER 4

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 13

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4300 VOL/VOL
FIELD CAPACITY	=	0.3210 VOL/VOL
WILTING POINT	=	0.2210 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3212 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.330000003000E-04 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #13 WITH A FAIR STAND OF GRASS, A SURFACE SLOPE OF 3.% AND A SLOPE LENGTH OF 1000. FEET.

SCS RUNOFF CURVE NUMBER	=	87.60
FRACTION OF AREA ALLOWING RUNOFF	=	100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000 ACRES
EVAPORATIVE ZONE DEPTH	=	21.0 INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	8.494 INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	9.030 INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	4.641 INCHES
INITIAL SNOW WATER	=	0.000 INCHES
INITIAL WATER IN LAYER MATERIALS	=	17.663 INCHES
TOTAL INITIAL WATER	=	17.663 INCHES
TOTAL SUBSURFACE INFLOW	=	0.00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM BALTIMORE MARYLAND

STATION LATITUDE	=	39.18 DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	102

END OF GROWING SEASON (JULIAN DATE)	=	300
EVAPORATIVE ZONE DEPTH	=	21.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	9.30 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	62.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	65.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	68.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR BALTIMORE MARYLAND

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.00	2.98	3.72	3.35	3.44	3.76
3.89	4.62	3.46	3.11	3.11	3.40

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR BALTIMORE MARYLAND

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
32.70	34.70	43.30	54.00	63.40	72.20
76.80	75.60	68.90	56.90	46.30	36.50

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR BALTIMORE MARYLAND AND STATION LATITUDE = 39.18 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

M2_OUT_1

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.50	3.30	3.36	3.35	3.77	3.77
	3.77	5.57	3.38	2.65	2.96	3.00
STD. DEVIATIONS	1.25	1.51	1.27	1.69	1.70	2.29
	1.76	2.71	2.41	1.41	1.46	1.56
RUNOFF						
TOTALS	0.563	1.149	0.628	0.092	0.153	0.300
	0.347	0.570	0.452	0.220	0.160	0.346
STD. DEVIATIONS	0.855	1.200	1.033	0.148	0.296	0.474
	0.652	0.683	0.630	0.383	0.217	0.829
EVAPOTRANSPIRATION						
TOTALS	1.090	1.036	2.484	2.851	3.618	4.071
	3.587	3.935	2.512	1.376	1.341	1.045
STD. DEVIATIONS	0.337	0.426	0.407	0.859	0.840	1.478
	1.489	1.487	0.840	0.424	0.276	0.179
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	1.1143	0.7505	1.3712	0.5718	0.4225	0.2694
	0.1111	0.2017	0.3653	0.3308	0.7965	1.1001
STD. DEVIATIONS	0.8916	0.6840	0.6590	0.6126	0.5143	0.4986
	0.2454	0.3513	0.6261	0.4703	0.6921	0.8346
PERCOLATION/LEAKAGE THROUGH LAYER 3						
TOTALS	0.0134	0.0067	0.0150	0.0026	0.0016	0.0014
	0.0003	0.0015	0.0030	0.0012	0.0063	0.0116
STD. DEVIATIONS	0.0196	0.0134	0.0182	0.0070	0.0037	0.0044
	0.0010	0.0054	0.0075	0.0032	0.0096	0.0173
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0133	0.0065	0.0146	0.0028	0.0023	0.0017
	0.0005	0.0016	0.0035	0.0014	0.0074	0.0118
STD. DEVIATIONS	0.0164	0.0106	0.0132	0.0071	0.0052	0.0052

	0.0016	0.0050	0.0087	0.0037	0.0103	0.0155

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3						
AVERAGES	3.7192	2.0006	4.1521	0.7077	0.4197	0.3818
	0.0751	0.4242	0.8445	0.3316	1.7814	3.1994
STD. DEVIATIONS	5.4932	4.0300	5.1089	2.0101	0.9988	1.2575
	0.2532	1.5136	2.1534	0.8740	2.7607	4.8617

****

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.37 (6.611)	150156.2	100.00
RUNOFF	4.980 (2.3527)	18078.70	12.040
EVAPOTRANSPIRATION	28.946 (3.6172)	105072.70	69.976
LATERAL DRAINAGE COLLECTED FROM LAYER 2	7.40516 (2.85223)	26880.727	17.90185
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.06448 (0.04651)	234.070	0.15588
AVERAGE HEAD ON TOP OF LAYER 3	1.503 (1.111)		
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.06731 (0.03941)	244.350	0.16273
CHANGE IN WATER STORAGE	-0.033 (1.2893)	-120.30	-0.080

****

****

PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	5.68	20618.398
RUNOFF	3.039	11029.8135
DRAINAGE COLLECTED FROM LAYER 2	0.07774	282.18137
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.002784	10.10427
AVERAGE HEAD ON TOP OF LAYER 3	24.132	
MAXIMUM HEAD ON TOP OF LAYER 3	38.910	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	193.1 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.003534	12.82975
SNOW WATER	3.90	14161.6172

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4300

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.2210

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

****

****

FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	8.8746	0.3698
2	0.1700	0.8500
3	0.0000	0.0000
4	7.6245	0.3177
SNOW WATER	0.000	

****
****

ATTACHMENT 2

CALCULATION OF WATER DEPTH ABOVE GEOMEMBRANE – SIDESLOPES

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    C:\HELP3\M2_4_2.D4
TEMPERATURE DATA FILE:      C:\HELP3\M2_7_2.D7
SOLAR RADIATION DATA FILE:  C:\HELP3\M2_13_2.D13
EVAPOTRANSPIRATION DATA:    C:\HELP3\M2_11_2.D11
SOIL AND DESIGN DATA FILE:  C:\HELP3\M2_10_2.D10
OUTPUT DATA FILE:           C:\HELP3\M2_OUT_2.OUT


TIME:  11:31     DATE:   2/ 6/2020


******************************************************************************

     TITLE:  TRL CAP DESIGN EVALUATION SIDE SLOPES

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                 LAYER  1
                                 --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
```



```
                        MATERIAL TEXTURE NUMBER  13
  THICKNESS                  =     24.00   INCHES
  POROSITY                   =      0.4300 VOL/VOL
  FIELD CAPACITY             =      0.3210 VOL/VOL
  WILTING POINT              =      0.2210 VOL/VOL
  INITIAL SOIL WATER CONTENT =      0.3514 VOL/VOL
  EFFECTIVE SAT. HYD. COND.  =  0.330000003000E-04 CM/SEC
NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
         FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                              LAYER  2
                              --------

                  TYPE 2 - LATERAL DRAINAGE LAYER
                    MATERIAL TEXTURE NUMBER   0
  THICKNESS                  =      0.20   INCHES
  POROSITY                   =      0.8500 VOL/VOL
  FIELD CAPACITY             =      0.0100 VOL/VOL
  WILTING POINT              =      0.0050 VOL/VOL
  INITIAL SOIL WATER CONTENT =      0.0301 VOL/VOL
  EFFECTIVE SAT. HYD. COND.  =   2.27999997000     CM/SEC
  SLOPE                      =     25.00   PERCENT
  DRAINAGE LENGTH            =    165.0    FEET


                              LAYER  3
                              --------

                  TYPE 4 - FLEXIBLE MEMBRANE LINER
                    MATERIAL TEXTURE NUMBER  35
  THICKNESS                  =      0.04   INCHES
  POROSITY                   =      0.0000 VOL/VOL
  FIELD CAPACITY             =      0.0000 VOL/VOL
  WILTING POINT              =      0.0000 VOL/VOL
  INITIAL SOIL WATER CONTENT =      0.0000 VOL/VOL
  EFFECTIVE SAT. HYD. COND.  =  0.199999996000E-12 CM/SEC
  FML PINHOLE DENSITY        =      2.00   HOLES/ACRE
  FML INSTALLATION DEFECTS   =      2.00   HOLES/ACRE
  FML PLACEMENT QUALITY      =  3 - GOOD
```

LAYER 4

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 13

```
THICKNESS                  =     24.00   INCHES
POROSITY                   =      0.4300 VOL/VOL
FIELD CAPACITY             =      0.3210 VOL/VOL
WILTING POINT              =      0.2210 VOL/VOL
INITIAL SOIL WATER CONTENT =      0.3210 VOL/VOL
EFFECTIVE SAT. HYD. COND.  =  0.330000003000E-04 CM/SEC
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #13 WITH A FAIR STAND OF GRASS, A SURFACE SLOPE OF 25.% AND A SLOPE LENGTH OF 165. FEET.

```
SCS RUNOFF CURVE NUMBER            =     89.30
FRACTION OF AREA ALLOWING RUNOFF   =    100.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE =      1.000  ACRES
EVAPORATIVE ZONE DEPTH             =     21.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE  =      7.290  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE =      9.030  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE =      4.641  INCHES
INITIAL SNOW WATER                 =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS   =     16.142  INCHES
TOTAL INITIAL WATER                =     16.142  INCHES
TOTAL SUBSURFACE INFLOW            =      0.00   INCHES/YEAR
```

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM BALTIMORE MARYLAND

```
STATION LATITUDE                      =  39.18 DEGREES
MAXIMUM LEAF AREA INDEX               =   2.00
START OF GROWING SEASON (JULIAN DATE) =    102
```



```
END OF GROWING SEASON (JULIAN DATE)    =    300
EVAPORATIVE ZONE DEPTH                 =  21.0  INCHES
AVERAGE ANNUAL WIND SPEED              =   9.30 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY  =  62.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY  =  65.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY  =  71.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY  =  68.00 %
```

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR BALTIMORE MARYLAND

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.00	2.98	3.72	3.35	3.44	3.76
3.89	4.62	3.46	3.11	3.11	3.40

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR BALTIMORE MARYLAND

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
32.70	34.70	43.30	54.00	63.40	72.20
76.80	75.60	68.90	56.90	46.30	36.50

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR BALTIMORE MARYLAND AND STATION LATITUDE = 39.18 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.50	3.30	3.36	3.35	3.77	3.77
	3.77	5.57	3.38	2.65	2.96	3.00
STD. DEVIATIONS	1.25	1.51	1.27	1.69	1.70	2.29
	1.76	2.71	2.41	1.41	1.46	1.56
RUNOFF						
TOTALS	0.538	1.196	0.668	0.182	0.277	0.435
	0.488	0.817	0.627	0.310	0.291	0.421
STD. DEVIATIONS	0.746	1.180	0.982	0.263	0.458	0.626
	0.779	0.866	0.835	0.452	0.328	0.793
EVAPOTRANSPIRATION						
TOTALS	1.085	1.035	2.481	2.838	3.637	4.187
	3.524	3.873	2.482	1.349	1.326	1.029
STD. DEVIATIONS	0.335	0.425	0.398	0.868	0.844	1.452
	1.441	1.473	0.818	0.420	0.262	0.180
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	1.0169	0.6945	1.3026	0.3816	0.2808	0.1490
	0.0255	0.0821	0.2132	0.1857	0.7759	1.1642
STD. DEVIATIONS	1.1451	0.8692	0.8835	0.4548	0.4197	0.2751
	0.0805	0.2808	0.5841	0.3482	0.7524	1.1625
PERCOLATION/LEAKAGE THROUGH LAYER 3						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

	0.0000	0.0000	0.0000	0.0002	0.0002	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3						
AVERAGES	0.0018	0.0013	0.0023	0.0007	0.0005	0.0003
	0.0000	0.0001	0.0004	0.0003	0.0014	0.0020
STD. DEVIATIONS	0.0020	0.0016	0.0015	0.0008	0.0007	0.0005
	0.0001	0.0005	0.0011	0.0006	0.0014	0.0020

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.37 (6.611)	150156.2	100.00
RUNOFF	6.250 (2.6009)	22686.77	15.109
EVAPOTRANSPIRATION	28.846 (3.5231)	104710.70	69.735
LATERAL DRAINAGE COLLECTED FROM LAYER 2	6.27200 (2.64808)	22767.355	15.16245
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.00008 (0.00003)	0.293	0.00019
AVERAGE HEAD ON TOP OF LAYER 3	0.001 (0.000)		
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00006 (0.00022)	0.207	0.00014
CHANGE IN WATER STORAGE	-0.002 (1.0722)	-8.90	-0.006

****

PEAK DAILY VALUES FOR YEARS 1 THROUGH 30

	(INCHES)	(CU. FT.)
PRECIPITATION	5.68	20618.398
RUNOFF	3.482	12638.0059
DRAINAGE COLLECTED FROM LAYER 2	0.75019	2723.18872
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.000008	0.02732
AVERAGE HEAD ON TOP OF LAYER 3	0.041	
MAXIMUM HEAD ON TOP OF LAYER 3	0.095	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	0.0 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000855	3.10331
SNOW WATER	3.90	14161.6172

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4100

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.2210

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	8.3611	0.3484
2	0.0037	0.0183
3	0.0000	0.0000
4	7.7039	0.3210
SNOW WATER	0.000	

****

****

Geosyntec consultants

Appendix L: Engineering Specifications

Prepared for:
TOLSON AND ASSOCIATES, LLC
24024 Frederick Road
Clarksburg, Maryland 20871

ENGINEERING SPECIFICATIONS

APPENDIX L
PROPOSED VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL: PHASE III REPORT

Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Prepared by

Geosyntec consultants

10211Wincopin Circle, 4th Floor
Columbia, Maryland 21044

Project Number: ME1606
Document Number: MD18235

July 2020

TABLE OF CONTENTS

ENGINEERING SPECIFICATIONS

Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

SECTION 01430

CONSTRUCTION QUALITY ASSURANCE

PART 1 GENERAL

1.01 SUMMARY

A. OWNER shall retain a Construction Quality Assurance (CQA) Consultant who shall be responsible for quality assurance testing and construction oversight for the Project. The CQA Consultant shall perform the quality assurance testing and construction oversight in accordance with the CQA Plan and the Specifications.

B. All Work shall be monitored or tested in accordance with the requirements of the CQA Plan which is a part of the Documents of this Solicitation. CONTRACTOR shall be familiar with the contents of the CQA Plan.

C. CONTRACTOR shall take the quality assurance testing frequencies and procedures into account when planning the construction schedule. CONTRACTOR shall not claim delay of the Work as a result of quality assurance testing.

D. CQA testing procedures and frequencies for individual products, materials, and procedures are described in the CQA Plan and in the Specifications.

1.02 DEFINITIONS

A. Construction Quality Assurance (CQA) is a planned and systematic pattern of the means and actions designed to provide adequate confidence that items or services meet contractual and regulatory requirements, and will perform satisfactorily in service.

B. For this Project, CQA refers to means and actions employed by CQA Consultant and testing laboratories to assure that the components of the design are produced and installed to conform to the requirements of the Drawings and Specifications.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01450

CONSTRUCTION QUALITY CONTROL

PART 1 GENERAL

1.01 SUMMARY

A. CONTRACTOR shall assign one person as the Quality Control Manager for the Project. The Quality Control Manager shall be responsible for preparing and submitting quality control certifications and test results to the Construction Quality Assurance (CQA) Consultant, as applicable.

B. CONTRACTOR shall maintain an appropriate frequency of contact with ENGINEER and the CQA Consultant to ensure that work quality is being maintained.

C. CONTRACTOR shall perform Construction Quality Control (CQC) field and laboratory testing as required by the Drawings and Specifications and as necessary to demonstrate compliance with the Specifications. If CONTRACTOR is unable to self-perform these tasks, CONTRACTOR shall retain a CQC Consultant to complete the required CQC field and laboratory testing.

1.02 DEFINITIONS

A. Construction Quality Control (CQC) are those actions that provide a means to measure and regulate the characteristics of an item or service to contractual and regulatory requirements.

B. CQC refers to those actions taken by the manufacturers, fabricators, installers, or CONTRACTOR to ensure that the materials and the workmanship meet the requirements of the Drawings and the Specifications.

1.03 SUBMITTALS

A. Within seven (7) days after notice to proceed the CONTRACTOR shall submit to the ENGINEER their CQC Plan for the Project. The Plan shall: (i) identify the Quality Control Manager; (ii) identify CONTRACTOR's CQC Consultant and/or testing laboratories, if required; and (iii) describe the proposed means and method for quality control to be implemented by CONTRACTOR. The CQC Consultant and/or laboratories shall be acceptable to both OWNER and ENGINEER.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01 GENERAL

A. CONTRACTOR shall be responsible for performing quality control oversight and documentation as necessary to ensure that the Work is in conformance with the requirements of the Drawings, Specifications, and CQA Plan.

B. Quality control testing procedures and frequencies for individual products and material are described in the Specifications.

3.02 SAMPLING AND TESTING

A. CONTRACTOR shall perform CQC testing as described in the Specifications during construction and shall promptly provide all test results to ENGINEER and/or the CQA Consultant, as required.

B. CONTRACTOR shall be responsible for cooperating with ENGINEER and the CQA Consultant during all CQC and CQA testing activities and in resolving all problems identified during testing. CONTRACTOR shall provide all equipment and labor required to access CQA testing locations. CONTRACTOR shall repair any damage to finished Work caused by the sampling or testing activities.

C. Quality Control material sampling and testing for concrete, geosynthetics, pipe, etc., is the responsibility of CONTRACTOR and shall be performed by the appropriate manufacturer. CONTRACTOR and its subcontractor(s) shall be responsible for cooperating with the CQA Consultant during all testing activities. CONTRACTOR and its subcontractor(s) shall provide equipment and labor required to access CQA testing locations. CONTRACTOR and its subcontractor(s) shall repair any damage to finished Work caused by sampling or testing activities.

D. CONTRACTOR shall be responsible for geometric control of the Work. CONTRACTOR shall verify the accuracy of benchmarks, vertical datum, or other survey information provided by OWNER or ENGINEER as part of its construction layout. Any surveying that may be performed by OWNER, ENGINEER, or CQA Consultant does not relieve CONTRACTOR of its responsibility to layout, control, and document its Work. Any additional surveying that is required, if the initial CQC survey shows that the Work has not yet been completed to the lines and grades shown on the Drawings, shall be performed at the expense of CONTRACTOR.

E. CONTRACTOR shall abide by all qualification requirements identified in these Specifications (for subcontractors, supplies, manufacturers, etc.).

F. The work shall, at all times, be subject to the observation of the OWNER, ENGINEER, and/or CQA Consultant. Observation or non-observation by the OWNER, ENGINEER, and/or the CQA Consultant shall not relieve CONTRACTOR from his contractual obligation to furnish work and material as required, and properly complete the work in accordance with these Contract Documents. If OWNER or the ENGINEER considers that the work is not being properly accomplished, he may condemn or reject all or any part of the work and any materials or equipment incorporated into it. If any material, equipment, or work is condemned or rejected by the OWNER or ENGINEER, the CONTRACTOR shall bear all expenses for removal and proper replacement of such material, equipment, or work required to be provided by Contract Documents. The expense of replacing any work performed by Others that is adversely affected by removal and proper replacement of improper work performed by CONTRACTOR shall be borne by CONTRACTOR.

F. The ENGINEER’s or CQA Consultant’s presence does not include supervision or direction of the actual work by CONTRACTOR, his employees, or agents. Neither the presence of the ENGINEER or CQA Consultant nor any observations and testing performed by either party shall excuse CONTRACTOR from defects discovered in his work.

G. The OWNER or OWNER’S representative has the right to perform quality assurance testing and to observe the work at any time.

3.03 PROTECTION

A. CONTRACTOR shall use all means necessary to protect all prior Work, including all materials and completed Work of other Sections.

3.04 SUBSTANDARD WORK OR MATERIALS

A. Any defective or substandard work or materials furnished by CONTRACTOR that is discovered before the final acceptance of the work, as established by the ENGINEER’s Certificate of Substantial Completion, or during the subsequent guarantee period, shall be removed immediately by CONTRACTOR even if it had been initially overlooked by the ENGINEER and recommended for payment.

Satisfactory work or materials shall be substituted by CONTRACTOR for that rejected.

B. The ENGINEER may order tests on substandard or damaged work, equipment, or materials to determine the required functional capability for possible acceptance, if there is no other reason for rejection. The cost of such tests shall be borne by CONTRACTOR, and the nature, extent, and supervision of the tests will be as determined by the ENGINEER. If the results of the tests indicate that the required functional capability of the work, equipment, or material is impaired, consistent with the final general appearance of same, the work, equipment, or materials may be deemed substandard and shall be replaced by CONTRACTOR. The CONTRACTOR may elect to replace the substandard work or material in lieu of performing the tests.

END OF SECTION

SECTION 01721

SURVEY REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. CONTRACTOR shall employ a licensed Surveyor to provide field survey control for and prepare as-built Record Drawings of CONTRACTOR's construction activities.

B. CONTRACTOR's Surveyor shall work with the Construction Quality Assurance (CQA) Consultant to ensure that the Work is completed as required on the Drawings and in these Specifications.

C. CONTRACTOR shall comply with the requirements of this Section regarding field surveying.

D. CONTRACTOR shall be responsible for coordination of all as-built surveying. Should as-built surveying data not meet the requirements of this Specification, CONTRACTOR shall be solely responsible for all project delays and costs associated with uncovering completed Work in order to obtain necessary as-built data.

1.02 QUALIFICATIONS OF SURVEYOR

A. CONTRACTOR's Surveyor shall meet the following minimum qualifications:
   1. is a registered professional surveyor in the State of Maryland;
   2. have an established office in either the states of Maryland or Delaware which provides land surveying services;
   3. can document prior experience on at least one previous landfill construction project requiring earthwork as-built surveying; and
   4. is acceptable to ENGINEER and OWNER

1.03 SUBMITTALS

A. At least fourteen (14) days prior to the Preconstruction Meeting, CONTRACTOR shall submit to ENGINEER the name, contact information, and qualifications of the Surveyor.

B. Upon request, submit to ENGINEER the project staffing, scheduling, and the type of equipment the Surveyor intends to use in the field and in the office (i.e., computer software) to complete the Project.

C. On request, submit to ENGINEER, documentation verifying accuracy of survey work.

D. At least fourteen (14) days prior to first mobilization to the site, CONTRACTOR's surveyor shall submit to the ENGINEER a survey plan and material quantity verification submittal plan for MDE submittals.

E. Survey plan shall include the proposed grid system for quantity estimates as described in Section 1.08.B of these specifications. ENGINEER and CQA Consultant shall review CONTRACTOR's surveyor's material quantity verification plan and coordinate to finalize the contents of the submittal package as outlined in Section 1.08.B of these specifications.

1.04 PROJECT AS-BUILT DRAWINGS

A. CONTRACTOR or CONTRACTOR's Surveyor shall maintain a complete and accurate log of control and survey work as work progresses.

B. CONTRACTOR shall keep and update as-built drawings of all Work consistent with the requirements of Part 1.07.D of this Section. CONTRACTOR shall allow the CQA Consultant to routinely inspect the interim record drawings. At the end of the Project, CONTRACTOR shall submit a complete set of As-Built Drawings and the surveyor's log of control and survey work to the CQA Consultant for its use in preparing the final report of construction activities.

C. CONTRACTOR shall submit final as-built drawings to the ENGINEER and OWNER no later than twenty one (21) days after project close out. Final invoice that includes project close out will not be rendered until after final as-built drawings are submitted and approved by OWNER and ENGINEER in accordance with Section 01775 of these specifications.

1.05 EXAMINATION

A. CONTRACTOR or CONTRACTOR's Surveyor shall verify locations of survey control points prior to starting Work.

B. CONTRACTOR shall promptly notify OWNER of any discrepancies discovered.

1.06 SURVEY REFERENCE POINTS

A. CONTRACTOR shall protect preexisting survey control and reference points.

B. The control datum for survey is that indicated on Drawings. CONTRACTOR or CONTRACTOR's Surveyor shall verify the accuracy of benchmarks, vertical datum, or other survey information provided by OWNER or ENGINEER as part of its Work.

C. CONTRACTOR shall protect survey control monuments during construction.

D. CONTRACTOR shall promptly report to OWNER the loss or disturbance of any monument or relocation required because of changes in grades or other reasons.

E. CONTRACTOR's Surveyor shall replace disturbed monuments based on original survey control. Changes shall not be made without prior written notice to OWNER and ENGINEER.

1.07 SURVEY REQUIREMENTS

A. CONTRACTOR or CONTRACTOR's Surveyor shall provide field survey services to perform CONTRACTOR's work using accepted engineering survey practices.

B. CONTRACTOR's Surveyor shall provide all materials required to establish and maintain benchmarks, control points, grade stakes, and other necessary items.

C. All topographic surveying shall have a horizontal scale of 1 in. = 50 ft. with 1-ft. contour intervals. Elevations shall be taken at a maximum 50-ft grid to confirm as-built grades.

D. To prepare As-Built Drawings, CONTRACTOR's Surveyor shall establish the as-built elevations, lines and levels for the features of the construction project including, but not limited to:

1. Topography within the limit of Work (including disposal cell, perimeter berms, channels, perimeter access road and equipment laydown area) following removal of topsoil and before placement of structural fill to establish subgrade. Survey of the limit of Work shall extend to at least 10 ft. beyond the limits of grading. This survey shall serve as the baseline for structural fill volume computations.
2. Original ground surface topography of on-site borrow area before construction. Topographic survey of the Work area shall extend at least 10 ft. in all directions beyond the limits of grading.
3. Ground surface topography of on-site borrow area after construction. Topographic survey of the Work area shall extend at least 10 ft. in all directions beyond the limits of grading.

5. Topography of the prepared subgrade (including perimeter berms, channels, and perimeter access road) following structural fill placement and prior to placement of select clay liner. Survey of the Work area shall extend to at least 10 ft. beyond the limits of the entire subgrade. This survey shall serve as the finished surface for structural fill volume computations.
6. Topography of select clay liner prior to geosynthetics installation. Survey of the Work area shall extend to at least 5 ft. beyond the limits of the entire select clay liner.
7. Limits of geosynthetics. Survey shall include anchor trenches, geomembrane panels, seams, repairs, and destructive sample locations.
8. Topography and thickness of protective cover layer as well as the location and dimension of leachate collection piping within protective cover layer. Survey of the Work area shall extend to at least 5 ft. beyond the limits of the entire protective cover area.
9. Location and pipe sizes of leachate transmission system components, including manholes/vaults, vaults, transmission piping, electrical and communication wiring. Gravity piping shall be measured for slope at maximum 25-ft intervals along the pipe;
10. Location of centerline of electrical and communication duct banks and electrical and communication manholes/vaults
11. Location, dimension, and profile of stormwater management channels.
12. Location and dimensions of permanent access roads

E. Elevations, slopes, and component thicknesses may be verified by the CQA Surveyor, as described in the CQA Plan.

1.08 SURVEY FOR QUANTITY ESTIMATES

A. CONTRACTOR is responsible to obtain and submit all survey documentation required for verification of quantities. All quantity verification submittals shall be submitted to the ENGINEER for review. These submittals shall include but are not limited to, an aerial figure of the work area with an engineering title block showing the survey grid system, pre and post material placement topography, and a table indicating the pre and post material placement elevations for each grid point. CONTRACTOR shall also submit pre and post material placement CAD files, isopach indicating material thicknesses, and volume of material placed to the ENGINEER for review. ENGINEER shall verify measurements and quantities.

B. CONTRACTOR's surveyor shall establish a grid system for material thickness verification. Grid system shall include fixed survey locations across the work area that shall be surveyed for each material quantity measurement. This grid system shall be included in the survey plan submittal for approval by ENGINEER.

B. Should ENGINEER determine that insufficient survey data has been submitted to accurately verify quantities, ENGINEER shall notify CONTRACTOR of deficiencies. CONTRACTOR shall address identified deficiencies prior to further review of quantities.

C. In the event that survey data provided by CONTRACTOR is not sufficient to determine actual completed quantity and the status of Work prevents additional data from being obtained, ENGINEER shall attempt to reasonably estimate the completed quantity based on available information. ENGINEER's estimate shall be final.

D. OWNER shall have the right to retain a third-party Surveyor licensed in the State of Maryland to review field survey data and/or resurvey portions of the Work to check as-built quantity estimates. In the case of conflict between the two surveys, ENGINEER shall review the two surveys and determine the final pay quantity.

1.09 TOLERANCES

A. All constructed products shall meet the following survey tolerances:

1. Length, thickness, or distance: ±0.1 ft
2. Length, thickness, or distance with a specified minimum: 0 to +0.2 ft
3. Vertical elevation: ±0.1 ft
4. Slope angles: ± 5 percent of specified slope (e.g. 3H:1V = 33.3 percent ±1.7 percent)
5. Slope angles with a specified minimum: 0 to + 10 percent of specified slope
6. Horizontal coordinates: ±0.1 ft

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 02055

SOILS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. CONTRACTOR shall furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary to place and compact soil as specified in this Section, as shown on the Drawings, and in accordance with the Construction Quality Assurance (CQA) Plan.

B. Soil described in this Section shall be used for construction as follows.
   1. Structural fill shall be the soil used to construct the perimeter berm, base of the landfill cell, beneath roads and structures, and other uses under structural loads.
   2. Select clay liner shall be the soil used as the low-permeability component below the liner system geosynthetics.
   3. Protective cover drainage layer shall be soils used to construct the protective cover/leachate collection zone above the liner system geosynthetics.
   4. Topsoil shall be used to support permanent vegetation.
   5. Common fill shall be used for general grading purposes in areas without structural loads, unless otherwise specified.

C. CONTRACTOR shall be prepared to place and compact soil in conjunction with the construction of other components of the Work.

D. The Work of this Section shall include, but not necessarily be limited to:
   1. furnishing, placing, and compacting soil;
   2. sampling and testing (laboratory and field) soil; and
   3. disposal and stockpiling of surplus soil.

E. Soil placed and compacted shall conform to the dimensions, lines, grades, and sections indicated on the Drawings.

F. CONTRACTOR shall be responsible to ensure that the soil meets the requirements of this Section. Any soil that does not conform to this Section will be rejected by ENGINEER and/or the CQA Consultant and shall be replaced by CONTRACTOR with soil that conforms to this Section at no cost to OWNER.

G. CONTRACTOR shall perform the required field and laboratory CQC tests described in this Section.

1.02 SUBMITTALS

A. At least 14 days prior to the delivery of soil to the Site, CONTRACTOR shall provide the following information to ENGINEER:
   1. the proposed material source or sources (either on-site or off-site); and
   2. laboratory test data in conformance with the requirements of Part 2.01.

B. At least 14 days prior to starting soil placement and compaction, CONTRACTOR shall provide ENGINEER the following:
   1. The date and time that soil delivery operations will start; and
   2. The date and time that soil placement and compaction operations will start

C. As soon as the information is available, CONTRACTOR shall provide ENGINEER and the CQA Consultant the results of field and laboratory tests performed on soil. Test reports of field tests are to be submitted by the following morning.

D. If Work is interrupted for reasons other than inclement weather, then CONTRACTOR shall notify ENGINEER a minimum of 24 hours prior to the resumption of Work.

1.03 CONSTRUCTION QUALITY ASSURANCE

A. Construction and testing of soil shall be monitored by the CQA Consultant as outlined in the CQA Plan.

B. CONTRACTOR shall be aware of the activities outlined in the CQA Plan and shall account for these activities in the construction schedule. This specifically includes the time required for off-site shipment and testing of soils.

PART 2 PRODUCTS

2.01 GENERAL

A. CONTRACTOR shall employ an independent geotechnical testing laboratory acceptable to OWNER and ENGINEER to perform pre-qualification tests (at a frequency of 1 set of tests per source) on each off-site borrow source that is proposed for use and shall provide the test results to ENGINEER. Geotechnical and/or agricultural testing laboratory requirements are provided in Table 02055-1.

B. The final approval of a source for the soil will be at the sole discretion of ENGINEER.

2.02 STRUCTURAL FILL

A. Structural fill shall consist of relatively homogeneous soil that is free of debris, foreign objects, excess silt, excess roots, and excess organics.

B. Structural fill shall meet the Unified Soil Classification System (USCS) classification for GC, GM, SW, SP, SM, SC, or SP-SM according to ASTM D 2487, and shall have a maximum PI of 15, as determined in accordance with ASTM D 4318.

C. Structural fill shall have no particles larger than 2 in. when tested in accordance with ASTM D 422.

D. Structural fill shall no more than 3 percent organic matter when tested in accordance with ASTM D 2974, Method C.

2.03 SELECT CLAY LINER

A. Select clay liner shall consist of relatively homogeneous soil that is free of debris, foreign objects, excess roots, and excess organics.

B. Select clay liner soils shall meet the Unified Soil Classification System (USCS) classification for SC, ML, CL, or CH according to ASTM D 2487.

C. Select clay liner shall have no particles larger than 1 in. when tested in accordance with ASTM D 422.

D. Select clay liner shall have a maximum hydraulic conductivity of 1×10^{-5} cm/s when tested in accordance with ASTM D 5084. The test shall be run at an effective confining stress of 10 psi.

E. CONTRACTOR shall construct a test pad as described in Part 3.03 to develop a window of acceptable in-place moisture content and dry density to meet maximum hydraulic conductivity required in Part 2.03D of this Section. The evaluation of the moisture-density-hydraulic conductivity relationship of the material shall be based on hydraulic conductivity testing (ASTM D5084) performed on a minimum of 3 thin-walled, undisturbed samples (Shelby tubes) tests taken from the test pad. Acceptable moisture-density relationship shall be obtained from the test pad and used by the CONTRACTOR and CQA Consultant during construction.

F. During construction, should in-situ hydraulic permeability test data indicate failing test results despite having moisture and compaction results within the pre-qualification window, CONTRACTOR shall perform additional testing at its expense to refine the acceptable in-place moisture and density window for remaining work.

G. Select clay liner shall have no more than 5 percent organic matter when tested in accordance with ASTM D 2974, Method C.

2.04 PROTECTIVE DRAINAGE LAYER

A. The protective drainage layer shall consist of relativity homogenous soil or aggregate that is free of debris, foreign objects, excess silt, roots and organics.

B. For soil materials, the protective drainage layer shall meet the USCS classification of GP, GW, SP-SM, SW, or SP according to ASTM D 2487.

C. The protective drainage layer shall be non-plastic, as determined in accordance with ASTM D 4318.

D. The protective drainage layer shall have a maximum particle size of 1 in. and no more than 30 percent of particles less than 0.075 mm. Protective cover drainage layer soils shall have a minimum hydraulic conductivity as required on the Drawings (either 1×10^{-2} cm/s or 1×10^{-3} cm/s) when tested in accordance with ASTM D 2434.

2.05 TOPSOIL

A. Topsoil shall be defined as the upper natural surface soil, typically having high organic content, presenting the characteristics of representative soils on the site that promote growth of grass or other vegetation. For topsoil salvaged from on-site borrow sources, topsoil shall typically extend to a depth of approximately 6 to 12 inches.

B. Topsoil shall consist of relatively homogenous soil that is free of debris, foreign objects, and excess roots.

C. Topsoil shall conform to the following requirements as outlined in the E&SC plan:
   1. pH between 6.0 and 7.0;
   2. soluble salts less than 500 parts per million;
   3. less than 40 percent clay but enough fine-grained material (greater than 30percent silt plus clay) to provide the capacity to hold a moderate amount of moisture. An exception: in lovegrass will be planted, then a sandy soil (less than 30 percent plus clay) would be acceptable;

4. contains a minimum of 2.5 percent organic matter by weight when tested in accordance with ASTM D 2974, Method C; and,
5. contains sufficient pore space to permit adequate root penetration.

D. If topsoil does not meet the material requirements specified herein, CONTRACTOR may propose to amend the topsoil to bring it into conformance with project requirements. CONTRACTOR shall submit to ENGINEER for approval a soil amendment plan describing the materials, application rates, and equipment proposed for topsoil amendment. Approval of the topsoil amendment plan shall be at the sole discretion of ENGINEER.

E. Any amendments applied shall be incorporated throughout the entire thickness of the topsoil layer using a disc harrow or other suitable equipment which will result in a uniform distribution of amendments within the topsoil.

2.06 EQUIPMENT

A. CONTRACTOR shall furnish, operate, and maintain grading equipment as is necessary to produce uniform layers, sections, and smoothness of grade for compaction and drainage.

B. CONTRACTOR shall furnish, operate and maintain compaction equipment as is necessary to produce the required in-place soil density and moisture content.

C. CONTRACTOR shall furnish, operate, and maintain tank trucks, pressure distributors, or other equipment designed to apply water uniformly and in controlled quantities to variable surface widths, if moisture conditioning of soil is required to achieve the specified in-place density and moisture content.

D. CONTRACTOR shall furnish, operate, and maintain soil spreading equipment that travels on the material being spread without traveling directly on the surface of or causing damage to the underlying compacted soil surface layer.

E. CONTRACTOR shall furnish, operate, and maintain miscellaneous equipment such as scarifiers, disc harrows, spring tooth or spike tooth harrows, earth hauling equipment, and other equipment necessary for earthwork construction.

PART 3 EXECUTION

3.01 GENERAL

A. Prior to placing and compacting soils, CONTRACTOR shall become thoroughly familiar with the Site, the site conditions, and all patrons of the Work falling under this Section and other relevant Sections related to specific uses of soil.

B. Prior to placing and compacting soil, CONTRACTOR shall carefully inspect the installed Work of all other sections and verify that all Work is complete to the point where Work of this Section may properly commence without adverse impact.

C. Soil shall be placed and compacted to the lines and grades shown on the Drawings.

D. No frozen or thawing soils shall be placed or compacted. Soil shall be placed only on dry, unfrozen subgrade surfaces.

3.02 STRUCTURAL FILL

A. Structural fill shall be placed in loose lifts that result in a compacted lift thickness of 12 in. or less. Compaction shall be performed using a static smooth-drum roller or padded-foot compactors as specified elsewhere in this Section. Hand compaction of material shall be used in locations where larger compaction is inappropriate due to limited area.

B. Unless otherwise specified, each soil lift shall be compacted to at least 95 percent of the maximum dry density and at a moisture content between -4 to +2 percent of the optimum moisture content as determined by ASTM D 698. At CONTRACTOR's request, ENGINEER may consider revising the range of acceptable moisture contents based on the field and laboratory test results submitted by CONTRACTOR.

C. Field testing of each lift of structural fill shall be tested by CQA Consultant as required by Table 02055-2. Should field testing indicate the moisture or density of any portion of a lift of structural fill outside of acceptable values, CONTRACTOR shall scarify, moisture condition, and recompact the lift as necessary to bring it into conformance with acceptable moisture and density values

D. CONTRACTOR shall finish each day's work with a smooth-drum roller to create a smooth surface, free from ruts or indentations, which will minimize moisture penetration. The area shall be left in a manner to promote runoff at the end of each day.

E. Prior to continuing construction from the previous day's work, CONTRACTOR shall scarify the surface to provide a bond between the layers.

3.03 SELECT CLAY LINER TEST PAD

A. Prior to full-scale select clay liner construction, CONTRACTOR shall prepare an approximate 100 ft by 100 ft test pad for each clay source to demonstrate the select clay liner meets the hydraulic conductivity requirements outlined in Section 2.03D. The test pad shall be constructed within the limits of the cell being constructed to the lines and grades shown on the Drawings, and shall be left in-place once passing results are obtained.

B. If the select clay liner material from difference sources are consistent (i.e. similar USCS soil type classification, liquid and plastic limits, grain size distribution, moisture density relationship and permeability characteristics) one test pad will be adequate provided it is approved by the CQA Consultant.

C. During test pad construction, CONTRACTOR shall use the placement and compaction equipment and techniques that will be used during full-scale select clay liner construction. Test pad construction shall meet the lift thickness and minimum compaction criteria in Part 3.04 of this Section.

D. During test pad construction, CONTRACTOR shall establish the range of moisture and compaction criteria that will achieve required permeability results. A minimum of three undisturbed Shelby tube samples shall be taken during test pad construction and tested in accordance with ASTM D-5084 to confirm acceptable in-situ permeability. At CONTRACTOR's request, ENGINEER may consider revising the range of acceptable density and/or moisture contents based on the field and laboratory test results obtained during test pad construction. At no time will a moisture-density relationship be accepted which results in a hydraulic conductivity greater than what is specified in Part 2.03D of this Section. Portions of the test pad that have failing results shall be moisture conditioned and recompacted until acceptable in-situ permeability results are obtained.

