Coke Point Area Work Plan

Assessment of the Current Groundwater to Surface Water Discharges from the Coke Point Area
Tradepoint Atlantic
Sparrows Point, Maryland

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ARM Project 170194M

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TABLE OF CONTENTS

FIGURES

APPENDICES

1.0 INTRODUCTION

1.1. INTRODUCTION

ARM Group Inc. (ARM), on behalf of EnviroAnalytics Group (EAG), has prepared the following Work Plan to assess current groundwater to surface water discharges on the portion of the Tradepoint Atlantic property that has been designated as the Coke Point Area (CPA). The CPA is a peninsula in the southwest portion of the Tradepoint Atlantic Property (Figure 1), bordering on the Patapsco River to the west and south, and the Turning Basin to the east. The CPA comprises approximately 308 acres of the approximately 3,100-acre former plant property and includes the former Coke Oven Area and Coke Point Landfill. The CPA includes three separate parcels of land defined as Parcel B10 (164 acres), Parcel B11 (92 acres), and Parcel B12 (52 acres) located as shown on **Figure 1**.

The proposed groundwater investigation of the CPA is a discrete phase of the ongoing Site-Wide Groundwater Assessment for the overall Tradepoint Atlantic property at Sparrows Point. This focused investigation is intended to address the following objectives:

1. determine whether constituents are present in the groundwater at levels that may present a potential concern with respect to sediment toxicity;

2. evaluate the groundwater quality to assess whether current discharges could be adversely impacting the off-shore environment;
3. delineate the areas of the CPA where current groundwater discharges could be causing off-shore impacts;
4. assess whether additional off-shore data are needed to determine remedial objectives for protection of benthic and other aquatic organisms; and
5. assess whether the currently implemented remedies have been or are likely to be effective at reducing or eliminating discharges of constituents of concern to the surface water.

This proposed groundwater investigation of the CPA will provide information necessary to complete the Groundwater Environmental Indicators (CA 750) impact screening assessment with respect to the potential for impacts to human health, as well as to offshore ecosystems. Results of this work will be used to define the scope of subsequent investigations, if necessary, that will provide data to develop relationships between on-site groundwater quality and off-shore pore water and surface water quality. Subsequent investigations may be necessary if the current groundwater quality data collected in this investigation indicates a potential to cause continued adverse impacts to the off-shore environment.

1.2. PREVIOUS INVESTIGATIONS

Table 1 presents a listing of previous groundwater investigation reports completed for the Sparrows Point property.

The most recent data from the CPA wells is shown in **Figure 2** (collected in 2017 for most wells and 2015 for some as indicated on **Figure 2**). The figure indicates the concentrations of each compound that exceeds the Project Action Limit (PAL) for each groundwater monitoring well. The data are presented in tabular form in **Appendix A**.

1.2.1. EA 2009 Site Assessment Report

The report titled ***"Site Assessment for Proposed Coke Point Dredged Material Containment Facility at Sparrows Point"*** (EA, 2009) presented the results of off-shore sampling of surface water and sediments, as well as fill and non-aqueous phase liquid samples collected on shore, and compared these results to groundwater chemistry data provided by URS in the Nature and Extent report (URS, 2005A) and the response to regulatory comments for this document (URS, 2006). EA's findings and conclusions are discussed below.

Similarity of Polynuclear Aromatic Hydrocarbon (PAH) fingerprints were noted in the assessment for both the offshore sediment samples and onshore subsurface soil samples. This similarity was determined to indicate that the offshore PAHs are most likely derived from sources associated with industrial activities on the Peninsula. With respect to the PAHs found in the off-shore sediments, the report stated that calculations based on sediment analyses indicated that PAHs were likely present in some sediment locations as residual NAPLs, and that these NAPLs were inferred to be byproducts of coking operations possibly derived from the historical placement of slag laden with byproducts. Furthermore, based on groundwater chemistry data provided by URS in the 2005 Nature and Extent report, EA noted that, at that time (prior to the implementation of interim measures), the highest PAH concentrations were shown to occur off the western and southern shorelines, whereas the highest groundwater PAH concentrations are along the eastern shoreline. The report indicated that this data suggests that groundwater is not the primary source of PAHs to offshore sediments. EA concluded that it appears that pyrogenic PAH-rich hydrocarbon material similar to that seen in their onshore investigation areas was also released offshore. EA noted that the magnitude of sediment impacts did not correlate with the highest fluxes of impacted groundwater, and sorption modeling indicated that the naphthalene present in the sediments could not result solely from contact with groundwater.

It should be noted that the current groundwater data (since the implementation of interim measures) show lower concentrations of naphthalene in the perimeter wells along the eastern shore of coke point than some of the levels on the western shore. However, the conclusions in the EA report regarding the historical relationship between groundwater and sediment, at the time of the sediment sampling (prior to interim measures), remain valid.

It was also concluded that, as with the PAHs, metal concentrations in the offshore sediments appear to be decoupled from potential sources on land. Metals present in the sediments were not elevated in discharging groundwater, suggesting that if the metals originated from the CPA, they were transported in a solid phase by overland flow or released by some other mechanism to the offshore environment. The concentrations of metals observed at depth within the sediments would require that the solid phase transport occurred historically. Thus, it was concluded that most of the metals in the offshore sediments originated from a CPA source, likely through historical offshore release(s) of impacted material.

1.2.2. EA 2011 Risk Assessment Report

The report titled ***"Risk Assessment of Offshore Areas Adjacent to the Proposed Coke Point Dredged Material Containment Facility at Sparrows Point"*** (EA, 2011) identified potential risks to human health and the environment based on off-shore sediment and surface water concentrations.

The 2011 risk assessment concluded that surface (uppermost 1 foot) bottom sediments presented a potential ecological risk due to metals, PAHs, and PCBs based upon a comparison of whole sediment analytical results to benchmark toxicity reference values. Benzene and other volatile compounds were determined not to present a concern in the surface sediments.