E. Following completion of the test pad, full-scale select clay liner construction shall conform to the moisture and density limits identified.

3.04 SELECT CLAY LINER

A. Select clay liner shall be placed in loose lifts that result in a compacted lift thickness of 8 in. or less. Compaction shall be performed using a static padded-foot or sheepsfoot compactor with a minimum weight of 35,000 lbs, unless other equipment of compaction equipment is approved by ENGINEER. Hand compaction of material shall be used in locations where larger compaction is inappropriate due to limited area.

B. Each soil lift shall be compacted to at least 95 percent of the maximum dry density and at a moisture content as determined by the acceptable moisture-density-hydraulic conductivity window identified in Part 2.03E of this section.

C. Field testing of each lift of select clay liner shall be tested by CQA Consultant as required by Table 02055-2. Should field testing indicate the moisture or density of any portion of a lift of select clay liner outside of acceptable values, CONTRACTOR shall scarify, moisture condition, and recompact the lift as necessary to bring it into conformance with acceptable moisture and density values.

D. CONTRACTOR shall finish each day's work with a smooth-drum roller to create a smooth surface, free from ruts or indentations, which will minimize moisture penetration. The area shall be left in a manner to promote runoff at the end of each day.

E. Prior to continuing construction from the previous day's work, CONTRACTOR shall scarify the surface to provide a bond between the layers.

3.04 COMMON FILL

A. Common fill shall be placed and compacted within trenches and in other non-specified areas to the lines and grades shown on the Drawings.

B. Common fill shall be placed in loose lifts that result in a compacted lift thickness of 12 in. or less. Compaction shall be performed using a bulldozer, smooth-drum roller, or padded-foot compactor. Hand compaction of material shall be used in locations where larger compaction is inappropriate due to limited area.

C. Each soil lift shall be compacted using at least two passes of compaction equipment. A single pass is defined as traveling both forward and backward over a particular location.

D. CONTRACTOR shall finish each day's work with a smooth-drum roller to create a smooth surface, free from ruts or indentations, which will minimize moisture penetration. The area shall be left in a manner to promote runoff at the end of each day.

E. Prior to continuing construction from the previous day's work, CONTRACTOR shall scarify the surface to provide a bond between the layers.

3.05 PROTECTIVE DRAINAGE LAYER

A. Protective drainage layer soils shall be placed over the geosynthetics within the limits of the disposal cells.

B. Protective drainage layer shall be placed in a single lift to a thickness of 12-in. using low-ground pressure equipment. Additional requirements for placement of protective drainage layer soils are found in Part 3.06 of Section 02075.

C. On finished slopes greater than 15 percent, protective drainage layer placement shall begin at the bottom of slope pushing progressively up slope. Equipment shall not travel perpendicular to the slope.

3.06 TOPSOIL

A. Topsoil shall be placed in a single lift to a minimum 6” thickness or the total thickness required as shown on the Drawings.

B. CONTRACTOR shall place soil in a manner that minimizes compaction. Low ground pressure equipment shall be used during placement. Multiple passes by spreading equipment should be avoided when placing soils.

C. CONTRACTOR shall apply fertilizer and permanently stabilize as described in Section 02370 and on the Drawings.

D. The surface of the completed topsoil shall be tracked immediately after placement and addition of soil amendments. Tracking is to be performed by low-ground pressure bulldozers operating in the direction of runoff flow. The tracks of the bulldozer shall have grousers of sufficient height to leave visible indentations in the completed cover surface. The indentations shall be perpendicular to the direction of runoff flow to reduce erosion potential.

3.07 FIELD QUALITY ASSURANCE

A. The CQA Consultant will monitor the placement and compaction of soils in accordance with the CQA Plan.

B. CQA Consultant shall perform field CQA testing of soil during placement and compaction, as described below.
   1. The minimum testing frequencies for material evaluation and construction quality evaluation are presented in Tables 02055-1 and 02055-2.
   2. Sampling locations will be selected by ENGINEER or the CQA Consultant.

3. A special testing frequency will be used at the discretion of ENGINEER or the CQA Consultant when visual observations of construction performance indicate a potential problem. Additional testing will be considered when:
    a. the rollers slip during rolling operation;
    b. the lift thickness is greater than specified;
    c. the soil is at improper and/or variable moisture content;
    d. fewer than the specified number of roller passes are made;
    e. dirt-clogged rollers are used to compact the material;
    f. the rollers do not have optimum ballast; or
    g. the degree of compaction is doubtful.
4. During construction, the frequency of testing may also be increased by ENGINEER or the CQA Consultant in the following situations:
    a. adverse weather conditions;
    b. breakdown of equipment;
    c. at the start and finish of grading;
    d. if the material fails to meet specifications; or
    e. the work area is reduced.

C. Perforations:
1. Perforations in the compacted soil that must be filled shall include, but not be limited to:
    a. nuclear density test probe locations;
    b. drive cylinder test locations; and
    c. sand cone test locations.
2. Perforations in the compacted soil shall be backfilled with similar soil. The soil shall be hand-tamped by CONTRACTOR to the satisfaction of the CQA Consultant.

D. Defective Areas:
1. If a defective area is discovered in the compacted soil, then the CQA Consultant will notify CONTRACTOR who shall proceed to determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, then CONTRACTOR will determine the extent of the defective area by additional tests, observations, a review of records, or other means that CONTRACTOR deems appropriate. If the defect is related to adverse site conditions, such as overly wet soils or surface desiccation, then CONTRACTOR will define the limits and nature of the defect.
2. After the extent and nature of a defect has been determined, CONTRACTOR shall correct the deficiency to the satisfaction of ENGINEER and the CQA Consultant. The cost of corrective actions shall be borne by CONTRACTOR.

3. Additional testing will be performed by CONTRACTOR to verify that the defect has been corrected. This additional testing will be performed and submitted to the ENGINEER before any additional work is allowed in the area of deficiency.

3.08 TOLERANCE

A. The soils shall be constructed to within the tolerances found in Part 1.09 of Section 01721.

TABLE 02055-1

MINIMUM TESTING FREQUENCIES FOR LABORATORY SOIL EVALUATION[1]

TEST	SOIL TYPE REQUIRING TEST [2]	METHOD	MINIMUM FREQUENCY OF TESTING
Grain Size Analysis (Sieve and Hydrometer)	SF, SC, PD, TS, CF	ASTM D 422	1 per 10,000 yd^3 (minimum 1 test per material type and source)
Moisture Content	SF, SC, PD	ASTM D 2216	1 per 10,000 yd^3 (minimum 1 test per material type and source)
Atterberg Limits	SF, SC, PD	ASTM D 4318	1 per 10,000 yd^3 (minimum 1 test per material type and source)
Standard Proctor	SF, SC	ASTM D 698	1 per 10,000 yd^3 (minimum 1 test per material type and source)
Organic Content	SF, PD, TS	ASTM D 2974	1 per 10,000 yd^3 (minimum 1 test per material type and source)
Hydraulic Conductivity	SC, PD	ASTM D 2434 or ASTM D 5084	1 per 10,000 yd^3 (minimum 1 test per material type and source)
Agricultural Analyses	TS	---	1 per 5,000 yd^3 (minimum 1 test per material type and source)

Notes:

1. Tests to be performed by CQA Consultant on samples of bulk soil samples collected from soil to be placed. These tests will be performed in addition to the pre-qualification tests required in this Specification.
2. Abbreviations: SF = Structural Fill; SC = Select Clay Liner; PD = Protective Drainage Layer; TS = Topsoil; CF = Common Fill

TABLE 02055-2

MINIMUM FIELD TESTING FREQUENCIES(1)

TEST	METHOD	MINIMUM FREQUENCY OF TESTING
Moisture Content (Nuclear Gauge)	ASTM D 3017	1 per 10,000 ft^2 per lift (minimum of six per lift)
In-Place Dry Density (Nuclear Gauge)	ASTM D 2922	1 per 10,000 ft^2 per lift (minimum of six per lift)
In-Situ Hydraulic Conductivity(2)	ASTM D 5084	1 per acre per lift
Moisture Content (Field Oven Test)	ASTM D 2216	3 per material type and source
In-Place Dry Density (Drive Cylinder Method or Sand Cone)	ASTM D 2937 or D 1556	1 per material type and source

Note:

1. Field tests are to be performed by CQA Consultant on in-place, compacted structural fill and select clay liner materials.
2. In-situ hydraulic conductivity shall only be performed on select clay liner.

END OF SECTION

SECTION 02060

AGGREGATE AND RIP RAP

PART 1 GENERAL

1.01 SCOPE OF WORK

A. CONTRACTOR shall furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary for the placement of aggregate, pea gravel, recycled concrete, and riprap as specified in this Section, as shown on the Drawings, and in accordance with the Construction Quality Assurance (CQA) Plan.

B. CONTRACTOR shall be prepared to place aggregate, pea gravel, recycled concrete, and riprap in conjunction with other components of the Work.

C. The Work of this Section shall include procurement, testing, and placement of all aggregate, pea gravel, recycled concrete, and riprap.

D. Aggregate, pea gravel, recycled concrete, and riprap placed shall conform to the dimensions, lines, grades, and sections indicated on the Drawings.

E. Aggregate, pea gravel, recycled concrete, and riprap described in this Section shall be used for construction as follows.
   1. Leachate collection aggregate shall be used around leachate collection piping.
   2. Pea gravel shall be used in secondary leachate detection sumps.
   3. Access road aggregate or recycled concrete shall be used for construction of access roads.
   4. Riprap shall be used in the protection of outfalls, channels, and other stormwater features.

F. CONTRACTOR shall retain a Construction Quality Control (CQC) Consultant to perform the required field and laboratory tests described in this Section. The CQC Consultant shall be acceptable to OWNER and ENGINEER.

1.02 SUBMITTALS

A. At least 14 days prior to the delivery of any aggregate, pea gravel, recycled concrete, or riprap, CONTRACTOR shall provide ENGINEER the following information.
   1. The proposed source(s) for aggregate, pea gravel, recycled concrete, and riprap.
   2. The results of tests performed on the proposed aggregate and recycled concrete in accordance with Tables 901A and 901B as specified in Section 901.01 of the Maryland State Highway Administration “Standard Specifications for

Construction and Materials" dated July 2018, herewith "MSHA STANDARDS (2018)."

3. The results of grain-size analysis performed in accordance with ASTM C 136, tests to determine soundness performed in accordance with ASTM C 88, and tests to determine degradation performed in accordance with ASTM C 535 on the proposed pea gravel.
4. Certification that the proposed riprap has the correct gradation and meets the material quality requirements specified in Sections 901.02 through 901.05 of the MSHA STANDARDS (2018).

B. The tests identified in Part 1.02.A shall be carried out by CONTRACTOR's CQC Consultant for each proposed material source and type of aggregate, pea gravel, recycled concrete, or riprap.

C. As soon as the information is available, CONTRACTOR shall provide ENGINEER and the CQA Consultant the results of field and laboratory tests performed on aggregate, pea gravel, recycled concrete, and riprap. Test reports of field tests are to be submitted by the following morning.

D. If Work is interrupted for reasons other than inclement weather, then CONTRACTOR shall notify ENGINEER a minimum of 24 hours prior to the resumption of Work.

1.03 CONSTRUCTION QUALITY ASSURANCE

A. The size and installation of the aggregate, pea gravel, recycled concrete, and riprap will be monitored and tested by CQA Consultant.

B. CONTRACTOR shall be aware of the activities outlined in the CQA Plan and shall account for these activities in the construction schedule.

PART 2 PRODUCTS

2.01 LEACHATE COLLECTION AGGREGATE

A. Leachate collection aggregate shall conform to the material requirements specified in Section 901.01 of the MSHA STANDARDS (2018) for coarse aggregate No. 57.

B. Aggregate supplied shall conform to the size and type shown on the Drawings.

2.02 PEA GRAVEL

A. Pea gravel shall be washed, free-flowing, and free of loam, clay, ice, snow, and debris, etc.

B. Pea gravel shall be a mix of rounded particles, sizes between 1/8 inch and 3/4 inch. The pea gravel must conform to the specifications of ASTM C-33. The pea gravel size must conform to AASHTO M 43 as No. 6, 67, or 7. No more than 5% (by weight) of the pea gravel shall pass through a No. 8 sieve.

2.03 ACCESS ROAD AGGREGATE

A. Access road aggregate shall conform to the material requirements specified in Section 901.01 of the MSHA STANDARDS (2018), as appropriate.

B. Aggregate supplied shall conform to the size and type shown on the Drawings.

2.04 RECYCLED CONCRETE

A. Recycled concrete shall consist of relatively homogeneous material that is free of loam, clay, and deleterious material such as brick, reinforcing steel, wood, paper, plaster, lathing, and building rubble.

B. Recycled concrete shall conform to the material requirements specified in Section 901.01 of the MSHA STANDARDS (2018), as crusher run aggregate CR-6.

C. Recycled concrete supplied shall conform to the size and type shown on the Drawings.

2.05 RIPRAP

A. Riprap shall conform to the material requirements stone for riprap as specified in Sections 901.02 through 901.05 of the MSHA STANDARDS (2018).

B. Riprap supplied shall conform to the size and type shown on the Drawings.

PART 3 EXECUTION

3.01 GENERAL

A. Prior to placing aggregate, pea gravel, recycled concrete, and riprap, CONTRACTOR shall become thoroughly familiar with the Site, the site conditions, and all patrons of the Work falling under this Section and other relevant Sections related to specific use.

B. Prior to placing aggregate, pea gravel, recycled concrete, and riprap, CONTRACTOR shall carefully inspect the installed Work of all other sections and verify that all Work is complete to the point where Work of this Section may properly commence without adverse impact. If CONTRACTOR has any concerns regarding the installed work of other sections, then CONTRACTOR shall immediately notify ENGINEER prior to the initiation of aggregate placement. Failure to notify ENGINEER in writing shall be construed as CONTRACTOR's acceptance of the relative Work of all other Sections.

C. Aggregate, pea gravel, recycled concrete, and riprap shall be placed and compacted to the lines and grades shown on the Drawings.

D. Aggregate, pea gravel, recycled concrete, and riprap shall be placed only on dry, unfrozen subgrade surfaces.

3.02 FIELD QUALITY CONTROL

A. CONTRACTOR shall perform quality control testing of aggregate, pea gravel, and recycled concrete. Grain size analysis on the aggregate shall be performed in accordance with Table 901A of Section 901.01 of the MSHA STANDARDS (2018) on each 5,000 yd^3 placed to ensure conformance with this Section.

B. If visual observation of recycled concrete indicates any foreign material, at the request of the CQA Consultant, CONTRACTOR shall reject that recycled concrete.

C. If visual observation of riprap indicates potentially nonconforming materials, at the request of the CQA Consultant, CONTRACTOR shall perform field conformance testing of riprap.

3.03 FIELD QUALITY ASSURANCE

A. CQA Consultant will visually observe the placement of aggregate, pea gravel, recycled concrete, and riprap.

B. CQA Consultant may perform additional conformance testing at its sole discretion.

3.04 LEACHATE COLLECTION AGGREGATE

A. Leachate collection aggregate shall be placed to the lines, grades, and cross-sections shown on the Drawings.

B. Filter geotextile placed around leachate collection aggregate shall overlap a minimum of 12-in. Adjacent panels shall be overlapped a minimum of 6-in.

C. Placement of aggregate shall be performed in a manner that does not damage underlying geosynthetic materials, or cause excessive wrinkling or movement of underlying geosynthetics. Vehicles and heavy equipment are prohibited from operating directly on geosynthetics.

3.05 PEA GRAVEL

A. Pea gravel shall be placed in leachate detection sumps to the lines, grades, and cross-sections, shown on the Drawings.

B. Placement of pea gravel in leachate detection sumps shall be performed in a manner that does not damage underlying geosynthetic materials, or cause excessive wrinkling or movement of underlying geosynthetics. Vehicles and heavy equipment are prohibited from operating directly on geosynthetics.

3.06 ACCESS ROAD AGGREGATE

A. Access road aggregate shall be placed to the lines, grades, and cross-sections shown on the Drawings.

B. Geotextile placed underneath access road aggregate shall extend under the full width of the access road. Adjacent panels shall be overlapped a minimum of 6-in.

C. Access road aggregate shall be placed in loose lifts that result in a compacted lift thickness of 12 in. or less. Compaction shall be performed using a vibratory smooth drum roller. Hand compaction of material shall be used in locations where larger compaction is inappropriate due to limited area.

D. Access road aggregate shall be compacted using a minimum of 3 passes. A single pass is defined as traveling both forward and backward over a particular location.

3.07 RECYCLED CONCRETE

A. Recycled concrete shall be placed to the lines, grades, and cross-sections shown on the Drawings.

B. Geotextile placed underneath recycled concrete shall extend under the full width of the access road. Adjacent panels shall be overlapped a minimum of 6-in.

C. Recycled concrete shall be placed in loose lifts that result in a compacted lift thickness of 12 in. or less. Compaction shall be performed using a vibratory smooth drum roller. Hand compaction of material shall be used in locations where larger compaction is inappropriate due to limited area.

D. Recycled concrete shall be compacted using a minimum of 3 passes. A single pass is defined as traveling both forward and backward over a particular location.

3.08 RIPRAP

A. Riprap shall be placed to the lines, grades, and cross-sections shown on the Drawings.

B. Placement of riprap shall be performed manually or using a piece of equipment that allows for controlled placement that minimizes impact damage to underlying materials. The maximum drop height shall be 18 inches.

3.09 PRODUCT PROTECTION

A. CONTRACTOR shall use all means necessary to protect all prior Work and materials and completed Work of other Sections.

END OF SECTION

SECTION 02071

GEOTEXTILE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. CONTRACTOR shall furnish all geotextile, labor, incidental materials, tools, supervision, transportation, and installation equipment necessary for the installation of geotextile, and as specified herein, as shown on the Drawings, and in accordance with the Construction Quality Assurance (CQA) Plan.

B. CONTRACTOR shall obtain the geotextile from a Geotextile Manufacturer that has the demonstrated experience with geotextile manufacturing as stated in Part 1.02.A of this Section.

C. CONTRACTOR shall install all geotextile and shall be responsible for field handling, storing, deploying, seaming or connecting, temporary restraining, anchoring, and other aspects of geotextile installation.

D. CONTRACTOR shall be prepared to install geotextile in conjunction with the other components of the project.

1.02 QUALIFICATIONS

A. The Geotextile Manufacturer shall have successfully manufactured a minimum of 10,000,000 ft^2 of the same type of geotextile as specified for this Project.

B. The Geotextile Manufacturer shall have sufficient manufacturing capacity and qualified personnel to meet the requirements of this Section and the demands (e.g., quantity production and quality control) of this Project.

1.03 SUBMITTALS

A. At least 14 days prior to shipping any geotextile, CONTRACTOR shall provide ENGINEER with the following documentation on the proposed geotextile:
1. manufacturer and product name;
2. minimum property values of the proposed geotextile and corresponding test procedures;
3. proposed geotextile delivery dates; and
4. a statement from the Geotextile Manufacturer that the geotextiles will retain their structure during handling, placement, and long-term service; and be capable of

withstanding direct exposure to sunlight (UV) for a minimum of 30 days with no measurable deterioration.

B. At least 7 days prior to deploying the geotextile, CONTRACTOR shall submit to ENGINEER the following documentation on geotextile production:
1. a list of geotextile roll numbers delivered to the Site;
2. lot, batch and/or roll numbers and identification; and
3. results of quality control tests, including a description of the test methods, signed by a responsible party employed by the Geotextile Manufacturer (e.g., Production Manager).

1.04 CONSTRUCTION QUALITY ASSURANCE

A. The installation of the geotextile shall be monitored by the CQA Consultant as outlined in the CQA Plan.

B. CONTRACTOR shall be aware of the activities in the CQA Plan and shall account for these CQA activities in the construction schedule.

PART 2 PRODUCTS

2.01 GEOTEXTILE PROPERTIES

A. Unless otherwise noted on the Drawings, the Geotextile Manufacturer shall furnish materials whose "Minimum Average Roll Values", as defined by the Federal Highway Administration (FHWA), meet or exceed the criteria specified in Table 02071-1 (for non-woven geotextiles) and Table 02071-2 (for woven geotextiles).

2.02 MANUFACTURING QUALITY CONTROL

A. The Geotextile Manufacturer shall sample and test the geotextile, at a minimum, once every 100,000 ft^2 of geotextile manufactured to demonstrate that the material conforms to all requirements in Table 02071-1.

B. Sampling shall, in general, be performed on sacrificial portions of the material such that repair of the material is not required.

C. Any geotextile sample that does not comply with the requirements of this Section shall result in the rejection of the roll from which the sample was obtained. The Geotextile Manufacturer shall replace any rejected roll at no cost to OWNER.

D. If a geotextile sample fails to meet the quality control requirements of this Section, then CONTRACTOR shall require that the Geotextile Manufacturer sample and test each roll manufactured in the same lot, or at the same time, as the failing roll, at no cost to OWNER. Sampling and testing of rolls shall continue until a pattern of acceptable test results is established.

E. Additional sample testing may be performed at the Geotextile Manufacturer's discretion and expense, to more closely identify any non-complying rolls and/or to qualify individual rolls.

F. The Geotextile Manufacturer shall comply with the certification and submittal requirements of this Section.

2.03 PACKING AND LABELING

A. Geotextile shall be supplied by the Geotextile Manufacturer in rolls wrapped in relatively waterproof and opaque protective covers.

B. Geotextile rolls shall be marked or tagged with the following information:
   1. manufacturer's name;
   2. product identification;
   3. lot number;
   4. roll number; and
   5. roll dimensions.

C. Geotextile rolls which cannot be identified per 2.03.B because of missing or damaged labels will be removed from the job site and replaced at no additional expense to the OWNER.

2.04 TRANSPORTATION

A. CONTRACTOR shall be liable for all damages to the materials incurred prior to and during transportation.

B. Geotextile shall be delivered to the Site at least seven (7) days before the scheduled date of deployment to allow the CQA Consultant adequate time for taking inventory and obtaining additional conformance samples, if needed. CONTRACTOR/ Geosynthetic Installer shall notify OWNER a minimum of 24 hours prior to any delivery.

2.05 HANDLING AND STORAGE

A. CONTRACTOR shall be responsible for handling, unloading, storage, and care of the geotextile prior to, during, and following installation. CONTRACTOR shall be liable for all damages to the geotextile incurred prior to final acceptance by OWNER and ENGINEER.

B. CONTRACTOR shall be responsible for storage of the geotextile at the Site after the material is delivered and shall protect the geotextile from moisture, long-term direct exposure to sunlight, puncture, or other damaging or deleterious conditions (e.g., mud, dirt, and dust). CONTRACTOR shall be responsible for any additional storage procedures required by the Geotextile Manufacturer.

2.06 CONFORMANCE TESTING

A. Conformance testing, if required, shall be performed in accordance with the CQA Plan. CONTRACTOR shall assist the CQA Consultant in obtaining conformance samples, if requested. The CQA Consultant has the option of collecting samples at the manufacturing facility.

B. Passing test results are required before any geotextile is deployed.

C. Samples shall be taken at a minimum frequency rate stated in the CQA Plan, with a minimum of one sample per lot. If the Geotextile Manufacturer provides material that requires conformance sampling at a frequency (due to lot size, shipment size, etc.) resulting in one sample per less than 85 percent of the frequency in the CQA Plan, then CONTRACTOR shall pay the cost for all additional testing.

D. The CQA Consultant may increase the frequency of sampling in the event that test results do not comply with the requirements of Part 2.01 of this Section until passing conformance test results are obtained for all geotextile that is received at the Site. This additional testing shall be performed at the expense of CONTRACTOR.

PART 3 EXECUTION

3.01 FAMILIARIZATION

A. Prior to implementing any Work described in this Section, CONTRACTOR shall become thoroughly familiar with all portions of the Work falling within this Section.

B. Prior to implementing any of the Work of this Section, CONTRACTOR shall carefully inspect the installed Work of all other Sections and verify that all such

Work is complete to the point where the Work of this Section may properly commence without adverse impact.

3.02 HANDLING AND PLACEMENT

A. The geotextile shall be handled in such a manner as to ensure that it is not damaged.

B. Precautions shall be taken to prevent damage to underlying materials during placement of the geotextile.

C. After unwrapping the geotextile from its opaque cover, the geotextile shall not be left exposed for a period in excess of 15 days unless a longer exposure period is approved by ENGINEER. Approval may be based on a formal demonstration from the Geotextile Manufacturer that the geotextile is stabilized against ultraviolet degradation for a period in excess of 15 days. If the geotextile is exposed for a period longer than 15 days, and the longer exposure period is not approved by ENGINEER, then CONTRACTOR shall replace the geotextile.

D. CONTRACTOR shall examine the surfaces to be covered with geotextile before deployment to ensure there are no potentially harmful foreign objects. Foreign objects shall be removed prior to deploying the geotextile at no additional cost to the OWNER.

E. All geotextile shall be anchored with ballast to prevent wind uplift and associated damage. Such ballasts shall be installed during placement and shall remain until the geotextile is covered.

F. The CQA Consultant shall examine the deployed geotextile surface after installation to ensure that no potentially harmful foreign objects are present either above or below the geotextile.

G. Geotextile shall not be placed on saturated or frozen subgrade standing water.

3.03 SEAMS AND OVERLAPS

A. Nonwoven geotextile shall be continuously seamed or sewn (i.e., spot sewing or lystering is not allowed).

B. On slopes steeper than 10 horizontal to 1 vertical, geotextile shall be continuous down the slope; that is, no horizontal seams are allowed. Horizontal seams shall be considered as any seam having an alignment exceeding 20 degrees from being perpendicular to the slope contour lines, unless otherwise approved by ENGINEER. No horizontal seams shall be allowed within 5 ft. of the top or toe of the slopes.

C. Geotextile panels shall be overlapped as indicated on the Drawings or at a minimum of 3 in.

D. When sewing, nonwoven geotextile shall be continuously sewn (i.e., spot sewing is not allowed) using Stitch Type 401 and a flat or single "prayer" seam (Federal Seam Type SSa), with the stitching a minimum of 1.5 in. from the edge of the geotextile. Stitching shall have an average of greater than 5 stitches per in. that will result is a seam strength greater or equal to 75 percent of the fabric strength. Where indicated on the drawings, in high stress locations a "J' type seam is required (Federal Seam Type SSn). Geotextile shall be sewn with polymeric thread, having similar strength and chemical resistance characteristics as the geotextile

E. For seaming, nonwoven geotextile shall be welded using an automated vehicular-mounted apparatus equipped with gauges giving the instantaneous temperatures and pressures of the machine. Seams must be uniform, continuous, without burn-through of either geotextile panel resulting in a seam strength greater or equal to 75 percent of the fabric strength, and without "fishmouths" or wrinkles that result in gaps in the seam. Prior to each day's production seaming, the Geosynthetics Installer shall perform trial welding on scraps of geotextile in the presence of the CQA Consultant to document that the seaming equipment is properly adjusted and the method of seaming will result in an acceptable seam.

3.04 REPAIR

A. Any holes or tears in the geotextile shall be repaired using a patch made from the same geotextile. Geotextile patches will be sewn into place no closer than 1 in. from any panel edge. Should any tear exceed 33 percent of the width of the roll, that roll shall be removed and replaced.

B. Where geosynthetic materials underlie the geotextile being placed, care shall be taken to remove any soil or other material that may have penetrated the torn geotextile.

3.05 MATERIALS IN CONTACT WITH GEOTEXTILE

A. CONTRACTOR shall place all soil or aggregate on top of geotextile such that:
   1. the geotextile and underlying materials are not damaged;
   2. minimum slippage occurs between the geotextile and underlying layers; and
   3. excess stresses are not induced in the geotextile.

B. Equipment shall not be driven directly on the geotextile. Unless otherwise specified by ENGINEER, all equipment operating on earthen materials overlying the geotextile shall comply with the following.

Allowable Equipment Ground Pressure (psi)	Minimum Thickness of Overlying Soil (ft)
< 5	1.0
≥ 5 to 20	2.0
> 20	3.0

3.06 PRODUCT PROTECTION

A. CONTRACTOR shall use all means necessary to protect all prior Work and materials and completed Work of other Sections.

B. In the event of damage, CONTRACTOR shall immediately make all repairs and replacements necessary to the approval of ENGINEER or the CQA Consultant and at no cost to OWNER.

TABLE 02071-1

REQUIRED NON-WOVEN GEOTEXTILE PROPERTIES[1]

PROPERTIES	QUALIFIERS	UNITS	VALUE			TEST METHOD
Polymer Composition (polypropylene or polyester)	Minimum	Percent	95			---
Construction Type	---	---	Needle-punched, Non-woven			---
Mass Per Unit Area	Minimum	oz/yd^2	8	10	12	ASTM D 5261
Apparent Opening Size	Maximum	US Sieve	$O_{95} \geq 80$			ASTM D 4751
Grab Strength	Minimum	lb.	200	230	300	ASTM D 4632
Tear Strength	Minimum	lb.	80	95	115	ASTM D 4533
CBR Puncture Strength	Minimum	lb.	580	700	800	ASTM D 6241
UV Resistance at 500 hrs	Minimum	percent	70			ASTM D 4355

Note:

1. All values represent minimum average roll values (i.e., any roll in a lot should meet or exceed these values).

TABLE 02071-2

REQUIRED WOVEN GEOTEXTILE PROPERTIES(1)

PROPERTIES	QUALIFIERS	UNITS	VALUE	TEST METHOD
Construction Type	---	---	Slit film woven	---
Mass Per Unit Area	Minimum	oz/yd^2	5.8 (NOM 6)	ASTM D 5261
Grab Tensile Strength	Minimum	lb.	315	ASTM D 4632
Wide Width Tensile Strength	Minimum	lb/in	300 x 350	ASTM D 4595
Trapezoidal Tear Strength	Minimum	lb.	120	ASTM D 4533
CBR Puncture Strength	Minimum	lb.	950	ASTM D 6241
UV Resistance at 500 hrs	Minimum	percent	70	ASTM D 4355

Note:

1. All values represent minimum average roll values (i.e., any roll in a lot should meet or exceed these values).

END OF SECTION

SECTION 02075

GEOMEMBRANE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. CONTRACTOR shall furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary for the installation of geomembrane as specified herein, as shown on the Drawings, and in accordance with the Construction Quality Assurance (CQA) Plan.

B. Textured high-density polyethylene (HDPE) geomembrane shall be used as the geomembrane for this Project. The approved geomembrane will have properties that comply with the requirements specified in Table 02075-1.

C. CONTRACTOR shall retain the services of a Geosynthetics Installer to install the approved geomembrane in conjunction with the other components of the Project. The Geosynthetics Installer shall be approved by the Geomembrane Manufacturer and have the demonstrated experience with installation of the geomembrane as stated in Part 1.02.A of this Section.

1.02 QUALIFICATIONS

A. Geosynthetic Installer:
   1. The Geosynthetic Installer shall be responsible for field handling, storing, deploying, seaming, temporarily restraining (against wind), and other aspects of the geomembrane and other components of the liner system, and shall provide qualified installation personnel, as outlined in this Section. The Geosynthetics Installer may also be responsible for anchoring systems.
   2. As a firm, the Geosynthetic Installer shall have successfully installed a minimum of 10,000,000 ft^2 of HDPE geomembrane for at least ten landfill projects in the past five years.
   3. The superintendent assigned to this project shall have supervised the installation of a minimum of 2,000,000 ft^2 of either HDPE geomembrane on at least ten similar containment projects.
   4. All personnel performing seaming operations shall be qualified by experience or by successfully passing seaming tests.
      a. At least one seamer shall have experience seaming a minimum of 1,000,000 lineal ft. of HDPE geomembrane seams using the same type of seaming apparatus to be used at this Site. Seamers with such experience will be designated “master seamers” and shall provide direct supervision over less experienced seamers.

b. Seaming personnel shall have seamed at least 100,000 lineal ft. of HDPE geomembrane seams using the same type of seaming apparatus to be used at this Site.

B. CONTRACTOR shall accept and retain full responsibility for all materials and installation and shall be held responsible for any defects.

1.03 SUBMITTALS

A. At least 14 days prior to the scheduled date of geomembrane installation, the Geosynthetics Installer shall submit to ENGINEER the following:
1. Copy of Geomembrane Installer's letter of approval or license by the Geomembrane Manufacturer.
2. Installation capabilities, including:
   a. information on equipment and personnel;
   b. average daily production anticipated for this Project; and
   c. quality control procedures;
3. A list of at least ten landfill or similar containment projects within the last five years that the Geomembrane Installer has installed a minimum of 10,000,000 ft^2 of HDPE geomembrane. The following information shall be provided for each facility:
   a. the name and purpose of the facility, its location, and dates of installation;
   b. the names of OWNER, ENGINEER, and CONTRACTOR;
   c. thickness and surface area of installed geomembrane; and
   d. type of seaming and type of seaming apparatus used.
4. Resumes of all personnel who will perform seaming operations on this Project, including dates and duration of employment.
5. A drawing showing the installation layout identifying field seams, as well as any variance or additional details that deviate from the Drawings. The layout shall be adequate for use as a construction plan and shall include dimensions, details, etc.
6. Installation schedule.
7. A Certificate of Calibration less than 12 months old for the field tensiometer referenced in Parts 3.05.I and K of this Section.

B. During the installation, the Geosynthetic Installer shall be responsible for the timely submission to ENGINEER the following:
1. quality control documentation; and
2. subgrade acceptance certificates, signed by the Geosynthetic Installer, for each area to be covered by geomembrane.

C. Upon completion of the installation, CONTRACTOR/Geosynthetic Installer shall submit to ENGINEER record drawings of the installation as specified in Section 01721.

1.04 CONSTRUCTION QUALITY ASSURANCE

A. The installation of geomembrane shall be monitored by the CQA Consultant as outlined in the CQA Plan.

B. Geosynthetic Installer shall be aware of the activities in the CQA Plan and shall account for these CQA activities in the installation schedule.

C. CONTRACTOR shall provide the CQA Consultant the opportunity to obtain conformance samples at the geomembrane manufacturing facility in order to expedite the conformance testing and approval process.

PART 2 PRODUCTS

2.01 TRANSPORTATION

A. CONTRACTOR shall be responsible for the coordination of delivery/transportation of the geomembrane to the site.

B. CONTRACTOR shall be liable for all damages to the geomembrane incurred prior to and during transportation to the Site.

C. Geomembrane shall be delivered to the Site at least seven days before the scheduled date of installation to allow the CQA Consultant adequate time for taking inventory and obtaining conformance samples, if needed. CONTRACTOR shall notify OWNER a minimum of 24 hours prior to any delivery.

2.02 HANDLING AND STORAGE

A. CONTRACTOR/Geosynthetic Installer shall be responsible for handling, storing, and caring for the geomembrane prior to and following installation at the Site. CONTRACTOR/Geosynthetic Installer shall be liable for all damages to the materials incurred prior to final acceptance by OWNER and ENGINEER.

B. CONTRACTOR/Geosynthetic Installer shall be responsible for storage of the geomembrane at the Site. During storage, the geomembrane shall be protected from excessive heat or cold, puncture, cutting, or other damaging or deleterious conditions. The geomembrane shall be stored in accordance with any additional requirements of the Geomembrane Manufacturer.

2.03 CONFORMANCE TESTING

A. Conformance testing shall be performed in accordance with the CQA Plan. CONTRACTOR shall assist the CQA Consultant in obtaining conformance samples, if requested.

B. Passing test are required before any geomembrane is deployed.

PART 3 EXECUTION

3.01 FAMILIARIZATION

A. Prior to implementing any Work described in this Section, the Geosynthetic Installer shall become thoroughly familiar with all portions of the Work required by these specifications.

B. The Geosynthetic Installer shall carefully inspect the installed Work of all other Sections and verify that all Work is complete to the point where the Work of this Section may properly commence without adverse impact to the project.

3.02 SURFACE PREPARATION

A. If not already provided during GCL deployment, the Geosynthetics Installer shall provide certification in writing that the surface on which the geomembrane will be installed is acceptable. The surface shall be free of stones, litter, organic matter, irregularities, protrusion, loose soil, and any abrupt changes in grade that could damage the geomembrane. The certification of acceptance shall be given to and accepted by the CQA Consultant prior to commencement of geomembrane installation in the area under consideration.

B. Special care shall be taken to maintain the prepared subgrade.

C. When deploying over select clay liner, no geomembrane shall be placed onto an area which has been softened by precipitation, or which has cracked due to desiccation. When deploying over GCL, no geomembrane shall be placed over GCL that has become hydrated. The soil or GCL surface shall be continuously observed by the Geosynthetics Installer for conformance with surface requirements.

D. Any damage to the soil surface caused by installation activities shall be repaired at CONTRACTOR's expense.

E. CONTRACTOR shall be responsible for dewatering areas that have been accepted for geomembrane deployment, including anchor trenches.

F. CONTRACTOR shall make efforts to grade the area to direct surface water away from the installation area and pump any accumulation of water immediately from the installation area.

3.03 ANCHORAGE

A. The anchor trench shall be excavated prior to geomembrane placement to the lines, grades, and configuration shown on the Drawings and as specified in the Specifications.

B. Slightly rounded corners shall be provided in the trench where the geomembrane adjoins the trench to avoid sharp bends in the geomembrane.

C. Loose soil shall be compacted or removed from the anchor trench prior to installation of the geomembrane.

D. The anchor trench shall be backfilled and compacted after the geosynthetics has been installed in the trench. Care shall be taken when backfilling the trenches to prevent any damage to the geosynthetics.

E. Soils used in the anchor trench shall conform to structural fill or protective cover as specified in Section 02055. Although field density testing is not required, soils shall be placed in nominal 12-in thick lifts and compacted using compaction equipment.

3.04 GEOMEMBRANE DEPLOYMENT

A. The Geosynthetic Installer shall prepare a geomembrane installation layout drawing(s) prior to geomembrane deployment. These drawings shall indicate the geomembrane configuration, dimensions, details, locations of seams, etc. ENGINEER must approve the layout drawings prior to the installation of any geomembrane. The layout drawings, as modified and/or approved by ENGINEER, shall become part of the Contract Documents.

B. Field Panel Identification
1. A geomembrane field panel is a roll or a portion of roll cut in the field. The Geosynthetic Installer shall be responsible to identify and track all partially used rolls by marking the roll number clearly on the roll after cutting a field panel.
2. Each field panel must be given an identification code (number or letter-number). This identification code shall be agreed upon by the CQA Consultant and Geosynthetics Installer. The field panel identification code shall be related, through a table or chart, to the original resin, and the constituent rolls and factory panels.

C. Field Panel Placement

1. Field panels shall be installed as approved or modified at the location and positions indicated in the layout drawings.
2. Field panels shall be placed one at a time, and each field panel shall be seamed to adjacent panels the same day that it is placed.
3. Geomembrane may only be deployed during daylight hours between one hour after sunrise and one hour before sunset, unless otherwise approved by OWNER and ENGINEER.
4. Geomembrane shall not be placed when the ambient temperature is below 32°F or above 104°F, unless otherwise authorized by ENGINEER.
5. Geomembrane shall not be placed during any precipitation, in the presence of excessive moisture (e.g., frost, ice, fog, dew), in an area of ponded water, or in the presence of winds exceeding 20 miles per hour.
6. The overlaps shall be shingled to aid in shedding water.
7. The Geosynthetic Installer shall employ placement methods consistent with the following:
    a. no vehicular traffic shall be allowed on the geomembrane, other than low ground pressure rubber tired all-terrain vehicles. Prior to operating any vehicle on geomembrane, tires shall be visually inspected for sharp and hard objects such as, but not limited to rocks, metal shards, etc. that could puncture the geomembrane. When vehicles are operating on the geomembrane, steps should be taken to prevent any sharp turns, excessive braking or accelerating to mitigate bunching and tearing of the geomembrane under the tires of the vehicle. Damages to the geomembrane caused by vehicular operation shall be repaired at the discretion of the CQA Consultant and/or ENGINEER at no cost to the OWNER. If misuse of the all-terrain vehicle is observed, use may be prohibited at the sole discretion of the CQA Consultant, with no additional cost to the OWNER for changes in construction procedure or schedule due to the prohibition of equipment.
    b. equipment used shall not damage the geomembrane by handling, trafficking, leakage of hydrocarbons, or other means.
    c. personnel working on the geomembrane shall not smoke, wear damaging shoes, or engage in other activities that could damage the geomembrane.
    d. the method used to unroll the panels shall not scratch or crimp the geomembrane and shall not damage the supporting soil.
    e. the prepared surface underlying the geomembrane shall not be allowed to deteriorate after acceptance of the surface, and shall remain acceptable up to the time of geomembrane placement.
    f. the method used to place the panels shall minimize wrinkles (especially differential wrinkles between adjacent panels).
    g. temporary loads and/or anchors (e.g., sand bags, tires), not likely to damage the geomembrane, may be placed on the geomembrane to prevent uplift by

wind (in high winds, continuous loading is recommended along panel edges to minimize the risk of wind flow under the panels).