In addition to the potential ecological risk concerns, the 2011 risk assessment identified potentially unacceptable carcinogenic risk to adult and adolescent recreational users and to watermen, primarily due to dermal exposure to two PAHs [benzo(a)pyrene and dibenz(a,h)anthracene] in surface water. The revised carcinogenic slope factors for these PAHs provided in the June 2017 EPA RSL screening tables will reduce the estimates of cancer risks associated with these PAHs to within the acceptable range.

An unacceptable non-cancer hazard was also identified for the child recreational user. Essentially all of this non-cancer risk was associated with consumption of crabs and an assumed dioxin concentration in crabs that was derived using a bio-accumulation factor from literature and that was not the result of field-collected tissue samples. Therefore, the non-cancer hazard may be grossly overstated and should be re-evaluated. However, dioxin does not typically migrate in groundwater, so the current contribution from groundwater discharges to any non-cancer risk is considered to be negligible and irrelevant to the calculated risk and should not be a focus of this investigation.

1.3. EVALUATION OF EXISTING DATA

1.3.1. Sediment Data

A recent EPA report ***"Developing Sediment Remediation Goals at Superfund Sites Based on Pore Water for the Protection of Benthic Organisms from Direct Toxicity to Non-ionic Organic Contaminants"*** (EPA 2017); provides a recommended approach for evaluating the potential for sediment toxicity to benthic organisms based on pore water concentrations, rather than relying on benchmark toxicity reference values for whole sediments. This approach has been published subsequent to the previous assessment of the off-shore sediments. Therefore, it is appropriate to re-evaluate the conclusions of the 2011 risk assessment based on the more recent guidance on developing sediment criteria based on pore water concentrations.

The existing surface sediment data (**Appendix B**) was evaluated using the approach outlined in the EPA 2017 guidance to determine samples/areas where the newer methodology would indicate a potential for impact to benthic organisms. In accordance with the EPA guidance, pore water concentrations were estimated from the existing sediment data, using an equilibrium partitioning coefficient approach, and the estimated pore water concentrations were compared to Final Chronic Values (FCV) or Secondary Chronic Values (SCV) for those organic compounds for which values were available. These calculations and comparisons are presented in **Appendix C**. None of the existing sediment concentrations exceed the FCV or SCV criteria listed in the guidance.

The existing sediment data was then used to calculate the Total Toxic Units for each sediment sample. The calculations are limited by the existing analyses, as the existing analyses only provide data for a subset of 18 of the 34 PAHs recommended by the U.S. EPA's Ecological Monitoring and Assessment Program (EMAP) for assessing toxicity in contaminated sediments. The results of this evaluation of the existing sediment data indicate where the Total Toxic Units (TTUs) in the sediment samples exceed 1, and may exhibit toxicity to benthic organisms. The calculations for the existing sediment data are presented in the **Appendix C**. The results of the TTU analysis are presented on **Figure 3**. This evaluation should not be considered adequate to rule out all areas of concern with respect to sediment toxicity because of the limited nature of the subset of PAH analyses.

On the northwestern shoreline of the CPA, adjacent to the former Benzol Processing Area (Locations 1 through 5, **Figure 3**), the TTU values exceed 1 in 6 of the 7 samples. Location 1 had a TTU value less than 1. Location 5 had no individual compound with a TTU value greater than 1, and only had an exceedance due to cumulative contributions from multiple PAHs. In 5 of the 6 samples with TTU values exceeding 1 (Locations 2, 3A, 3B, 3C, and 4), the exceedances were caused essentially solely by naphthalene, with minimal additional contributions from other constituents. Of these, only one sample (Location 3B) had a TTU value of greater than 5.

Sample 3B was reported in slag fill and had an anomalously high level of naphthalene and field screening data indicated the presence of NAPL. Therefore, the anomalous impact in this sediment sample is not suspected to be associated with groundwater migration.

On the southwestern shoreline, adjacent to the Coke Point Landfill Area (locations 6 and 7), a number of constituents, mostly heavier PAHs, contributed to the exceedances, with less contribution from naphthalene in each location as you move to the south and to the east. Locations 6 and 7 had TTU values of greater than 10, with significant contributions from almost all of the PAHs. At Location 6, benz(a)anthracene, benzo(b)fluoranthene, chysene, fluoranthene, and naphthalene exceed 1 individually. At Location 7, the individual TU values for benz(a)anthracene, benzo(a)pyrene, chrysene and fluoranthene exceed 1.

Along the southern boundary Locations 8, 9 and 10 had TTU values of 2.27 to 3.68, with the average value of 3.16 for the southern boundary. The TTU values are caused by the cumulative effect of multiple PAHs and there are no individual constituents of concern that exceed 1 in these sediment samples.

On the eastern boundary (Locations 11 through 14), the TTU values for surface sediment samples exceed 1 in only 2 of the 6 locations (Locations 11 and 13A). The TU values for naphthalene exceed 1 at both of these locations.

1.3.2. Groundwater Data

Existing organic compound data for groundwater was evaluated using the approach outlined in the EPA 2017 guidance document. The purpose of this evaluation was to determine if the groundwater contains constituents of concern identified within the sediments at concentrations that may contribute to toxicity to benthic organisms.

The groundwater data were divided into three data sets which were analyzed for different constituents. The most extensive analysis was performed on the samples collected for the Area B groundwater investigation (SW wells shown on **Figure 2**). The 9 SW wells were sampled and analyzed as part of the Area B groundwater investigation for the VOCs and SVOCs following the procedures specified in the approved QAPP. As a result, the reporting limits for these samples were typically much lower.

The second data set consists of groundwater monitoring wells for the Coke Point landfill (CP wells shown on **Figure 2**). The 13 CP wells are sampled on a semi-annual basis as part of the groundwater monitoring program for the Coke Point Landfill. These wells are analyzed for VOCs and SVOCs.