8. Any field panel or portion thereof that becomes seriously damaged (torn, twisted, or crimped) shall be replaced with new material at no cost to OWNER. Less serious damage may be repaired at the CQA Consultant's sole discretion and at no cost to OWNER. Damaged panels or portions of damaged panels that have been rejected shall be removed from the work area.
9. Placement of geomembrane shall not damage the underlying geosynthetic clay liner.

3.05 FIELD SEAMING

A. In general, seams shall be oriented parallel to the line of maximum slope, (i.e., oriented down, not across, the slope). In corners and at odd-shaped geometric locations, the number of field seams shall be minimized. No horizontal seam shall be made within 5 ft. of any toe of the slope, except where approved by ENGINEER and/or the CQA Consultant. Horizontal seams shall be considered as any seam having an alignment exceeding 20 degrees from being perpendicular to the slope contour lines, unless otherwise approved by ENGINEER. No seams shall be located in an area of potential stress concentration, as defined by ENGINEER.

B. All personnel performing seaming operations shall be qualified as indicated in this Section. No seaming shall be performed unless a "master seamer" (as defined in this Section) is present.

C. The geomembrane shall have field seams that equal or exceed the strength requirements presented in Table 02075-2.

D. Weather Conditions for Seaming
   1. Seaming shall not be attempted at ambient temperatures below 32°F or above 104°F or when wind velocity exceeds 20 miles per hour. At ambient temperatures between 32°F and 50°F, seaming shall be allowed if the geomembrane is preheated either by the sun or a hot air device, and if there is no excessive cooling from wind. At ambient temperatures above 50°F, no preheating will be required. In all cases, the geomembrane shall be dry and protected from excessive wind.
   2. If the Geosynthetics Installer wishes to use methods that allow seaming at ambient temperatures below 32°F or above 104°F, then he shall demonstrate that the seam so produced is equivalent to those produced under normally approved conditions, and that the overall quality of the geomembrane is not adversely affected. In addition, an addendum to the Contract between OWNER and the Geosynthetics Installer shall be required that specifically states that the seaming procedure does not cause any physical or chemical modification to the

geomembrane that will generate any short or long term damage to the geomembrane.

3. To minimize geomembrane contraction stresses, seaming should ideally be carried out in the morning and late evening when the geomembrane is relatively contracted, and during the middle of the day if overcast conditions prevail. If the geomembrane must be seamed in the middle of a sunny day, then the Geosynthetics Installer shall ensure that the panels to be seamed are at the same temperature and that there is sufficient slack in the geomembrane to prevent the generation of excessive stresses or trampolining when the geomembrane contracts as cooler temperatures prevail. The Geosynthetics Installer shall determine the required amount of slack and it should not be so much so as to cause significant wrinkling of the geomembrane. If trampolining of the geomembrane is observed, then the Geosynthetics Installer will be required to make repairs so that the problem is eliminated.
4. Ambient temperatures shall be measured 6 in. above the geomembrane surface.

E. Overlapping and Temporary Bonding

1. Geomembrane panels shall be overlapped a minimum of 3 in. for extrusion welding and 5 in. for fusion welding, but in any event, sufficient overlap shall be provided to allow peel tests to be performed on the seam.
2. The procedure used to temporarily bond adjacent panels together shall not damage the geomembrane. The temperature of the air at the nozzle of the spot welding apparatus shall be controlled such that the geomembrane is not damaged.
3. No solvent or adhesive shall be used unless OWNER has approved the product in writing. Samples of any proposed solvent or adhesive shall be submitted to CONTRACTOR for testing and evaluation at the Geosynthetics Installer's expense.

F. Seam Preparation

1. Prior to seaming, the seam area shall be cleaned and made free of moisture, dust, dirt, debris of any kind, and foreign material.
2. If seam overlap grinding is required, then the process shall be completed according to the Geomembrane Manufacturer's instructions within 20 minutes of the seaming operation and in a manner that does not damage the geomembrane. The grind depth shall not exceed ten percent of the geomembrane thickness. Grinding marks shall not appear beyond 0.25 in. of the extrudate after it is placed.
3. Seams shall be aligned with the fewest possible number of wrinkles and "fishmouths".

G. General Seaming Requirements
1. Seaming shall extend to the outside edge of panels, including those panels placed in the anchor trench.
2. If required to provide a firm substrate, then a board, or similar hard surface, placed directly under the seam overlap may be used to achieve proper support.
3. Fishmouths or wrinkles at the seam overlaps shall be removed by cutting the geomembrane along the ridge of the wrinkle. At the end(s) of the cut, cut a circle in the geomembrane to achieve a flat overlap. The cut shall be seamed as described in this Section. Any portion where the overlap is inadequate shall then be patched with an oval or round patch of the same geomembrane that extends a minimum of 6 in. beyond the cut in all directions.

H. Seaming Process
1. Approved processes for field seaming are extrusion welding and fusion welding. Seaming equipment shall be operated in a manner that does not cause damage to the geomembrane. Only apparatus that ENGINEER has specifically approved by make and model shall be used. Proposed alternate seaming processes shall be documented and submitted to ENGINEER.
2. Extrusion Equipment and Procedures:
   a. The Geosynthetics Installer shall maintain at least one spare operable extrusion seaming apparatus on Site at all times.
   b. Extrusion welding apparatus shall be equipped with gauges giving the temperature in the apparatus.
   c. Prior to beginning a seam, the extruder shall be purged until all heat-degraded extrudate has been removed from the barrel.
   d. The electric generator used for power supply to the welding machines shall be placed outside the area to be lined or mounted on soft tires such that no damage occurs to the geomembrane. The electric generator shall be equipped with a grounding rod that is driven into the ground outside the lined area. A smooth insulating plate or fabric shall be placed beneath the hot welding apparatus after use.
3. Fusion Equipment and Procedures:
   a. The Geosynthetics Installer shall maintain at least one spare operable seaming apparatus on Site at all times.
   b. Fusion-welding apparatus shall be automated vehicular-mounted devices equipped with gauges giving the instantaneous temperatures and pressures of the machine.
   c. The edges of cross seams shall be abraded to a smooth incline (top and bottom) prior to welding.
   d. A movable protective layer may be used directly below each geomembrane overlap to be seamed to prevent the buildup of moisture between the sheets.

e. The electric generator used for power supply to the welding machines shall be placed outside the area to be lined or mounted on soft tires such that no damage occurs to the geomembrane. A smooth insulating plate or fabric shall be placed beneath the hot welding apparatus after use.

I. Trial Seams

1. Trial seams shall be made prior to production seaming by all seamers and by all equipment to be used during production seaming. The trial seams shall be made on fragment pieces of geomembrane to verify that seaming conditions are adequate. Such trial seams shall be made at the beginning of each seaming period, and at least once each five hours, for each seaming apparatus used that day. Trial seams shall be made under the same conditions as actual production field seams. The trial seam sample shall be at least 5-ft. long by 1-ft. wide (after seaming) with the seam centered lengthwise. Seam overlap shall be as specified in Part 3.05.E of this Section.
2. Four specimens, each 1.0-in. wide, shall be cut from the trial seam sample by the Geosynthetics Installer. The specimens shall be tested in peel (both tracks for fusion welds) using an electronic readout field tensiometer, and the specimen shall fail by film tear bond (FTB) (i.e., failure in the parent material) rather than in the seam. The Geosynthetics Installer shall test the specimens in the presence of the CQA Consultant. Testing using the field tensiometer shall be performed in accordance with ASTM D6392, at a strain rate of 2 in./minute. Ideally, the samples shall be conditioned at 73°F at a relative humidity of 50 percent for two hours prior to testing. If test conditions vary from this requirement, then a 1-in. wide specimen of the parent geomembrane (no weld) shall be tested in the same manner as the seam specimens to determine the break strength at this condition. At no time shall the specimens be soaked in water.
3. If a specimen fails to comply with the properties stated in Table 02075-2, then the entire operation shall be repeated. If the additional specimen fails to meet these requirements, then the seaming apparatus or seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two consecutive successful trial seams are achieved.
4. After completion of the above-described tests, the remaining portion of the trial seam sample can be discarded. If a trial seam sample fails a test, then a destructive test seam sample may be taken from the seams completed by the seamer during the shift related to the considered trial seam at the discretion of ENGINEER or the CQA Consultant. These samples shall be forwarded to CQA geosynthetics laboratory and, if they fail the tests, the procedure indicated in Part 3.05.K.5 of this Section shall apply. The results of all testing shall be reported to the CQA Consultant. The conditions of this paragraph shall be considered as met for a given seam if a destructive seam test sample has already been taken from the considered seam.

J. Nondestructive Seam Continuity Testing
   1. The Geosynthetics Installer shall nondestructively test all field seams over their full length using a vacuum test, air pressure test (for double fusion seams only), or other approved method. Continuity testing shall be carried out as the seaming work progresses, not at the completion of all field seaming. The installer shall complete any required repairs in accordance with Part 3.05.L of this Section. The following procedures shall apply to locations where seams cannot be nondestructively tested:
      a. If the seam is accessible to testing equipment prior to final installation, then the seam shall be nondestructively tested prior to final installation.
      b. If the seam cannot be tested prior to final installation, then the seaming operations must be observed in their entirety by the CQA Consultant for uniformity and completeness.
   2. Vacuum testing of extrusion field seams and repairs shall be performed in accordance with ASTM D 5641.
   3. Air pressure testing shall be performed on double fusion seams only, and shall be performed in accordance with ASTM D 5820 and the following:
      a. Energize the air pump to a pressure between 25 and 30 psi, close valve, allow two minutes for pressure to stabilize, and sustain the pressure for not less than 5 minutes.
      b. If loss of pressure exceeds 4 psi, or if the pressure does not stabilize, then locate faulty area and repair in accordance with Part 3.05.L of this Section.
      c. Cut opposite end of air channel from pressure gauge and observe release of pressure to ensure that the entire channel is not blocked.
      d. Remove needle, or other approved pressure feed device, and seal repair in accordance with Part 3.05.L of this Section.
   4. ENGINEER may allow spark testing in accordance with ASTM D 6365 if the seam cannot be tested using other nondestructive methods.

K. Destructive Testing
   1. Destructive testing of field seams shall be performed on samples collected from selected locations to evaluate seam strength and integrity according to the requirements for seam strength presented in Table 02075-2. Destructive testing shall be carried out as the geomembrane installation progresses, not at the completion of all field seaming.
   2. Sampling
      a. Field seam samples shall be collected for destructive testing at a minimum average frequency of one test location per 1,000 ft. of seam length per seamer. Test locations shall be determined during seaming, and may be prompted by suspicion of excess crystallinity, contamination, offset seams, or any other potential cause of imperfect seaming. The CQA Consultant

will be responsible for choosing the locations. The Geosynthetics Installer shall not be informed in advance of the locations where the seam samples will be taken. ENGINEER or the CQA Consultant reserves the right to increase the sampling frequency.

b. Samples of the field seams shall be cut with rounded corners by the Geosynthetics Installer at the locations designated by the Geosynthetics CQA Consultant as the seaming progresses. Passing laboratory test results must be obtained before the field seams are covered by another material. All holes in the geomembrane resulting from the field seam sampling shall be immediately repaired in accordance with the repair procedures described in Part 3.05.L of this Section. The continuity of the new seams in the repaired areas shall be tested according to Part 3.05.J of this Section.

c. Two strips, 1-in. wide and 12-in. long with the seam centered parallel to the width, shall be taken. The strips shall be spaced a clear distance of 42-in. apart. These samples shall be tested using the field tensiometer in accordance with Part 3.05.I.2 of this Section. If these samples pass the field test, then a laboratory sample shall be taken. The laboratory sample shall be at least 1-ft. wide by 42-in. long with the seam centered lengthwise. The sample shall be cut into three parts and distributed as follows:

   i. one 1-ft. long portion to the Geosynthetics Installer.
   ii. one 1-ft. long portion to OWNER for its archives; and
   iii. one 1.5-foot long portion to the CQA Consultant laboratory testing.

3. If any field test sample fails to meet the required seam strength properties presented in Table 02075-2, then the procedures outlined in Part 3.05.K.5 of this Section shall be followed.

4. Samples shall be tested in the laboratory in accordance with the requirements of this Section and the CQA Plan.

5. Destructive Test Failure

   a. The following procedures shall apply whenever a sample fails a destructive test, whether the test is conducted by the CQA laboratory, the Geosynthetics Installer's laboratory, or by a field tensiometer. The Geosynthetics Installer shall have two options, as described in b and c below.

   b. The Geosynthetics Installer can reconstruct the seam (e.g., remove the old seam and reseam) between two passing destructive test locations. The welding path of the seaming apparatus shall be tracked (in each direction).

   c. The Geosynthetics Installer can trace the welding path to an intermediate location, a minimum of 10 ft. from the location of the failed test (in each direction) and take a small sample for an additional field test at each location. If these additional samples pass the tests, then full laboratory samples shall be taken. If these laboratory samples pass the tests, then the seam shall be reconstructed between these locations. If either sample fails, then the process shall be repeated to establish the zone in which the seam should be reconstructed. In any case, all acceptable seams must be bounded by two locations from which samples passing laboratory destructive tests have been taken, or by one location in the case where the other limit of the failing seam is bounded by the beginning or the end of the day's production seaming. In cases where the length of reconstructed seam exceeds 150 ft., a destructive sample taken from within the reconstructed zone must pass destructive testing. Whenever a sample fails, the CQA Consultant may require additional tests for seams that were formed by the same seamer and/or seaming apparatus or seamed during the same time shift.

L. Defects and Repairs
1. All seams and non-seam areas of the geomembrane will be examined by the CQA Consultant and the Geosynthetic Installer for evidence of defects, holes, blisters, undispersed raw materials and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of examination. The geomembrane surface shall be swept or washed by the Geosynthetics Installer if surface contamination inhibits examination. The Geosynthetics Installer shall ensure that this examination of the geomembrane precedes any seaming of that section.
2. Each suspect location, both in seam and non-seam areas, shall be nondestructively tested using the methods described Part 3.05.J of this Section, as appropriate. Each location that fails nondestructive testing shall be marked by the CQA Consultant and repaired by the Geosynthetics Installer. Work shall not proceed with any materials that will cover the defective area until the suspect location is repaired and passing nondestructive test are obtained. In addition, passing destructive test results shall be achieved prior to placing any material over geomembrane.
3. When seaming of a geomembrane is completed (or when seaming of a large area of a geomembrane is completed) and prior to placing overlying materials, the CQA Consultant shall identify excessive geomembrane wrinkles. The Geosynthetics Installer shall cut and reseam the wrinkle areas so identified. The seams thus produced shall be tested like any other seams.
4. Repair Procedures.
   a. Any portion of the geomembrane exhibiting a flaw, or failing a destructive or nondestructive test, shall be repaired by the Geosynthetics Installer. Several repair procedures are specified below. The final decision as to the appropriate repair procedure shall be agreed upon between the CQA Consultant and the Geosynthetics Installer. The procedures available include:
      i. patching, used to repair large holes, small tears, undispersed raw materials, and contamination by foreign matter;
      ii. abrading and reseaming, used to repair small sections of extruded seams;
      iii. spot seaming, used to repair minor, localized flaws;

iv. capping, used to repair lengths of failed seams;
v. removing failed seam and replacing with a strip of new material seamed into place (used with long lengths of fusion seams) and/or extrusion seams.

b. In addition, the following shall be satisfied:
i. surfaces of the geomembrane that are to be repaired shall be abraded no more than 20 minutes prior to the repair;
ii. all surfaces must be clean and dry at the time of repair;
iii. all seaming equipment used in repair procedures must be approved by ENGINEER or the CQA Consultant;
iv. the repair procedures, materials, and techniques shall be approved in advance, for the specific repair, by the CQA Consultant and Geosynthetics Installer;
v. patches or caps shall extend at least 6 in. beyond the edge of the defect, and all corners of holes and patches shall be rounded with a radius of at least 3 in.; and
vi. the geomembrane below large caps shall be appropriately cut to avoid water or gas collection between the two sheets.

5. Each repair shall be numbered and logged and shall be nondestructively tested using the methods described in this Section. Repairs that pass the nondestructive test shall be taken as an indication of an adequate repair. Failed tests will require the repair to be redone and retested until a passing test result is achieved. At the discretion of the CQA Consultant, destructive testing may be required on large caps.

3.06 MATERIALS IN CONTACT WITH THE GEOMEMBRANE

A. The Geosynthetics Installer shall take all necessary precautions to ensure that the geomembrane is not damaged during its installation or during the installation of other components of the liner system or by other construction activities. Installation on rough surfaces, such as concrete, shall be performed carefully.

B. Equipment shall not be driven directly on the geomembrane. Unless otherwise specified by ENGINEER, all equipment operating on materials overlying the geomembrane shall comply with the following:

Allowable Equipment Ground Pressure (psi)	Minimum Thickness of Overlying Soil (ft.)
<5	1.0
≥ 5 to 20	2.0
>20	3.0

C. In heavily trafficked areas such as access ramps, and in areas trafficked by rubber tire vehicles, the thickness of overlying compacted soil shall be at least 3 ft.

D. Installation of the geomembrane in sump areas, and connection of the geomembrane to appurtenances shall be made according to these Specifications and as shown on the Drawings. Extreme care shall be taken while seaming around sumps and appurtenances since neither nondestructive nor destructive testing may be feasible in these areas. The Geosynthetics Installer shall ensure that the geomembrane has not been visibly damaged while making connections to sumps and appurtenances. Because of the difficulty of vacuum testing seams in the sump area, fusion seams should be made at all possible locations in the sump.

E. Placement of soils above the geomembrane will not proceed at an ambient temperature below 32°F nor above 104°F unless otherwise specified, or approved by ENGINEER.

3.07 GEOMEMBRANE ACCEPTANCE

A. The Geosynthetics Installer shall retain all ownership and responsibility for the geomembrane until accepted by OWNER and ENGINEER.

B. The geomembrane will not be accepted by OWNER and ENGINEER until all of the following conditions are met:
   1. the installation is finished;
   2. all documentation of installation is completed;
   3. verification of the adequacy of all field seams and repairs, including associated testing, is complete; and
   4. written certification documents, including record drawings, sealed by a professional land surveyor licensed in the State of Maryland, have been received by OWNER and ENGINEER, in accordance with Section 01721.

3.08 PRODUCT PROTECTION

A. CONTRACTOR shall use all means necessary to protect all prior Work and all materials and completed Work of other Sections.

B. In the event of damage, CONTRACTOR shall immediately make all repairs and replacements necessary, to the approval of the CQA Consultant and at no additional cost to OWNER.

TABLE 02075-1

REQUIRED TEXTURED GEOMEMBRANE PROPERTY VALUES(1)

PROPERTIES	QUALIFIERS	UNITS	SPECIFIED VALUES	TEST METHOD
Thickness	nominal	mils	60	ASTM D 5994
	minimum average	mils	57	ASTM D 5994
	lowest for 8 out of 10 values	mils	54	ASTM D 5994
	lowest for any of the 10 values	mils	51	ASTM D 5994
Asperity Height	minimum average	mils	10	ASTM D7466
Density	minimum	g/cc	0.940	ASTM D 792 or ASTM D 1505
Tensile Properties (each direction)				
1. Yield Strength	minimum	lb/in.	126	ASTM D 6693
2. Break Strength	minimum	lb/in.	90	ASTM D 6693
3. Yield Elongation	minimum	%	12	ASTM D 6693
4. Break Elongation	minimum	%	100	ASTM D 6693
Puncture Resistance	minimum	lb.	90	ASTM D 4833
Interface Friction (see Note 2)	minimum	degrees	See Note 3	ASTM D 5321
Carbon Black Content		%	2.0-3.0	ASTM D 4218
Carbon Black Dispersion	N/A	none	See Note 4	ASTM D 5596
Stress Crack Resistance (see Note 5)	minimum	hours	300	ASTM D 5397

Notes:
1. All values represent minimum average roll values (i.e., any roll in a lot should meet or exceed these values).
2. Interface friction testing shall be performed by CONTRACTOR on the entire liner system cross section using the proposed liner system materials (i.e., subgrade, select clay liner, geomembrane, geocomposite, and protective drainage layer). Test specimens shall be compacted to 95 percent of maximum dry density and within two percent of the optimum moisture content as determined by the standard Proctor compaction test (ASTM D 698). The soil/geosynthetic interface shall be wetted and the test specimen shall be saturated for 24 hours prior to testing. Base liner testing shall be performed at normal stresses of: 100 lb/ft^2, 500 lb/ft^2, 4,000 lb/ft^2, and 8,000 lb/ft^2.
3. Under normal pressure of 100 lb/ft^2, the liner interface should have a friction angle greater than 25 degrees, or equivalently a shear strength of 56 lb/ft^2. GCL used can be non-hydrated for test under this normal pressure. Under normal pressures of 500, 4,000 and 8,000 lb/ft^2, the liner interface should have a friction angle greater than 15 degrees. GCL shall be fully-hydrated for tests under these three confining pressures.
4. Carbon black dispersion (only near spherical agglomerates) for 10 different views:
   - minimum 9 in Categories 1 or 2; and
   - maximum 1 in Category 3.
5. Stress crack resistance testing is required for Manufacturing Quality Control Testing only.

TABLE 02075-2

REQUIRED TEXTURED GEOMEMBRANE SEAM PROPERTIES

PROPERTIES	QUALIFIERS	UNITS	SPECIFIED VALUES	TEST METHOD
Gauge	nominal	Mils	60	ASTM D5994
Shear Strength[1] at yield point	minimum	lb/in	108	ASTM D6392
Peel Adhesion FTB[2] Fusion	minimum	lb/in	90	ASTM D6392
Peel Adhesion FTB[2] Extrusion	minimum	lb/in-	78	ASTM D6392

Notes:
1. Also called "Bonded Seam Strength."
2. In addition to the minimum passing values, passing seams shall not separate more that 10 percent of the width into the weld and shall exhibit the following location of breaks:
    - Fusion Welded Seams – BRK, SE1, SE2, and AD-BRK
    - Extrusion Welded Seams – SE1, SE2, SE3, BRK1, and BRK2

END OF SECTION

SECTION 02078

GEOCOMPOSITE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. CONTRACTOR shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary for the installation of the geocomposite drainage layer as specified herein, as shown on the Drawings, and in accordance with the Construction Quality Assurance (CQA) Plan.

B. The Geosynthetics Installer shall be prepared to install the geocomposite drainage layer in conjunction with earthworks and other components of the liner system.

1.02 QUALIFICATIONS

A. Geocomposite Manufacturer:
   1. The Geocomposite Manufacturer shall be capable of manufacturing geocomposite rolls and shall have sufficient production capacity and qualified personnel to meet the requirements of this Section and the demands (e.g., quantity production and quality control) of this Project.
   2. The Geocomposite Manufacturer shall have successfully manufactured a minimum of 10,000,000 ft^2 of geocomposite for use in at least ten similar containment projects in the past five years.

1.03 SUBMITTALS

A. At least 14 days prior to shipping any geocomposite to the Site, CONTRACTOR/Geosynthetics Installer shall provide ENGINEER with the following documentation on the Geocomposite Manufacturer that will supply the geocomposite.
   1. Manufacturing capabilities, including:
      a. daily production quantity available for this Contract;
      b. manufacturing quality control procedures; and
      c. list of material properties, including certified test results, to which are attached geocomposite samples.
   2. A list of at least ten landfill or similar solid waste containment projects within the last five years that the Geocomposite Manufacturer has manufactured a minimum of 10,000,000 ft^2 of HDPE geocomposite. The following information shall be provided for each facility:
      a. name, location, and purpose of facility, and date of installation;
      b. names of OWNER, ENGINEER, and CONTRACTOR; and

c. type of geocomposite manufactured.

B. Prior to transporting any geocomposite to the Site, CONTRACTOR shall submit the following documentation on the raw materials used to manufacture the geocomposite to ENGINEER.
1. Copies of quality control certificates issued by the raw material supplier including the production dates of the raw material and origin of the raw materials used to manufacture geocomposite for the project.
2. Results of tests conducted by the Manufacturer to verify the quality of the resin used to manufacture the geocomposite rolls assigned to the project and the origin of the resin and quality control certificates issued by the resin supplier.
3. Certification that no reclaimed polymer is added to the resin during the manufacture of the geocomposite to be used in this project.
4. Results of the product’s hydraulic transmisivity as measured using the GRI GC-8 method. One specimen will be required to be tested through 100 hours duration at the specified maximum confining pressure and hydraulic gradient.

C. CONTRACTOR shall submit to ENGINEER the following information on geocomposite production prior to the shipment of the geocomposite rolls.
1. Manufacturing quality control certificates for each shift’s production signed by responsible parties employed by the Manufacturer (such as the production manager).
2. The quality control certificate shall include:
   a. roll numbers and identification; and
   b. results of quality control tests, including descriptions of test methods used.
3. The Manufacturer quality control tests to be performed are outlined in Part 2.03 of this Section.

1.04 CONSTRUCTION QUALITY ASSURANCE

A. The installation of the geocomposites shall be monitored by the CQA Consultant as outlined in the CQA Plan.

B. CONTRACTOR shall be aware of the activities outlined in the CQA Plan and shall account for these CQA activities in the installation schedule.

PART 2 PRODUCTS

2.01 GEOCOMPOSITE MATERIAL

A. The geocomposite shall be composed of a high density polyethylene drainage net with a nonwoven, needlepunched geotextile bonded to each side of the drainage net. The geotextile shall not be glued or bonded to the geonet in any manner other than heat bonding. Along the edges, six inches of the geotextile shall not be heat bonded to the geonet to allow connection in the field.

2.02 GEOCOMPOSITE MATERIAL PROPERTIES

A. The Manufacturer shall furnish geocomposite having material properties that comply with the required property values shown in Table 02620-1. The Manufacturer shall provide test results for these procedures, as well as a certification that the materials meet or exceed the specified values.

B. In addition to the property values listed in Table 02620-1, the geocomposite shall be chemically inert when immersed in a leachate representative of that from a typical landfill. The geonet shall contain a maximum of one percent by weight of additives, fillers, or extenders (not including carbon black) and shall not contain foaming agents or voids within the ribs of the geonet.

2.03 MANUFACTURING QUALITY CONTROL

A. The geocomposite shall be manufactured with quality control procedures that meet generally accepted industry standards.

B. The Manufacturer shall sample and test the geocomposite to demonstrate that the material complies with the Specifications.

C. Any geocomposite sample that does not comply with the Specifications will result in rejection of the roll from which the sample was obtained. The Manufacturer shall replace any rejected rolls at no additional cost to OWNER.

D. If a geocomposite sample fails to meet the quality control requirements of this Section, then the Geocomposite Manufacturer shall sample and test each roll manufactured in the same lot, or at the same time, as the failing roll. Sampling and testing of rolls shall continue until a pattern of acceptable test results is established.

E. Additional sample testing may be performed, at the Manufacturer’s discretion and expense, to more closely identify any non-complying rolls and/or to qualify individual rolls.

F. Sampling shall, in general, be performed on sacrificial portions of the geocomposite material such that repair is not required. The Manufacturer shall sample and test the geocomposite to demonstrate that its properties conform to the values specified in Table 02078-1. At a minimum, the following manufacturing quality control tests shall be performed:

Component	Test	Procedure	Frequency
Geonet	Specific gravity	ASTM D792 or 1505	100,000 ft^2
	Thickness	ASTM D5199	100,000 ft^2
	Carbon black	ASTM D4218	100,000 ft^2
Geotextile	Mass per unit area	ASTM D5261	100,000 ft^2
	Apparent opening size	ASTM D4751	500,000 ft^2
	Permittivity	ASTM D4491	500,000 ft^2
	Grab strength	ASTM D4632	100,000 ft^2
	Trapezoidal Tear	ASTM D4533	100,000 ft^2
Geocomposite	Peel strength	ASTM D7005	100,000 ft^2
	Transmissivity	ASTM D4716	500,000 ft^2

G. The Manufacturer shall provide test results to the CQA Consultant demonstrating that the Manufacturer performed the tests and that acceptable results were obtained.

2.04 LABELING

A. Geocomposite material shall be supplied in rolls wrapped in waterproof and opaque protective covers.

B. Geocomposite rolls shall be labeled with the following information:
1. Manufacturer’s name;
2. product identification;
3. lot number;
4. roll number; and
5. roll dimensions.

2.05 TRANSPORTATION

A. CONTRACTOR shall be liable for all damages to the materials incurred prior to and during transportation to the Site. CONTRACTOR/Geosynthetic Installer shall notify the ENGINEER and CQA Consultant a minimum of 24 hours prior to any delivery.

2.06 HANDLING AND STORAGE

A. Handling, storage, and care of the geocomposite material prior to and following installation at the Site, is the responsibility of the Geosynthetics Installer. The Geosynthetics Installer shall be liable for all damages to the materials incurred prior to final acceptance of the lining system by the CQA Consultant.

B. The Geosynthetics Installer shall be responsible for storage of the geocomposite material at the Site. The geocomposite material shall be stored off the ground and out of direct sunlight, and shall be protected from mud, dirt, and dust. Any additional storage procedures required by the Manufacturer shall be the Geosynthetics Installer's responsibility.

2.07 CONFORMANCE TESTING

A. Conformance testing, if required, shall be performed in accordance with the CQA Plan. CONTRACTOR shall assist the CQA Consultant in obtaining conformance samples, if requested. The CQA Consultant has the option of collecting samples at the manufacturing facility.

B. Samples shall be taken at a minimum frequency specified in the CQA Plan with a minimum of one sample per lot. If CONTRACTOR's/Geosynthetic Installer's supplier provides material that requires sampling at a frequency (due to lot size, shipment size, etc.) resulting in one sample per less than 85 percent of this value, then CONTRACTOR/Geosynthetic Installer shall pay the cost for all additional testing.

C. Passing test results are required before deploying any geocomposite.

D. The ENGINEER or CQA Consultant may increase the frequency of sampling in the event that test results do not comply with the requirements of Part 2.02 of this Section until passing conformance test results are obtained for all material that is received at the job site. This additional testing shall be performed at the expense of the Manufacturer.

PART 3 EXECUTION

3.01 HANDLING AND PLACEMENT

A. The Geosynthetic Installer shall handle all geocomposite material in such a manner as to ensure the geocomposite material is not damaged in any way.

B. The Geosynthetic Installer shall take any necessary precautions to prevent damage to underlying layers during placement of the geocomposite layers.

C. The Geosynthetic Installer shall ballast the geocomposite layers with sandbags to prevent displacement of the geocomposite by wind. Such sandbags shall be installed during placement and shall remain on the geocomposite until it is covered with soil at which time they will be removed. Care shall be exercised when handling sandbags, to prevent rupture or damage of the sandbags.

D. The geocomposite shall be secured in the anchor trench and then rolled down the slope in such a manner as to continually keep the geocomposite in tension.

E. The geocomposite shall be positioned by hand after being unrolled to minimize wrinkles.

F. Care shall be taken during placement of geocomposite material not to trap dirt or excessive dust in the geonet that could cause clogging of the drainage system, and/or stones that could damage the adjacent liner.

G. Tools and sand bags shall not be left on or in the geocomposite.

H. After unwrapping the geocomposite material from its opaque cover, the geocomposite material shall not be left exposed for a period in excess of 15 days unless a longer exposure period is approved by OWNER. Such approval shall be based on a formal demonstration from the Manufacturer that the geotextile component of the composite is stabilized against ultraviolet degradation for a period in excess of 15 days.

3.02 SEAMS AND OVERLAPS

A. The components of the geocomposite (i.e., geotextile-geonet-geotextile) are not to be bonded together at the ends and edges of the rolls. Each component will be secured or seamed to the like component at overlaps.

B. Geonet Components
   1. The geonet components shall be overlapped by at least 4 inches. These overlaps shall be secured by tying.
   2. Tying shall be achieved by plastic fasteners, or polymer braid. Tying devices shall be white or yellow for easy inspection. Metallic devices shall not be used.
   3. Tying shall be every 5 feet along the slope, and every 2 feet on end-to-end seams.

C. Geotextile Components
   1. The bottom layers of geotextile shall be overlapped a minimum of 4 inches prior to seaming.
   2. The top geotextile shall be continuously seamed or sewn (i.e., spot sewing or lystering is not allowed).
   3. For sewing, the top layers of geotextiles shall be sewn using Stitch Type 401 and a flat or single "prayer" seam (Federal Seam Type SSa), with the stitching a minimum of 1.5 in. from the edge of the geotextile. Stitching shall have an average of greater than 5 stitches per inch that will result is a seam strength greater or equal to 75 percent of the fabric strength. Where indicated on the drawings, in high stress locations a "J' type seam will be required (Federal Seam Type SSn). Polymeric thread, with chemical resistance properties equal to or exceeding those of the geotextile component, shall be used for all sewing.
   4. For seaming, the top geotextile shall be welded using an automated vehicular-mounted apparatus equipped with gauges giving the instantaneous temperatures

and pressures of the machine. Seams must be uniform, continuous, without burn-through of either geotextile resulting in a seam strength greater or equal to 75 percent of the fabric strength, and without "fishmouths" or wrinkles that result in gaps in the seam. Prior to each day's production seaming, the Geosynthetics Installer shall perform trial welding on scraps of geotextile in the presence of the CQA Consultant to document that the seaming equipment is properly adjusted and the method of seaming will result in an acceptable seam.

3.03 REPAIR

A. If the geonet is undamaged but the geotextile is damaged, then the Geosynthetic Installer shall repair the damaged area as follows:
   1. Remove damaged geotextile.
   2. Cut patch of new geotextile to provide minimum 12-inch overlap in all directions.
   3. Thermally bond geotextile patch to existing geocomposite.

B. All seams that have no geotextile flaps available for sewing shall have a geotextile patch, extending 1-ft beyond the edges of the panel, thermally bonded.

C. Any holes or tears in the geocomposite material shall be repaired by removing the damage portion of the geonet, placing a patch under the panel extending 0.5 ft beyond the edges of the hole or tear. The patch shall be secured by tying fasteners through the patch, and through the panel. The patch shall be secured every 6 inches with approved tying devices. A geotextile patch shall be heat sealed to the top of the geocomposite needing repair. If the hole or tear width across the roll is more than 33 percent of the width of the roll, then the entire damaged geocomposite panel shall be removed and replaced.

3.04 PLACEMENT OF SOIL MATERIALS

A. CONTRACTOR shall place soil cover over geocomposite as soon as practical. On slopes greater than 10 percent, soil shall be placed at the base of the slope upwards. In addition, soil placement methods shall ensure:
   1. the geocomposite and underlying materials are not damaged;
   2. minimal slippage occurs between the geocomposite layer and underlying layers; and
   3. excess tensile stresses are not produced in the geocomposite.

B. Only low-ground pressure 4-wheel ATVs shall be allowed to travel directly on the geocomposite. They may be used only for deployment of overlying geosynthetics. The Geosynthetics Installer shall submit proposed equipment to ENGINEER for approval. ATVs may travel only at low speeds without sharp turns or excessive braking or accelerating. ATVs may not travel off and on the geocomposite without a thorough inspection of tires for rocks or other damaging objects. If at any time the CQA Consultant or ENGINEER have concerns regarding damage to the geocomposite from ATV use, at their sole discretion, they may prohibit further use of ATVs directly on the geomembrane. CONTRACTOR shall not be reimbursed for any additional costs of schedule loss due to prohibition of ATV use.

C. All non-ATV equipment operating on soil material overlying the geocomposite drainage layer shall comply with the following. Manufacturer data regarding the ground pressure for proposed equipment operating on less than two feet of cover soil shall be submitted to the ENGINEER for review.

Maximum Allowable Equipment Ground Pressure (psi)	Minimum Thickness of Overlying Fill (ft.)
<5	1.0
≥5 to 20	2.0
>20	3.0

3.05 PRODUCT PROTECTION

A. CONTRACTOR shall use all means necessary to protect all prior work and all materials and completed work of other Sections.

B. In the event of damage, CONTRACTOR shall immediately make all repairs and replacements necessary, to the approval of the CQA Consultant and at no additional cost to OWNER.

TABLE 02078-1

GEOCOMPOSITE PROPERTY VALUES[(1)]

PROPERTIES	QUALIFIERS	UNITS	VALUES	METHOD
Geonet Component				
Resin Density	minimum	g/cc	0.935	ASTM D792 or 1505
Carbon Black Content	range	%	2.0 - 3.0	ASTM D4218
Thickness	minimum	Mils	250	ASTM D5199
Geotextile Component [(2)]				
Mass Per Unit Area	minimum	oz/yd^2	7.8	ASTM D5261
Apparent Opening Size	minimum	US sieve	$O_{95} \geq 80$	ASTM D4751
Permittivity	minimum	$gal/min/ft^2$	95	ASTM D4491
Grab Strength	minimum	lb.	200	ASTM D4632
Trapezoidal Tear Strength	minimum	lb.	90	ASTM D4533
Geocomposite [(3)]				
Transmissivity	minimum	gal/ft/min	2.4	ASTM D4716
Ply Adhesion	minimum	lb/in	1.0	ASTM D7005
Interface Shear Strength	minimum	Degrees	See note 4	ASTM D5321

Notes:
1. All values represent minimum average roll values (i.e., test results for samples collected from any roll in a lot should meet or exceed the values in this table).
2. Geotextile properties prior to adhesion.
3. Transmissivity to be measured using water at 68°F (20°C) with hydraulic gradient(s) of 0.5, under a confining pressure of 8,000 lb/ft^2. The geocomposite shall be placed in the testing device between the protective cover soil material and the selected and approved textured 60 mil geomembrane. Measurements are taken one hour after application of confining pressure.
4. See Section 02075 for details on interface shear strength testing.

END OF SECTION

SECTION 02081

HIGH-DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. CONTRACTOR shall furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary for installation of all high density polyethylene (HDPE) pipe, fittings and appurtenances as specified herein.

B. CONTRACTOR shall coordinate the installation of the HDPE pipe and fittings with other construction activities and subcontractors at the Site.

1.02 SUBMITTALS

A. At least 14 days prior to the start of HDPE pipe installation, CONTRACTOR shall provide ENGINEER complete, detailed construction layout drawings showing the proposed layout of landfill gas piping, joints, and connections, identifying proposed deviations from the Drawings.

B. Upon delivery of pipe materials to the Site, CONTRACTOR shall comply with the HDPE pipe manufacturer's recommendations for handling, storing, and installing HDPE pipes and fittings.

C. Prior to transporting any HDPE pipe or fittings to the Site, CONTRACTOR shall provide ENGINEER in writing from the HDPE pipe manufacturer that the pipe supplied meets the requirements of Part 2.02 of this Section.

1.03 RESPONSIBILITY

A. CONTRACTOR is responsible for field layout and adjustment of the work. Should actual field conditions not allow piping to be installed as shown on the Drawings, CONTRACTOR shall immediately contact ENGINEER for guidance.

B. Because landfills settle, for landfill gas piping within the limits of the landfill, CONTRACTOR shall carefully review field conditions versus the Drawings and identify adjustments to pipe locations that are needed in order to maintain minimum slopes as identified on the drawings. Note that adjustments to piping within the landfill may affect piping outside of the landfill limits. CONTRACTOR shall coordinate with ENGINEER on all field adjustments in order to ensure that the completed Work performs as intended.

C. See Specification Sections 02315 and 02260 for additional requirements regarding trenching and pipe installation.

1.04 CONSTRUCTION QUALITY ASSURANCE

A. Monitoring of the installation of HDPE pipe and fittings shall be conducted by CQA Consultant in accordance with the CQA Plan.

B. CONTRACTOR shall be aware of and shall account for these CQA activities in the installation schedule.

PART 2 PRODUCTS

2.01 PIPE SUPPLY AND MANUFACTURER

A. Qualified manufacturers include:

1. ISCO, HDPE Pipe
2. DiscoPlex, Division of Chevron Chemical DriscoPlex® Series 4100
3. J-M Manufacturing, HDPE IPS Pressure Pipe

2.02 HDPE PIPE MATERIAL

A. The HDPE pipe shall have a minimum Hydrostatic Design Basis (HDB) of 1,600 psi, as determined in accordance with ASTM D 2837.

B. All HDPE pipe and fittings shall comply with the ASTM F 714.

C. HDPE landfill gas pipe shall have a Standard Dimension Ratio (SDR) of 17 unless otherwise stated on the Drawings. All HDPE fittings shall have an SDR of 11.

D. HDPE leachate forcemain pipe shall have a SDR of 11 unless otherwise stated on the Drawings. HDPE secondary containment pipe shall have a SDR of 17.

D. HDPE pipe shall be supplied in standard laying lengths not exceeding 50 ft.

E. HDPE pipes and fittings shall be homogeneous throughout and free of visible cracks, holes (other than intentional manufactured perforations), foreign inclusions, or other deleterious effects, and shall be uniform in color, density, melt index and other physical properties.

F. HDPE pipe shall be furnished non-perforated or perforated as shown on the Drawings. Perforations shall be drilled into the pipe after manufacture, prior to delivery to the Site. Perforations shall be in accordance with the Drawings.

E. The pipe Manufacturer must certify compliance with the above requirements.

2.03 PIPE LOCATING SYSTEM

A. Underground Type Plastic Line Markers: Manufacturer's standard permanent, bright colored, continuous printed plastic tape, intended for direct burial service; not less than 6" wide × 4 mils thick. Provide tape with black printing reading "CAUTION - LINE BURIED BELOW". Tape shall also be capable of detection by magnetic location techniques.

2.04 PIPE BEDDING MATERIAL

A. Pipe bedding material shall conform to the requirements of Structural Fill as specified in Section 02055.

2.05 ELECTROFUSION FITTINGS

A. Fittings shall be PE3408 HDPE, Cell Classification of 345464C as determined by ASTM D 3350-02. Electrofusion Fittings shall have a manufacturing standard of ASTM F 1055. Fittings shall have a pressure rating equal to the pipe unless otherwise specified on the plans. All electrofusion fittings shall be suitable for use as pressure conduits, and per AWWA C906, have nominal burst values of three and one-half times the Working Pressure Rating (WPR) of the fitting.

PART 3 EXECUTION

3.01 HANDLING AND STORAGE

A. Care shall be taken in loading, transporting and unloading to prevent damage to the pipe. Pipe or fitting shall not be dropped. All pipe or fitting shall be examined before installation, and no piece shall be installed which is found to be damaged or defective. If any damaged or defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner by CONTRACTOR, at its own expense.

B. Care shall be taken during transportation of the pipe such that it will not be cut, kinked or otherwise damaged.

C. Ropes, fabric or rubber protected slings and straps shall be used when handling pipes. Chains, cables or hooks inserted into the pipe ends shall not be used. Two slings spread apart shall be used for lifting each length of pipe.

D. Pipes shall be stored on level ground, preferably turf or sand, free of sharp objects, which could damage the pipe. Stacking of the polyethylene pipe shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature conditions. Where necessary due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitably and of such width as not to allow deformation of the pipe at the point of contact with the sleeper or between supports.

E. Pipe shall be stored and transported in a manner prevent undue scratching or gouging. The handling of the pipe shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. The maximum allowable depth of cuts, scratches or gouges on the exterior of the pipe is 5 percent of wall thickness. The interior pipe surface shall be free of cuts, gouges or scratches.

3.02 CLEANING

A. CONTRACTOR shall complete the work in manner that prevents shavings from pipe cuts, stones, dirt, or other debris from entering the pipe. CONTRACTOR shall promptly remove all shavings, stones, dirt, or other debris that may have entered during the construction period.

3.03 INSTALLATION

A. General:

1. All HDPE pipe and fittings shall be installed in accordance with the pipe manufacturer’s instructions.
2. CONTRACTOR shall carefully examine all pipe and fittings for cracks, damage or defects before installation. Defective materials shall be immediately removed from the Site and replaced at no cost to OWNER.
3. The interior of all pipe and fittings shall be inspected, and any foreign material shall be completely removed from the pipe interior before it is moved into final position.

4. Field-cutting of pipes, where required, shall be made with a machine specifically designed for cutting pipe. Cuts shall be carefully made, without damage to pipe or lining, so as to leave a smooth end at right angles to the axis of pipe. Cutter ends shall be tapered and sharp edges filed off smooth. Flame cutting will not be allowed.
5. All pipe and fittings shall be laid or placed to the lines and grades shown on the Drawings with bedding and backfill shown on the Drawings and as specified in this Section.
6. No pipe shall be laid until the CQA Consultant has approved the bedding conditions and the trench layout.
7. No pipe shall be brought into position until the preceding length has been bedded and secured in its final position.
8. Blocking under piping shall not be permitted unless specifically accepted by ENGINEER for special conditions.
9. CONTRACTOR shall provide all necessary adapters and/or connection pieces required when connecting different types and sizes of pipe or when connecting pipe made by different manufacturers.

B. CONTRACTOR shall obtain pre-fabricated fittings as needed. No field modification or manufacture of fittings is allowed without the approval of ENGINEER.

C. CONTRACTOR shall exercise extreme care when working with piping that contained or contains landfill gas. Landfill gas pipes shall be purged with nitrogen and monitored for explosion hazard prior to any fusion being performed. In addition, CONTRACTOR shall protect against static electric discharges by placing a wet rag with a grounded wire attached over the HDPE piping.

D. Installation of the piping may require locating existing underground utilities and conduits, and moving or regrading these lines and/or adjusting the grade of the HDPE piping to be installed, such that the slope requirements for the new piping are not compromised.

3.04 JOINTS AND CONNECTIONS

A. HDPE pipe shall be joined with thermal butt-fusion joints. All joints shall be made in strict compliance with ASTM D 2657 and the pipe manufacturer’s recommendations, and shall be performed by pipe manufacturer’s authorized, trained fusion personnel.

B. The use of either electrofusion or mechanical couplings for buried piping shall be held to a minimum. They should only be used to make field closures necessitated by the pipe laying sequence. If, in the sole opinion of ENGINEER, CONTRACTOR's pipe laying sequence results in the excessive use of electrofusion couplings, CONTRACTOR shall be required to stop pipe installation work and resubmit its lay layout sequence for ENGINEER's approval. CONTRACTOR shall bear the all costs and delay associated with the preparation and execution of a revised pipe laying sequence.

C. Mechanical connections of HDPE pipe to auxiliary equipment such as valves, flow meters, pumps and tanks shall consist of the following unless otherwise specified by ENGINEER.

1. An HDPE flange shall be butt-fused to the HDPE pipe. Outside diameter and drillings shall comply with ANSI B16.1.
2. A 316 stainless steel back-up shall be provided if buried within limits of waste. Outside diameter and drillings shall comply with ANSI B16.5.
3. Epoxy-coated steel back-up rings shall be used in valve boxes, manholes, and beyond the limits of waste.
4. Flange connections shall be provided with a full-face nitrile gasket.

D. Polyethylene stub ends and flanges must be at the ambient temperature of the surrounding soil at the time they are bolted tight to prevent relaxation of the flange bolts and loosening of the joint due to thermal contraction of the polyethylene. Bolts shall be drawn up evenly and in line.

E. Pipe shall be laid to lines and grade shown on the Drawings with bedding and backfill as shown on the Drawings.

F. At the end of each working day, the open ends of the pipe shall be closed by fabricated plugs, caps, or by other approved means.

G. Sections of pipe with cuts, scratches or gouges exceeding 5 percent of the pipe wall thickness shall be removed completely and the ends of the pipeline rejoined.

H. All HDPE pipe must be at the temperature of the surrounding soil at the time of backfilling and compaction.

I. Open Trench Installation:

1. The pipe shall be laid in the centerline of the trench. Laying instructions of the manufacturer shall be explicitly followed.

2. Good alignment shall be preserved during installation. Deflection of the pipe shall be maintained within pipe manufacturer allowances and as approved by ENGINEER.
3. Each length of the pipe shall have the assembly mark aligned with the pipe previously laid and held securely until enough backfill has been placed to hold the pipe in place. Joints shall not be "pulled" or "cramped".
4. Precautions shall be taken to prevent flotation of the pipe in the trench.
5. When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and the backfill. Trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below top of the pipe. As trench boxes, moveable sheeting, shoring or plates are moved, pipe bedding shall be placed to fill any voids created and the backfill shall be recompacted to provide uniform side support for the pipe.
6. Restrained joints shall be installed where shown on the Drawings or as directed by ENGINEER.

3.05 TESTING OF HDPE PIPE AND FITTINGS

A. General:

1. CONTRACTOR shall pressure test all solid pipe and fittings.
2. ENGINEER shall be notified a minimum of 24 hours in advance of any testing.
3. CONTRACTOR shall provide all testing apparatus, including pumps, hoses, gauges, taps, plugs, temporary connections, and fittings. If desired, OWNER reserves the right to furnish gauges for the test, but all necessary assistance for conducting the test will be furnished and paid for by CONTRACTOR.
4. All tests shall be performed in the presence of ENGINEER.

B. Leachate Forcemain Hydrostatic Test

1. The length of force main under test shall be slowly filled with water and brought to test pressure by means of a pump connected to the pipe so as to obtain the specified hydrostatic test pressure at the lowest point in the section of main under test. All air must be expelled from the pipe line prior to the test period.
2. The test consists of maintaining a pressure of 10 psi over a period of four (4) hours. If the pressure then remains within five percent (5%) of the target value, this indicates there is no leakage in the system.

3. Testing shall be performed for both the primary carrier pipe and the secondary containment pipe.

C. Landfill Gas Pipe Pressure Test

1. The pipe shall be slowly filled with compressed air and brought to test pressure of 5 psig. A steady 5 psig pressure shall be observed for several minutes before the test period begins.
2. Upon initiation of the test, the test pressure of 5 psig shall be held for a period of 15 minutes, indicating no leakage in the pipe.

D. Should test results on a section of pipe disclose an inability to hold the stipulated test pressure, the CONTRACTOR shall, at his own expense, locate and correct any defects and retest the failed section of piping to the satisfaction of the ENGINEER.

E. At the conclusion of the pressure testing, the CONTRACTOR shall submit all test data to ENGINEER.

3.06 SURVEY REQUIREMENTS

A. Prior to backfilling any pipe trench, CONTRACTOR's surveyor shall determine the location and elevation of the pipe invert at points spaced no greater than 25 ft apart. The survey may be performed on the compacted bedding material prior to pipe placement.

3.07 TOLERANCE

A. Pipe shall be installed at the specified or minimum slope as indicated on the Drawings.

3.08 PRODUCT PROTECTION

A. CONTRACTOR shall use all means necessary to protect all prior work and materials and completed work of other Sections.

B. In the event of damage to prior work or work completed as specified in this Section, CONTRACTOR shall immediately make all repairs and replacements necessary, to the approval of ENGINEER, and at no cost to OWNER.

[END OF SECTION]

SECTION 02083

LANDFILL GAS WELLHEADS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Supply all labor, materials, tools, supervision, transportation, and installation equipment necessary for the manufacture, delivery, storage, installation, and testing of the landfill gas wellheads (wellheads), including installation as specified herein and as shown on the Drawings.

1.02 SUBMITTALS

A. At least 7 days prior to any wellhead installation, CONTRACTOR shall submit to ENGINEER the following:
1. wellhead manufacturer's information;
2. proposed wellhead-to-well pipe assembly;
3. wellhead manufacturer's operation and maintenance (O&M) manual;
4. flexible hosing manufacturer's information; and
5. proposed wellhead labels.

1.03 RESPONSIBILITY

A. Handling, storage, and care of the wellhead prior to and following installation at the Site is the responsibility of CONTRACTOR. During storage, the wellhead shall be protected from excessive heat or cold, puncture, cutting, or other damaging or deleterious conditions. The wellhead shall be stored in accordance with additional requirements of the wellhead manufacturer. CONTRACTOR shall be liable for all damages to the materials incurred prior to final acceptance of the work by OWNER.

PART 2 PRODUCTS

2.01 GAS EXTRACTION WELLHEAD

A. Due to the specialty nature of landfill gas wellheads and the need to maintain consistency of equipment, the wellhead shall be nominal 2-in. diameter wellhead and shall consist of well head piping, flow control valve, gas temperature gauge, gas sampling port, static and impact pressure ports, flexible connector, union disconnect, and dust cap. Qualified manufacturers are:
1. Landtec Accu Flow or Exact Flow; or
2. QED Environmental

B. The wellhead shall be leak free and shall be height adjustable in the field using adapter bushings.

C. The wellhead-to-well pipe connection shall be fabricated using procedures and materials approved by OWNER. A single 8-in. by 2-in. rubber reducing coupling is not acceptable. A two-piece connection with an 8-in by 4-in. bushing and a 4-in. by 2-in. reducing coupling, or other connections recommended by the wellhead manufacturer, will be acceptable.

D. The wellhead shall be capable of being used with the LANDTEC GEM-2000™ and GEM-5000™ Gas Extraction Monitor and support all GEM monitoring functions.

E. It is the intent of this Specification that the wellhead shall be supplied as a complete manufactured unit.

F. The gas flow rate measurement assembly shall be pre-calibrated and lab certified. The measurement assembly shall have an accuracy and repeatability of ± 5 percent through the recommended flow range when used and maintained in accordance with the wellhead manufacturer's instructions and recommendations.

2.02 FLEXIBLE HOSE CONNECTIONS

A. Flexible hosing shall be at least the same diameter as the wellhead and shall be used to connect the wellhead to the header.

B. Flexible hosing shall be manufactured from PVC or other materials specifically rated for use in landfill gas applications and exterior applications. Qualified manufacturers:
   1. QED Solarguard; or
   2. Landtec.

C. The flexible hose connector shall be approved by the ENGINEER prior to installation.

2.03 WELLHEAD MONITORING PORTS

A. Monitoring ports shall be 1/4-inch diameter labcock ball valve with barbed sampling port manufactured from PVC or other materials specifically rated for use in landfill gas applications and exterior applications. Qualified manufacturers:
   1. Asahi America;
   2. Harrington Industrial Plastics; or
   3. Approved Equal

2.04 LABELS

A. Each wellhead shall be permanently labeled with the well number using a stamped metal or UV resistant plastic tag. Lettering shall be at least 2-inches in height with a color contrast between the lettering and the tag that allows the tag to be clearly read from a distance of 5 feet. CONTRACTOR shall attach the tag to each wellhead using metal band clamps or other similar material that is not subject to UV degradation.

2.05 NUTS, BOLTS, AND GASKETS

A. Nuts and bolts shall be type 304 stainless steel.

B. Gasket for flange installation shall be neoprene rubber.

PART 3 EXECUTION

3.01 FAMILIARIZATION

A. Prior to implementing any of the Work described in this Section, CONTRACTOR shall become thoroughly familiar with all portions of the Work falling within this Section.

B. Prior to implementing any of the Work in this Section, CONTRACTOR shall carefully inspect the installed Work of all other Sections and verify that all work is complete to the point where the installation of this section may properly commence without adverse impact.

3.02 INSTALLATION

A. The wellhead shall be handled and installed according to written instructions supplied by the wellhead manufacturer.

B. The wellhead and 2-in. connector line shall be installed within 1 percent of vertical.

C. The wellhead shall be installed such that the flow measurement assembly is concentric with the well casing.

D. Install the wellhead so that wellhead valves are at least 3 ft., but not greater than 4.5 ft. above finished ground.

E. Flexible hosing shall be used to connect the wellhead to the header. Flexible hoses shall be a maximum 4 ft in length. Install the flex hose with at least 1 ft of slack to allow for landfill settlement but with no sags in flex hose that could collect condensate. Adjust the landfill gas lateral pipe connection as necessary to locate it close enough to the landfill gas wellhead to meet the flexible hose length and slack requirements.

3.03 TESTING

A. At the time of system start up, CONTRACTOR shall demonstrate to the satisfaction of OWNER that all wellheads are fully operational. Using the LANDTEC GEM-2000 and other gas monitoring instruments as required, CONTRACTOR shall demonstrate that components and connections are leak free, the temperature gauge is accurate, the flow measurement assembly is accurate, and the control valve is fully operable.

3.04 ACCEPTANCE

A. CONTRACTOR shall retain responsibility for the wellhead until accepted by OWNER.

B. The wellhead shall be accepted by OWNER when:
   1. the installation is finished;
   2. verification that the wellhead has passed the tests specified in Section 3.03; and
   3. verification of the adequacy of all repairs, including associated testing, is complete.

END OF SECTION

SECTION 02084

LANDFILL GAS VALVES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Supply and install gas control valves for use in LFG collection piping systems, where the maximum service temperature does not exceed 140°F, according to the Drawings.

1.02 SUBMITTALS

A. At least 14 days prior the start of pipe installation, CONTRACTOR shall provide ENGINEER certificates of compliance on materials furnished, and valve manufacturers' brochures containing complete information and instructions pertaining to the storage, handling, installation, and inspection of valves.

B. At least 14 days prior to the start of pipe installation, CONTRACTOR shall provide ENGINEER a copy of each label and piping schematic required under Part 3.02 of this Section.

PART 2 PRODUCTS

2.01 BUTTERFLY VALVES

A. Control valves shall be PVC butterfly valve ASAHI or equal, sized to match pipe diameter, as specified in the Drawings.

B. Shaft, stem, seat, bearings, handles, gear operator with hand wheel, and valve body shall be stainless steel. Valve assembly, components and materials shall be as provided by the Manufacturer.

C. The shaft shall be positively attached to the disc and be totally sealed from exposure to the process gas or environment.

D. The shaft also shall have a directional indicator on top to indicate disc position.

E. Stem extension shall be the length necessary such that the handle is between 3 ft. and 4 ft. above finished grade. All stem extensions shall consist of a two-piece stem extension ASAHI Style A or equal. Exposed portions shall be painted with two coats of orange enamel. A reinforced concrete pad shall be constructed around each stem as specified in the Drawings.

F. Valve seat material shall be Viton or Teflon.

2.02 GAS MONITORING PORTS

A. Monitoring ports installed on the valve shall be plastic barbed ports with a ball valve manufactured from PVC or other materials specifically rated for use in landfill gas applications and exterior applications. Qualified manufacturers:
   1. Asahi America;
   2. Harrington Industrial Plastics; or
   3. Approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation shall be as specified by the valve manufacturer's printed instructions and in accordance with the Drawings and Technical Specifications.

B. For butterfly valves, CONTRACTOR shall supply and install Manufacturer-supplied spacers to allow full travel of the disc.

3.02 LABELING

A. Each valve shall be labeled with an engraved tag labeled with the pipeline type (i.e., landfill gas, compressed air, or leachate) and the valve number.

END OF SECTION

SECTION 02370

EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. CONTRACTOR shall furnish all labor, materials, tools, supervision, transportation, installation equipment, and incidentals required to install the erosion and sediment control features shown on the approved erosion and sediment control (E&SC) drawings, including: (i) erosion control mat; (ii) silt fence; and (iii) temporary stabilization, as specified herein and as shown on the Drawings.

B. CONTRACTOR shall furnish all labor, material, tools, supervision, transportation, installation equipment, and incidentals required to install E&SC not shown on the Drawings, but required to prevent sedimentation or pollution to waters of the State or Federal waterways.

C. CONTRACTOR shall furnish all labor, materials, tools, supervision, transportation, installation equipment, and incidentals required to maintain all E&SC features and structures throughout the duration of the Project and removal of temporary measures and structures, where and when necessary, as directed by OWNER or ENGINEER.

D. CONTRACTOR shall furnish all labor, materials, tools, supervision, transportation, installation equipment, and incidentals required to construct and maintain soil stockpiles on site.

1.02 SUBMITTALS

A. At least ten days prior to the Preconstruction Meeting, CONTRACTOR shall provide ENGINEER the proposed product material data sheets, and manufacturer recommended method of installation for:
   1. erosion control mat; and
   2. silt fence.

B. At least seven days prior to applying any temporary or permanent stabilization, CONTRACTOR shall provide ENGINEER information of:
   1. seed mixture, quantity, and application rate;
   2. mulch type and application rate;
   3. fertilizer type and application rate; and
   4. seed bed preparation.

C. At least seven days prior to installing a E&SC control feature not addressed in this Section, CONTRACTOR shall provide ENGINEER Shop Drawings and/ or product information on the proposed feature, along with calculations necessary to verify the proper functioning of the feature for the intended purpose.

1.03 CONSTRUCTION QUALITY ASSURANCE

A. The installation, use, and maintenance of the E&SC feature shall be monitored by the CQA Consultant as outlined in the CQA Plan.

B. CONTRACTOR shall be aware of the activities outlined in the CQA Plan and shall account for these when preparing the project schedule.

C. At the discretion of OWNER or ENGINEER, the Work of this Section may be subjected to CQA monitoring.

PART 2 PRODUCTS

2.01 EROSION CONTROL MAT

A. If not specified on the Drawings, erosion control mat shall be double-sided Curlex II or approved equal.

B. If not specified on the Drawings, erosion control mat shall demonstrate acceptable performance when subjected to at least 20 hours of continuous water flow under the following conditions:
   1. permissible velocity of 7.3 ft/sec; and
   2. permissible tractive shear stress of 1.8 lb/ft^2.

2.02 SILT FENCE

A. Silt fence shall meet the requirements for Silt Fence as described in Section E of the "*2011 Maryland Standards and Specification for Erosion and Sediment Control*" and as shown on the approved E&SC drawings.

2.03 INLET SEDIMENT CONTROL DEVICE

A. Device shall be manufactured from woven polypropylene geotextile and sewn by a double needle machine using a high strength nylon thread. Device shall be manufactured to fit the opening of the drop inlet and shall have the following features: two dump straps attached at the bottom to facilitate emptying; lifting loops as an integral part of the device to be used to lift the device from the drop inlet; a restraint cord approximately halfway up the device to keep the sides away from the drop inlet walls.

B. The device seams shall have a certified average wide width strength of 165.0 pounds per inch (lb/in) per ASTM D 4884. Device shall also have the following minimum average roll values (MARVs):

Property	Test Method	Units	Value
Grab Tensile	ASTM D 4632	lb	315x300
Grab Elongation	ASTM D 4632	%	15x15
Puncture	ASTM D 4833	lb	125
Mullen Burst	ASTM D 3786	lb/in^2	650
Trapezoid Tear	ASTM D 4633	lb	120x150
UV Resistance	ASTM D 4355	%	90
Apparent Opening	ASTM D 4751	US Sieve	40
Flow Rate	ASTM D 4491	$gal/min/ft^2$	40
Permittivity	ASTM D 4491	sec^{-1}	0.55

2.04 TEMPORARY STABILIZATION

A. Temporary stabilization shall consist of placing seed, mulch, fertilizer, and/or soil amendments as needed, for the area to be stabilized.

B. Seed, fertilizer, mulch, and soil amendments shall meet the requirements for Temporary Stabilization as described in Sections B-4-2, B-4-3, and B-4-4 of the "*2011 Maryland Standards and Specification for Erosion and Sediment Control*" and as shown on the approved E&SC drawings.

C. Temporary Seed mix shall conform to Tables B.1 and B.3 in Section B-4-4 of the "*2011 Maryland Standards and Specification for Erosion and Sediment Control*" and as shown on the approved E&SC drawings.

2.05 PERMANENT STABILIZATION

A. Permanent stabilization shall consist of placing seed, mulch, fertilizer, and/or soil amendments as needed, for the area to be permanently stabilized.

B. Seed, lime, fertilizer, mulch, and soil amendments shall meet the requirements for Permanent Stabilization as described in Sections B-4-2, B-4-3, and B-4-5 of the "*2011 Maryland Standards and Specification for Erosion and Sediment Control*" and as shown on the approved E&SC drawings.

C. Liquid mulch binders shall not be used.

D. Permanent seed mix shall conform to Seed Mix No. 1 or 2 within Tables B.3 and B.4 of Section B-4-5 of the "*2011 Maryland Standards and Specification for Erosion and Sediment Control*" and as shown on the approved E&SC drawings.

2.06 OTHER EROSION AND SEDIMENT CONTROL FEATURES

A. CONTRACTOR shall select appropriate erosion and sediment control features from "*2011 Maryland Standards and Specification for Erosion and Sediment Control*" and as shown on the approved E&SC drawings.

B. CONTRACTOR may use erosion and sediment control features presented in other published erosion and sediment control guidance documents or manufacturers recommendations as approved by ENGINEER.

PART 3 EXECUTION

3.01 FAMILIARIZATION

A. Prior to implementing any of the Work described in this Section, CONTRACTOR shall become thoroughly familiar with all portions of the Work falling within this Section.

3.02 EROSION CONTROL MAT

A. Erosion control mat shall be installed either 48 hours prior to or within 48 hours after seeding operations have been completed in the work areas.

B. The mat shall be placed on a smooth surface that is free of trash, ruts, and rocks.

C. Erosion control mat shall be placed flat and shall conform to the contours of soil surface.

D. Placement on Slopes:

1. Anchor trenches shall be located at the crest and the toe of the terrace. Anchor trenches shall be a minimum of 6 in. deep. The anchor trench at the crest shall be located at 1 ft. from the edge of the slope. The geometry of the anchor trench, type of fastener, fastener spacing, and method of construction of the anchor trenches shall be in accordance with the manufacturer's instructions.
2. Erosion mat shall be unrolled as directed by the manufacturer. Adjacent panels of erosion mat shall be installed with a minimum overlap of 4 in. Fastening of the erosion mat shall begin in the toe anchor trench and shall progress upslope to the crest anchor trench. Spacing of fasteners shall be in intervals of 3 to 5 ft. vertically upslope. Horizontal spacing of fasteners shall be in accordance with the manufacturer's instructions. Backfill shall be placed in anchor trenches over fasteners as construction proceeds.

3.03 SILT FENCE

A. CONTRACTOR shall install silt fence on a level grade downslope of all disturbed areas as shown on the approved E&SC drawings. Both ends of the silt fence section must extend at least 8 ft upslope at 45 degrees to the main fence alignment.

B. Sediment accumulated against the silt fence shall be removed when it reaches one half of the above ground height of the fence.

3.04 INLET SEDIMENT CONTROL DEVICE

A. CONTRACTOR shall install the device in all curb and yard inlets as shown on the approved E&SC drawings.

B. When the restraint cord is covered with sediment, CONTRACTOR shall remove, empty, and clean the device and re-install.

3.05 TEMPORARY STABILIZATION

A. CONTRACTOR shall install temporary stabilization over disturbed areas, as needed, to minimize the potential for erosion in accordance with the requirements of Standards and Specifications for Temporary Stabilization as described Section B-4-4 in the "*2011 Maryland Standards and Specification for Erosion and Sediment Control*" and as shown on the approved E&SC drawings.

B. The selection of temporary stabilization shall be agreed to between CONTRACTOR and ENGINEER based on season, ground and weather conditions, and anticipated time area will be left undisturbed.

C. Temporary stabilization shall be applied over any disturbed area that will be left bare for more than 15 days.

3.06 PERMANENT STABILIZATION

A. CONTRACTOR shall install permanent stabilization over areas that will not be disturbed in accordance with the requirements of Standards and Specifications for Permanent Stabilization as described in Section B-4-5 of the "*2011 Maryland Standards and Specification for Erosion and Sediment Control*" and as shown on the approved E&SC drawings.

3.07 OTHER EROSION AND SEDIMENT CONTROL FEATURES

A. CONTRACTOR shall install, operate, and maintain erosion and sediment control features in accordance with published literature and/or manufacturers recommendations throughout the duration of the Contract and direction by OWNER and ENGINEER.

3.08 STOCKPILING

A. CONTRACTOR shall install temporary stabilization over disturbed areas, as needed, to minimize the potential for erosion in accordance with the requirements of Standards and Specifications for Stockpile Areas as described Section B-4-8 in the "*2011 Maryland Standards and Specification for Erosion and Sediment Control*" and as shown on the approved E&SC drawings.

END OF SECTION

SECTION 02375

GABIONS AND RENO MATTRESS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. CONTRACTOR shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary to perform the work of this Section which shall include, but not limited to; preparation of subgrade, fabricating gabions and reno mattresses, placing aggregate and geotextile, placing, filling, and fastening gabions and reno mattresses.

1.02 CONSTRUCTION QUALITY ASSURANCE

A. All of the activities listed in this specification shall be monitored as outlined in the CQA Plan by the CQA Consultant.

B. CONTRACTOR shall be aware of the CQA activities set forth in the CQA Plan and shall account for these activities in the construction schedule.

1.03 SUBMITTALS

A. CONTRACTOR shall furnish copies of the manufacturer's gabion and reno mattress fabrication, erection, and installation instructions to ENGINEER minimum 14 days before beginning basket construction.

PART 2 – PRODUCTS

2.01 GABIONS AND RENO MATTRESS

A. Gabions and reno mattresses shall be manufactured with all components mechanically connected at the production facility with the exception of the mattress lid that will be attached in the field. Reno mattress shall be uniformly partitioned into internal cells. CONTRACTOR shall fabricate the Reno mattresses in such a manner that the sides, ends, lid, and diaphragms can be assembled at the construction site into baskets.

B. All gabions and reno mattresses shall be constructed to the dimensions shown on Construction Drawings and as specified in the project specification.

C. The gabion and reno mattress materials and mesh openings shall conform to the requirements of Table A. Openings shall be uniform in size. Wire mesh must be fabricated in such a manner as to be non-raveling.

TABLE A

MATERIAL	DIMENSION
Mesh Type/ Opening Size	"6 by 8 mesh" nominal 2.5 inch opening
Mesh Wire	0.087 inch
Selvedge Wire	0.120 inch
Lacing Wire and Stiffener Wire	0.087 inch
Fasteners	0.120 inch

F. The individual wire mesh shall have tensile strength no less than 75,000 psi and galvanizing in accordance with Class II soft temper coating as determined by ASTM A641/A641-M-03.

G. Lacing wire or ring fasteners shall be used for assembling mattresses and interconnecting adjacent mattresses.

H. Only where identified on Construction drawings or where directed by ENGINEER for the purpose of forming joints, angles, curves, or slopes that are not possible to obtain in structures with standard gabion and reno mattresses, shall a mattress be cut, folded, and wired together.

2.02 RING FASTENERS

A. Overlapping ring fasteners may be used in lieu of, or to complement, lacing wire for basket assembly and installation. Overlapping ring fasteners shall meet or exceed the following minimum requirements

1. *Galvanized Fasteners*. Diameter = 0.120 in., according to ASTM A313, Type 302, Class I
2. *Tensile strength*. 230,000 to 273,000 psi in accordance with ASTM A764
3. *Proper installation of rings*. A properly formed fastener shall have a nominal overlap of 1 in.

2.03 ROCK FILL FOR RENO MATTRESSES

A. Gabions and reno mattress rock fill shall be clean, sound, dense, and angular having a size between 4 and 7 inches.

2.04 GEOTEXTILE SEPARATOR

A. CONTRACTOR shall ensure that the geotextile placed as part of gabion and reno mattress installation conforms to Section 02071.

PART 3 – EXECUTION

3.01 FAMILIARIZATION

A. Prior to implementing any of the work described in this Section, CONTRACTOR shall become thoroughly familiar with the site, the site conditions, and all portions of the work falling within this Section.

B. Prior to implementing any of the work in this Section, CONTRACTOR shall carefully inspect the installed work of all other Sections and verify that all work is complete to the point where the work of this Section may properly commence without adverse impact.

3.02 SUBGRADE PREPARATION

A. CONTRACTOR shall place aggregate and geotextile to the dimensions shown on the Drawings prior to gabion and reno mattress installation.

3.03 FABRICATION OF GABIONS AND RENO MATTERESSES

A. During erection, CONTRACTOR shall ensure that each gabion and reno mattress cage is stretched, aligned, and wired to the adjacent cage. Spiral binders shall pass through the opening and be secured at both ends. The spacing of the ring fasteners during all phases of assembly and installation shall nominally be 6 in. and not exceed 8 in.

B. CONTRACTOR shall ensure that the assembly and erection of the baskets comply with manufacturer's recommendations. All gabions or reno mattresses formed for the purpose of forming joints, angles, curves, or slopes that are not possible to obtain with standard baskets shall be neatly cut, and the surplus mesh shall be completely removed, or folded back, or folded and tightly wired to an adjacent gabion/mattress face. The cut edges of the mesh shall be securely laced together with binding wire.

C. CONTRACTOR shall ensure that gabions/reno mattresses are constructed as single units, i.e., the base, lid, ends, and sides are either woven into a single unit or one edge of these members are connected to the base section of the gabion in such a manner that strength and flexibility at the point of connection is at least equal to that of the mesh.

D. Prior to any rock fill CONTRACTOR shall put all baskets to tension and remove any kinks from the mesh. The stretching of empty basket units shall be accomplished in such a manner as to prevent any possible unraveling and distortion.

3.04 ROCK FILLING

A. The condition and line of the baskets must be approved by CQA Consultant before filling with rock.

B. Rock filling operations shall carefully proceed with placement by hand or machine so as not to damage galvanized wire coating, to assure a minimum of voids between the stones, and to ensure the maintenance of alignment throughout the filling.

C. CONTRACTOR shall ensure that maximum height form which the stone is dropped into the basket is no more than 18 inches.

D. Gabions and reno mattress baskets shall be overfilled a minimum of 1 inches above the top of the basket to allow for settlement and provide an even surface.

F. The cells in any row shall be filled in stages to avoid local deformation. CONTRACTOR shall ensure that at no time, a cell be filled to a depth exceeding 12 inches more than the adjoining cell.

3.05 SECURING STACKED GABIONS

A. CONTRACTOR shall ensure that all perimeter edges of the mesh forming the gabion be securely selvedged so that the joints formed by tying the selvedges have at least the same strength as the body of the mesh. The bottom of each stacked basket shall be fastened to the top of the underlying reno mattress along the front and back of the overlap.

3.06 LID CLOSING

A. The closing and wiring-down of lids shall proceed as soon as practical after the filling operations.

B. The lid shall be closed tight over the filling until the lid meets the perimeter edges of the front and end panels.

C. The lid of twisted mesh gabions shall be closed with an approved lid closure tool to minimize mesh deformation. Single point tools (stakes or pry bars) shall not be permitted.

D. CONTRACTOR shall ensure that the lid is tightly closed (laced or fastened) along all edges, ends and diaphragms in the same manner as described in Section 3.03 above.

3.07 BACKFILLING

A. Soil backfilling behind the downchute created by the gabion and reno mattress shall follow erection as closely as possible.

3.08 SURVEYING AND CONSTRUCTION TOLERANCES

A. All surveying shall be performed in accordance with Section 01721 of these Specifications.

3.09 PROTECTION OF WORK

A. CONTRACTOR shall use all means necessary to protect all prior work, including all materials and completed work of other Sections.

B. In the event of damage to, or deterioration of, constructed portions of the subgrade, geotextile, or any parts of the gabions or reno mattresses, CONTRACTOR shall make all repairs necessary to the approval of ENGINEER, at no additional cost to OWNER.

[END OF SECTION]

SECTION 02610

LANDFILL GAS WELLS

PART 1 GENERAL

1.01 SCOPE

A. Furnish all equipment, materials, and labor needed to drill and install landfill gas (LFG) extraction wells described herein and as indicated on the Drawings.

1.02 SUBMITTALS

A. At least 7 days prior to LFG well drilling and installation, CONTRACTOR shall submit to ENGINEER the following:

1. LFG well pipe information;
2. Bentonite pellet information; and
3. LFG well aggregate information.

B. CONTRACTOR shall keep detailed well logs and construction diagrams for all wells drilled, including: (i) diameter of borehole; (ii) the total depth of drilling; (iii) the temperature of waste spoils; (iv) a description of waste spoil conditions; (v) the occurrence of any water in the borehole; (vi) length of solid and slotted pipe installed; (vii) length of aggregate installed; (viii) length of bentonite and soils installed; and (ix) length of well stick-up above finished ground surface, water. Well logs shall be submitted to ENGINEER within 5 days of well completion.

D. CONTRACTOR shall include the ground surface elevation and location survey data from the as-built survey and include them on the well construction logs.

1.03 CONSTRUCTION QUALITY ASSURANCE

A. Construction of LFG wells shall be monitored by the ENGINEER as outlined in the CQA Plan.

B. CONTRACTOR shall be aware of the activities outlined in the CQA Plan and shall account for these activities in the construction schedule.

1.04 SITE CONDITIONS

A. Obstructions and/or saturated conditions are sometimes encountered when drilling in a landfill, many of which can be drilled through. CONTRACTOR is expected to make reasonable effort to drill through obstructions and/or saturated conditions and will be paid for offset re-drilling and boring abandonment only if approval is given by ENGINEER. CONTRACTOR will be paid for abandoned holes and for wells installed at new location. Wells shall not be relocated under any circumstances without the permission of ENGINEER.

PART 2 MATERIALS

2.01 AGGREGATE

A. Aggregate supplied by the Contractor to be used for the slotted portions of the well must meet the requirements of AASHTO No. 3 or No. 5 aggregate.

2.02 BENTONITE SLURRY MIX

A. Coarse-ground, granular bentonite obtained from an approved source shall be thoroughly mixed with potable water at a ratio of 5 gallons of water to every 50 lbs of bentonite.

B. “Soil/bentonite plug,” if used, shall refer to a mixture consisting of four parts soil backfill to one part bentonite.

2.03 STRUCTURAL FILL

A. Structural Fill for the non-slotted portions of the well shall be soil that has only minor amounts of organic materials, loam, wood, trash, and other objectionable materials that may be compressible or that cannot be properly compacted. Structural Fill shall not contain stones larger than 4 in. in the largest diameter, broken concrete, masonry rubble, or other similar materials. Natural soils visually classified and sandy or silty that are friable and free flowing or mixtures of these soil types are acceptable.

2.04 SOLID WALL PIPE

A. All pipe and fittings for vertical extraction wells shall be rigid PVC Schedule 80, meeting the requirements of ASTM D 1784 and ASTM D 1785.

2.05 SLOTTED/PERFORATED PIPE

A. Slots in PVC extraction well piping shall be 8 inch long by 3/8 inch wide, spaced 90° around the circumference of pipe as shown on the Drawings. Contractor shall present other configuration types to ENGINEER for approval. Slotting may be completed in the factory, or in the field. If slotting is performed in the field, the slotting must be completed per this Section and visually reviewed for approval by ENGINEER prior to installation.

PART 3 EXECUTION

3.01 DRILLING

A. Extraction wells shall be drilled at the locations shown on the Drawings. CONTRACTOR shall verify assumed ground elevation for each LFG well versus the Drawings before starting drilling work. If the ground elevation varies by ±1 ft from the elevation on the Drawings, CONTRACTOR shall obtain guidance from ENGINEER on adjustments to the well drilling depth. Wells shall not be relocated under any circumstances without written authorization from ENGINEER.

B. Extraction wells shall be 36 inch in diameter, drilled to the depth shown on the Drawings. CONTRACTOR shall only use dry drilling equipment; wet rotary drilling equipment shall not be used. All borings shall be made with bucket type augers.

C. The borehole for the well shall be both vertical and straight.

D. If for any reason the CONTRACTOR suspects that drilling may have advanced to or beyond the liner system, CONTRACTOR shall immediately notify OWNER and ENGINEER.