The third data set is the Coke Oven Area wells (CO wells and TS well shown on **Figure 2**). These 23 wells are sampled to monitor the progress of the interim measures in the Coke Oven Area. Fourteen of these wells are sampled for VOCs. Nine of the CO wells also have data for SVOCs.

The groundwater data were screened against the FCV, SCV, and the narcosis benchmarks for those organic compounds for which values were available. Exceedances of these chronic toxicity values are indicated on **Figure 4**. There was only one exceedance (for toluene) in the SW wells. There were exceedances for the Benzene, Toluene, Ethylbenzene and Toluene (BTEX) compounds and naphthalene in many of the CO wells. In the CP wells there were only slight exceedances in 2 of the 14 wells (toluene in CP05-PZM019 and benzene and toluene in CP16-PZM035).

Total Toxic Unit (TTU) values have been calculated for each well sample using the methodology presented in the guidance. These calculations are presented in **Appendix D**. **Figure 5** presents the calculated TTUs for each well. These calculations are limited by the existing analyses, as the existing analyses only provide data for a subset of the analytes that are used to calculate TTUs in the guidance. Therefore, the results of this evaluation of the existing groundwater data indicate where the TTUs in the groundwater samples exceed 1, and may exhibit toxicity to benthic organisms. However, the evaluation is not adequate to rule out areas of concern with respect to potential to cause sediment toxicity due to the incomplete characterization.

SW Wells – The TTU values exceed 1 in 3 of the 9 SW wells (SW-029-MWS, SW13-PZM003 and SW14-PZM004). The exceedances in these 3 wells are due to contributions from naphthalene and high molecular weight PAHs (including acenaphthene, anthracene, benz(a)anthracene, benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, chrysene, dibenz(ah)anthracene, fluoranthene, fluorene, indeno(123-cd)pyrene, phenanthrene and pyrene). These 3 wells are located in the vicinity of the former coke oven batteries and coke oven gas and tar handling facilities. Therefore, it is possible that these exceedances are caused by dissolved PAHs in the groundwater.

CP Wells – The TTU values exceed 1 in the 13 CP wells evaluated. There were no detections of constituents at levels that would cause a TTU of 1 and none of the exceedances were due to benzene, naphthalene or the sum of these two constituents.

CO Wells – The TTU values exceed 1 in 21 of the 23 CO wells. In most cases the exceedances are caused by benzene and naphthalene concentrations. The TTUs would exceed 1 in 20 of the 23 wells due to either benzene, naphthalene, or the sum of these two compounds. The naphthalene concentrations in 15 of the CO wells exceed the pore water narcosis criterion. The benzene concentrations exceed the pore water criterion in 11 wells. Only wells CO104-PZM and

CO30-PZM060 on the southwestern shore of the Coke Oven Area, and CO10-PZM006 would not exceed 1 due to benzene and/or naphthalene concentrations.

1.3.3. Groundwater Contribution to Sediment Toxicity

The evaluation of the existing sediment data indicate that VOCs did not contribute significantly to the TTU in the off-shore surface (uppermost 1 foot) sediment samples. No significant concentrations of VOCs were detected in the 2009 surface sediment samples, even though, based on the 2005 URS groundwater quality data, the VOC concentrations in the groundwater at the time of the sediment sampling were higher than current levels. Therefore, concentrations of VOCs in the groundwater are not relevant to the potential for toxicity to benthic organisms.

As noted, not all of the constituents that contribute to TTUs have been analyzed in the wells. Therefore, the cumulative effect cannot be determined without further analysis. Sampling of certain wells to achieve lower reporting limits and to quantify the alkylated PAHs may result in different findings with respect to the potential for adverse impacts to benthic organisms.

The relationship of the on-site groundwater to the off-site sediment impacts was examined by comparing results from paired well/sediment sample locations. **Table 2** lists each constituent that has a calculated individual toxicity unit (TU) value of 0.10 or greater in each surface sediment sample. The table then lists the TU values in the paired perimeter groundwater wells for each of the constituents of concern identified in the specific sediment samples. If the TU value in the wells exceeds the TU value in the sediment, the result is highlighted in the table.

Locations 1, 12, 13B, 13C and 14 had cumulative total toxic units (TTU) values less than 1, indicating no evidence of sediment toxicity based on the existing data. Therefore, groundwater quality is not an issue at these locations. Locations 6 and 11 have no corresponding paired well location and are assessed based on other locations within the same discharge areas.

As indicated in the table, naphthalene is the only constituent of concern in the sediment samples that is actually detected in the groundwater at concentrations that might contribute to the toxicity of the sediments. Although naphthalene is present at locations 7, 9, and 10, the potential presence of other constituents of concern in the groundwater cannot be ruled out due to elevated reporting limits for these compounds.

This evaluation supports the findings in the 2009 EA report that, with the exception of naphthalene, there is little correlation between the constituents found in the sediments and the groundwater and supports the conclusion that the sediment impacts are primarily associated with historical direct releases.

Based on this evaluation of existing data, naphthalene seems to be the only constituent present in groundwater that has the potential to impact off-shore sediment toxicity. The potential for adverse impacts appears to be limited to the northwestern discharge area (Locations 2, 3, 4 and 5) and along the eastern discharge area (Location 13A). At the other sediment sample locations at the CPA, the existing sediment data did not show evidence of toxicity (Locations 1, 12, 13B, 13C, and 14), indicating that current levels of groundwater discharges are not causing unacceptable impacts in these areas, or the existing data indicates that the compounds actually detected in the groundwater are not the primary constituents of concern causing toxicity in the sediments (Locations 7, 8, 9 and 10).

1.4. SAMPLING DESIGN

1.4.1. Groundwater Sampling

Groundwater from the CO and CP wells has not been sampled and analyzed for the full suite of target parameters listed in the Quality Assurance Project Plan (QAPP). In addition, the groundwater has never been analyzed for the full list of 34 EMAP PAH and Alkylated PAH compounds that are considered in the benthic narcosis evaluation.

Each groundwater well adjacent to the sediment sampling locations as reported in the 2009 EA Off-shore Assessment Report will be selected for sampling for the full suite of target parameters and the full list of 34 EMAP PAH and Alkylated PAH compounds. In addition, well CO27-PZM046 will be selected for sampling, since it contains the maximum concentration of naphthalene in the CPA perimeter wells. The following 11 wells are proposed for groundwater sampling and are indicated on **Figure 6**:

- CO26-PZM007
- CO58-PZM001
- CP14-PZM009
- CP12-PZM012
- CP09-PZM010
- CP05-PZM019
- CO30-PZM015
- CO29-PZM010
- CO28-PZM048
- CO36-PZM043
- CO27-PZM046

This round of groundwater samples will be collected using conventional low-flow groundwater sampling techniques. Passive sampling, as discussed in the 2017 EPA guidance for pore water analysis, was considered to obtain free dissolved concentrations in groundwater, but passive sampling would add at least 2 months to the schedule for this task. Passive sampling would provide more of an averaged groundwater concentration over the required equilibration period. It was determined that groundwater concentrations should not be highly variable over a one month period and conventional groundwater sampling approaches would provide adequate results to expedite this sampling event. The proposed analytical method for the 34 EMAP constituents will yield reporting limits well below the pore water toxicity values provided in the 2017 EPA guidance and the results will provide total concentrations which will be more conservative than the dissolved concentrations obtained via passive sampling.

1.4.2. Surface Water Sampling

Surface water samples were last collected in 2009 as reported in the 2009 EA report. The 2009 assessment included sampling for VOCs and PAHs in the surface water. The results indicated detections of benzene, toluene and ethylbenzene in surface water, and identified naphthalene and other PAHs above background levels at several locations near the shore of the CPA. The subsequent 2011 EA report indicated that screening for metals, ethylbenzene and toluene indicates that these chemicals do not exceed their toxicity reference values and unlikely to produce risks. The benzene levels were well below the Maryland Numerical Criteria for Toxic Substances in Surface Waters (COMAR 26.08.02.03-2). However, the 2011 report concluded that high molecular weight and low molecular weight PAHs (including naphthalene) may produce a potential for risk to aquatic organisms.

Interim measures have been implemented and have been operating for a number of years since the completion of the previous off-shore assessment. Therefore it is appropriate to re-sample surface water to assess current conditions. Surface water samples will be collected from the locations shown on **Figure 6** to facilitate evaluation of current surface water impacts. Near-shore surface water samples will be collected from locations where the previous sampling or modeling indicated a potential for elevated concentrations of VOCs or PAHs in the surface water. The samples will be analyzed for VOCs and PAHs, as well as total and available cyanide, as listed in the Quality Assurance Project Plan (QAPP) to evaluate the potential for impact to aquatic organisms and to assess the progress of the interim measures.

1.4.3. Other Sampling Approaches

The existing sediment data has been evaluated in accordance with the most recent EPA guidance on developing sediment remediation goals for protection of benthic invertebrates. Pore water concentrations were estimated using the equilibrium partitioning approach described in the guidance. As noted, the sediment samples in the 2009 EA study were only analyzed for 16 of the 34 EMAP parent and alkylated PAH compounds that are considered in the benthic narcosis evaluation.

The 2009 EA report also indicated that the source of the contamination in the sediments was pyrogenic. Therefore, much of the high carbon content observed in the sediment samples may be in the form of black carbon. The sorption of nonionic organic contaminants to black carbon has been observed to be up to 10−1,000 times stronger than the sorption to natural sedimentary organic carbon (NSOC), which includes diagenic organic carbon, such as plant material. Since the estimates of TTUs in the sediment samples are based on partitioning calculations from whole sediment analysis, it is possible that measurement of free dissolved concentrations (FDCs) in the pore water will yield lower values for TTUs for these compounds. Therefore, dependent on the results of this proposed investigation, subsequent passive sampling of pore water may be determined to be beneficial to better assess sediment toxicity and the required degree of toxicity reduction to further refine groundwater cleanup goals for the protection of benthic organisms.

The proposed groundwater sampling will determine if the groundwater contains other PAH and alkylated compounds at levels that could contribute to sediment pore water toxicity. Further testing of the off-shore sediment may not be necessary to establish target concentrations in the groundwater discharge if the groundwater is found to not be a potential source of these compounds, and naphthalene is confirmed to be the only constituent of concern in the groundwater that would be significant with respect to sediment toxicity. As such, groundwater sampling results will be evaluated prior to the development and implementation of pore water sampling, if warranted or beneficial for the assessment of groundwater contribution to sediment toxicity.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1. PROJECT PERSONNEL

The investigation of groundwater in the CPA will be conducted by ARM under a contract with EAG. ARM will provide project planning, field sampling and reporting support. The required laboratory services will be contracted directly by EAG. The management, field, and laboratory responsibilities of key project personnel are defined in this section.

The ARM Project Manager, Mr. Eric Magdar is responsible for ensuring that all activities are conducted in accordance with this Work Plan and the contract requirements. Mr. Magdar will provide technical coordination with the MDE, EPA and EAG. The ARM Project Manager is responsible for managing all operations conducted for this project including:

- Ensure all personnel assigned to this project review the technical project plans before initiation of all tasks associated with the project.
- Review of project plans in a timely manner.
- Ensure proper methods and procedures are implemented to collect representative samples.
- Monitor the project budget and schedule and ensure the availability of necessary personnel, equipment, subcontractors, and other necessary services.