D. As soon as drilling is completed, a safety screen shall be placed over the top of the borehole. This screen shall stay in place until backfilling is within 4 feet of the surface. Safety screen size should be large enough to accommodate all pipe and backfill materials and any tools used during backfill yet not large enough for any human to accidentally fall through.

3.02 LFG WELL PIPING

A. LFG well pipe shall be installed in the center of the borehole. CONTRACTOR shall center the pipe in the middle of the borehole before backfilling using a clamping device or centering screen to aid in centering the pipe. The pipe shall not be suspended within the borehole during backfilling. Wells that are leaning more than 5 degrees from the vertical shall be replaced by CONTRACTOR at no additional cost to OWNER

B. PVC pipe joints shall be solvent cemented and lag bolted prior to insertion into the LFG borehole.

C. CONTRACTOR shall leave a minimum 4 ft stickup of the solid well casing above the finished landfill grades (intermediate or final cover) at the well location.

3.03 BACKFILLING VERTICAL WELLS

A. Backfilling of the well shall commence immediately after well drilling is completed and the well piping has been installed in the borehole. Backfill materials shall be installed as indicated on the Drawings.

B. Gravel pack shall be poured or scooped through the screen at a rate that will not endanger the integrity of the well casing. Care shall be taken during backfilling to prevent bridging.

C. The well seal will be formed by installing a barrier geotextile as shown on the Drawings prior to evenly distributing two 50 lb bags of bentonite material around the annulus of the well and then adding 10 gallons of fresh water in a manner that will allow for a thorough hydration of the bentonite material. This process will be continued until the plug thickness as shown on the Drawings has been achieved. Alternatively, well seal can be formed by mixing bentonite with water in a surface mixer and then pouring the slurry down hole.

D. Soil backfill shall be rodded in the boring to provide even distribution and compaction. Finished grade at the well location shall prevent any water accumulation near the well by promoting drainage away from the well.

E. All material layer thicknesses shall be verified by taking measurements before, during, and after installation of each layer.

F. CONTRACTOR shall remove all working platforms constructed for the drill rig after the installation of the well. Hauling, construction, removal and other work tasks related to well installation shall be carried out with minimal disturbance to the vegetation on the landfill.

3.04 DISPOSAL OF WASTE

A. Excavated refuse shall be loaded and hauled by CONTRACTOR to the active disposal areas of the landfill for disposal as directed by OWNER. There will be no disposal charge for landfill gas well drilling cuttings. As directed by OWNER, CONTRACTOR shall keep an accurate record of the quantity of refuse disposed.

B. If the active disposal area is temporarily unavailable, CONTRACTOR shall stockpile drilling spoils on the landfill surface. Waste spoils shall either be covered with: (i) temporary plastic covers that are anchored firmly by use of weights to prevent uplift by winds; or (ii) a minimum of 12-inch of soil cover. CONTRACTOR shall haul and dispose the stored materials as soon as the waste disposal operations are resumed.

[END OF SECTION]

SECTION 03100

CONCRETE FORMS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. CONTRACTOR shall furnish all labor, materials, tools, and supervision necessary to construct the forms required for cast-in-place concrete construction as indicated on the Drawings and in this Section.

B. CONTRACTOR shall be prepared to construct the forms in conjunction with other Work at the Site.

C. CONTRACTOR shall be entirely responsible for meeting the requirements of this Section.

1.02 CONSTRUCTION QUALITY ASSURANCE

A. Construction of the concrete forms shall be monitored by the CQA Consultant as outlined in the CQA Plan.

B. CONTRACTOR shall be aware of the activities outlined in the CQA Plan and shall account for these activities in the construction schedule.

C. CONTRACTOR shall ensure that the materials and methods used for construction of the concrete forms meet the requirements of the Drawings and Specifications. Any material or method that does not conform to these documents, or to alternatives approved by ENGINEER will be rejected by the CQA Consultant and shall be repaired or replaced by CONTRACTOR at no cost to OWNER.

D. CONTRACTOR shall perform all Work in accordance with ACI 347.

PART 2 PRODUCTS

2.01 MATERIALS

A. Concrete formwork shall be designed for vertical loads and lateral pressures in accordance with the standards prescribed in ACI 347.

B. Plywood forms shall be grade marked B-B Plyform, Exterior Class 1 and 2 Medium Density Overlaid Plywood Concrete Form, B-Matte Formguard, or equal, conforming to the requirements of U.S. Product Standard PS-1, "*Construction and Industrial Plywood"*.

C. Steel forms shall be a minimum 16-gauge steel, matched, tight fitting, and stiffened to support the weight of the concrete.

D. Form ties shall be factory fabricated, snap-off metal ties of adequate design to minimize form deflection and preclude concrete spalling upon removal. The ties shall be fabricated to that set back in the concrete is such that the portion of the tie remaining after snap-off and removal of the exterior portions is at least 1½ in. back from the concrete surface.

E. Bond breaker or form release agent shall be a non-staining mineral oil or similar liquid product that imparts a waterproof film to prevent adhesion of concrete and will not leave a paint impending coating on the face of the concrete or release agents which will not transfer to the concrete.

PART 3 EXECUTION

3.01 FAMILIARIZATION

A. Prior to implementing any of the Work described in this Section, CONTRACTOR shall become thoroughly familiar with the Site, the site conditions, and all portions of the Work falling within this Section.

B. Prior to implementing any of the Work in this Section, CONTRACTOR shall carefully inspect the installed Work of all other Sections and verify that all Work is complete to the point where the installation of this Section may properly commence without adverse impact.

C. If CONTRACTOR has any concerns regarding the installed Work of other Sections, then CONTRACTOR shall notify ENGINEER in writing prior to commencing the Work. Failure to notify ENGINEER or construction of the concrete formwork will be construed as CONTRACTOR's acceptance of the related Work of all other Sections.

3.02 CONSTRUCTION

A. CONTRACTOR shall construct and adequately brace the formwork so that the resulting concrete surfaces will conform to the dimensions specified on the Drawings and in accordance with requirements of ACI 301.

B. CONTRACTOR shall provide mortar tight forms of approved materials that conform to the required shapes, lines and dimensions, and will produce a smooth surface without fins and projections.

3.03 COATING

A. CONTRACTOR shall coat the forms with bond breaker prior to the placement of reinforcing steel.

B. CONTRACTOR shall allow excess coating material neither to stand in puddles in the forms nor to come in contact with concrete against which fresh concrete is to be placed.

C. CONTRACTOR shall coat bolts and rods that are to be completely removed or that are to be free to move with a bond breaker.

3.04 EMBEDDED ITEMS

A. CONTRACTOR shall thoroughly clean items to be embedded in concrete from oil or other foreign matter that would weaken the bond of the concrete to these items.

3.05 FORMWORK TOLERANCES

A. CONTRACTOR shall construct the formwork to maintain tolerances required by ACI 301.

B. CONTRACTOR shall install in the formwork requisite inserts, anchors, sleeves, and other items specified under other Sections of these Specifications. Close ends of conduits, piping, and sleeves shall be embedded in concrete with caps or plugs.

C. Concrete pads, curbs, pedestals, and similar means devised by CONTRACTOR to support the forms will be subject to review by ENGINEER and the CQA Consultant.

D. Before depositing concrete, the location and support of items that are partially or wholly embedded shall be checked by CONTRACTOR.

E. CONTRACTOR shall provide openings and recesses and place sleeves in the concrete as may be required and furnished by other Sections of these Specifications.

3.06 REMOVAL OF FORMS

A. CONTRACTOR shall maintain forms, falsework, and centering in place until the concrete has attained the minimum percentage of specified design strength to carry their own weight and any loads to which they will be subjected without exceeding the permissible stresses and without deforming.

B. CONTRACTOR shall compute these permissible stresses on the basis of 0.6 of the compressive strength attained by the concrete at the time of removal. The concrete strength attained prior to form removal shall be determined from the results of test cylinders cured adjacent to and under the same conditions as the placed concrete. The test cylinders shall be obtained and tested in accordance with the procedures of Section 03300, Cast-in-Place Concrete.

3.07 PROTECTION OF WORK

A. CONTRACTOR shall use all means necessary to protect all Work of this Section and materials and completed Work of other Sections.

B. In the event of damage to this Work or other Work, CONTRACTOR shall immediately make all repairs and replacements if necessary, to the approval of ENGINEER and the CQA Consultant and at no cost to OWNER.

*** [END OF SECTION] ***

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. CONTRACTOR shall furnish all labor, materials, equipment, tools, and supervision necessary to place the concrete reinforcement to the requirements indicated on the Drawings and in this Section.

B. CONTRACTOR shall be prepared to construct the reinforcement in conjunction with other Work at the Site.

C. CONTRACTOR shall be entirely responsible for meeting the requirements of this Section.

1.02 SUBMITTALS

A. Shop Drawings

1. The CONTRACTOR shall submit a list of the bars to be used including their weights, dimensions, placement locations, bending diagrams, schedules, and any additional information require for fabrication and placement. Calculated weights of the bars shall be as specified in ACI 318.
2. The CONTRACTOR shall review the Drawings for anchor bolt locations, anchors, hangers, inserts, conduits, sleeves, and any other items that are to be cast in the concrete that could cause possible interference with the reinforcing steel.
3. Detailing of the reinforcing steel shall be in accordance with ACI 315.

B. CONTRACTOR shall submit the Manufacturer's product data for reinforcement materials and accessories.

C. CONTRACTOR shall also submit a certificate of compliance stating that the grades and properties of the reinforcing steel are in conformance with ASTM A370, and any other applicable ASTM Standards.

1.03 CONSTRUCTION QUALITY ASSURANCE

A. Placement of the concrete reinforcement shall be monitored by the CQA Consultant as outlined in the CQA Plan.

B. CONTRACTOR shall be aware of the activities outlined in the CQA Plan and shall account for these activities in the construction schedule.

C. CONTRACTOR shall ensure that the materials and methods used for construction of the concrete reinforcement meet the requirements of the Drawings and Specifications. Any material or method that does not conform to these documents, or to alternatives approved by ENGINEER, will be rejected by the CQA Consultant and shall be repaired or replaced by CONTRACTOR at no cost to OWNER.

PART 2 PRODUCTS

2.01 MATERIALS

A. Reinforcement shall be of the size specified in the Drawings.

B. Reinforcing bars shall conform to the requirements of the "Standard Specifications for Deformed Billet Steel Bars for Concrete Reinforcement" (ANSI/ ASTM A6l5). Reinforcing bars shall be Grade 60.

C. Welded wire fabric for concrete reinforcement shall be electrically-welded wire fabric of cold-drawn wire conforming to "Specification for Welded Steel Wire Fabric for Concrete Reinforcement" (ANSI/ASTM A185).

PART 3 EXECUTION

3.01 FAMILIARIZATION

A. Prior to implementing any of the Work described in this Section, CONTRACTOR shall become thoroughly familiar with the Site, the site conditions, and all portions of the Work falling within this Section.

B. Prior to implementing any of the Work in this Section, CONTRACTOR shall carefully inspect the installed Work of all other Sections and verify that all Work is complete to the point where the installation of this Section may properly commence without adverse impact.

3.02 PRODUCT DELIVERY, STORAGE AND HANDLING

A. CONTRACTOR shall be responsible for delivery, storage, and handling of the concrete reinforcement steel.

B. Reinforcement shall be shipped to the Site with bars of the same size and shape securely fastened in bundles with wired metal identification tags shall be labeled with the same designation as shown on submitted bar schedules and shop drawings.

C. All bars shall be stored off the ground and shall be protected from moisture and kept free from dirt, oil, and other foreign substances.

D. CONTRACTOR shall protect the reinforcing steel and wire fabric from damage and dirt, oil, grease, other foreign matter, and rust causing conditions.

3.02 FABRICATION

A. Reinforcement shall be accurately formed to the dimensions indicated on the Drawings. All bars shall be bent cold. Diameter of bend measured on inside of bar, other than for stirrups and ties in sizes No. 3 through No. 5, shall not be less than specified in Table 3E-1. Inside diameter of bends for stirrups and ties shall not be less than 4 bar diameters for No. 5 bar and smaller. For bars larger than No. 5, diameter of bend shall comply with Table 3E-1 shown on the next page.

TABLE 3E-1
MINIMUM DIAMETERS OF BEND

Bar Size	Minimum Diameter
Nos. 3 through 8	6 Bar Diameters
Nos. 9, 10, and 11	8 Bar Diameters
Nos. 14 and 18	10 Bar Diameters

B. Metal reinforcement shall not be straightened or bent in a manner that will injure the material. Bars with kinks, or bends not shown on the drawings, shall not be used. Heating of the reinforcement or welding to the reinforcement shall not be permitted.

3.04 BAR SUPPORTS AND SPACERS

A. CONTRACTOR shall support bars by means of bolsters or chairs with no less than the minimum required by ACI 315.

B. Reinforcing steel that is located in the bottom of slabs resting on earth may be supported by concrete, brick, mortar blocks, or reinforcing steel supports.

C. CONTRACTOR shall hold reinforcing steel in position in walls, columns, piers, and abutments by means of mortar blocks, bar supports, or spacers wired to reinforcing steel.

D. CONTRACTOR shall not use stones, clay bricks, wood blocks, or pieces of broken concrete to support reinforcing steel.

E. CONTRACTOR shall not place bars or fabricated mats on layers of fresh concrete as the work progresses.

3.05 PLACING AND FASTENING

A. CONTRACTOR shall arrange and place reinforcing steel as specified in the Drawings.

B. CONTRACTOR shall secure reinforcement positively against displacement during placing of concrete.

C. CONTRACTOR shall wire or clip bars together as recommended in Concrete Reinforcing Steel Institute Recommended Practice for Placing Reinforcing Bars.

D. The steel shall be free from dirt, mill and rust scale, oil, grease, and other foreign matter.

E. CONTRACTOR shall furnish reinforcing bars in full lengths as shown on the Drawings and Shop Drawings.

F. CONTRACTOR shall not splice bars unless approved by ENGINEER in writing.

G. CONTRACTOR shall place reinforcement so that there will be a clear distance of at least 2 in. between the reinforcement and any forms or embedded metal work.

H. Unless otherwise shown on the Drawings, splices in reinforcement bars shall be lapped not less than 24 diameters. All bar splices shall be staggered wherever possible. When splicing bars of different diameters, the length of lap is based on the larger bar.

I. Before placing in position, reinforcement shall be thoroughly cleaned of loose mill and rust scale, dirt, and other coatings that may reduce or destroy bond. Where there is delay in depositing concrete after reinforcement is in place, bars shall be reinspected and cleaned when necessary.

3.07 INSPECTION

A. CONTRACTOR shall deposit concrete only when the placement of the reinforcement has been checked and approved by ENGINEER or the CQA Consultant.

3.08 PROTECTION OF WORK

A. CONTRACTOR shall use all means necessary to protect all Work of this Section and materials and completed Work of other Sections.

B. In the event of damage to this Work or other Work, CONTRACTOR shall immediately make all repairs and replacements if necessary, to the approval of ENGINEER or the CQA Consultant and at no cost to OWNER.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. CONTRACTOR shall furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary for the manufacture, storage, delivery, and installation of cast-in-place concrete, as specified herein and as shown on the Drawings.

B. CONTRACTOR shall coordinate the installation of the cast-in-place concrete with other construction activities and subcontractors at the Site.

C. All Work shall be performed in accordance with ACI 318 and ACI 301.

D. CONTRACTOR shall retain a Construction Quality Control (CQC) Consultant to perform the field and laboratory testing of cast-in-place concrete. The CQC Consultant must be acceptable to OWNER.

1.02 SUBMITTALS

A. At least 14 days prior to starting the Work of this Section, CONTRACTOR shall submit to ENGINEER Shop Drawings for all cast-in-place concrete. These Shop Drawings shall provide details for formwork and reinforcing steel.

B. At least 14 days prior to staring the Work of this Section, CONTRACTOR shall submit to ENGINEER the proposed concrete design mixes. The design mixes shall present the composition of the concrete mix including all materials, admixtures, ratios, compressive strength, slump, and air entrainment in accordance with ACI 318.

C. At least 14 days prior to starting the Work of this Section, CONTRACTOR shall submit to ENGINEER the methods proposed for use against low and high temperatures for protection of the concrete.

D. At least 14 days prior to starting the Work of this Section, CONTRACTOR shall submit to ENGINEER information describing the qualifications and capabilities of the CQC Consultant.

E. For each truck load of concrete delivered to the Site, CONTRACTOR shall submit a delivery ticket to the CQA Consultant. The certificate or delivery ticket shall set forth the following information:
   1. name of supplier;
   2. name of batching plant and location;
   3. date;
   4. truck number;
   5. specific job designation (contract number and location);
   6. the volume of concrete (cubic yards);
   7. specific Class and Type of concrete (in conformance with the Specifications);
   8. time loaded;
   9. type and brand of cement;
   10. weight of cement;
   11. maximum size of aggregates;
   12. weights of coarse and fine aggregates, respectively;
   13. amount of water added at the plant and maximum amount of water to be added at the site, if any; and
   14. kind and amount of admixtures.

F. As soon as the data is available, CONTRACTOR shall submit to ENGINEER compression test data from compression test cylinders. Testing of compression test cylinders shall be performed by CONTRACTOR's Construction Quality Control (CQC) Consultant in accordance with the ACI Code and ASTM C 39. Cast-in-place concrete that does not meet these Specifications shall be removed and replaced at CONTRACTOR's expense or may be subjected to a load test, also at CONTRACTOR's expense.

G. Following installation, CONTRACTOR shall submit a placement log to the CQA Consultant for all cast-in-place concrete items including the following information:
   1. date of placement;
   2. location and extent of placement;
   3. quantity of concrete;
   4. air temperature; and
   5. tests and samples taken.

1.03 CONSTRUCTION QUALITY CONTROL

A. Placement of cast-in-place concrete shall be monitored by CONTRACTOR's CQC Consultant.

B. CONTRACTOR shall be aware of the activities outlined in the CQA Plan and shall account for these activities in the construction schedule.

C. The Ready Mixed Concrete Plant selected by CONTRACTOR for this Project shall be currently certified to comply with approval requirements of one or more of the following:
   1. Concrete Materials Engineering Council;
   2. National Ready Mixed Concrete Association; and
   3. Prestressed Concrete Institute.

D. CONTRACTOR's CQC Consultant shall be currently accredited by one or more of the following:
   1. Concrete Materials Engineering Council; and
   2. Other accreditation authority of equivalent standing to the above, on the basis if its compliance with the requirements of ASTM C 1077.

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

A. Concrete mix shall conform with ASTM C 94, and shall be ready-mixed, normal weight, air entrained, with a minimum compressive strength 4,000 psi at 28 days. Slump and air entrainment shall be in accordance with ACI 318.

B. Cement shall conform to ASTM C 150, Type I.

C. Aggregate shall conform with ASTM C 33. Maximum size of coarse aggregate shall be the smallest of 1½ in., ¾ of the minimum clear spacing between reinforcing bars, or one half the thickness of slab.

D. Water shall be potable.

E. All deformed billet steel shall conform to ASTM A 615, Grade 60. All wire fabric shall be welded steel in conformance with ASTM A 185.

F. Anchor bolts shall be hot-dipped galvanized carbon steel conforming to ASTM A 307.

2.02 ADMIXTURES

A. Admixtures shall be free of all chlorides.

B. Water-reducing admixtures shall conform to ASTM C 494, Type A and shall be used in accordance with manufacturer's recommendations. Technical assistance from the manufacturer's representative shall be provided upon request.

C. Air-entraining admixtures shall conform to ASTM C 260 and shall be used in accordance with manufacturer's recommendations. Testing of air-entraining admixtures shall be performed in accordance with ASTM C 233. Technical assistance from the manufacturer's representative shall be provided upon request.

D. Other admixtures shall not be used without written acceptance by ENGINEER.

2.03 CONCRETE MIXING

A. Concrete mixing shall conform to ACI 211.1 and ACI 304R-85.

B. Mix proportions for all concrete, unless otherwise specified, shall be selected preferably on the basis of field experience. In the case where sufficient or suitable strength test data is not available, concrete shall be proportioned on the basis of laboratory trial mix design.

C. The concrete shall have adequate workability and proper consistency to allow it to be readily worked into the forms and around reinforcement without excessive segregation or bleeding.

D. Ready Mix Concrete shall comply with requirements of ASTM C 94 for mixing time and water addition. Total mixing time for concrete shall be determined in accordance with ASTM C 94 for type of mixing equipment used.

E. Concrete that has been in a truck for more than 1½ hours after addition of water, or had more than 300 revolutions, or concrete which has become hard or non-plastic, shall not be used and shall be rejected by ENGINEER or the CQA Consultant.

F. Concrete that has been in a truck for more than 1½ hours from batch plant to placement shall not be used and shall be rejected by ENGINEER or the CQA Consultant.

F. When concrete arrives at the Site with a slump below that specified herein, water may be added only if neither the maximum specified water/cement ratio nor the maximum specified slump is exceeded. At no time shall more than 10 gallons of water be added to any one truck load. The additional water should be incorporated into the mix by increasing the mixing time at least 1½ times the total mixing time required by ASTM C 94. However, CONTRACTOR shall bear total responsibility for the effects of adding water on the quality and strength of the concrete.

G. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required.

PART 3 EXECUTION

3.01 FAMILIARIZATION

A. Prior to implementing any of the Work described in this Section, CONTRACTOR shall become thoroughly familiar with all portions of the Work falling within this Section.

B. Prior to implementing any of the Work in this Section, CONTRACTOR shall carefully inspect the installed Work for all other Sections and verify that all Work is complete to the point where the installation of this Section may properly commence without adverse impact.

C. If CONTRACTOR has any concerns regarding the installed Work of other sections, then CONTRACTOR shall notify ENGINEER in writing within 48 hours of the Site inspection. Failure to inform ENGINEER in writing or installation of cast-in-place concrete shall be construed as CONTRACTOR's acceptance of the related Work of all other Sections.

3.02 EXAMINATION AND PREPARATION

A. The CQA Consultant shall examine formwork, reinforcing steel, enbed inserts, sleeves, and joint materials prior to placement of concrete. Defective material shall be removed and replaced with new material at no cost to OWNER.

B. CONTRACTOR shall clean all formwork and structural excavations of foreign matter, debris, loose material, and water.

C. ENGINEER and the CQA Consultant shall be notified at least two working days in advance of a scheduled delivery to allow time for adequate observation of the Site.

3.03 PLACING CONCRETE

A. Concrete shall not be placed until the forms, reinforcement and other conditions are approved by ENGINEER or the CQA Consultant.

B. Water shall be removed from the space to be occupied by concrete, and any continuous flows of water shall be diverted to a sump or removed by pumping.

C. Concrete placement practices shall comply with ACI 304.
   1. Concrete shall be conveyed from the mixer to the place of final deposit by methods that will prevent segregation or loss of materials.
   2. Aluminum conveying equipment shall not be used.
   3. Conveying equipment shall be capable of providing a supply of concrete at the placement site without interruptions sufficient to permit loss of plasticity between successive increments.
   4. Concrete shall be place as nearly as practicable to its final position to avoid segregation due to re-handling or flowing. If the distance of the discharge end of the chute is more than 3 ft above the finished surface of the concrete, a spout or "elephant trunk" shall be used and the lower end maintained as near to the surface of deposit as practicable.
   5. Concrete placement shall be performed at such a rate that the concrete is plastic at all times and readily flows into the spaces between the reinforcement.
   6. Concrete placement shall be performed at such a rate to assure that lifts below have not taken initial set before fresh concrete is placed.
   7. Concrete that has partially set shall not be re-tempered; it shall be discarded.
   8. No concrete that has hardened or has been contaminated by foreign materials shall be placed, nor shall re-tempered concrete or concrete that has been re-mixed after initial set be used, unless approved by ENGINEER.

D. Concrete shall be consolidated by internal mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping in accordance with ACI 309 during and immediately after placing.

E. Reinforcing shall be maintained in proper position during concrete placement.

F. In the event of rain during concrete placement, the placement shall be terminated as soon as practicable at a point approved by the CQA Consultant and freshly placed concrete shall be protected with a waterproof covering that shall prevent marring or damage of surfaces.

G. Concrete shall not be placed without consent of ENGINEER or the CQA Consultant when the temperature is 50°F or less, or when there is reason to expect a drop in temperature to below 50°F within 12 hours of the conclusion of the pour. Concrete placed at air temperature below 40°F shall have a minimum temperature of 60°F. When the air temperature is below 40°F or near 40°F and falling, the water and aggregates shall be heated before mixing. Accelerating chemicals shall not be used to prevent freezing.

H. Hot weather placement of concrete shall comply with ACI 305R.

I. Cold weather placement of concrete shall comply with ACI 306R.

3.04 CONCRETE CURING

A. Freshly placed concrete shall be protected from premature drying and excessive cold or hot temperatures.

B. Curing procedures shall begin immediately after placement in accordance with ACI 308 procedures to provide continuous moist curing above 50°F for at least seven days.

C. Curing of concrete shall be performed by moist curing and by moisture retaining cover curing, as herein specified. Moisture curing shall be provided by one of the following methods: covering with water, sprinkled with water, continuous water fog spray, and covering concrete surface with specified absorptive cover, thoroughly saturating cover with water, and keeping continuously wet. No salt, manure, or other chemicals shall be used for protection.

3.05 FINISHES

A. Concrete shall be finished as follows:

1. Rough Formed Finished may be utilized for cast in place concrete not exposed to public view. All tie holes and defective areas are to be repaired prior to backfilling or burial.

2. Smooth Formed Finish: To apply to all formed surfaces exposed to the public view and as defined in ACI 301.
3. Trowel Finish: To apply to interior building slabs.
4. Nonslip Broom Finish: To apply to all exterior concrete surfaces.

B. All concrete surfaces shall be finished by experienced finishers, as specified, as soon after placing the concrete as conditions will permit. The placing of concrete and the removal of forms shall be scheduled so that finishing the surfaces can be completed before the concrete reaches a final hard set. No cement plaster or cement brush-coats will be acceptable.

C. Unformed concrete surfaces shall be struck off to established grade and floated until all irregularities are removed. Where required the surface shall then be troweled either with a wood trowel or a steel trowel, depending on the finish requirement of the area to be troweled, until a smooth dense finish is obtained. Troweling of the floated surface shall not be done until all excess water has evaporated.

3.06 PROTECTION OF COMPLETED WORK

A. Concrete shall be protected from damaging mechanical disturbances, water flow, loading, shock, and vibration during the entire curing period.

B. Concrete surfaces shall be kept free from all foot and vehicular traffic and all other sources of abrasion for not less than 72 hours after finishing.

C. Any protective coverings shall be maintained continuously during entire curing period, and damage to coverings shall be repaired immediately at no additional expense to OWNER.

D. Finished surfaces and slabs shall be protected from the direct rays of the sun to prevent checking and crazing.

3.07 REPAIRS

A. Repair of rock pockets, honeycombs, and sand streaks shall be done by:
1. cutting and removing concrete to at least 1-in. deep with sides perpendicular to surface;
2. flushing with clean water;
3. coating with neat cement paste;
4. filling with cement drypack mix;

5. curing as specified for concrete; and
6. grinding smooth and flush with adjacent surfaces.

3.08 FIELD QUALITY CONTROL

A. CONTRACTOR's CQC Consultant shall perform tests and submit test reports as defined in this Section.

B. Sampling fresh concrete shall be performed in accordance to ASTM C 172, except modified for slump to comply with ASTM C 94:
   1. Slump test according to ASTM C 143 and air content test according to ASTM C 231 shall be measured as follows:
      a. one test at point of discharge for each set of compression cylinders taken;
      b. additional tests when concrete consistency appears to have changed; and
      c. one test on each truck load of concrete delivered to the site.
   2. Molded concrete compression cylinders shall be sampled in accordance with ASTM C 172, processed and cured in accordance with ASTM C 31, and prepared and tested in accordance with ASTM C 39:
      a. One set of six cylinders shall be obtained for each 50 cubic yards, or fraction thereof, for each day's placement of each mix design.
      b. Two cylinders shall be tested at seven days and two cylinders for one valid strength test at 28 days.
      c. Two cylinders shall be cured and held for testing at 42 days if 28-day test indicated deficient results, or as a spare in case of cylinder damage.

C. Written reports, signed and sealed by a Profession Engineer licensed in the State of Maryland, shall be promptly submitted with the following additional data:
   1. time concrete batched and time sampled;
   2. water added at Site;
   3. strength class;
   4. delivery ticket number;
   5. concrete suppliers mix designation;
   6. location of concrete in the Work;
   7. results of slump and air content testing; and
   8. results of laboratory compressive strength testing.

3.09 PRODUCT PROTECTION

A. CONTRACTOR shall use all means necessary to protect all prior Work, including all materials and completed Work of other Sections.

B. In the event of damage to prior Work or Work specified in this Section, CONTRACTOR shall immediately make all repairs and replacements necessary to the approval of OWNER or ENGINEER and at no cost to OWNER.

END OF SECTION

SECTION 03400

PRECAST CONCRETE STRUCTURES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. CONTRACTOR shall furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary to install precast concrete structures, frames, covers, manhole rungs, appurtenances, and related Work, as specified herein and as shown on the Drawings.

B. CONTRACTOR shall coordinate the installation of the precast concrete structures with other construction activities and subcontractors at the Site.

1.02 SUBMITTALS

A. At least 10 days prior to starting the Work of this Section, CONTRACTOR shall submit to ENGINEER the following:
   1. Shop Drawings showing, as a minimum, the layout and details of all precast concrete structures, including reinforcing, joints, joint fillers and gaskets, pipe connections, rungs, frames, and covers;
   2. Shop Drawings shall have seal of Professional Engineer licensed in the State of Maryland;
   3. design calculations bearing the seal of a Professional Engineer licensed in the State of Maryland;
   4. materials list; and
   5. manufacturer's product data and recommended methods of installation.

1.03 CONSTRUCTION QUALITY ASSURANCE

A. The installation of precast concrete structures shall be monitored by the CQA Consultant as outlined in the CQA Plan.

B. CONTRACTOR shall be aware of the activities outlined in the CQA Plan and shall account for these activities in the construction schedule.

C. The quality of all materials, the process of manufacture, and the finished sections shall be subject to inspection and approval by ENGINEER. Such inspections may be made at the place of manufacture, or at the Site after delivery, or at both locations. The materials shall be subject to rejection for failure to meet any of the requirements of these Specifications even though samples may have been accepted as satisfactory at the place of manufacture. Material rejected after delivery to the Site shall be marked by CONTRACTOR for identification. CONTRACTOR shall immediately remove the rejected materials from the Site and shall replace them with new materials at no cost to OWNER. All materials damaged after delivery to the Site will be rejected, and if already installed, shall be acceptably repaired, if permitted, or removed and replaced with new materials, entirely at CONTRACTOR's expense.

D. The materials will be examined for compliance with ASTM standards, these Specifications, and the approved manufacturer's Shop Drawings. Precast concrete sections shall be inspected for general appearance, dimensions, "scratch-strength", blisters, cracks, roughness, soundness, etc. The surface shall be dense and close-textured.

E. Imperfections in precast concrete sections may be repaired, subject to the approval of OWNER or ENGINEER, after demonstration by the Manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval.

PART 2 PRODUCTS

2.01 GENERAL

A. Products used in the Work of this Section shall be produced by manufacturers regularly engaged in the production of similar items and with a history of successful production acceptable to ENGINEER.

B. Precast concrete barrel sections with precast top slabs and precast concrete transition sections shall be designed for a minimum of H-20 loading plus the weight of the soil above.

C. The date of manufacture and the name and trademark of the manufacturer shall be clearly marked on the inside of each precast section.

2.02 MATERIALS

A. Cement shall conform to ASTM C 150, Type II. The same brand, type, and source of supply shall be used throughout.

B. The air-entraining agent shall conform with ASTM C 260.

C. Aggregates shall conform with ASTM C 33.

D. Potable water or water which is free from foreign materials in amounts harmful to the concrete shall be used.

E. All deformed billet steel shall conform to ASTM A 615, Grade 60. All wire fabric shall be welded steel in accordance with ASTM A 185.

F. Grouts used for repairs shall be mixed at a rate of one part Portland cement to two parts sand (by volume). The amount of water shall be kept to a minimum, yet the sand and cement shall be as specified for use in concrete.

G. All bonding agents shall be moisture insensitive, epoxy-resin bonding agent as manufactured by one of the following, or an equal:
   1. Epoxtite (W.R. Grace);
   2. Euco Epoxy (Euclid Chemical Company); or
   3. Sikastix 370 (Sika Chemical Company). The bonding agent shall be used as specified for repair of units and in conformance with Manufacturer's printed instructions.

H. Cement mortar used for repairs shall have a minimum compressive strength of 4,000 psi after seven days and 5,000 psi after 28 days, when tested in 3-in. by 6-in. cylinders stored in the standard manner.

I. Epoxy mortar may be used, subject to the approval of ENGINEER.

2.03 MIXES

A. The concrete mix shall achieve a minimum 4,000 psi compressive strength at 28 days.

2.04 FABRICATION

A. Formwork shall be designed and constructed so as to maintain precast concrete units within their specified tolerances. Anchorage devices shall be securely attached to formwork in locations not affecting position of main reinforcement or placing of concrete.

B. Concrete shall be placed in a continuous operation to prevent formation of seams.

C. Placed concrete shall be consolidated by vibration without dislocation or damage to reinforcement and built-in items.

D. Permanent marking shall be provided in precast unit to identify pick-up points and location in structure.

E. Precast units shall be cured until 70 percent of the minimum 28 day compressive strength has developed before removing the units from the forms.

2.05 OTHER MATERIALS

A. All materials, not specifically described, but required for a complete and proper installation of precast concrete sections, shall be provided by CONTRACTOR subject to the approval of ENGINEER.

PART 3 EXECUTION

3.01 FAMILIARIZATION

A. Prior to implementing any of the Work described in this Section, CONTRACTOR shall become thoroughly familiar with all portions of the Work falling within this Section.

B. Prior to implementing any of the Work specified in this Section, CONTRACTOR shall carefully inspect the installed Work of all other Sections and verify that all Work is complete to the point where the installation of the Work specified in this Section may properly commence without adverse impact.

3.02 INSTALLATION

A. Care shall be taken in loading, transporting, and unloading to prevent damage to precast structures and components. CONTRACTOR shall examine all materials before installation. CONTRACTOR shall not install any material that is defective. ENGINEER and/or the CQA Consultant may reject defective materials. Defective materials shall be removed and replaced with new materials by CONTRACTOR at no cost to OWNER.

B. Precast concrete structures shall be constructed to the dimensions shown on the Drawings and as specified in these Specifications.

C. All work shall be protected against flooding and flotation.

3.03 PRODUCT PROTECTION

A. CONTRACTOR shall use all means necessary to protect all prior Work and materials and completed Work of other Sections.

B. In the event of damage to prior Work or Work specified in this Section, CONTRACTOR shall immediately make all repairs and replacements necessary, to the approval of ENGINEER and CQA Consultant and at no cost to OWNER.

END OF SECTION

Appendix M: Construction Quality Assurance Plan

Tolson & Associates, LLC

Construction Quality Assurance/Quality Control Plan
Tolson Rubble Landfill
Crofton, Maryland

November 30, 2009

Project Number: 0100203

Environmental Resources Management
200 Harry S Truman Parkway
Suite 400
Annapolis, Maryland 21401

Tolson & Associates, LLC

Construction Quality Assurance/ Quality Control Plan

Tolson Rubble Landfill
Crofton, Maryland

September 4, 2009

Project Number: 0100203

Matthew Erbe, P.G.
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Project Engineer

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Partner

Environmental Resources Management
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TABLE OF CONTENTS

LIST OF FIGURES

1.0 CONSTRUCTION QUALITY ASSURANCE/QUALITY CONTROL PLAN

1.1 STATEMENT OF PURPOSE

This plan sets forth the Construction Quality Assurance/Quality Control Plan (CQA/QC Plan) requirements for the Tolson Rubble Landfill and the related construction certification report. The CQA/QC Plan is designed to meet the requirements set forth in COMAR 26.04.07: Solid Waste Management Regulations. This Plan defines the various management and inspection staff personnel directly responsible for the construction quality control (CQC) activities as well as construction quality assurance (CQA) activities, including position descriptions, responsibilities, and experience requirements. In addition, the Plan addresses specific QA/QC testing requirements for each of the various components of the Tolson landfill construction. During construction, supplemental supporting documents will be provided by the contractors, vendors, and others involved in the implementation; these requirements will be addressed in the technical specifications. This CQA/QC Plan will be used as the baseline to certify the final design and construction of any of the items which are incorporated into the rubble landfill.

2.0 POSITION RESPONSIBILITIES

The construction contractor will be responsible for the quality of construction in the finished product and for compliance with the construction documents, drawings and specifications. The Project Manager will have ultimate responsibility for the oversight of construction and for conformance with the construction drawings, specifications, and quality assurance requirements. The complete construction, design, and CQA team organization is presented on Figure 1.

The CQC team members will be employed by the construction contractor. Therefore, specific positions, and their associated descriptions and responsibilities, will be set forth by the contractor procured. However, the construction contract documents include a requirement that the contractor assigns an individual to manage the CQC and that the individual will not be directly involved in supervising construction activities.

2.1 CQA TEAM

The CQA Team will solely participate in the quality assurance function, and will not be involved in any other aspect of the construction effort. This team will, however, possess all of the credentials, capabilities and experience of an independent design/construction oversight team. Each position is described below with respect to duties and responsibilities. One individual or entity may perform multiple CQA responsibilities.

<u>Project Manager.</u> The Project Manager is responsible for overall implementation and management of the CQA/QC Plan and will supervise the preparation of the certification report of construction. The Project Manager will be independent of Tolson & Associates, LLC (Tolson) and the construction contractor but directly accountable to Tolson for the successful completion of the work. The duties and responsibilities of the Project Manager include the following:

- Review and approve shop drawings.
- Provide support to the CQA Manager in interpreting the meaning and intent of the construction plans and specifications and in the performance and supervision of the CQA testing program.
- Provide consultation and technical support to Tolson.

- Inspect the project with the CQA Manager, as appropriate, to identify discrepancies or deficiencies in the work. Any deficiencies, which, in the opinion of the Project Manager, require immediate attention, will be reported to Tolson immediately.
- Provide certification for the construction certification report. The report will be certified, signed, and sealed by a Professional Engineer registered in the State of Maryland, who will attest to the quality of the work being certified. The report will include the results of all CQA and CQC testing and document deviations from the construction plans and specifications. In addition, the report will include "as-built" drawings, daily inspection reports, photographs, and other applicable data.
- Prepare the final "as-built" drawings indicating the features constructed and the existing location of all facilities.
- Make recommendations to Tolson regarding the approval of construction subcontractors and material vendors.
- Evaluate the contractor's project schedule.
- Review and make recommendations to Tolson regarding any delays to the project schedule.
- Review and evaluate contractor-proposed contract change orders. The Owner, Designer, CQA Team, or the Maryland Department of the Environment (MDE) may also propose change orders. All change orders will require a signature indicating approval from all the parties referenced above.
- Provide other technical support, as required, to Tolson.

<u>CQA Manager.</u> The CQA Manager will be assigned to the landfill on a full-time basis, and will report directly to the Project Manager. The duties and responsibilities of the CQA Manager include the following:

- Perform and/or oversee all CQA testing activities.
- Coordinate CQA activities with the Construction Manager and the Project Manager.
- Review contractor invoices and recommend payment to the Project Manager.
- Maintain copies of all CQA and CQC testing results and certifications.
- Preparation and distribution of weekly construction reports.
- Provide leadership and input to the construction certification report.

The primary duties of the CQA Manager are to verify that all QA and QC tests required under the contract are performed, assure that all installed equipment and materials have passed the various tests, and, in general, ensure that a full, complete, and properly constructed product in accordance with all of the plans and specifications is provided by the contractor. Upon completion of material and equipment tests, the CQA Manager will maintain reports of testing results, reports of any failures, and the corrective actions employed to obtain acceptable test results. All test data, reporting data and contractor submissions will be included in the construction certification report. The CQA Manager shall be permitted to suspend construction activities under conditions such as inclement weather, where they believe the integrity of the cell or any of its components will be compromised.