The lead ARM Project Scientist, Mr. Nicholas Kurtz, will be responsible for coordinating field activities including the collection, preservation, documentation and shipment of samples. Mr. Kurtz will directly communicate with the ARM Project Manager and Laboratory Project Manager on issues pertaining to sample shipments, schedules, container requirements, and other necessary issues. Mr. Kurtz is also responsible for ensuring the accuracy of sample documentation including the completion of the chain-of-custody (CoC) forms.

Pace Analytical Services, Inc. (PACE) of Greensburg, Pennsylvania and Alpha Analytical, Inc. (Alpha) of Mansfield, MA will provide the analytical services for this project. The addresses for the laboratories are as follows:

Pace Analytical
1638 Roseytown Road
Greensburg, PA 15601

Alpha Analytical
320 Forbes Boulevard
Mansfield, MA 02048

During the field activities, the Laboratory Project Manager for each laboratory will coordinate directly with the ARM Project Manager on issues regarding sample shipments, schedules, container requirements, and other field-laboratory logistics. The Laboratory Project Managers will monitor the daily activities of the laboratory, coordinate all production activities, and ensure that work is being conducted as specified in this document. The Laboratory Project Managers for this project will be Ms. Samantha Bayura for PACE and Ms. Susan O'Neil for Alpha.

2.2. HEALTH AND SAFETY ISSUES

Because of the potential presence of hazardous constituents in the groundwater at the CPA, the investigation will be conducted under a Health and Safety Plan (HASP) to protect investigation workers from possible exposure to contaminated materials. The HASP to be used during the field investigation of the CPA is included as **Appendix E**.

Based on information provided to ARM, the planned site activities will be conducted under modified Level D personal protection. The requirements of the modified Level D protection are defined in the attached HASP. All field personnel assigned for work at the Site have been trained in accordance with the Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response standard (29 CFR 1910.120) and other applicable OSHA training standards. All field staff will be experienced in hazardous waste site work, use of personal protective equipment (PPE), and emergency response procedures.

3.0 FIELD ACTIVITIES AND PROCEDURES

3.1. SAMPLING PLAN

The purpose of this Groundwater Work Plan is to identify current conditions in the groundwater of the CPA. This Work Plan presents the methods and protocols to be used to complete the groundwater investigation. These methods and procedures follow the MDE-VCP and EPA guidelines. Information regarding the project organization, field activities and sampling methods, sampling equipment, sample handling and management procedures, the laboratory analytical methods and selected laboratory, quality control and quality assurance procedures, investigation-derived waste (IDW) management methods, reporting requirements are described in detail in the QAPP that has been developed to support the investigation and remediation of the Tradepoint Atlantic Site (Quality Assurance Project Plan, ARM Group Inc., October 2, 2015). The proposed schedule of this investigation is contained in this work plan (Section 8.0).

3.2. WELL SAMPLING

ARM will check each existing well for the presence of NAPL (non-aqueous phase liquid) using an oil-water interface probe, in accordance with methods referenced in the QAPP Worksheet 21 – Field SOPs, SOP No. 19 – Depth to Groundwater and NAPL Measurements. A synoptic round of water level measurements will be collected from the groundwater wells to better define the groundwater flow within the CPA. The resulting elevation data will be used to create an updated groundwater contour map for the study area.

Groundwater samples will be collected from the selected wells in accordance with the procedures referenced in the QAPP Worksheet 21 – Field SOPs, SOP No. 6 – Groundwater Sampling. All groundwater samples will be analyzed for VOCs, SVOCs, TAL Metals (dissolved and total), Oil & Grease, TPH-DRO, TPH-GRO, hexavalent chromium (dissolved), and cyanide (total and available). Analytical methods, sample containers, preservatives, and holding times for the sample analyses are listed in the QAPP Worksheet 19 & 30 – Sample Containers, Preservation, and Holding Times.

Groundwater samples will be submitted for analysis for parent and alkylated PAHs by GC/MS via 8270D SIM (SOP #2247 in **Appendix F**). This method requires collection of 2 amber 1000-ml jars, with no preservative. The holding time on these samples is 7 days. The list of analytes will be the 34 PAHs recommended by the U.S. EPA's Ecological Monitoring and Assessment Program (EMAP) for assessing toxicity in contaminated sediments, as shown in the table labeled PM4476-1 in **Appendix G**. The associated method detection limit study used to determine the detection limits shown in PM4476-1 is also provided in **Appendix G**.

3.3. SURFACE WATER SAMPLING

Surface water samples will be collected in accordance with the procedures referenced in the QAPP Worksheet 21 – Field SOPs, SOP No. 4 – Surface Water Sampling. At each location, depth-discrete samples will be collected from the surface, mid-depth and bottom depths with the water column. Surface water samples will be submitted to Pace for analysis for VOCs and cyanide (total and available). Analytical methods, sample containers, preservatives, and holding times for the sample analyses are listed in the QAPP Worksheet 19 & 30 – Sample Containers, Preservation, and Holding Times.

In addition, surface water samples will be submitted for analysis for parent and alkylated PAHs by GC/MS via 8270D SIM (SOP #2247 in **Appendix F**). This method requires collection of 2 amber 1000-ml jars, with no preservative. The holding time on these samples is 7 days. The list of analytes will be the 34 PAHs recommended by the U.S. EPA's Ecological Monitoring and Assessment Program (EMAP) for assessing toxicity in contaminated sediments, as shown in the table labeled PM4476-1 in **Appendix G**. The associated method detection limit study used to determine the detection limits shown in PM4476-1 is also provided in **Appendix G**.

3.4. SAMPLE DOCUMENTATION

3.4.1. Sample Numbering

Samples will be numbered in accordance with the QAPP Appendix C – Data Management Plan.

3.4.2. Sample Labels & Chain-of-Custody Forms

Samples will be labeled and recorded on the Chain-of-Custody form in accordance with methods referenced in the QAPP Worksheet 26 & 27 – Sample Handling, Custody and Disposal.