Geosynthetic Materials CQA Manager. The Geosynthetic Materials CQA (GM-CQA) Manager will be on site full-time during the installation of all geomembranes, geocomposites, and geotextile fabrics. The Geosynthetic Materials CQA Manager will manage his/her supporting staff and coordinate the work performed by the Geosynthetic Materials CQA Laboratory. The GM-CQA Manager will report to the CQA Manager. The CQA Manager shall be permitted to suspend construction activities under conditions such as inclement weather, where they believe the integrity of the cell or any of its components will be compromised.

Geosynthetic Materials CQA Laboratory. The Geosynthetic Materials CQA Laboratory is an independent geosynthetic testing laboratory that will test samples split during CQC testing. Samples will be randomly selected for independent CQA verification. To ensure unbiased sample analysis, the GM-CQA Laboratory will be different than that selected by the construction contractor for CQC geosynthetics testing. The GM-CQA Laboratory will be responsible for performing the various CQA tests on geosynthetic materials and seams as presented in this plan. The GM-CQA Laboratory will report directly to the CQA Manager.

Geotechnical CQA Manager. The Geotechnical CQA (G-CQA) Manager will be on-site during all earthwork operations requiring quality assurance testing, including excavation and site preparation; liner system, berm and access roadway construction; and cover placement operations. He/she will oversee the activities of the G-CQA Inspectors and coordinate the testing programs of the G-CQA laboratory. The G-CQA Manager will report to the CQA Manager.

Geotechnical CQA Laboratory. The Geotechnical CQA (G-CQA) Laboratory is an entity independent of Tolson and the construction contractor, located either on- or off-site, that will be responsible for conducting tests on soil materials to ensure conformance with the contract plans and specifications. The Geotechnical

CQA Laboratory will not analyze soils provided by any party involved with the supply of materials, the construction contractor or subcontractors. The G-CQA Laboratory will report directly to the CQA Manager.

Field CQA Inspectors. Field CQA Inspectors will report directly to the CQA Manager, and will be present during all major construction activities. The duties and responsibilities of this position include the following:

- Visually inspect materials imported to the site for conformance with the specifications and for variations from material that was tested before being delivered to the site.
- Obtain samples for geotechnical CQA testing.
- Observe field sampling and testing performed by the contractor's CQC staff, reviewing the results.
- Observe and record observations regarding the proper storage and handling of equipment and materials.
- Independently verify quantity calculations.
- Prepare daily reports documenting all contractor activities.
- Assist the Construction Manager in the generation of soil volume placement estimates.
- Assist with the preparation of "as-built" drawings.

2.2 CQC TEAM

Key positions in the CQC team will be delineated in the construction contract; e.g., Contractor Superintendent, Construction CQC Manager, etc. Other CQC positions and responsibilities will be assigned at the discretion of the specific contractor. The construction contractor's CQC Team will be subject to the review and approval of the CQA Manager before site mobilization is authorized. Team members may be employed directly by the contractor, or as subcontracted firms or individuals. One individual or entity may perform multiple CQC responsibilities.

Construction Contractor Superintendent. The construction Contractor Superintendent will have overall responsibility for implementing the CQC program, including appointment of a CQC Manager and providing daily construction reports documenting testing and construction activities. The daily reports will be provided to the CQA Manager. The CQC Manager may not be the superintendent and must be approved by the engineer.

CQC Manager. The CQC Manager will be responsible for overseeing all quality control testing performed by the contractor and providing contractor certification reports to the CQA Manager. Other related duties include coordinating and submitting shop drawing submittals, providing required samples, and coordinating work and testing with the CQA Manager. The CQC Manager will provide daily construction reports which document all testing and describe construction activities performed at the site. The CQC daily report will be provided to the Construction Superintendent, and a copy provided to the CQA Manager. The CQC Manager will report directly to the Construction Superintendent.

Geotechnical CQC Laboratory. The Geotechnical CQC (G-CQC) Laboratory will be an independent, qualified soils and materials testing laboratory retained by the contractor. The laboratory will conduct tests on representative soils at the source of the material, in the field, and/or at the laboratory to determine compliance with the construction contract documents.

Field CQC Inspectors. Field CQCA Inspectors will report directly to the CQC Manager, and will be present during all major construction activities. The duties and responsibilities of this position include the following:

- Visually inspect materials imported to the site for conformance with the specifications and for variations from material that was tested after being delivered to the site.
- Perform moisture-density relationship tests on constructed soils to ensure that compaction and moisture content are in conformance with the CQC specifications.
- Obtain samples for geotechnical CQC testing.
- Observe and record observations regarding the proper storage and handling of equipment and materials.
- Prepare daily reports documenting all contractor activities.
- Assist the Construction Manager in the generation of soil volume placement estimates.
- Assist with the preparation of "as-built" drawings.

Geosynthetic Materials Installer. The Geosynthetics Materials Installer will be responsible for on-site handling, storing, placing, seaming, loading against displacement by wind, and other aspects of the geosynthetics materials installation. Depending upon the contractual arrangement with the construction contractor, the installer may also be responsible for the transportation of the geosynthetic materials to the site. The Geosynthetics Materials Installer will report directly to the construction Contractor Superintendent.

Geosynthetic Materials CQC Laboratory. The Geosynthetic Materials CQC Laboratory is an independent geosynthetic testing laboratory that will test all samples collected for CQC testing. To ensure unbiased sample analysis, the GM-CQA laboratory will be different than that selected by the construction contractor for CQC geosynthetics testing. The GM-CQC Laboratory will be responsible for performing the various CQC tests on all geosynthetic materials and seams as presented in this Plan. The GM-CQC Laboratory will report directly to the CQC Manager.

Land Surveyor. The survey crew will consist of a qualified land surveyor and assistants. The land surveyor will identify and establish initial horizontal and vertical control for the construction contractor and will also provide ground and aerial surveying of the site the preparation of certified "as-built" drawings for inclusion in the construction certification report. The land surveyor must be licensed in the State of Maryland and certify all "as-built" drawings and thicknesses as required in the technical specifications. The survey crew will report directly to the CQC Manager.

3.0 LEVEL OF EXPERIENCE

3.1 CQA TEAM

Project Manager. The Project Manager will be a Professional Engineer, or work under the direct supervision of a Professional Engineer, registered in the State of Maryland. The Project Manager will have a thorough knowledge and familiarity with the project and demonstrated experience in the design and construction of state-of-the art residual waste disposal facilities. In addition, he/she will have experience in the construction of concrete, storm drainage structures, and earthwork. The Project Manager will have a minimum of 10 years experience in civil engineering design and construction, and a minimum of 5 years of experience in landfill design, operations, and/or construction.

CQA Manager. The CQA Manager will have experience in civil construction projects including earthwork and soils and materials testing. The CQA Manager will have a thorough familiarity with the project and the testing requirements, and have directly-applicable experience in the testing of materials used to construct liner or cover systems for landfills. The CQA Manager will have a minimum of 5 years experience in materials testing or equivalent experience. The CQA Manager will be certified for operation of a nuclear density gauge.

Geosynthetic Materials CQA Manager. The Geosynthetic Materials CQA Manager will be knowledgeable regarding the installation of geosynthetics and will be trained and experienced with the manufacture and seaming of geosynthetics. The GM-CQA shall be required to hold a Professional Engineers License, have 5 years experience of similar project experience, or the appropriate certification(s) from The National Institute for Certification in Engineering Technologies (NICET). The GM-CQA Manager will have a minimum of 2 years experience with the installation of geosynthetics; this experience will include the installation of polyethylene geomembranes, geotextiles, and geocomposites at landfills.

Geosynthetics Materials CQA Laboratory. The Geosynthetics Materials CQA Laboratory will have experience in testing geosynthetics and other liner/cover system components, and will be familiar with American Society of Testing and Materials (ASTM), National Sanitation Foundation (NSF), and other applicable testing standards. The Geosynthetic Materials CQA Laboratory must be accredited by the Geosynthetics Accreditation Institute-Laboratory Accreditation Program (GAI-LAP) for each of the tests required to be performed. The

Geosynthetics Materials CQA Laboratory will be capable of providing polyethylene geomembrane seam test results within 24 hours of receipt of sample and will maintain that standard throughout the construction project duration.

Geotechnical CQA Manager. The Geotechnical CQA Manager will have a working knowledge of field and laboratory geotechnical testing protocols and procedures for a wide variety of soil materials. He/she must have a minimum of 3 years experience in performing and overseeing earthwork operations at landfills, and 1 year as a geotechnical inspector.

Geotechnical CQA Laboratory. The Geotechnical CQA Laboratory will have experience in testing soils and other construction materials and will be familiar with related ASTM, American Association of State Highway and Transportation Officials (AASHTO), and other construction materials testing standards.

Field CQA Inspectors. Field CQA Inspectors will have experience and/or training in both the testing and inspection of storm sewer, earthwork, granular materials, landfill liner/cover materials, concrete, and other site improvements. The inspectors that perform soil testing will have a minimum of one (1) year experience performing the required tests, including familiarity with the use and application of sand cone, scales, ovens, Shelby-tube sampling, nuclear density gauges, levels and tripods, and will be certified for operation of a nuclear density gauge.

3.2 *CONSTRUCTION QUALITY CONTROL TEAM*

Construction Contractor Superintendent. The construction Contractor Superintendent will be trained in the areas of landfill/civil/earthwork construction and engineering. The Superintendent will have demonstrated experience in earthwork projects, landfill/liner/cover installation, construction with concrete, and stormwater drainage structures, and will have a familiarity with the project. The Superintendent will have a minimum of 10 years experience in the construction field.

CQC Manager. The CQC Manager will have a working knowledge of landfill/civil/earthwork, construction, engineering and materials testing. The CQC Manager will have demonstrated experience with earthmoving and placement projects, geosynthetics installation, concrete construction, and construction of stormwater management facilities. The CQC Manager will have a minimum of 5 years experience in construction and materials testing.

Field CQC Inspectors. Field CQC Inspectors will have experience and/or training in both the testing and inspection of storm sewer, earthwork, granular materials, landfill liner/cover materials, concrete, and other site improvements. The inspectors that perform soil testing will have a minimum of 1 year experience performing the required tests, including familiarity with the use and application of sand cone, scales, ovens, Shelby-tube sampling, nuclear density gauges, levels and tripods, and will be certified for operation of a nuclear density gauge.

Geotechnical CQC Laboratory. The Geotechnical CQC Laboratory will be an independent laboratory subject to the approval of the CQA Manager. The G-CQC Laboratory will have a minimum of 3 years experienced in testing soils and concrete, and will be familiar with ASTM, AASHTO and other applicable test standards.

Geosynthetics Materials CQC Laboratory. The Geosynthetics Materials CQC Laboratory will have experience in testing geosynthetics and other liner system components, and will be familiar with ASTM, NSF, and other applicable test standards. The Geosynthetic Materials CQC Laboratory must be accredited by the Geosynthetics Accreditation Institute-Laboratory Accreditation Program (GAI-LAP) for each of the tests required to be performed. The Geosynthetics Materials CQC Laboratory will be capable of providing polyethylene geomembrane seam test results within 24 hours of receipt of sample and will maintain that standard throughout the construction project duration.

Geosynthetics Materials Installer. The Geosynthetics Materials Installer will be trained and qualified to install geosynthetic system components. The geosynthetic manufacturer/fabricator will have experience in manufacturing or fabricating at least 10,000,000 square feet of geosynthetic materials. In addition, the Geosynthetics Materials Installer will have experience in installing at least 10,000,000 square feet of geosynthetic materials. The installer of the geomembrane will be approved and/or licensed by the manufacturer or the fabricator of the geomembrane material. A copy of the approval letter or license will be submitted by the geomembrane installer to the CQA Manager. Prior to implementation of field activities, the Geosynthetic Materials Installer will provide the CQA Manager with the following written information:

- equipment and personnel to be utilized;
- daily anticipated installation rate;
- quality control manual for installation; and,
- samples of seams and certified test results.

The personnel to perform the seaming operations under the supervision of the Geosynthetic Materials Inspector will be qualified by experience. The field crew foreman must have documented experience of successfully installing at least 5,000,000 square feet of landfill or comparable geosynthetic systems on a total of at least ten different projects. He/she will also have experience seaming geomembranes using the same method of seaming that will be used for this specific project. The field crew foreman will provide direct supervision over less experienced seamers; no field seaming will be performed without the foreman being present.

Land Surveyor. The Land Surveyor will have at least 5 years experience as a crew chief in performing topographic surveys, and must be a professional land surveyor registered in the State of Maryland.

4.0 QUALITY ASSURANCE AND QUALITY CONTROL TESTING

Quality assurance and quality control (QA/QC) testing will be conducted for each of the major items of construction. The components of the landfill subject to the testing include:

- hydraulic barrier - geomembrane;
- synthetic drainage medium - geocomposite;
- natural drainage medium – sand/gravel;
- geotextile;
- topsoil;
- general earthwork - prepared subbase, structural fill, and protective cover;
- granular material; and,
- piping.

Each component is discussed separately below.

4.1 HYDRAULIC BARRIER - GEOMEMBRANE

4.1.1 Pre-Construction

- A minimum of two weeks prior to the anticipated placement of geomembrane material, the Contractor must submit the following information to the CQA Manager:
    - Geomembrane panel diagram;
    - The origin and production date of the resin;
    - A copy of the quality control certificates issued by the resin supplier; and,
    - Reports of tests conducted by the manufacturer to verify that the quality of the geomembrane is in conformance with all requirements or values identified and used in the calculations of the Technical Specifications. If the values cannot be met at the time of construction, new calculations shall be performed to verify the material properties are acceptable. These calculations, if required, will be provided to MDE for their records.

- Resumes and qualifications of the geomembrane superintendent, foreman, and field crew.
- Geosynthetics Laboratory qualifications.

▪ A minimum of one week prior to the anticipated shipment of materials, the Contractor must submit the following information to the CQA Manager:

  - Roll numbers and identification numbers;
  - Quality control certificates that provide reference to the roll numbers, identification numbers, sampling procedures, test methods and test results, which must include those tests listed in the following table unless the industry standards have changed:

Test	**Procedure**
Asperity Height	--
Melt Flow Index	ASTM D-1238
Density	ASTM D-l 505
Thickness	ASTM D-5199 or D-5994
Carbon Black Content	ASTM D-1603
Carbon Black Dispersion	ASTM D-5596
Tensile Properties	ASTM D-63 8
Puncture Resistance	FTMS 101, Method 2065 or ASTM D-4833, ASTM D-5514
Tear Resistance	ASTM D-1004, Die C
Dimensional Stability	ASTM D-1204
Direct Shear	ASTMD-5321

  - Unless otherwise specified, the quality control tests must be conducted at the frequency of one per lot or a minimum of one per each 100,000 square feet, whichever is more frequent. One lot is defined as a group of consecutively numbered rolls or panels from the same manufacturing lines. The frequency of testing and test methods will be evaluated at the time of construction. A change in test method or frequency will be in accordance with Industry Standards and as approved by the Engineer;

- Immersion testing results on the actual geomembrane shall be conducted for this project. One immersion test shall be performed for each type of material and from each source of the material. The testing of the geomembrane shall be in accordance with ASTM standard D5322-98 (D5322-98 Standard Practice for Immersion Procedures for Evaluating the Chemical Resistance of Geosynthetics to Liquids). After the immersion testing is complete, contractor shall test the sample source from the immersion test to confirm that it meets the ASTM standards for the tensile properties, puncture resistance, tear resistance, and chemical resistance.

- Non-destructive seam testing results on all fabricated seams. The testing must have been conducted over the full length of the seam using a test method acceptable to the CQA Manager; and,

- Destructive seam testing results on all fabricated seams. A minimum of one sample must be tested per 500 lineal feet of seam.

- Asperity height of textured geomembrane.

▪ Upon delivery to the site, the Geosynthetic Materials Installer and the Geosynthetic Materials CQC Manager must inspect the physical condition of each roll of material. If the protective wrapping is damaged, or if damage to the roll is suspected by the GM-CQC Manager, the roll will be separated from the lot for more detailed inspection.

▪ The GM-CQC Manager will inspect the storage of the geomembrane rolls on a daily basis. The GM-CQC Manager will inspect the storage of the geomembrane periodically and prior to deployment.

4.1.2 Construction

▪ Both the GM-CQA Manager and the Geosynthetic Materials Installer must certify in writing that the surface upon which the geomembrane is to be installed is acceptable. The statement must be submitted to the CQA Manager prior to initiating the placement of any geomembrane material.

▪ The anchor trench must be inspected and approved by the CQA Manager prior to the placement of geomembrane.

▪ The GM-CQA Manager must be provided conformance samples at the frequency of one sample per lot or a minimum of one sample per 100,000 square feet. The GM-CQA Manager will forward the samples to the GM CQA Laboratory. The GM-CQA Laboratory will conduct analyses of all geomembrane samples for density, carbon black content, carbon black dispersion, thickness, tensile strength, and asperity height.

- The GM-CQC and GM-CQA Managers will visually inspect all panels after they have been unrolled and placed into the proper position for seaming. The GM-CQC Manager and the GM-CQA manager will verify the labeling of all panels and the correct location of all seams in accordance with the approved panel layout plan previously submitted.
- Trial seams shall be made on fragment pieces of geomembrane to verify that seaming conditions are adequate. Such trial seams will be made at the beginning of each seaming period, and at least once each four hours, for each seaming apparatus used that day. Trial seam testing will include peel and shear tests.
- The Geosynthetic Materials Installer must non-destructively test all field seams and repairs using a vacuum test unit, air pressure test, or other method approved by the CQA Manager.
- A minimum of one CQC destructive test sample must be obtained and tested by the Geosynthetic Materials Installer every 500 feet of seam length. The sampling and testing must be conducted in accordance with the following procedures:
    - Samples must be cut by the Geosynthetic Materials Installer as the seaming progresses so that the results from the Geosynthetic CQC Laboratory may be available prior to the placement of any materials on top of the geomembrane.
    - The GM-CQA Manager will select the location of each sample, observe the cutting, assign a number to each sample, and mark the sample and location accordingly.
    - The samples must be a minimum of 12 inches wide by 44 inches long with the seam centered lengthwise. Two 1 -inch strips will be cut from each end of the sample to be tested in the field. The remaining sample will be cut into three parts as follows: one portion 12 inches by 12 inches provided to the CQA Manager for random testing; one portion 12 inches by 12 inches provided to the CQA Manager for archive storage; the remainder of the sample, a minimum of 12 inches by 18 inches submitted to the GM-CQC Laboratory for testing.
    - The geomembrane seams must be tested by the GM-CQC Laboratory for seam strength and peel adhesion.

- The two 12-inch by 12-inch strips will be tested in the field by the GM-CQA Manager, in the presence of the GM-CQC, by hand or tensiometer capable of providing measurable results for peel and shear, respectively, and must not fail in the seam.

▪ The following procedures apply whenever a sample fails a destructive test, whether the test was conducted by the GM-CQA Laboratory, the Geosynthetic Materials Installer's Laboratory, or by a field tensiometer. The Geosynthetic Materials Installer has the following two options for repairs:

  - The Geosynthetic Materials Installer may reconstruct the seam between any two locations where destructive seam tests passed; or,

  - The Geosynthetic Materials Installer may trace the seaming path to an intermediate location at least 10 feet from the point of the failed test (in each direction) and take samples for additional field tests at each location. If the additional samples pass tensiometer testing, then full destructive laboratory samples must be obtained. If the destructive testing conducted by the Geosynthetic Materials Installer pass the tests, then the seam may be re-constructed between the sample locations by capping. If either sample fails, then the process must be repeated to establish the zone in which the seam is to be re-constructed.

  - In situations where the length of re-constructed seam exceeds 150 feet, a sample must be taken from within the re-constructed zone. The sample must be tested by the GM-CQC Laboratory. This procedure is to be repeated in the event the sample fails the testing by the GM-CQC Laboratory.

▪ The GM-CQA and GM-CQC Managers will document all actions taken in conjunction with destructive testing.

4.1.3 Post-Construction

▪ The Geosynthetic Materials Installer must submit a full CQC monitoring report of all non-destructive and destructive testing conducted. The Geosynthetic Materials Installer must submit complete records on all repairs, seaming, and panel placement.

▪ The Geosynthetic CQC Manager will prepare record drawings indicating the location of all field panels, seams, sample locations, patches and repairs. The CQA Manager will verify that the Record Drawings are correct. The CQC-Surveyor must certify the Record Drawings.

4.2 SYNTHETIC DRAINAGE MEDIUM - GEOCOMPOSITE

4.2.1 Pre-Construction

- A minimum of two weeks prior to the anticipated placement of geocomposite material, the Contractor must submit the following information to the CQA Manager:
  - Origin and production date of the resin;
  - A copy of the quality control certificates issued by the resin supplier;
  - Reports of tests conducted by the manufacturer to verify that the quality of the geocomposite is in conformance with all requirements identified in the Technical specifications; and
  - Certification that no reclaimed polymer is added to the resin.
- Prior to shipment of materials, the Contractor must submit the following information to the CQA Manager:
  - Roll numbers and identification numbers; and,
  - Quality control certificates that provide reference to the roll numbers, identification numbers, sampling procedures, test methods and test results, which must include the following:
- The CQA Manager will compare the property value of the geocomposite with the properties used in the design calculations to ensure the properties are acceptable. If the values listed in the table cannot be met due to a change in Industry Standards, then the design calculations will be revised to include the available properties. The revised calculations will ensure that the new material properties are acceptable for use in construction. All revised calculations shall be submitted to MDE for approval.

Component	**Test**	**Procedure**
Geotextile	Flow Rate	ASTMD-4491
	Hydraulic Conductivity/ Permittivity	ASTM D-4491
	Fabric Weight	ASTM D-3776
	Trapezoidal Tear Strength	ASTM D-4533
	Grab Elongation	ASTM D-4632
	Apparent Opening Size	ASTM D-4751

Component	Test	Procedure
Geonet	Puncture Strength	ASTM D-4833
	Specific Gravity	ASTM D-l 505
	Carbon Black Content	ASTM D-l 603
Geocomposite	Nominal Thickness	ASTM D-5199
	Peel Strength	ASTMD-413
	Transmissivity Under Load	ASTM D-4716

- Unless otherwise specified, the quality control tests must be conducted at the frequency of one per lot or one per each 100,000 square feet, whichever is more frequent. The frequency of testing, test methods, and results will be evaluated against Industry Standards at the time of construction. A change in test method or frequency must be approved by the ENGINEER.
- Upon delivery to the site, the Geosynthetic Materials Installer, the Geosynthetic CQA Manager, and the Geosynthetic CQC Manager shall inspect the physical condition of each roll of material. If the protective wrapping is damaged, or if damage to the roll is suspected by the Geosynthetic CQA or Geosynthetic CQC Managers, the roll will be separated from the lot for more detailed inspection.

4.2.2 Construction

- The Geosynthetic CQA Manager or Geosynthetic CQA Inspector will inspect the placement of the geocomposite to verify the following:
    - Geocomposite panels are rolled down the slope in such a manner as to continually keep the geocomposite panel in tension;
    - No damage occurs to underlying layers during geocomposite placement; and,
    - No dust, dirt, or foreign materials are entrapped in the geocomposite. If dust, dirt, or foreign materials are entrapped in the geocomposite, it should be cleaned prior to placement of the next material on top of it.
- The Geosynthetic CQA Manager or Geosynthetic CQA Inspector will visually inspect all rolls after they have been unrolled and placed into the proper position for joining adjacent rolls. The inspection will note the minimum overlap of adjacent panels, the presence of any wrinkles, and general physical condition.

- Conformance samples will be obtained by the Geosynthetic CQA Manager at the frequency of one sample per lot or a minimum one sample per 100,000 square feet. The Geosynthetic CQA Manager will forward the samples to the Geosynthetic CQA Laboratory. The Geosynthetic CQA Laboratory will conduct analyses of all geocomposite samples for flow rate, hydraulic conductivity, fabric weight, trapezoidal tear strength, grab elongation, apparent opening size, puncture strength, specific gravity, carbon black content, thickness, transmissivity under load, and peel strength.

4.2.3 Post-Construction

- The Geosynthetic CQA and CQC Managers will conduct one additional inspection of the finished work effort prior to the placement of any materials on top of the geocomposite. The inspection will include verification of all required ties between panels, physical condition; any accumulated dust or dirt discovered must be removed. All repairs will be completed by the Contractor at the Contractor's expense.

4.3 NATURAL DRAINAGE MEDIUM – SAND/GRAVEL

4.3.1 Pre-Construction

- The Contractor must submit the location of all borrow sources and the available quantity of soil from each source to the CQA Manager no less than two weeks prior to the anticipated placement of any drainage medium materials.
- The Contractor must submit a 50-pound sample from each of the sources proposed to furnish the required quantity of drainage medium materials. The samples must be submitted to the CQA Manager no less than two weeks prior to the anticipated placement of any soil materials.
- The Contractor shall submit with each sample the sample location, a sketch of the sample location, depth of the sample, a description of the soil, the sampling methodology, and estimated available quantity of soil.
- The Contractor must submit the results of the moisture content, soil classification, particle-size analyses, and hydraulic conductivity tests with moisture content and density tests conducted in accordance with ASTM D-2216, ASTM D-2487, ASTM D-422, ASTM D-2434, and ASTM D-698, respectively, and the Technical Specifications. The test results must verify that the drainage medium material meets the requirements of the Technical Specifications. The test results must be submitted to the CQA Manager no less than one week prior to the anticipated placement of any drainage medium materials.

- The CQA Manager, or his/her designee, will inspect each borrow source identified for visual observation and obtain one sample for independent analysis for particle-size distribution and hydraulic conductivity.

4.3.2 Construction

- The Contractor will obtain a sample for each 2,500 cubic yards of material imported to the site, or more frequently if any change in the size, consistency or texture of the material is noted. The samples must be tested in accordance with ASTM D-2216, ASTM D-2487, ASTM D-422, ASTM D-2434, and ASTM D-698 by the Geotechnical CQC Laboratory prior to placement of the material. All testing shall be completed at the Contractor's expense.
- The drainage medium shall be placed to a 24-inch depth for the liner system and a 12–inch depth for the cover system by hand methods, unless otherwise successfully demonstrated on a test area outside the cell that another method can be safely utilized and maintain the integrity of the underlying synthetic(s). Alternative methods to be approved by the CQC and CQA Managers.
- If test results indicate that the in-place material does not meet the required Specifications, the material must be removed, replaced and retested at Contractor expense. The CQA personnel shall determine the extent of the area that will be subject to recompaction and/or removal, replacement, and re-testing. The CQA personnel may require additional CQA or CQC testing at the CONTRACTOR'S expense to define the aerial extent of unacceptable material and/or placement. Both CQA and CQC personnel shall ensure that the equipment used is similar to that used for placement of drainage material. Equipment shall be recorded on daily logs.
- The final grade of the drainage medium material must be smooth and even, and measured to within two-tenths of one foot across any 10-foot section. The final grade must also be measured to within one-tenth of one foot on a 100-foot grid. All thicknesses and "As-Built" Drawings are required to be certified by the CQC- Surveyor.

4.3.3 Post-Construction

- No testing required

4.4 GEOTEXTILE

4.4.1 Pre-Construction

- A minimum of two weeks prior to the anticipated placement of any geotextile material, the Contractor must submit the name and manufacturer, and the specific product of the manufacturer, certificate of compliance, and methods for sewing adjacent panels of geotextile.
- A minimum of two weeks prior to the anticipated placement of any geotextile filter material, the Contractor must submit manufacturer's quality control data test results for flow rate (ASTM D-4491); permeability (ASTM D 4491); trapezoidal tear strength (ASTM D-4533); grab elongation (ASTM D-4632); fabric weight (ASTM D-3776); puncture strength (ASTM D-4833) and apparent opening size (ASTM D-4751) for all proposed geotextile fabrics. Unless otherwise specified, the quality control tests must be conducted at the frequency of one per lot, or a minimum of one per each 50,000 square feet, whichever is more frequent.

4.4.2 Construction

- The CQA Manager will inspect each roll of geotextile material delivered to the site. The CQA Manager will inspect the rolls to verify that the protective wrapping is intact and that no visible damage is noted.
- The CQA Manager will be responsible for verification that the geotextile material is stored out of direct sunlight and is protected from precipitation and physical damage.
- The CQA Manager will inspect the placement of the geotextile and verify that no foreign materials are trapped within the fabric, and that proper installation techniques are utilized.

4.4.3 Post-Construction

- No testing required.

4.5 VEGETATIVE COVER

4.5.1 Pre-Construction

- The Contractor must submit the locations of all borrow sources to the CQA Manager no less than two weeks prior to the anticipated placement of any topsoil materials.

- The Contractor must submit a 50-pound sample from each of the borrow pits proposed to furnish the required quantity of drainage layer materials. The samples must be submitted to the CQA Manager no less than two weeks prior to the anticipated placement of any topsoil materials.
- The Contractor must submit the results of the following test performed once every 2,000 cubic yards or change in material: particle-size analysis (ASTM D-422), organic content analyses (USDA Circular #757), soluble salts (ASTM D-4542), and pH test (ASTM D-4972). The test results must verify that the vegetative cover material meets the Technical Specifications. The test results must be submitted to the CQA Manager no less than one week prior to the anticipated placement of any topsoil materials.
- The CQA Manager, or his/her designee, will inspect each borrow pit identified for visual observation and obtain one sample for independent analysis for particle-size and organic content.

4.5.2 Construction

- The CQC Manager will obtain a sample of vegetative cover material if he/she notes any change in the color, consistency or texture of the material. The samples will be tested for particle-size distribution, organic content, soluble salts, and pH by the Geotechnical CQC Laboratory, utilizing the test methods previously identified.
- If test results indicate that the in-place material does not meet the required Specifications, the material must be removed, replaced and retested at Contractor expense.
- The final grade of the vegetative cover material must be smooth and even, and measure within two-tenths of one foot across any 100-foot section. The final grade must also be measured to within one-tenth of one foot on a 100-foot grid. All thicknesses and "As-Built" Drawings are required to be certified by the CQC-Surveyor.

4.5.3 Post-Construction

- No testing required.

4.6 GENERAL EARTH WORK – PREPARED SUBBASE

4.6.1 Pre-Construction

- The Contractor must submit the locations of all borrow sources to the CQA Manager no less than two weeks prior to the anticipated placement of any soil materials.

- The Contractor must submit a 50-pound sample from each of the borrow sources proposed to furnish the required quantity of soil materials. The samples must be submitted to the CQA Manager no less than two weeks prior to the anticipated placement of any soil material.
- The Contractor shall submit with each sample the sample location, a sketch of the sample location, depth of the sample, a description of the soil, the sampling methodology, and estimated available quantity of soil.
- The Contractor must submit the results of the following tests performed: moisture content and density relationship (ASTM D-698), particle-size analyses (ASTM D-422), Atterberg Limits (ASTM D-4318), soil classification (ASTM D-2487), moisture content (ASTM D-2216), and hydraulic conductivity (ASTM D-5084) performed once every 5,000 cubic yards or a minimum of one set of results. The test results must verify that the soils meet the Technical Specifications, including a laboratory permeability less than or equal to $1x10^{-5}$ cm/sec. The test results must be submitted to the CQA Manager no less than one week prior to the anticipated placement of any subbase materials.
- The CQA Manager or his/her designee will inspect each borrow source identified for visual observation and obtain one sample for independent analysis for particle-size distribution and hydraulic conductivity.
- A summary report will be prepared by the CQA Manager and will include: a summary of laboratory test data, drawings depicting sample and test locations, a summary of sampling methods, and a brief letter certifying that the volume of soil meets or exceeds the regulatory and construction criteria.

4.6.2 Construction

- The Contractor must test the in-place density and moisture content of all subbase material in accordance with ASTM D-2922 and the Technical Specifications. Nine tests must be conducted per acre per lift. The subbase will be compacted to 95% of the maximum Standard Proctor Density (ASTM D-698); every 25th nuclear density test and moisture test must be verified in accordance with ASTM D-1556 and ASTM D-2216, respectively.
- The CQA Manager must obtain one, 50-pound sample for each 10,000 cubic yards of subbase material imported to the site, or if he/she notes any change in the color, consistency or texture of the material. The sample will be tested in accordance with ASTM D-422.
- The soils must be placed using loose lifts, 8 inches in thickness or less, to achieve uniform compaction at a maximum thickness of 6 inches. The maximum clod size must not exceed the lift thickness.

- If test results indicate that the in-place subbase material does not meet the required Specifications, the material must be removed, replaced and retested at Contractor expense.
- The final grade of all soils must be smooth and even, and measure a minimum of two feet from the original elevation. All thicknesses and "As-Built" Drawings are required to be certified by the CQC-Surveyor.

4.6.3 Post-Construction

- The in-place subbase material must be protected from rain, drying, desiccation, and erosion.
- Any and all defective areas, as defined by the CQA Manager, must be removed, repaired, and re-tested at Contractor expense in accordance with the CQA/QC Plan.
- The subbase material will be inspected for cracks, holes, defects or on other features that may be detrimental to the structural performance, as determined by the CQA Manager. Approval will be made by CQA Manager.
- Upon completion of construction, a certification report will be submitted before construction activities commence for the geomembrane barrier layer system.

4.7 GENERAL EARTH WORK - STRUCTURAL FILL

4.7.1 Pre-Construction

- The Contractor must submit the locations of all borrow sources to the CQA Manager no less than two weeks prior to the anticipated placement of any soil materials.
- The Contractor must submit a 50-pound sample from each of the borrow sources proposed to furnish the required quantity of soil materials. The samples must be submitted to the CQA Manager no less than two weeks prior to the anticipated placement of any soil material.
- The Contractor shall submit with each sample the sample location, a sketch of the sample location, depth of the sample, a description of the soil, the sampling methodology, and estimated available quantity of soil.
- The Contractor must submit the results of the following tests performed: particle-size analyses (ASTM D-422), moisture content and density relationship (ASTM D-698), Atterberg Limits (ASTM D-4318), soil classification (ASTM D-2487), moisture content (ASTM D-2216), and hydraulic conductivity (ASTM D-5084) performed once every 5,000 cubic

yards or a minimum of one set of results. The test results must verify that the soils meet the Technical Specifications, including a laboratory permeability less than or equal to $1x10^{-5}$ cm/sec. The test results must be submitted to the CQA Manager no less than one week prior to the anticipated placement of any soil materials.

- The CQA Manager or his/her designee will inspect each borrow source identified for visual observation and obtain one sample for independent analysis for particle-size distribution and hydraulic conductivity.
- A summary report will be prepared by the CQA Manager and will include: a summary of laboratory test data, drawings depicting sample and test locations, a summary of sampling methods, and a brief letter certifying that the volume of soil meets or exceeds the regulatory and construction criteria.

4.7.2 *Construction*

- The Contractor must test the in-place density and moisture content of all structural fill material in accordance with ASTM D-2922 and the Technical Specifications. Nine tests must be conducted per acre per lift. The structural fill will be compacted to 90% of the maximum Standard Proctor Density (ASTM D-698); every 9th nuclear density test and moisture test must be verified in accordance with ASTM D-1556 and ASTM D-2216, respectively.
- The CQA Manager must obtain one, 50-pound sample for each 10,000 cubic yards of structural fill material imported to the site, or if he/she notes any change in the color, consistency or texture of the material. The sample will be tested in accordance with ASTM D-422.
- The soils must be placed using loose lifts, 12 inches in thickness or less, to achieve uniform compaction at a maximum thickness of 9 inches. The maximum clod size must not exceed the lift thickness.
- If test results indicate that the in-place structural fill material does not meet the required Specifications, the material must be removed, replaced and retested at Contractor expense.
- The final grade of all soils must be smooth and even, and measure a minimum of one foot from the original elevation. All thicknesses and "As-Built" Drawings are required to be certified by the CQC-Surveyor.

4.7.3 *Post-Construction*

- The in-place structural material must be protected from rain, drying, desiccation, and erosion.

- Any and all defective areas, as defined by the CQA Manager, must be removed, repaired, and re-tested at Contractor expense in accordance with the CQA/QC Plan.
- The structural fill material will be inspected for cracks, holes, defects or on other features that may be detrimental to the structural performance, as determined by the CQA Manager. Approval will be made by CQA Manager. Upon completion of construction, a certification report will be submitted before construction activities commence for any overlying soil/geosynthetic systems or structures.

4.8 GENERAL EARTHWORK - PROTECTIVE COVER

4.8.1 General

- Protective cover over the liner system will consist of select-screened rubble waste; protective cover over the cover system will consist of soil. Select-screened rubble waste will be placed by the OPERATOR, and is not addressed herein. The remainder of this section applies to protective cover soil in the cover system.

4.8.2 Pre-Construction

- The Contractor must submit the locations of all borrow sources to the CQA Manager no less than two weeks prior to the anticipated placement of any soil materials.
- The Contractor must submit a 50-pound sample from each of the borrow pits proposed to furnish the required quantity of general fill materials. The samples must be submitted to the CQA Manager no less than two weeks prior to the anticipated placement of any soil materials.
- The Contractor shall submit with each sample the sample location, a sketch of the sample location, depth of the sample, a description of the soil, the sampling methodology, and estimated available quantity of soil.
- The Contractor must submit the results of the following test; particle-size analysis (ASTM D-422), moisture content (ASTM D-2216), Atterberg Limits (ASTM D-4318), and Soil Classification (ASTM D-2487). The test results must verify that the soil meets the Technical Specifications. The test results must be submitted to the CQA Manager no less than one week prior to the anticipated placement of any protective cover soil furnished from off-site.
- The CQA Manager, or his/her designee, will inspect each borrow source identified for visual observation and obtain one sample for independent analyses for particle-size distribution analysis.

4.8.3 *Construction*

- The Contractor must obtain a sample for each 5,000 cubic yards of protective cover soil imported to the site, or if any change in the color, consistency or texture of the material is noted. The sample will be tested in accordance with ASTM D-422, ASTM D-2216, ASTM D-2487, and ASTM D-4318, by the Geotechnical CQC Laboratory.
- If test results indicate that the in-place material does not meet the required specifications, the material must be removed, replaced and retested at Contractor expense.
- The final grade of all protective cover material must be smooth and even, and measure to within two-tenths of one foot across any 10-foot section. The final grade must also measure to within one-tenth of one foot on a 100-foot grid. All thicknesses and "As-Built" Drawings are required to be certified by the CQC-Surveyor.

4.8.4 *Post-Construction*

- The in-place material must be protected from rain, drying, desiccation, and erosion.
- Any and all defective areas, as defined by the CQA Manager, must be removed, repaired, and re-tested at Contractor expense in accordance with the CQA/QC Plan.
- Prior to the placement of any covering material, the fill material will be inspected and approved by the CQA and CQC Managers. The fill material will be inspected for cracks, holes, defects or on other features that may be detrimental to the structural performance, as determined by the CQA Manager.

4.9 *GRANULAR MATERIALS*

4.9.1 *Pre-Construction*

- The Contractor must submit the location of all borrow sources to the CQA Manager no less than two weeks prior to the anticipated placement of any granular materials.
- The Contractor must submit a 50-pound sample from each of the borrow sources proposed to furnish the required quantity of gravel, excluding riprap. The samples must be submitted to the CQA Manager no less than two weeks prior to the anticipated placement of any granular materials.

- The Contractor shall submit with each sample the sample location, a sketch of the sample location, depth of the sample, a description of the soil, the sampling methodology, and estimated available quantity of soil.
- The Contractor must submit the results of the particle-size analyses (ASTM C-136) conducted for the granular materials used for the perimeter outlet. The test results must be submitted to the CQA Manager no less than one week prior to the anticipated placement of any granular materials.
- The CQA Manager will visually inspect the specified riprap to verify that the riprap meets the sizing requirements.
- The Contractor must provide riprap gradation information in accordance with the Technical Specifications. The gradation information must be submitted no less than two weeks prior to the delivery of riprap.
- The CQA Manager, or his/her designee, will inspect each borrow source identified for visual observation and obtain one sample for independent analysis of particle-size distribution analysis.
- The CQA Manager will be required to assure proper installation, proper operation of equipment, and maintenance of the minimum required twelve (12) inches of granular material over the geosynthetics.