3.5. LABORATORY ANALYSIS

3.5.1. Groundwater Samples

EAG has contracted PACE of Greensburg, Pennsylvania to perform the laboratory analysis for groundwater samples for VOCs, SVOCs, TAL-Metals (dissolved and total), Oil & Grease, TPH-DRO, TPH-GRO, hexavalent chromium (dissolved), and cyanide (total and available). The samples will be submitted for analysis with a standard turnaround time (approximately 5 work days). The specific list of compounds and analytes that the samples will be analyzed for, as well as the quantitation limits and project action limits, is provided in QAPP Worksheet 15 – Project Action Limits and Laboratory-Specific Detection/Quantitation Limits.

EAG has contracted Alpha of Mansfield, Massachusetts to perform the laboratory analysis for parent and alkylated PAHs by GC/MS via 8270D SIM for this project. The samples will be submitted for analysis with a standard turnaround time (approximately 15 work days). The specific list of compounds that will be analyzed for, as well as the quantitation limits and method detection limits, is provided in SOP #2247 and PM4476-1 attached in **Appendix F**.

3.5.2. Surface Water Samples

EAG has contracted PACE of Greensburg, Pennsylvania to perform the laboratory analysis for surface water samples for VOCs, PAHs (by SIM), and cyanide (total and available). The samples will be submitted for analysis with a standard turnaround time (approximately 5 work days). The specific list of compounds and analytes that the samples will be analyzed for, as well as the quantitation limits and project action limits, is provided in QAPP Worksheet 15 – Project Action Limits and Laboratory-Specific Detection/Quantitation Limits.

4.0 QUALITY ASSURANCE AND QUALITY CONTROL PROCEDURES

All groundwater samples will be collected using dedicated equipment including new polyethylene tubing. Equipment for surface water sampling will be decontaminated in accordance with SOP No. 16 before each sample is collected. Each cooler temperature will be measured and documented by the laboratory upon receipt.

Quality control (QC) samples are collected during field studies for various purposes, among which are to isolate site effects (control samples), to define background conditions (background sample), and to evaluate field/laboratory variability (spikes and blanks, trip blanks, duplicates, etc.).

The following QC samples will be submitted for analysis to support the data validation:

- Trip Blank – at a rate of one per day
    - Water - VOCs only
- Blind Field Duplicate – at a rate of one duplicate per twenty samples
    - Groundwater - VOCs, SVOCs, Metals, TPH-DRO, TPH-GRO, Hexavalent Chromium, and Cyanide (Total and Available)
    - Surface Water – VOCs, PAHs (by SIM), and Cyanide (Total and Available)
- Matrix Spike/Matrix Spike Duplicate – at a rate of one per twenty samples
    - Groundwater - VOCs, SVOCs, Metals, TPH-DRO, TPH-GRO, and Hexavalent Chromium, and Cyanide (Total and Available)
    - Surface Water - VOCs, PAHs (by SIM), and Cyanide (Total and Available)
- Field Blank – at a rate of one per twenty samples (substitute Equipment Blank if sampling with non-dedicated equipment or submersible pumps)
    - Groundwater - VOCs, SVOCs, Metals, TPH-DRO, TPH-GRO, Hexavalent Chromium, and Cyanide
    - Surface Water - VOCs, PAHs (by SIM), and Cyanide (Total and Available)

The QC samples will be collected and analyzed in accordance with the QAPP Worksheet 12 – Measurement Performance Criteria, QAPP Worksheet 20 – Field Quality Control, and QAPP Worksheet 28 – Analytical Quality Control and Corrective Action.

5.0 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

All investigation derived waste (IDW) procedures will be carried out in accordance with methods referenced in the QAPP Worksheet 21 – Field SOPs, SOP No. 5 – Investigation-Derived Wastes Management.

6.0 DATA VALIDATION

Data validation will be performed on 100% of the samples. All data validation procedures will be carried out in accordance with the QAPP Worksheet 34 – Data Verification and Validation Inputs, QAPP Worksheet 35 – Data Verification Procedures, and QAPP Worksheet 36 – Data Validation Procedures.

7.0 REPORTING

Following the receipt of all groundwater/surface water sampling results from the CPA, a Groundwater Investigation Report will be prepared that will document the sample collection procedures and supporting rationale, and present and interpret the analytical results to fulfill the objectives listed below.

1. determine whether constituents are present in the groundwater at levels that may present a potential concern with respect to pore water toxicity;
2. evaluate the groundwater quality to assess whether current discharges could be adversely impacting the off-shore environment; and
3. delineate the areas of the CPA where current groundwater discharges could be causing impacts; and
4. assess whether additional off-shore data are needed to determine remedial objectives for protection of benthic and other aquatic organisms; and
5. assess whether the currently implemented remedies have been or are likely to be effective at reducing or eliminating discharges of constituents of concern to the surface water.

All results will be presented in tabular and graphical formats as appropriate to best summarize the data for future use.

Current groundwater results will be compared to conventional aquatic toxicity screening criteria (10 x Maryland Water Quality Standards or FCV or SCV from the 2017 EPA guidance) to identify constituents of potential concern with respect to surface water and pore water impacts. The results will be indicated by location on a figure.

Surface water results will also be compared to Maryland Water Quality Standards, the FCV or SCV values from the 2017 EPA guidance, and other relevant toxicity reference values. The results will be indicated by location on a figure.

The TTUs for narcosis to benthic organisms will be calculated for each groundwater sample. The results will be posted on a figure to indicate the well locations, if any, where the groundwater presents the potential to cause toxicity in off-shore pore water.

Constituents of potential concern (COPCs) with respect to surface water impacts or sediment toxicity, will be identified.

If the only significant COPCs are determined to be the PAHs for which there is existing sediment data (i.e., additional 18 PAHs are not detected at significant levels in the groundwater), then the existing data will be used to determine the degree of reduction required to ensure that the cumulative TTUs do not exceed 1. Target concentrations for each COPC in the sediment will be determined based on the required degree of reduction in the sediment and assuming no contribution from the historical off-shore impacts.