4.9.2 Construction

- The CQA and CQC Managers will verify that underlying geotextiles are free of tears, holes, wrinkles, and foreign objects, and are securely anchored and that finished grades, slopes and elevations conform to specified requirements.
- If test results indicate that the in-place material does not meet the Technical Specifications, the material must be removed, replaced and retested at Contractor expense.
- The final grade of the granular material, excluding riprap, must be measured to within two-tenths of one foot below to five tenths of one foot above (-0.2 to +0.5) the grades and contours indicated on the Drawings. All thicknesses and "As-Built" Drawings are required to be certified by the CQC-Surveyor.

4.9.3 Post-Construction

- The CQA Manager will perform thickness measurements in the field to check compliance with the Specifications. All thicknesses are required to be certified by the Contractor's licensed surveyor.

4.10 PIPING

4.10.1 Pre-Construction

- A minimum of two weeks prior to the anticipated placement of any piping, the Contractor must submit the name and the manufacturer, and the specific product of the manufacturer, jointing methods to be utilized, and all certificates of compliance.
- A minimum of two weeks prior to the anticipated placement of any piping, the Contractor must submit manufacturer's quality control data test results for compliance with the Technical Specifications.

4.10.2 Construction

- The CQA Manager will visually inspect each shipment of pipe delivered to the site for physical damage and compliance with previous Contractor submittals.
- The CQA Manager will verify that the pipe is stored at the site in such a manner as to prevent physical damage to the pipe.
- The CQA Manager will retain a minimum 1 -foot long specimen of each solid and perforated pipe of each pipe size.
- The CQA and CQC Managers will verify that the subgrade to receive the piping is to the correct lines and grades, and is acceptable for the placement of the pipe. The CQA Manager will verify that the proper jointing techniques are employed by the Contractor. The butt weld of the drainage pipe will be observed by the CQA Manager or his/her representative for any holes or bums in the weld that may potentially damage the geomembrane.
- The CQA Manager will verify the results of all field-testing by the Contractor.
- The leachate collection pipe network shall be inspected after the placement of the initial lift of waste to ensure that crushing has not occurred.

4.10.3 Post-Construction

- No testing required.

5.0 CONSTRUCTION CERTIFICATION REPORT

The Construction Certification Report will be prepared by a Professional Engineer, registered by the State of Maryland and submitted to the MDE in conformance with the requirements in COMAR 26.04.07: Solid Waste Management Regulations and as listed below. The report will be assembled and submitted within 45 days following complete construction of a particular phase or cell, and will include the following information:

- results of CQA and CQC testing;
- documented deviations from the design;
- record or "As-Built" Drawings, including:
    - plan views with test locations;
    - cross sections; and
    - necessary details
- daily reports;
- site photographs;
- a statement of certification and compliance, signed and stamped by the supervising Professional Engineer registered in the State of Maryland, for construction of the landfill components, including:
    - liner system
    - geomembrane
    - leachate collection/conveyance system
    - cover system
- geomembrane subbase acceptance certifications; and,
- professional land surveyor certification for Barrier Layer placement.

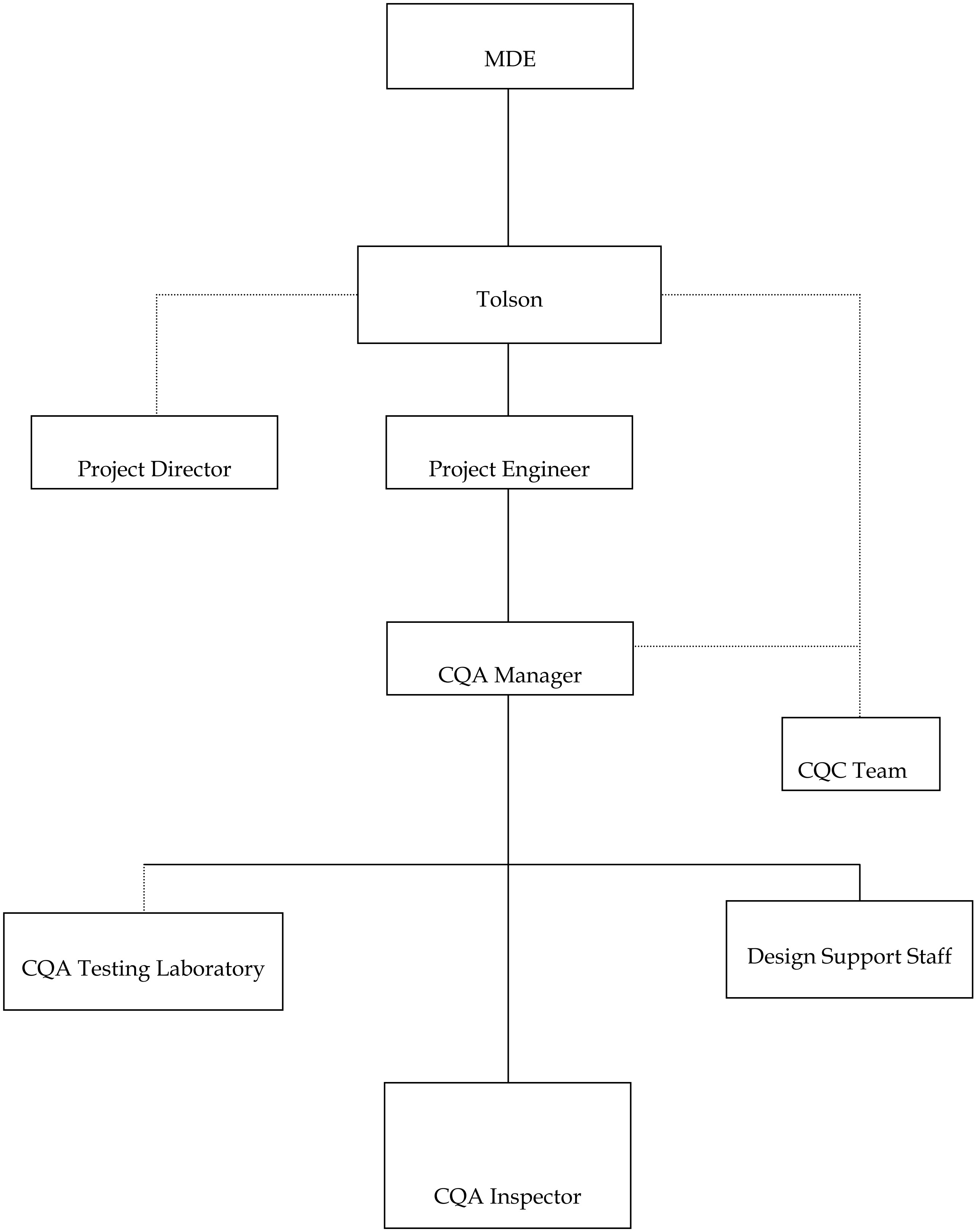
A separate construction certification report will be submitted for each phase of construction and at final closure.

6.0 *CONTINGENCY PLAN*

During construction of a liner system and cover system components, construction difficulties may occur. The following is a list of potential construction difficulties and their contingent solutions:

- Soil materials may be too wet - soil can be disked or harrowed and allowed to dry until the appropriate moisture content is obtained.
- Soil materials may be too dry - moisture can be added with the addition of water and thorough mixing, via disking.
- Geosynthetic may tear or rip during or after installation - any tear or rip in any synthetic material will be repaired immediately. A patch of similar material will be placed over the affected area and seamed to the unaffected areas.
- Erosion of newly placed soil may occur - Eroded areas will be repaired immediately and will be maintained until vegetation is established. Additional soil will be placed and compacted in affected areas. Extra silt fence and haybales will be installed as necessary to retard/redirect flows. Erosion mat, riprap or other controls will also be evaluated on a case-by-case basis.
- Inclement weather may impede the progress of the work - In the event that weather makes work difficult or affects the integrity of the work (i.e., freezing conditions during soils placement), work will be suspended until weather conditions permit.
- Leachate connection/conveyance piping may become blocked - Leachate piping will be inspected and cleaned out as needed during construction. Any structural damage will be repaired immediately.
- Groundwater wells may collapse - In the event that old wells collapse, replacement wells of similar dimensions will be constructed in accordance with MDE regulations.
- Stormwater ditches, ponds, and culverts may clog with sediments - All excess sediment will be removed from ditches and culverts as necessary for proper operation.
- Cover system soils may settle - Any significant settlement will be repaired immediately by the addition of fill material.

FIGURE 1. PROJECT ORGANIZATION CHART



Appendix N: Contingency Plan

Prepared for:
TOLSON AND ASSOCIATES, LLC
24024 Frederick Road
Clarksburg, Maryland 20871

EMERGENCY CONTINGENCY PLAN

APPENDIX N
PROPOSED VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL: PHASE III REPORT

Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Prepared by
Geosyntec consultants

10211Wincopin Circle, 4th Floor
Columbia, Maryland 21044

Project Number: ME1606

July 2020

TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

TABLES

1. INTRODUCTION

1.1 Terms of Reference

This Emergency Contingency Plan describes the safety and emergency response procedures that are to be followed during the expansion of the Tolson & Associates Rubble Landfill (TRL) located in Crofton, Anne Arundel County, Maryland. This Emergency Contingency Plan has been prepared in accordance with the requirements of COMAR 26.04.07.08. At a minimum, the contingency plan is required to address the following items:

- Emergency provisions for users of potable water supply
- A spill containment and prevention plan for any leachate collected or stored at the site; and
- Emergency telephone numbers and contact persons for fires and medical emergencies, and leachate spills.

These items are addressed in the following subsections. This report was prepared by Ms. Simone Smith, P.E. and reviewed by Ms. Carrie Pendleton, P.E., both of Geosyntec's Maryland Office, in accordance with the company's internal review policy.

1.2 Site and Project Description

Tolson and Associates, LLC (Tolson) plans to expand the existing TRL vertically within the existing property waste footprint at the TRL and current Cunningham Sand and Gravel operation in Crofton, Anne Arundel County, Maryland. The facility will be expanded vertically from approximately 210 feet above mean sea level (ft-msl) to reach a maximum elevation of 244 ft msl (with top of waste at 240 ft-msl). The vertical expansion also sees a lowering of base grades, and the addition of a herringbone cap to optimize airspace. The landfill will be reconfigured and seven new cells will be constructed.

Development and operation of the proposed landfill unit as planned will include the following activities:

- Construction of a liner and leachate collection system (LCS) for each of the five proposed cells at TRL.
- Construction of a leachate transmission system (LTS) to transport leachate collected in the leachate collection sump of the LCS to the leachate storage tanks.
- Excavation of current waste from Cell A into the newly constructed cell.

- Consumption of TRL disposal capacity through filling with construction and demolition waste collected from businesses and residents of Anne Arundel County and adjacent areas;
- Installation of vertical landfill gas wells, laterals and header and connection to existing landfill gas flare; and
- Construction of a cap and stormwater management system to close the seven-cell TRL after capacity is depleted and all cells have reached permitted final grade.

1.3 Purpose

The purpose of the Emergency Contingency Plan is to serve as an effective action plan to prevent, minimize, and abate hazards to human health, safety, and the environment from fires, explosions, or releases of toxic, hazardous, or other polluting materials to the air, soil, surface water, or groundwater during construction and operation of the TRL.

1.4 Organizational Format

This Emergency Contingency Plan for the TRL addresses each of the requirements of COMAR 26.04.07.08. The organization of this document is as follows:

- in Section 2, the designated emergency coordinators for the facility are presented and their responsibilities and limits of authority are outlined;
- in Section 3, a list of all emergency equipment and communications systems that will be present at the facility is provided;
- in Section 4, the dissemination procedures for the Emergency Contingency Plan are provided;
- in Section 5, a description of arrangements with local emergency response agencies for coordination and delivery of emergency services to the facility during operations is presented, including the evacuation routes and routes to the nearest hospital;
- in Section 6, emergency response actions to be followed are described;
- in Section 7, the procedures that will be implemented in the event of a spill or leak are presented;
- in Section 8, the Fire Control Plan for the facility is presented; and
- in Section 9, the protocol for making amendments to this plan is provided.

2. DESIGNATED EMERGENCY COORDINATOR

The Emergency Coordinator for the TRL will be responsible for directing all emergency response measures necessary to minimize or prevent harm to human health and the environment in the event of a fire, explosion, potentially hazardous emissions, and/or discharge of unacceptable wastes or materials into the air, soil, surface water, or groundwater.

Both an Emergency Coordinator and Alternative Emergency Coordinator are designated for the TRL as follows:

- The Emergency Coordinator is authorized to carry out and/or direct the procedures outlined herein the Emergency Contingency Plan in the event of an emergency and to commit the resources necessary to carry out the activities described in this Emergency Contingency Plan.

- - The Alternative Emergency Coordinator is authorized to fulfill the responsibilities of the Emergency Coordinator in the event that the Emergency Coordinator is on leave, incapacitated, otherwise unavailable, or when directed to assume responsibility by the Emergency Coordinator.

Details and contact information for the Emergency Coordinator and Alternative Emergency Coordinator are provided in **Table 1**. In the remainder of this document, the single term "Emergency Coordinator" is used to identify both the Emergency Coordinator and Alternative Emergency Coordinator (i.e., the person assuming responsibility to implement this Emergency Contingency Plan in accordance with the above designations).

The Emergency Coordinator will be available during working hours and non-working hours. Communication procedures for responding to emergencies that occur during non-working hours are presented in Section 3.3. The Emergency Coordinator will be trained to be thoroughly familiar with all aspects of this Emergency Contingency Plan, including all operations and activities, the location and characteristics of all materials handled, the location of all records, and the layout of the facility. The Emergency Coordinator will also be required to be familiar with the entire Operation Plan for the facility. The Emergency Coordinator will be responsible for maintaining all first aid equipment including first aid kits, major injury kits, and emergency washes.

3. EMERGENCY EQUIPMENT

3.1 Overview

The emergency equipment at the TRL will include fire extinguishers, spill control equipment and communication systems, and internal and external alarm systems. **Table 2** shows a list of emergency equipment to be stored at the site. The locations of all emergency equipment will be posted at the scale house, office trailer, and landfill working face. The basic procedures for operating and using the safety and emergency equipment will be posted near the respective equipment. All equipment will be maintained in a ready state at all times. Basic first aid procedures will be posted at strategic locations throughout the facility.

3.2 Fire Fighting Equipment

All construction and waste handling equipment will be equipped with a fire extinguisher and will have fire suppressant systems installed on the engine. Additional on-site equipment including a water truck, bulldozer, front-end loader, and other equipment may also be used to fight fires. In addition to on-site emergency fire-fighting equipment, the Anne Arundel County Fire Department will be contacted, if necessary.

3.3 Communication

The internal communications system at the site will consist of two-way radios in all equipment and in the Emergency Coordinator's vehicle. A sufficient number of two-way radios will be maintained on site so that the facility manager and all personnel engaged in key facility operations have access to a radio. The radio equipment will be selected so that it will be fully operational under any weather condition. Voice and hand signals will also be used for internal warning in areas where visibility is not restricted.

Oral communications with persons off site will be accomplished by using telephone(s) located in the site office. Additional telephones such as cellular phones may be used as needed. The persons currently designated to assume the responsibilities of Emergency Coordinator as described in Section 2 are listed in **Table 1** along with contact telephone numbers at which they can be reached during working hours and non-working hours.

The appropriate outside agencies (i.e., Fire Department, Sheriff's Office, etc.) will be contacted by telephone in the event of an emergency. A list of telephone numbers for emergency agencies will be placed near each office telephone.

3.4 First Aid/Safety Equipment

Wall-mounted industrial grade first aid kits will be kept in the on-site office trailer. First aid kits will be available to all personnel.

3.5 Warning System

A warning system will be maintained to provide effective communications during emergency situations. The features of the system are identified below.

- A telephone and two-way radio system will be used to obtain emergency assistance. Voice and hand signals will be used for internal warning in areas when visibility is not restricted.
- Major equipment and Site vehicles will be equipped with two-way radios. The gatehouse will also contain a two-way radio.
- Telephones will be installed in the scalehouse and office trailer.

4. PLAN DISSEMINATION

A copy of this Emergency Contingency Plan will be kept at the on-site office and will be made available to all facility staff responsible for developing, monitoring, and implementing this plan. This Emergency Contingency Plan will also be made available to all of the local emergency response contacts indicated in **Table 3**.

5. EMERGENCY RESPONSE AGENCIES

5.1 Arrangements with Agencies

The persons currently designated to assume the responsibilities of Emergency Coordinator as described in Section 2 are listed in **Table 1** along with contact telephone numbers at which they can be reached during working hours and non-working hours. Emergency response teams from the local Sheriff's Office, Fire Department, Rescue Squad, and/or Hospital will be contacted as deemed necessary by the Emergency Coordinator in the event of an emergency at the facility. In **Table 3**, a list of the telephone numbers of the appropriate Emergency Response Contacts is presented. This list will be kept up to date and posted near all telephones on-site to provide "ready" access to emergency response agencies.

5.2 Evacuation Plan for Personnel

5.2.1 General

In an emergency situation, the Emergency Coordinator is responsible for determining when evacuation of the facility is required. Imminent or actual dangers which may require evacuation include:

- a generalized fire or threat of fire that cannot be avoided;
- an explosion or threat of explosion that cannot be avoided; and
- a major spill or leak that cannot be contained and constitutes a threat to human health.

Personnel who are at the site of the emergency prior to the arrival of the Emergency Coordinator should evacuate the incident site if imminent danger or health threats exist.

The basic evacuation plan consists of moving the personnel to an off-site reassembly point where they are safe from danger. The reassembly point can be the scalehouse or other location decided by the Emergency Coordinator.

The personnel will remain at the prescribed reassembly point until directed to reenter the facility. The Emergency Coordinator is responsible for issuing the reentry order. The secondary reassembly point will be used if the primary point is inaccessible or is in danger from exposure to the emergency incident.

5.2.2 Outdoor Incident

If an emergency occurs outdoors, employees shall move far enough away from the incident to avoid harm. Proceed to the primary reassembly point, then reassemble at the primary reassembly point. Employees should wait at the reassembly point until further instructions are received from the Emergency Coordinator. If reassembly at the primary point is not feasible, then the secondary reassembly point will be used.

5.2.3 Indoor Incident

If an emergency occurs indoors that requires the evacuation of the scalehouse or other building, employees should exit the building by the most accessible exit and then proceed to the primary reassembly point. Employees evacuating the area of concern will proceed to the most accessible site gate, and then reassemble at the primary reassembly point. Employees should wait at the reassembly point until further instructions are received from the Emergency Coordinator. If use of the primary reassembly point is not advisable, then the secondary reassembly point will be used.

5.2.4 Personnel Movement

When notified of an emergency that requires movement of personnel, supervisors should:

1. quickly and quietly notify employees in their respective work areas where to move and by what route;
2. check all working areas, store rooms, conference rooms, and restrooms for personnel;
3. contact each of the employees when arriving at the reassembly point. Ascertain that all employees and visitors are accounted for;
4. relay headcount statistics to Emergency Coordinator; and
5. stay in contact with the Emergency Coordinator to provide assistance as necessary.

The personnel movement plan is implemented when movement of personnel is required from their normal workstation to a place of shelter or out of a building to the predetermined reassembly point. Development of a plan requires identification of places for shelter and places for reassembly after evacuation, and an assignment of individuals to account for all employees and visitors.

Generally, the Emergency Coordinator or appropriate supervisor will give the order to evacuate an area. Employees will be advised during training sessions not to wait for orders from the Emergency Coordinator or supervisor if imminent danger or health threats exist.

The Emergency Coordinator or their designated representative will direct reentry to buildings or other areas. No personnel will reenter the incident area until the site is cleaned and the Emergency Coordinator has approved the site for reentry.

6. EMERGENCY RESPONSE ACTIONS

6.1 Communication with Emergency Response Agency

In the event of a fire, explosion, or any other emergency situation that could threaten public or onsite personnel health, safety, or the environment, site personnel will contact appropriate emergency response personnel. The names and telephone numbers of the Emergency Coordinator and the Emergency Response Contacts for the TRL are included in **Tables 1 and 3**, respectively. At a minimum, the following information will be provided to emergency response personnel:

- name and telephone number of the person reporting the emergency;
- name and address of facility;
- time and type of incident;
- name and quantity of materials involved;
- extent of injuries, if any; and
- possible hazards to human health or safety.

6.2 Accident or Injury

In the event that an accident or injury occurs, the following procedures will be implemented:

- any equipment involved in the accident or injury will be shut down;
- the Emergency Coordinator will be notified;
- the extent of an individual's injuries (i.e., location, seriousness, etc.) will be determined;
- appropriate first aid measures will be implemented (only by qualified, trained personnel);
- if the victim is not breathing, CPR will be administered by personnel so qualified;
- victims will not be moved, unless:
    - victim is in a location potentially dangerous to others, or
    - victim can be moved without risk of causing additional injury;
- per the directive of the Emergency Coordinator, the Anne Arundel County Fire Department and/or Emergency Medical Service (EMS) Coordinator (911) will be contacted and the following information will be provided:
    - location on site where the injury occurred,
    - presence of consciousness, a pulse, and unaided breathing of the victim,
    - description of injuries; and

- o if necessary, the victim will be transported offsite to an appropriate medical treatment facility by qualified medical personnel.

7. EMERGENCY PROVISIONS FOR USERS OF POTABLE WATER SUPPLY

Should MDE determine that contaminants have leaked from the liner system and migrated off site to neighboring residential water supply wells, the TRL will replace the potable water source as quickly as possible and design a plan detailing a long-term solution to the problem. In order for the TRL to be confirmed as the source of contamination, the following must occur:

- MDE and the Tolson must be provided with the results of analytical tests that indicate that the water supply source may have been impacted by the TRL;
- MDE and the Tolson must be given the opportunity to sample the groundwater from the source and analyze the sample; and
- MDE and the Tolson must be given access to all records that are available regarding the water supply source.

If testing by Tolson or the MDE confirms that the TRL has impacted the potable water source, then the TRL will replace the source as soon as possible using a short-term method chosen by the TRL. Short-term replacement methods may include supplying bottled drinking water to affected areas. In the meantime, the TRL will develop a plan describing the manner in which alternative long-term water supplies will be provided to potentially affected areas around the landfill. This plan must:

- Be drafted and submitted to MDE for review within one year of notification by MDE;
- Be revised in accordance with any reasonable requirement of MDE;
- Contain sufficient detail to serve as construction and implementation documents for the proposed water supply;
- Include a schedule of all activities necessary to implement the plan, including all activities to be performed by the TRL to bid, oversee, and implement the plan as well as all activities by contractors; and
- Consider all areas within ½ mile of the property boundary of the landfill and any other groundwater use located downgradient of the landfill. The plan may also contain provisions for expansion of the area of impact should it become necessary to protect public health.

The plan may also include provisions for partial or staggered implementation, based on specific information about the cause and extent of the triggering event. Upon approval by MDE, the water supply contingency plan shall become attached as part of the refuse permit.

Should MDE determine that migration of contaminants from the property on which the landfill is located has occurred or is likely to occur, the TRL shall immediately implement the water supply contingency plan in accordance with the approved schedule.

8. SPILL AND LEAK RESPONSE PROCEDURES

8.1 General

The purpose of this section defines the response procedures to be followed during a spill or leak of a material that could have an adverse effect on human health or the environment. Spills and leaks of certain materials can have an adverse effect on the environment and have a potential for adverse public relations. Control of spills or leaks requires the talents of trained personnel. These persons should attempt to identify the spilled material. Once identified, measures are employed to stop or minimize the spill or leak. The residuals are then cleaned up, packaged, and transported to an approved disposal site. Often regulatory agencies must be notified of the incident. It is important that only trained persons be engaged to control spills or leaks of hazardous material.

The purpose of this plan is to inform employees of necessary actions in the event of a spill or leak of certain materials or substances at the site such as diesel fuel or leachate.

In general, the following procedures will be implemented in any of the following spill or leak situations:

- the spill or leak could result in the release of potentially harmful material, thus creating the potential for contamination or harm of people and/or the environment;
- the spill or leak could result in release of flammable, ignitable, or combustible liquids or vapors, thus causing a fire or gas explosion hazard;
- the spill or leak can be contained on site, but the potential exists for groundwater or other environmental contamination; and
- the spill or leak cannot be contained on site, resulting in off-site soil contamination and/or ground or surface water pollution.

8.2 Potential Sources of Spills or Leaks

Areas at the TRL where spills or leaks may occur include the following:

- fuel oil storage tanks;
- landfill mobile equipment;
- motor oil storage tanks;
- cleaning solvents;
- landfill leachate collection system;
- riser pipe housings;

- leachate forcemain (piping);
- waste oil storage tanks; and
- leachate storage facilities or transport vehicles.

8.3 Spill/Release Response

If a spill or release involving a potentially hazardous substance occurs, site personnel shall take the following actions immediately:

1. Call the Emergency Coordinator.
2. Make an initial survey of the scene, determining:
   - if people are potentially threatened or injured;
   - if the environment is potentially threatened;
   - the volume of material spilled or leaked;
   - the presence of fire, smoke, or fumes;
   - overall condition of the vehicle or container;
   - location of storm sewers, sanitary sewers, or sumps; and
   - location of nearest water body or stream.
3. Rescue the injured, if necessary and possible.
4. The Emergency Coordinator will identify the specific hazardous substance by noting container labels, shipping papers, vehicle placards, or material characteristics.
5. Do not release any substance from containers.
6. The Emergency Coordinator may contact the shipper(s) or manufacturer(s) of the substance for additional information.
7. If necessary, immediate assistance will be requested by:
   - Fire Department 911
   - Police Department 911

The types of materials that could be accidentally spilled or released include the following general categories:

- cleaning chemicals;
- fuel;
- lubricants; and

- leachate.

If any employee observes a spilled or released hazardous material or substance, the employee will immediately call the Emergency Coordinator. The Emergency Coordinator will make an evaluation of the spill or leak to determine appropriate response activities such as:

- building ventilation, using recirculation or outside air;
- notification of Fire Department, Police Department, or other emergency response agencies;
- containment and cleanup procedures to be used; and
- personnel evacuation, if necessary.

The following information will be available for spill reporting purposes:

- Location of spill (i.e., Tolson Rubble Landfill);
- Material spilled (leachate, acid, caustic, etc.);
- Name or identification of caller and telephone number;
- Time of spill;
- Source of spill (i.e., storage tank);
- Estimated volume of release; and,
- Anticipated rate and direction of movement of spill, including any toxic vapors or fumes.

The basic hand equipment available onsite for containment and cleanup is as follows:

- absorbent such as vermiculite, perlite, bentonite, or soil;
- shovels and brooms;
- face shields and goggles;
- large plastic bags;
- crescent wrench, vise grips, and pipe wrench; and
- plastic shoe covers.

Earth moving equipment will also be available for use in containment and cleanup of spills and leaks.

Spills and leaks shall be contained to as small an area as possible using available equipment, tools, and materials. After containment is achieved, the spilled/leaked materials should be cleaned up and properly disposed of at an approved facility at the direction of the Emergency Coordinator.

8.4 Additional Sources of Information

Additional information regarding site operations, including the leachate management system and landfill gas collection and control system, is provided in the Operation Plan included as Appendix D of the Phase III Report. In addition, the approved Stormwater Pollution Prevention Plan for TRL will provide useful information on preventing spilled or leaked materials from contacting surface water. Both documents should be referred to as necessary when responding to spills or releases at the TRL and made available to emergency response personnel.

9. FIRE CONTROL PLAN

9.1 Introduction

In this section of the Emergency Contingency Plan, the Fire Control Plan is presented, in which the procedures to be used to prevent and extinguish fires at the facility are provided. Fire protection measures for the TRL will include maintaining fire extinguishers on site, maintaining a supply of water in the stormwater retention basins, and installing suitable horizontal fire breaks. Personnel at the facility will have access to telephones or radios to contact the local fire department in the case of a fire.

Operations and training procedures are described within this section that will minimize the potential of fires on site. In addition, procedures are described for facility employees to follow in the event of a fire.

9.2 Fires on Equipment

All on-site heavy equipment shall be outfitted with a hand-held fire extinguisher and all equipment operators shall be trained in the use of the fire extinguishers. In most instances, fire extinguishers can extinguish small fires and can sufficiently contain larger fires until fire department personnel arrive at the site.

In case of an equipment fire, the operator shall detach the fire extinguisher from the cab, dismount the machine on the side opposite the fire, and attempt to extinguish the fire from the ground while maintaining a safe distance from the flame, if present, and heat. Extinguishers from other nearby equipment may also be used. Diesel fuel tanks on equipment are not likely to explode. If appropriate, a water truck will be available on site to assist in extinguishing the fire. After the fire has been extinguished and the equipment has cooled, necessary repairs may be made.

9.3 Fires in Buildings

Each building will have one or more portable fire extinguishers that may be used to extinguish or contain fires until the local fire department arrives. The fire risks will be minimized or eliminated by employee training, proper housekeeping procedures, and periodic inspections for fire risks by the TRL employees. Employee training and proper housekeeping procedures will minimize the potential for fires caused by flammable liquids, fires ignited by welding and cutting operations, fires fueled by improper fueling practices, fires fueled by parts-cleaning fluids, and fires caused by improper tobacco use. In addition, proper housekeeping procedures will minimize the potential for fires ignited by improperly stored lubricants and fires started in waste paper or other flammable materials. Periodic inspections occur to identify any improperly maintained heating equipment or improperly maintained electric tools. These inspections will be followed by repair of defective tools and defective equipment, if applicable.

If a fire starts in an on-site building, fire extinguisher(s) in the building may be used if the fire can be safely extinguished by personnel on the scene. If the fire cannot be extinguished be means of a fire extinguisher, the Fire Department will be contacted immediately. The building will be evacuated by way of the nearest and/or safest exit.

The Emergency Coordinator shall be immediately notified of all fires. If there is any question regarding the ability of on-site personnel to safely extinguish the fire, the personnel on the scene or the Emergency Coordinator will telephone the Fire Department. The names, addresses, and home and office telephone numbers of the persons currently designated to assume the responsibilities of Emergency Coordinator for the facility as described in Section 2 are listed in **Table 1**. A copy of **Table 1** will be kept next to all telephones in the office and by the telephones in each of the buildings on site.

9.4 Landfill Fires

In the case of a landfill fire, site personnel and equipment will contain, control, and extinguish small fires immediately. Regardless of the size of the fire, the burning material will be isolated and soil will be used to suffocate the fire. A minimum of 500 cy of soil will be made available at all times near the active working area to contain, abate, and suffocate fire. The soil will be used in two ways: (i) to build a berm around the burning waste (to contain and control); and (ii) to be placed on the waste to suffocate the fire. If the fire cannot be extinguished by smothering with soil, the exposed burning material will be wetted until the fire is extinguished.

9.5 Notification

In the event a fire does occur, the following notification procedures will be followed.

- The Fire Department will be notified if the fire cannot be immediately controlled, and will be provided with the following information:
    - site location;
    - location of fire or explosion in facility;
    - extent of fire or explosion;
    - type of fire or explosion;
    - actions being taken; and
    - injuries, if any.
- The Emergency Coordinator will be notified.
- The Anne Arundel County Sheriff’s Office will be notified, if necessary.
- MDE will be notified within 48 hours via email.

10. CONTINGENCY PLAN AMENDMENTS

The Emergency Contingency Plan will be reviewed and amended as necessary if:

- the plan fails in an emergency;
- changes occur to the project that warrant changes to the plan;
- the list of emergency equipment changes;
- there is a change in personnel for the Emergency Coordinator; and
- the list of emergency response contacts changes.

TABLES

TABLE 1

EMERGENCY COORDINATOR

Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Facility Emergency Coordinator:

Landfill Manager, Charlie Jones

Office: (301) 428-0800
Mobile: (301) 252-4243

Alternate Emergency Coordinator:

Floyd Cosner

Office: (301) 428-0800
Mobile: (410) 279-2849

TABLE 2

SAFETY AND EMERGENCY EQUIPMENT GENERAL LIST

Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

- Absorbent materials
- Coveralls to be worn during decontamination procedures
- Disposable gloves, hats, shoe covers, boots
- Filter-type respirators (organic vapors and dust)
- Fire blankets, eyewashes, and emergency showers
- Fire extinguisher
- Fire-resistant/retardant clothing
- First aid supplies
- Pumps (Submersible)
- Spill containment materials

TABLE 3

EMERGENCY RESPONSE CONTACTS
Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Local	**Telephone Number**	**Emergency Number**
Anne Arundel Medical Center 2001 Medical Pkwy Annapolis, MD 21401	(443) 481-1000	911
Anne Arundel County Sheriff	(410) 222-1571	911

In the Event of a Major Spill or Release of Oils or Hazardous Materials Impacts to the Environment

Anne Arundel County Fire and Rescue	(410) 222-8200
Anne Arundel County Sheriff	(41)0 222-7777
Anne Arundel County Health Department	(410) 222-7095
Anne Arundel County Emergency Management	(410) 222-0600

State

Maryland Department of the Environment	(410) 537-3315
Maryland Department of the Environment (after working hours)	(866) 633-4686
Maryland State Police	(301) 387-1101

National

United States Environmental Protection Agency (EPA):	
- National Response Center (to respond to Coast Guard)	(800) 424-8802
- National Response Center	(800) 424-8802
- Region III Philadelphia, PA	(215) 597-9905
United States Coast Guard	(757) 484-8192
Chemtrac (Chemical Transportation Emergency Center)	(800) 424-9300
National Poison Control Center	(800) 222-1222

Appendix O: Closure and Post Closure Plan

Prepared for:

TOLSON AND ASSOCIATES, LLC
24024 Frederick Road
Clarksburg, Maryland 20871

CLOSURE AND POST-CLOSURE CARE PLAN

APPENDIX O
VERTICAL EXPANSION OF TOLSON RUBBLE LANDFILL: PHASE III REPORT

Tolson Rubble Landfill
Crofton, Anne Arundel, Maryland

Prepared by

Geosyntec consultants

10211Wincopin Circle, 4th Floor
Columbia, Maryland 21044

Project Number: ME1606

July 2020

TABLE OF CONTENTS

TABLES

FIGURES

1. INTRODUCTION

1.1 Terms of Reference

The purpose of this Closure and Post-Closure Care Plan (plan) is to address the requirements for landfill closure and post-closure care for the Tolson & Associates Rubble Landfill (TRL) in Anne Arundel County, Maryland. The landfill is owned and operated by Tolson and Associates, LLC (Tolson). In this report, the requirements of the Code of Maryland (COMAR), Title 26, Subtitle 04, Section 07 (Solid Waste Management), subsections 21 and 22 (i.e., Closure and Post-Closure Care Monitoring and Maintenance) are addressed. This plan is Appendix L of the *"Phase III Report Permit Modification Application for the Vertical Expansion of Tolson Rubble Landfill, Crofton, Anne Arundel County, Maryland (permit application)"* (Phase III Report) for the vertical expansion of TRL.

This report was prepared by Ms. Simone Smith, P.E. and was reviewed by Ms. Carrie Pendleton, P.E., both of Geosyntec Consultants (Geosyntec) in accordance with the internal peer review policy of the firm.

1.2 Regulatory Requirements and Closure Plan Organization

This plan has been prepared to meet the State of Maryland and Federal requirements regarding closure and post-closure care for sanitary (rubble) landfills, as defined in COMAR Sections 26.04.07.17, 21 and 22 and in 40 CFR Parts 258.60 and 258.61. The required content of closure plans is presented in COMAR 26.04.07.21. The Closure Plan contents and the location where the requirements are addressed in this plan are as follows:

- in the remainder of Section 1, definitions and an overview of closure and post-closure care activities for TRL are presented;
- the methods, procedures, and processes that will be used to close TRL are described in Section 2;
- a description of the final closure system components is presented in Section 3;
- closure and post-closure cost estimates are presented in Section 4; and
- a post-closure care plan is presented in Section 5.

1.3 Definitions

After development and filling of the landfill disposal cells, the cells will be closed. The landfill will then enter into a period of post-closure care. The following definitions are used throughout this plan in relation to closure and post-closure care. These definitions are consistent with the definitions presented in COMAR 26.04.07.21 and .22, but they have been clarified to describe activities that will be performed for closure and post-closure care of TRL.

- "*Closure*" is defined as cessation of waste disposal operations at the Tolson Rubble Landfill. Tolson does not anticipate implementing closure activities during the operating life of TRL.
- "*Final Closure*" is defined as construction of the final cover system of the entire landfill area, completion of the stormwater management system and site access roads, revegetation of all disturbed areas, construction of any post-closure landfill gas removal system features, and development of post-closure use features (if any).
- "*Final Cover System*" refers to the grading layer plus the closure cap (described below).
- "*Grading Layer*" is defined as the 2-ft thick soil layer placed over the final waste lift no later than 90 days following completion of that final lift as required under COMAR 26.04.07.10(F). This layer may include 1-ft of intermediate cover soil and 1-ft of final cover soil. Construction of this layer before construction of the closure cap (described below) constitutes *"Partial Closure"*.
- *"Closure Cap"* refers to the cap that will be constructed over the grading layer (which is described above in this section). The closure cap includes the following components over the 2-ft grading layer (in ascending order):
    - Low-permeability cap (which is described in the following paragraph);
    - A drainage layer;
    - Final earthen cover;
    - Vegetative stabilization; and
    - Gas Management System.
- "*Low-Permeability Cap*" consists of the synthetic geomaterial component of the closure cap system. The low-permeability cap will be a 40-mil HDPE geomembrane, with a maximum permeability of 1×10^{-10} centimeters/second, as required by COMAR 26.04.07.21(E)(1).
- "*Post-Closure Care*" is defined as the maintenance and monitoring activities that will be performed during the post-closure care period (i.e., not less than five years, or as required by COMAR 26.04.07.16.B(17)). Post-closure care includes all activities that will be performed following closure, such as: operation of the leachate, landfill gas, landfill cap, and stormwater management systems; long-term maintenance; and environmental monitoring.

In this plan, the term "Drawings" refers to the drawing package entitled, *"Application for a Rubble Landfill Permit: Phase III Report, Vertical Expansion of Tolson Rubble Landfill, Crofton, Anne Arundel County, Maryland,"* dated July 2020 and prepared by Geosyntec Consultants, which is included as Appendix A of the Phase III Report.

1.4 Overview of Closure and Post-Closure Care Activities

1.4.1 Introduction

The Tolson Rubble Landfill will be closed according to the closure requirements of COMAR 26.04.07.21. In this section, an overview is presented of the activities that will be performed for closure and post-closure care of TRL, and references are provided for the location in this report where the activities are described in more detail.

1.4.2 Required Submittals and Notifications

Tolson will make several submittals and notifications to alert the Maryland Department of the Environment (MDE) to describe its intentions for closure and post-closure care to MDE and the public. These submittals and notifications are identified below.

- This plan has been prepared in accordance with COMAR 26.04.07.21(G) and is being submitted as part of the application for a permit to develop TRL.
- Written notification of Tolson's intent to close TRL will be provided to MDE at least 180 days before the date of final receipt of waste. Tolson expects that the TRL closure date will be in 2034. Tolson will set a preliminary date for notification of intent to close the landfill according to the operating conditions and regulatory requirements.
- Tolson will not commence closure of TRL until the closure design is approved by MDE. When Tolson submits its notification of intent to close TRL, a closure schedule and revised Closure and Post-Closure Plan will also be submitted to MDE. Once the Closure and Post-Closure Plan has been accepted, a permit will be issues and the plan will be implemented as described.
- A copy of this plan will be maintained at the facility at all times during facility operation and throughout the post-closure care period.
- After closure construction activities are completed, a certification of closure will be provided to MDE with the final report of construction quality assurance for the closure construction event. The certification will state that the closure was completed in conformance with the requirements of the closure plan.

- A notification in the deed to the Tolson property will be made at the time of closure. The notification will indicate that the land has been used as a solid waste disposal site and that the use of the land is restricted.

- The contact for final closure activities will be the Landfill Supervisor for the Tolson facility, whose responsibilities and duties are described in Section 3 of the Operation Plan (Appendix D of the Phase III Report).