If the groundwater sampling indicates that there are COPCs in the groundwater for which there is no existing sediment data, or if the target concentrations resulting from evaluation of the existing data are determined to be impracticable, then further evaluation will be required to assess the relative contributions of the groundwater versus the historical offshore sediment impacts. Passive sampling of actual free dissolved concentrations in pore water may be appropriate as a potential subsequent investigation.

8.0 SCHEDULE

The field activities below (including sample analysis and data validation) are planned so that they may be completed within approximately two (2) months of agency approval of this Work Plan. In addition, the investigation report will be submitted to the regulatory authorities within two (2) months of completion of the field activities in accordance with these approximate timeframes:

- Well inspection activities have already been completed;
- Well sampling will take approximately one (1) week to complete;
- Surface water sampling will take approximately two (2) to complete;
- Sample analysis, data validation and review is expected to require an additional eight (8) weeks to complete; and
- Preparation of the investigation report, including an internal Quality Assurance Review cycle, will require another six (6) weeks.

9.0 **REFERENCES**

EA Engineering, Science, and Technology, Inc (EA). “Site Assessment for Proposed Coke Point Dredged Material Containment Facility at Sparrows Point”, November 2009

EA Engineering, Science, and Technology, Inc. “Additional Offshore Delineation:
Proposed Coke Point Dredged Material Containment Facility at Sparrows Point.”
Baltimore County, Maryland. August 2010.

EA Engineering, Science, and Technology, Inc. ”Risk Assessment of Offshore Areas Adjacent to the Proposed Coke Point Dredged Material Containment Facility at Sparrows Point”, 2011

U.S. EPA. “Developing Sediment Remediation Goals at Superfund Sites Based on Pore Water for the Protection of Benthic Organisms from Direct Toxicity to Non-ionic Organic Contaminants”, October 2017

U.S. EPA/SERDP/ESTCP. 2017. Laboratory, Field, and Analytical Procedures for Using Passive Sampling in the Evaluation of Contaminated Sediments: User’s Manual. EPA/600/R- 16/357. Office of Research and Development, Washington, DC 20460

FIGURES

- 🟪 Groundwater Interim Measure
- 🟩 Coke Point Area
- 🟥 Parcel Boundary

Coke Point Area
Site Map
January 30, 2018

Figure
1

ARM Group Inc.
Earth Resource Engineers
and Consultants

EnviroAnalytics Group

ARM Project 170194M

Sparrows Point Terminal

Baltimore County, MD

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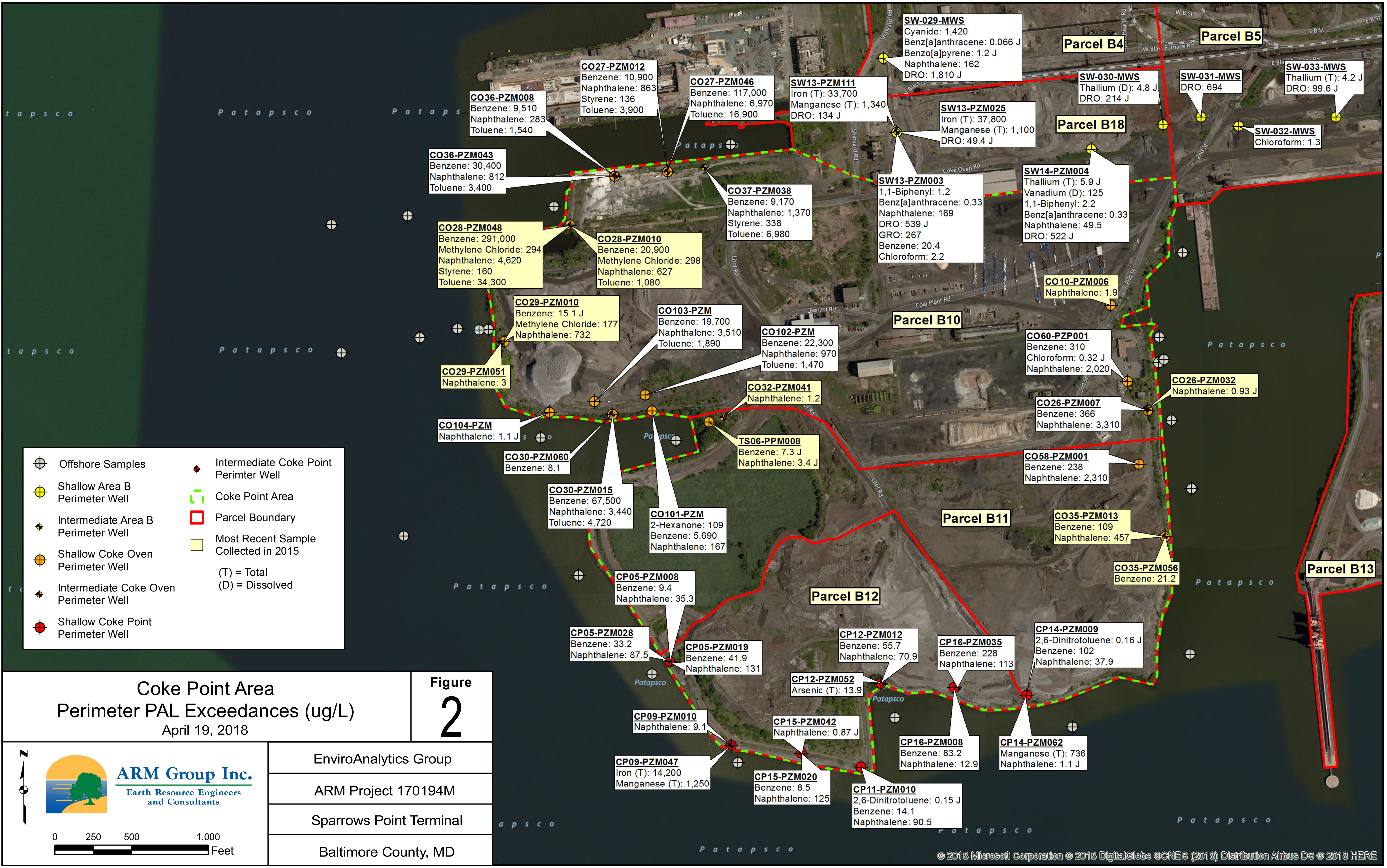