1.4.3 Closure Construction Activities

To close TRL, Tolson will perform several activities that are intended to minimize the need for further maintenance of the landfill and minimize the potential for escape of solid waste, leachate, and landfill gas constituents. These closure activities will include construction of the following features: (i) the final cover system; (ii) the landfill gas management system; and (iii) the stormwater management system. Construction activities associated with each of these features is briefly described in the following paragraphs.

Final Cover System. Tolson will construct a final cover system over all waste disposal areas after the landfill has been filled to the final permitted grades or capacity is exhausted. The final cover system, shown on Figure 1 of this Closure and Post-Closure Plan, will comply with the requirements of COMAR 26.04.07.21E. The final cover system is also shown on Drawing 14 in Appendix A of the Phase III Report. The 2-ft grading layer will be installed after the disposal areas reach final grades and may include 1-ft of intermediate cover soil and 1-ft of final cover soil. Construction of the closure cap will commence not later than 24 months after completion of the final lift of waste for the entire landfill and will be completed within one year, during which time the landfill gas management system and the stormwater management system will also be constructed.

Landfill Gas Management System. The landfill gas management system will be constructed upon closure of the landfill. The design of the landfill gas management system is described in Appendix I of the Phase III Report and is illustrated on Drawings 15 through 17 in Appendix A of the Phase III Report. As shown on the drawings, the gas system will consist of vertical gas extraction wells placed evenly throughout the landfill footprint to obtain good coverage for gas extraction.

Stormwater Management System. During construction of the landfill final cover system, additional stormwater management features will be constructed. The design of the system is presented in detail in Appendix G of the Phase III Report. During construction and filling of TRL, the stormwater management features that are already in place will be used for both sediment control and stormwater management; after closure (i.e., after all surfaces have been seeded and stabilized), the system will be used only for stormwater management. The stormwater management system described in the Phase III Report is designed to manage runoff from the entire TRL final cover system.

1.4.4 Post-Closure Care, Maintenance, and Monitoring

After closure of TRL has been completed, Tolson will provide post-closure care, maintenance, and monitoring in accordance with the requirements of COMAR 26.04.07.22 and 40 CFR Part 258.61. In general, this will include: (i) operating the landfill to manage leachate, landfill gas, and stormwater; (ii) monitoring ground water, surface water, and air at the site to detect releases of leachate, landfill gas, or waste that exceed regulatory requirements; (iii) maintaining the leachate management, landfill gas management, and stormwater management systems; and (iv) in the event of a problem, notifying the proper authorities of the problem and addressing the problem. Tolson's plan for providing post-closure operation, maintenance, and monitoring is presented in Section 5 of this plan.

The need for long-term maintenance of the landfill is described in Section 2.5. As described in Section 2.5 and as described in Section 5.6, after the first five years of post-closure care, the need for continued post-closure care will be reevaluated for each component of post-closure care (i.e., leachate management, landfill gas, groundwater monitoring, and final cover system). The purpose of the reevaluation will be to support a request to MDE that if post-closure care is no longer needed as described in this plan, then it will be terminated.

2. METHODS, PROCEDURES, AND PROCESSES FOR LANDFILL CLOSURE

2.1 Introduction

In this Section, the methods, procedures, and processes that will be employed by Tolson to close TRL are presented. The methods, procedures, and processes described in this section have been selected to meet the performance requirements of COMAR 26.04.07.21, which are:

- minimize the need for further maintenance of the landfill; and
- minimize the post-closure escape of solid waste, leachate, and landfill gases to surface water, ground water, or the atmosphere.

In the following sections, descriptions are provided of the methods, procedures, and processes that will be used to minimize the post-closure escape of solid waste (Section 2.2), leachate (Section 2.3), and landfill gas (Section 2.4) to surface water, ground water, and the atmosphere. Also, the need for long-term maintenance of the landfill is addressed (Section 2.5).

2.2 Containment of Solid Waste

The design of TRL provides for containment of solid waste throughout the entire period of landfill operation, closure, and post-closure care and minimizes the possibility for release of solid waste to the environment. Design features that will provide for containment of solid waste through the closure and post-closure period include the liner system, the perimeter berm, the grading layer, and the closure cap. These features are described below.

- *Landfill Liner System.* The landfill liner system is designed to contain and to prevent a release of solid waste (including any liquid wastes that may exist in the landfill) to the environment. As shown on Drawing 4 in Appendix A of the Phase III Report, the liner system extends beneath all areas that will receive solid waste. The design and the Operation Plan (provided in Appendix D of the Phase III Report) include techniques that are intended to minimize the possibility of damage to the liner system during the life of the landfill, including: (i) thorough construction quality assurance measures to identify and remediate problems with the liner system during construction; (ii) specific operation measures for waste placement and final cover construction that minimize the possibility of damage to the liner system; and (iii) monitoring of the landfill during operation and after closure to identify problems with the liner system. Using these techniques, the landfill will be effective in containing solid waste throughout the post-closure period.
- *Perimeter Berm.* The landfill is designed having a perimeter berm to provide containment of solid waste. The berm ranges in height from about 25 to 60 feet. The berm is designed

to provide stability to the landfill and to contain waste within the landfill cells. The landfill liner completely covers all the areas within the perimeter berm.

- *Grading Layer.* Tolson will install the final grading layer in areas where solid waste operations have permanently ceased. In these areas, the grading layer provides containment of waste and limits the release of landfill gas and the potential for excessive soil erosion, which could cause exposure and possibly a release of solid waste.

- *Closure Cap.* A closure cap as shown on Drawing 12 in Appendix A of the Phase III Report and in **Figure 1** of this plan will be installed on top of the grading layer for waste enclosure.

2.3 Containment of Leachate

The design of TRL provides for containment of leachate throughout the landfill operation, closure, and post-closure care period and minimizes the possibility for release of leachate from the landfill to the environment. Design features that will provide for containment of leachate throughout the closure and post-closure period include: (i) the landfill liner and leachate collection system; (ii) the leachate removal and transmission system; (iii) leachate treatment procedures; and (iv) the final cover system. These features are described below.

- *Liner and Leachate Collection System.* The liner system and leachate collection system will provide containment of leachate throughout the post-closure care period. The proposed liner system is illustrated on Drawing 4 in Appendix A of the Phase III Report. In addition to the liner system, all landfill cells have a leachate collection system above the liner. The liner system is designed to minimize leakage of leachate into the environment; as described in Appendix H of the Phase III Report, the leachate collection system is designed to route leachate from within the disposal areas to a leachate collection sump at the southwest the perimeter of the landfill while maintaining a hydraulic head less than 12 inches on top of the liner.

- *Leachate Removal and Transmission System.* As described above, leachate will drain by gravity from the disposal area to a leachate collection sump located at the perimeter of the landfill. The leachate removal system, which relies on a central gravity drain and pump, will be operated throughout the post-closure period to remove leachate from the leachate collection manholes and transfer it to the on-site leachate storage tanks. The leachate will then be transported to an off-site Publicly-Owned Treatment Works (POTW). The transmission piping system will consist of HDPE pipe.

- *Leachate Treatment System.* Throughout the post-closure period, leachate that is removed from the landfill will be transported to the POTW, where it will be treated to remove contaminants and then discharged in accordance with the POTWs discharge permit. During either the operation or closure of the landfill, Tolson may construct an on-site treatment plant for leachate and they would obtain the necessary permits at that time. If, at some point in the future, leachate quality analysis indicates that constituent concentrations in the leachate meet applicable discharge guidelines or can be treated passively (e.g., through a reed bed or wetland), then Tolson would petition MDE to alter the treatment methods for leachate at the site according to the provisions and procedures described in Section 5.6 of this Closure Plan.

- *Final Cover System.* A final cover system will be constructed over all areas of the landfill that receive solid waste. The final cover system will be maintained throughout the post-closure period. The final cover system will reduce the amount of infiltration that enters the landfill, thereby minimizing the amount of leachate that is generated during the post-closure period. The final cover system will also prevent the release of leachate from the landfill sideslopes in leachate 'break-outs'.

2.4 Containment of Landfill Gas

The design of TRL provides for containment of landfill gas throughout the landfill operation, closure, and post-closure care period and minimizes the possibility for release of landfill gas from the landfill to the environment. Design features that will provide for containment of landfill gas through the closure and post-closure periods include the landfill liner system, the final cover system, and the active gas management system. These features are described below.

- *Landfill Liner System.* The landfill liner system will prevent the escape of landfill gas by eliminating the possibility of downward or lateral migration of landfill gas into the ground beneath the landfill and subsequent lateral migration of gas.

- *Final Cover System.* The final cover system will cover all waste throughout the post-closure care period and will be designed to prevent the discharge of landfill gas to the atmosphere at concentrations exceeding applicable state and federal emissions guidelines. The final cover system will be anchored beyond, but near, the liner system at the perimeter berm to provide complete containment of the landfill gas.

- *Landfill Gas Management System.* As described in Section 1.4.3, an active landfill gas management system will be constructed for TRL at the time of closure and will be operated as needed during the post-closure period. The system will consist of a network of vertical wells to remove landfill gas, transmission pipes to convey the gas from the landfill, and a flare to burn landfill gas. The gas management system will be fully automated and will operate continuously at all times throughout the post-closure period.

2.5 Long-Term Landfill Maintenance

The TRL closure system has been designed to minimize maintenance throughout the post-closure period. Features of the design that minimize maintenance include:

- drainage terraces to limit the length of stormwater sheet flow off of the final cover slopes and thus limit erosion of the final cover soils;
- relatively flat drainage channels and short downchutes (instead of long downchutes, culverts, or piping systems) to route drainage off the final cover at low, non-erosive velocities;
- gravity drainage of leachate from the landfill to reduce the need for repair, replacement, or maintenance of leachate removal pumps;
- durable, hearty grasses for the cover that limit stormwater runoff and thus minimize erosion of the topsoil and vegetative support soil layers; and
- drainage features that transition gradually, instead of abruptly, to prevent concentrations of flow that could damage the final cover system.

3. DESCRIPTION OF FINAL CLOSURE SYSTEM COMPONENTS

3.1 Introduction

The closure system will consist of several components, including a final cover system, a landfill gas management system, and a stormwater management system. The leachate management system, which will be operated during the post-closure period, is not considered a closure system component because it will be constructed and operated before final closure occurs. In this section, the final cover, gas management, and stormwater management components of the closure system are described.

3.2 Grading Layer and Final Cover Material

After the final receipt of waste in an area and before construction of the closure cap, the surface of the landfill will be graded such that the computed post-settlement elevation of the final grading layer is the required depth below the contours shown on Drawing 11 of 18 in Appendix A. In preparation for construction of the closure cap, the final grading layer (2-ft thick, including intermediate and final cover soil) will provide smooth grades for construction of the closure cap, locally repair any damage caused by erosion of intermediate cover, and provide proper stormwater drainage for the closure cap. This grading layer will also provide temporary control of landfill gas, minimize the amount of infiltration into the landfill, reduce odors, and minimize the amount of maintenance required. Soils that will be used for the final grading soil layer will be obtained either from the on-site borrow area or off-site borrow areas and will conform to the requirements for soils identified in the specifications provided in Appendix N of the Phase III Report. All construction of final closure system components will be performed in accordance with the construction quality assurance procedures described in Appendix M (i.e., Construction Quality Assurance Plan) of the Phase III Report. Tolson will attempt to minimize the amount of final grading that is needed by filling the landfill as closely as possible to the required grades.

During final grading of the landfill final cover, some areas may require grading of waste or filling with additional waste in order to achieve the design final cover grades. Such grading will likely be needed, for example, to refill areas that experience settlement after waste placement ends but before closure construction begins. Also, regrading may be needed to provide smooth slopes, to allow construction of cover access roads, or to provide proper drainage of cover terraces. If such grading is required, Tolson will excavate the waste, or place new waste following the procedures described in Appendix D to the Phase III Report (i.e., Operation Plan), and will identify areas of the disposal area to receive the waste. As described in the Operation Plan, all relocated or newly placed waste will be covered with a minimum of 0.5 ft of periodic cover every three days once waste is relocated and then covered with the required intermediate and final cover soil layers.

3.3 Closure Cap

The closure cap (i.e., low permeability cap) will be constructed in accordance with the requirements of COMAR 26.04.07.21 and 40 CFR 258.60 to include a low-permeability layer overlain by a drainage layer, a 1.5-ft thick final cover soil layer, and a 6-in thick topsoil layer. A cross section of the closure cap is shown on Figure 1. As shown in the figure, the closure cap will consist of a geomembrane placed over the soil grading layer, which will be overlain by (in ascending order): (i) a geocomposite drainage layer; (ii) a protective cover soil layer; and (iii) a vegetated topsoil layer. The closure cap will be constructed in phases as portions of the landfill are filled to final grades. At the time of final closure, final cover terrace drainage features will be constructed above the final cover geomembrane and drainage layer.

3.4 Landfill Gas Control System

Landfill gas will be controlled by routing the gas from the landfill to a flare, as described in Appendix I of the Phase III Report. The landfill gas management system is designed to efficiently manage landfill gas throughout the operational and post-closure life of the landfill. The active gas collection system will be operated until active emission control is no longer necessary. Gases will be prevented from escaping the landfill by the final cover system. Regardless, a gas monitoring program (which is described in Section 5.4.4 of this Closure Plan) will be implemented to test for the presence of landfill gases outside of the landfill.

3.5 Stormwater Management System

At closure, the stormwater management system will be modified to meet the goals of post-closure care. During operation of the landfill, the system will have the dual purposes of: (i) managing stormwater; and (ii) minimizing erosion and off-site sedimentation. After closure, the primary purpose of the system will shift from erosion and sediment control (because all surfaces will be stabilized with vegetation) to stormwater management (i.e., conveyance of stormwater in a non-erosive manner to the adjacent tributaries and creeks). To modify the stormwater management system for long-term post-closure use, any sediment dewatering devices will be removed from the ponds, the sediment will be cleaned from the ponds, and all disturbed areas of the landfill will be stabilized with vegetation.

4. COST ESTIMATES

4.1 Introduction

In this section, cost estimates are presented for TRL final closure system construction and post-closure care. Costs for construction, operation, and any activities related to pre-closure are not addressed in this estimate.

4.2 Closure Construction Cost Estimate

Estimates of capital closure costs for the landfill final cover system (i.e., grading layer and low permeability cap) are included in **Table 1**. The closure cost estimates include those costs that will be incurred during: (i) construction of the final cover system for the landfill; (ii) removal of construction equipment from TRL; and (iii) establishment of the permanent landfill gas management system enhancements. As shown on **Table 1**, the estimated cost in 2020 dollars is $9,905,000 for the landfill final cover system.

4.3 Post-Closure Care Cost Estimate

An estimate of the post-closure cost for maintenance of the closure system for the landfill is presented in Table 2. The post-closure cost estimate includes the cost of:

- environmental quality monitoring (i.e., sampling and analysis of ground water, surface water);
- inspections of the final cover system, gas control system, stormwater management system, leachate collection system, and perimeter road;
- leachate removal, storage and hauling; and
- maintenance of the above-referenced systems.

As shown on **Table 2**, the estimated cost of post-closure care in 2020 dollars is $963,749. The estimate is based on a post-closure care period of five years as required by COMAR 26.04.07.16.

5. POST-CLOSURE CARE

5.1 Regulatory Requirements

This plan addresses the requirements of COMAR 26.04.07.22. As required by COMAR 26.04.07.22 and 40 CFR Part 258.61, maintenance will be performed for the TRL final cover system, all vegetation associated with the Tolson facility, the leachate management system, the groundwater monitoring system, the landfill gas management system, the stormwater management system, and other miscellaneous site features. A description of the different maintenance procedures is presented below. An inspection schedule for post-closure maintenance is presented in **Table 3**. In addition, groundwater, stormwater, leachate, and landfill gas will be monitored as described in Section 5.4. In this section, operation, maintenance, and monitoring of the landfill throughout the 5-year post-closure care period are described.

5.2 Post-Closure Operation

During the post-closure care period, leachate and landfill gas will continue to be generated at the landfill. Accordingly, the leachate management system and the landfill gas management system will be operated, maintained, and monitored routinely as described in the Operation Plan (i.e., Appendix D of the Phase III Report). Other features of the landfill will only be maintained and monitored. Operation of the leachate and landfill gas management systems will be performed according to the procedures described in the Operation Plan until such time that leachate and landfill gas are either not produced or are produced in limited quantities or with limited concentrations such that they are not harmful to human health or the environment. At that time, Tolson will demonstrate to MDE (using the approach described in Section 5.6 of this Closure Plan) that management of leachate and landfill gas is no longer necessary and, upon MDE’s approval, will cease operation of the leachate and landfill gas management systems. Individuals that are responsible for post-closure operation will be trained in accordance with the safety procedures described in the Operation Plan in Appendix D of the Phase III Report.

5.3 Post-Closure Maintenance and Inspection

5.3.1 Access Control and Road System

Access will be controlled throughout the post-closure period by monitoring the perimeter security features (i.e., fences and lockable gates) and access roads. On-site access roads and perimeter roads of the closed landfill will be maintained in a passable condition at all times during the post-closure period. These roads will be inspected quarterly for conditions that would prevent passage of vehicles (such as ruts, ponded water, washouts, gullies, ice or other frozen precipitation, or obstacles). If needed, repairs will be made to keep the roads passable.

5.3.2 Vegetation

Within 30 days after the final earthen cover has been installed, the area shall be vegetatively stabilized as required by COMAR 26.04.07.21. Vegetation (including permanent and screening vegetation) will be maintained in a condition that will minimize erosion of on-site soils (including the final cover soils) and will help screen the site from public view, and in accordance with the *2011 Maryland Standards and Specifications for Soil and Erosion and Sediment Control*, Section B-4 – Vegetative Stabilization. During the post-closure period, maintenance will consist of inspections on a quarterly basis and after major storm events (i.e., 24-hour, 10-year or greater storm return frequency) to identify locations of excessive erosion, washout, poor vegetation density, and damaged vegetation. If required, the identified areas will be regraded to repair damage to the final cover soils, including areas of surface settlement or erosion and cracking of the cover soils, and/or revegetated as discussed below:

- *Surface Settlement.* If settlement is observed during routine inspections of the cover, then the need for maintenance or repairs of the settled areas will be evaluated. Repairs will be needed if water is noted to be ponding in the area, resulting in distress to the vegetation or erosion problems. Repairs will consist of either filling the depressions or, if the depressions are significant, excavating to the geomembrane, filling back to the grading layer grades beneath the geomembrane, and reconstructing the cover system over the area.
- *Erosion or Cracking of Cover.* If the cover soils are noted to be eroded or cracking, then such areas will be repaired by filling erosion features or cracks, seeding, and fertilizing the new soils to establish vegetation in the new soil.

During landscaping inspections, all on-site slopes will be inspected for stability. The inspector will attempt to identify any signs of sloughing of the slope surface, bulging at the toes of slopes, tension cracks at the tops of slopes, and other conditions that may indicate slope instability. Unacceptable vegetation (i.e., trees or shrubs) will be removed. If areas of instability are identified, MDE will be notified and appropriate remedial measures will be implemented.

5.3.3 Stormwater Management System

The stormwater management system will be maintained to control run-on and runoff at the landfill. Run-on control will be provided by the perimeter berm, and the runoff will be prevented by the series of drainage terraces, downchutes, and channels in the final cover and around the perimeter of the landfill. The system will consist of all stormwater drainage features (both permanent and temporary), sedimentation basins, and associated sedimentation basin structures, and will be maintained in a condition that allows continuous control of surface water at the site. During the post-closure period, all drainage channels, culverts, and stormwater basins will be inspected quarterly and after major storm events (i.e., 24-hour, 10-year or greater storm return frequency) for conditions that would restrict flow, such as:

- washouts;
- excessive sediment in ditches or culverts;
- dislodged riprap; or
- gullies or erosion.

Washouts, excessive erosion, and gullies will be repaired by re-grading the areas to the proper elevations (as shown on the engineering plans), revegetating, or applying rip-rap. Channels having excessive deposits of sediment (i.e., 8 in. (20 cm) in depth or greater) will be cleaned. Dislodged rip-rap will be replaced as necessary.

5.3.4 Leachate Collection System

Routine maintenance will be performed on the leachate collection system to prevent clogging of the system. Maintenance will consist of cleaning all accessible leachate collection pipes (identified on Drawing 4 in Appendix A of the Phase III Report). Cleaning will be performed as necessary during the post-closure period until the leachate collection and leachate transmission, removal, and storage systems are taken out of service (as described in Section 5.6 of this Closure and Post-Closure Plan).

5.3.5 Leachate Removal and Transmission System

The components of the leachate removal and transmission system will be routinely inspected and maintained during the post-closure period to ensure that the system functions properly and that leachate is not released to the environment. Inspections of the leachate removal and transmission system (i.e., leachate pumps, vaults, and leachate transmission lines) will be performed quarterly to check for malfunctioning pumps, broken lines, malfunctioning meters and valves, and damaged leachate manholes. In addition, the electrical controls for the leachate transmission system will be checked to ensure that they are functioning properly.

Leachate will be sampled quarterly and will be tested to determine the concentration of chemical constituents. After an appropriate length of time during the post-closure period that the chemical constituents in the leachate do not exceed the parameters concentrations identified in the permit for TRL, then Tolson will make a demonstration to MDE that the leachate collection system is no longer needed and will be taken out of service. However, the leachate collection system will be left in place in the event that these features are needed at a future date.

5.3.6 Landfill Gas Removal System

The landfill gas removal system will be routinely inspected and maintained to provide continuous collection, transmission, and destruction of landfill gas at the site for as long as gas is generated in quantities requiring active collection and treatment. Gas recovery and transmission system components (including vertical gas extraction wells, header pipes, condensate sumps, connections between the wells and final cover geomembrane, and the blower/flare station) will be inspected, monitored, and maintained on a minimum of a quarterly basis, and likely more frequently, during the post-closure period for signs of damage to the components and for evidence of leaks in the gas transmission lines. Based on experience with similar gas management systems, routine maintenance involves: (i) checking the integrity of wellfield components such as wellheads, valves, gas collection wells, and monitoring probes; (ii) maintaining the condensate management system, including inspecting sump pumps, and sealing of sumps and condensate knockout; and (iii) maintaining the blower-flare station, including inspecting pipe fittings and valves, cleaning condensate knockout, cleaning control panels, and inspecting flare stations and flame sensor. Details of maintenance procedures for the landfill gas management system are included in Appendix D (i.e., Operation Plan) of the Phase III Report.

5.3.7 Environmental Monitoring System

All components of the environmental monitoring system (including groundwater monitoring wells, stormwater monitoring stations, leachate monitoring ports, and gas monitoring locations) will be inspected during each sampling event. The components will be inspected for damage and will be repaired or replaced, if necessary. Environmental monitoring is addressed in the Environmental Monitoring Plan (EMP) in Appendix J of the Phase III Report.

5.3.8 Miscellaneous Site Activities

Maintenance of other site features will be performed during the post-closure period on a routine basis, as described below.

- The site perimeter fence will be inspected quarterly for breaks in the fence and to ensure that the gates are working properly. The fence and gates will be repaired as needed to provide continuous access control around the entire site.
- The scales (if still in operation) will be inspected and calibrated at least annually.
- Buildings (including the office/scalehouse) will be inspected annually and will be maintained to provide continuous support for landfill maintenance and monitoring activities.

In addition:

- standing water will not be allowed to accumulate on the landfill;
- open burning will not be performed on the landfill;
- no activity that has not been approved in advance by MDE will be performed at the landfill; and
- access to the landfill will be limited to only those persons who are engaged in approved post-closure activities.

5.4 Post-Closure Monitoring

5.4.1 Introduction

In this section, the activities that Tolson will perform to monitor the site throughout the post-closure care period are described. These activities include groundwater, stormwater, landfill gas, and leachate monitoring. The sampling and analysis for environmental monitoring services will be performed either by Tolson or by its contractor. In the following sections, brief descriptions are provided of the specific monitoring procedures that are required by COMAR or relevant permit conditions. Individuals that are responsible for post-closure monitoring will be trained in accordance with the safety procedures described in Section 10 of the Operation Plan in Appendix D of the Phase III Report.

5.4.2 Groundwater Monitoring

Groundwater will be monitored throughout the post-closure care period, as specified in the permit and in the EMP (Appendix J of the Phase III Report). The site-specific groundwater monitoring requirements will be reviewed periodically during the post-closure period.

- All monitoring wells will be maintained and protected.
- Abandonment and replacement of monitoring wells due to construction activities will be performed in accordance with the provisions of COMAR 26.04.04.11.

5.4.3 Stormwater Monitoring

Surface water will be monitored to evaluate compliance with the requirements of the General NPDES Stormwater Discharge Permit for the site and with specific permit conditions.

5.4.4 Landfill Gas Monitoring

Landfill gas will be monitored as required by the air emission permit issued by MDE. The control and management of landfill gas will be performed in conformance with: (i) Part 70 Permit Program required by Title V of the 1990 Clean Air Act Amendments; (ii) COMAR 26.04.07.08(B)(15); and (iii) the Landfill Gas Monitoring Plan for the site that is provided in Section 7 of the Operation Plan in Appendix D of the Phase III Report. Odors will be prevented from escaping the site boundary through the use of engineered collection and/or combustion systems. The post-closure gas monitoring procedures are described below.

- Gas monitoring will be performed: (i) in confined spaces (i.e., scale house and office trailer) and (ii) at gas monitoring wells installed along landfill perimeters
- Gas monitoring will then be conducted in accordance with the approved monitoring plan.
- Results of gas monitoring will be submitted to MDE as part of the annual report for the Tolson facility.

In the event that landfill gas is detected in facility structures or at the property boundary in excess of 25 percent of the LEL, then the following response activities will be performed:

- take immediate steps to protect human health and the environment;
- immediately notify MDE;
- within seven days of detection, place a note in the operating record that states the levels detected and the steps taken to protect human health and the environment; and
- within 60 days of detection, implement a plan to remediate the release, place a copy of the plan in the operating record, and notify MDE that the plan has been implemented.

The remediation plan described above will contain a description of the following:

- the nature of the problem;
- the extent of the problem, including work performed by Tolson to evaluate the extent of the problem; and
- a proposed remediation plan, including the engineering analyses performed to estimate the effectiveness of the proposed solution.

5.4.5 Leachate Monitoring

Leachate will be monitored as required by COMAR 26.04.07.22. The specific post-closure leachate monitoring procedures are described below.

- The leachate monitoring system is designed to measure the rate and quantity of leachate flow and is designed to allow sampling of the leachate; such measurements and samples will be made during the post-closure care period.

- Within 45 days following the issue of a permit, Tolson will submit a leachate monitoring plan to MDE for approval for monitoring of leachate. This plan will include the sampling locations, frequency and analytical requirements as well as quality control and quality assurance procedures. Leachate monitoring will be performed throughout the post-closure period in accordance with the approved plan.

- Test methods used to analyze samples will be those described in the most current legal edition of EPA Publication SW-846 "Test Methods for Evaluating Solid Waste – Physical and Chemical Methods." If SW-846 does not contain a test method for a required parameter, that parameter will be tested according to methods described in the most recent edition of the EPA Publication "Methods of Chemical Analysis for Water and Wastes" or of "Standard Methods for Examination of Water and Wastewater" published by the American Water Works Association.

5.5 Post-Closure Use

The Tolson Rubble Landfill site will be used in the future for idle grassed and forested land or for MSW transfer, composting, wood chipping, wood/vegetation waste processing, recycling operations, construction and demolition waste transfer and/or recycling, and concrete/rubble crushing.

5.6 Duration of Post-Closure Care

As discussed in Section 1.4.4 of this Closure and Post-Closure Care Plan, post-closure, care will be provided in accordance with the requirements of 40 CFR Part 258.61 and COMAR 26.04.07.22, and relevant permit conditions. In this section, the general requirements for post-closure care are defined, including specific post-closure care activities and the duration of the post-closure care period. The requirements of COMAR 26.04.07.16 and 22 and relevant permit conditions are anticipated to include the following:

- the duration of post-closure care will be 5 years after the completion of closure;
- the Department may remove required elements of the post-closure care plan if it determines that they are no longer needed to protect human health and the environment;
- at any time during the post-closure period, the Department may reduce the length of post-closure care if it determines that such care is not needed to protect human health and the environment;

- prior to the end of post-closure care, the Department may extend the post-closure care period if it determines that an extended period is necessary to protect human health and the environment; and
- the Department will require actions to mitigate threats to human health and the environment if evidence exists of a contaminant release that could significantly threaten human health or the environment.

Based on these requirements, a performance-based approach will be applied to the duration of post-closure care at TRL. In general, this will consist of implementing the following approach.

- First, the requirements of the Post-Closure Care Plan (i.e., as described in Sections 5.1 through 5.5 of this Plan) will be implemented beginning at the completion of closure.
- At any time after the first year of post-closure care, an evaluation will be made of the need to continue post-closure care for each of the four components of post-closure care (i.e., leachate management, landfill gas management, groundwater monitoring, and final cover system). The approach for evaluating the need for continued post-closure care is outlined in Table 4. Depending on the outcome of the evaluation, the post-closure care plan may be revised so that it better reflects the actual threat of the landfill to human health and the environment.
- If changes are made to the post-closure care plan as a result of the evaluation of the need for continued post-closure care, then a demonstration will be made to MDE that the changes are reasonable based on the available information and the evaluations. No changes in post-closure care will be made before MDE formally approves such changes to the Closure and Post-Closure Care Plan and the permit for TRL. If the outcome of the evaluation is inconclusive (e.g., no change to the post-closure care plan is indicated by the data and evaluations), then post-closure care will continue as required in the post-closure plan.
- Additional evaluations of the need for continued post-closure care may be performed when additional data exist that could result in a different outcome of the evaluation. This includes evaluation outcomes that could indicate the need for a longer post-closure period or additional elements of the post-closure plan.

5.7 Facility Contact

The Tolson facility contact will be determined at the time of closure and provided to MDE.

TABLES

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TABLE 1

CLOSURE COST ESTIMATE

Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Disposal Cell	Area (acres)
Cell 1	7.2
Cell 2	9.2
Cell 3	12.9
Cell 4	11.6
Cell 5	12.0
Cell 6	6.8
Cell 7	12.3
Total area:	**72.0**

Item	Quantity	Units	Unit Cost	Percent of Area	Cost Per Acre	Total Cost
Construction documents	1	each	$ 60,000.00	--	$ 833.33	$ 60,000.00
Performance and payment bonds	1	each	$ 25,000.00	--	$ 347.22	$ 25,000.00
Mobilization: Earthwork Contractor	1	each	$ 85,000.00	--	$ 1,180.56	$ 85,000.00
Erosion and sediment control	1	acre	$ 2,500.00	100%	$ 2,500.00	$ 180,000.00
Slope preparation	1	acre	$ 2,500.00	100%	$ 2,500.00	$ 180,000.00
Grading Layer (12 inches)	1613	cy	$ 8.00	100%	$ 12,906.67	$ 929,280.00
CQA/surveying - earthwork & soil cap	1	acre	$ 4,500.00	100%	$ 4,500.00	$ 324,000.00
Mobilization - geosynthetics contractor	1	each	$ 30,000.00	--	$ 416.67	$ 30,000.00
40 mil textured geomembrane - material	43560	sq ft	$ 0.45	100%	$ 19,602.00	$ 1,411,340.00
40 mil textured geomembrane - installation	43560	sq ft	$ 0.12	100%	$ 5,227.20	$ 376,360.00
Drainage composite - material	43560	sq ft	$ 0.60	110%	$ 28,749.60	$ 2,069,970.00
Drainage composite - installation	43560	sq ft	$ 0.12	100%	$ 5,227.20	$ 376,360.00
Gas well boots/miscellaneous (see Note 1)	31	each	$ 750.00	--	$ 322.92	$ 23,250.00
CQA/surveying - geosynthetics	1	acre	$ 5,500.00	100%	$ 5,500.00	$ 396,000.00
Protective cover soil (18 inches)	2420	cy	$ 8.00	100%	$ 19,360.00	$ 1,393,920.00
Topsoil (6 inches)	807	cy	$ 13.00	100%	$ 10,491.00	$ 755,350.00
Vegetation and seeding	1	acre	$ 2,500.00	100%	$ 2,500.00	$ 180,000.00
Drainage control structures	3	each	$ 10,000.00	--	$ 416.67	$ 30,000.00
Stormwater features (riprap, erosion mat, gabions, etc.)	1	acre	$ 15,000.00	100%	$ 15,000.00	$ 1,080,000.00
				Average Closure Cap Cost Per Acre:	**$ 137,581**	
				Total Estimated Closure Cost:		**$ 9,905,830**

NOTES: 1. Assumes LFG collection system is already in place.
2. All costs are in 2020 dollars

TABLE 2

POST-CLOSURE CARE COST ESTIMATE

Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Current Year	**2020**
Expected Closure Year	**2034**
Time Until Closure (years):	**14**
Post-Closure Care Period (years):	**5**
Total Area of Landfill	**72.0**

Item	Units	Unit Cost	Average Annual Quantity	Annual Cost
Final cover repair (equipment and labor)	hour	$ 150	120	$ 18,000
General labor and inspections	hour	$ 50	120	$ 6,000
Seeding and fertilizing cap	acre	$ 1,800	7	$ 12,600
Mowing	acre	$ 45	216	$ 9,720
Stormwater management maintenance	annual	$ 2,500	1	$ 2,500
Fencing and security repairs	annual	$ 500	1	$ 500
Road maintenance	annual	$ 1,500	1	$ 1,500
Utilities (excluding LFG flare)	monthly	$ 100	12	$ 1,200
Groundwater sampling and analytical	semi-annual	$ 10,000	2	$ 20,000
Surface water sampling and analytical	semi-annual	$ 750	2	$ 1,500
Groundwater analytical statistics and report	annual	$ 7,500	1	$ 7,500
Surface water report	annual	$ 5,000	1	$ 5,000
Total leachate collection area (acres)	72.0			
Initial generation rate (gallons per acre-day)	18			
Final generation rate (gallons per acre-day)	0			
Total leachate generated (gallons)	1,157,985			
Leachate disposal cost	gallons	$ 0.05	231,597	$ 11,580
Leachate sampling and analysis	semi-annual	$ 750	2	$ 1,500
Leachate system repairs	annual	$ 3,000	1	$ 3,000
LFG collection system repairs	annual	$ 10,000	1	$ 10,000
Blower and flare repairs	annual	$ 1,500	1	$ 1,500
Electricity for blower	monthly	$ 750	12	$ 9,000
LFG system operator (full time)	annual	$ 55,000	1	$ 55,000
Condensate disposal	monthly	$ 200	12	$ 2,400
Condensate sampling and analysis	annual	$ 750	1	$ 750
LFG gas migration monitoring and reporting	quarterly	$ 3,000	4	$ 12,000
			Gross Annual Cost:	**$192,750**
			Total Gross Post-Closure Care Cost:	**$963,749**

NOTES: 1. All costs are in 2020 dollars

TABLE 3

POST-CLOSURE MAINTENANCE INSPECTION SCHEDULE

Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Item	Inspection Frequency
Access Roads	Semi-annually
Landscaping	Semi-annually and after major storm events[1]
Stormwater Management System	Semi-annually and after major storm events[1]
Equipment	Monthly
Leachate Collection System	Monthly
Leachate Removal and Transmission System	Monthly
Gas Management System	Semi-annually
Environmental Monitoring Systems	Semi-annually (during monitoring events)
Security Fence and Signs	Semi-annually
Leachate Storage Area	Daily (during use)
Buildings	Yearly

Notes:
1. A “major storm event” is defined as a 24-hour, 2-year return frequency storm.

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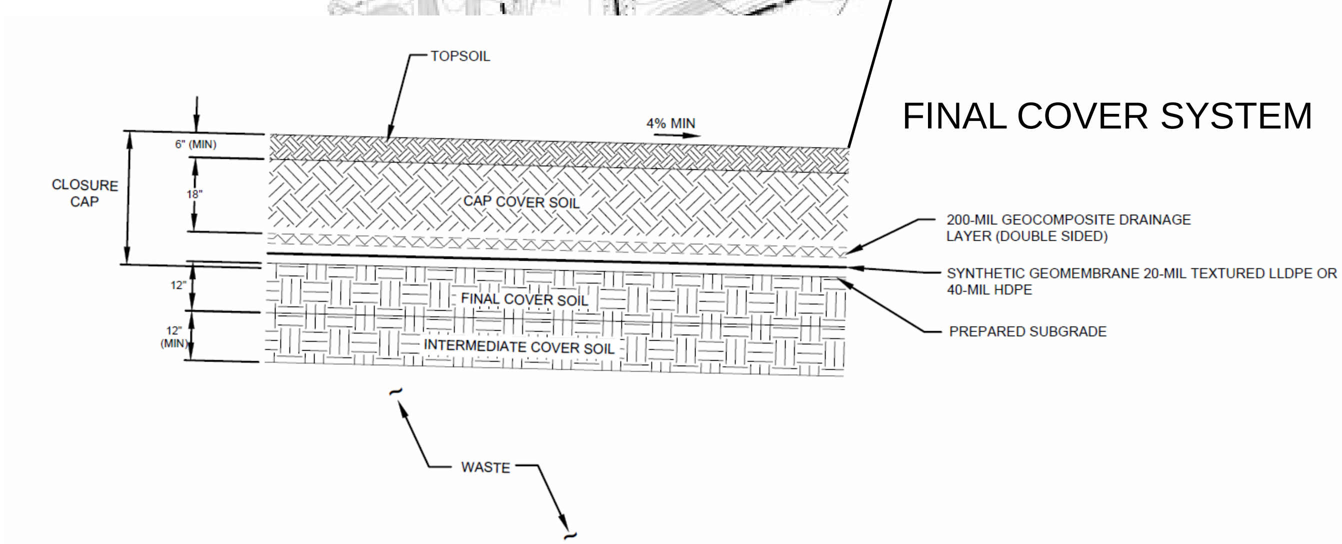
TABLE 4
APPROACH FOR EVALUATING NEED FOR CONTINUED POST-CLOSURE CARE

Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

Component of Post-Closure Care (PCC)	Purpose of PCC Component	Criteria for Demonstrating that PCC of Component is no Longer Necessary	Demonstration Approach
Leachate Management System (LMS)	Contain and treat leachate to prevent adverse impacts of leachate to surface water and ground water.	No risk of impacts from uncontrolled releases of leachate. In addition, operation of LMS must not be necessary to maintain geotechnical stability.	Show that uncontrolled releases of leachate of current quality and quantity will not violate water quality standards in receiving surface-water or groundwater. Also, show that geotechnical stability is not affected.
Landfill Gas Management System	Control of potential impacts of landfill gas with regard to: • Compliance with Clean Air Act; • Lateral migration (explosive potential); • Groundwater / Vadose Zone; and • Odor.	No potential for future lateral gas migration problems and no potential for future exceedance of Clean Air Act standards.	Show that annual volume and quality of gas generated at site is such that elimination of gas management will not result in violation of COMAR 26.04.07.21(E)(5) or any other applicable Federal or State regulation or permit requirement.
Groundwater Monitoring System	Verify that there are no unacceptable impacts to groundwater from leachate release or gas migration from site.	Status of leachate and gas evaluations is such that potential impacts to groundwater are acceptable (i.e., time required for impacts to have been detected has passed).	Confirm that ground-water monitoring has been performed at least as long as the time required for impacts for hypothetical leachate and gas release to have been detected at compliance location.
Cover System	Control of one or more of the following: • Infiltration (i.e., generation of leachate); • Gas emission / migration; • Direct exposure to waste; and/or • Geotechnical stability.	Loss of, or changes to, cover integrity must not adversely affect any of the purposes listed. Long-term condition of cover must be compatible with end-use obligations for the site.	Evaluate effect of cover integrity on all other aspects of PCC and end-use. Ensure compatibility between cover maintenance program and requirements for cover from other PCC components.

FIGURE



FINAL GRADING PLAN
Tolson Rubble Landfill
Crofton, Anne Arundel County, Maryland

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Columbia, Maryland | July 2020

Figure
1