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Coke Point Area
Perimeter PAL Exceedances (ug/L)

April 19, 2018

Figure
2

ARM Group Inc.
Earth Resource Engineers and Consultants

EnviroAnalytics Group

ARM Project 170194M

Sparrows Point Terminal

Baltimore County, MD

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Total Toxic Units in Coke Point Sediment Samples

April 20, 2018

Figure
3

ARM Group Inc.
Earth Resource Engineers and Consultants

EnviroAnalytics Group
ARM Project 170194M
Sparrows Point Terminal
Baltimore County, MD

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Toxicity Screening in Coke Point Perimeter Wells (ug/L)

May 4, 2018

Figure

4

ARM Group Inc.
Earth Resource Engineers and Consultants

EnviroAnalytics Group

ARM Project 170194M

Sparrows Point Terminal

Baltimore County, MD

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Total Toxic Units in Coke Point Groundwater Samples

April 19, 2018

Figure
5

ARM Group Inc.
Earth Resource Engineers and Consultants

0 250 500 1,000
Feet

EnviroAnalytics Group

ARM Project 170194M

Sparrows Point Terminal

Baltimore County, MD

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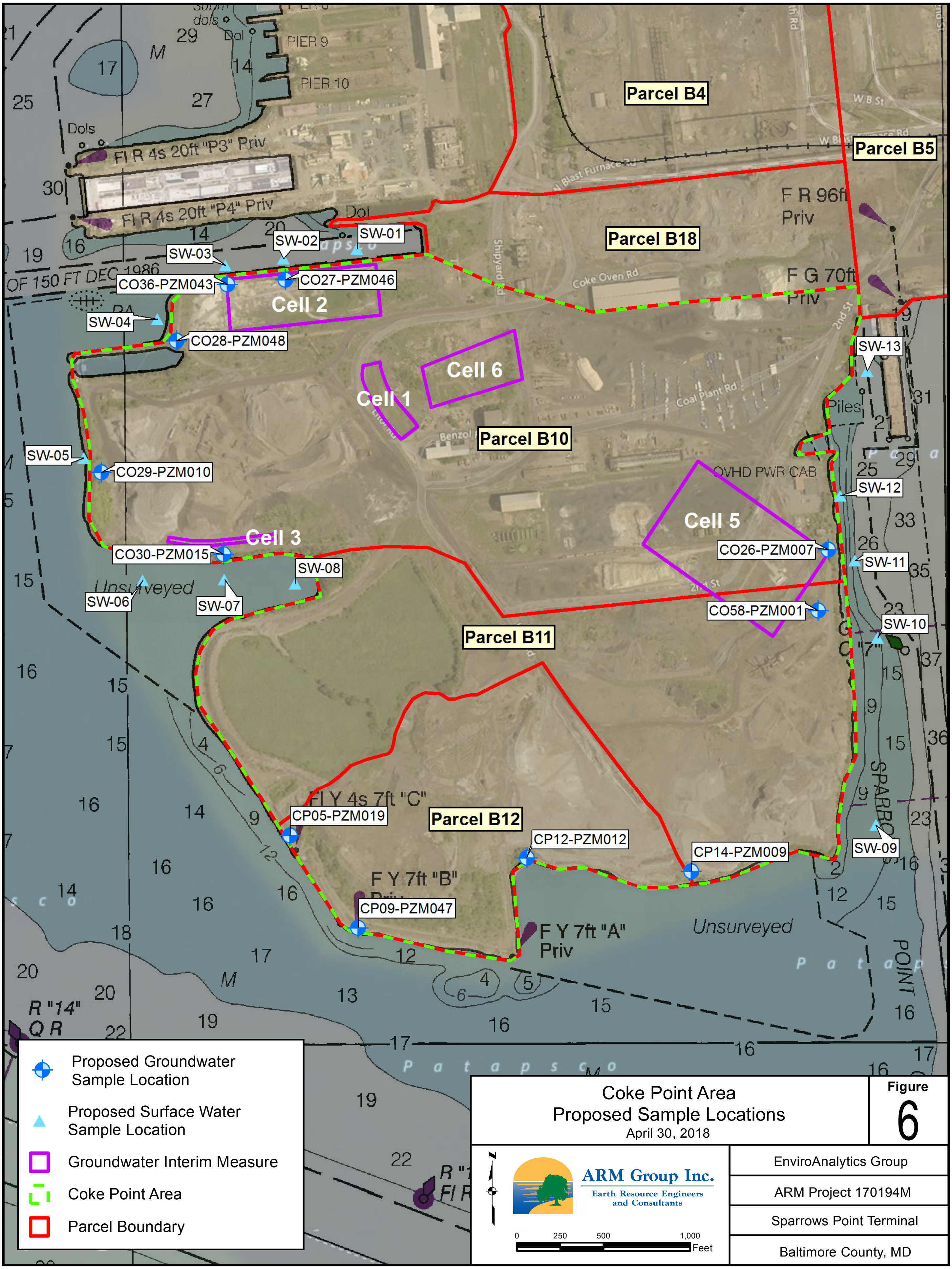

Coke Point Area
Proposed Sample Locations
April 30, 2018

Figure
6

ARM Group Inc.
Earth Resource Engineers and Consultants

EnviroAnalytics Group
ARM Project 170194M
Sparrows Point Terminal
Baltimore County, MD

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TABLES

Table 1 - Historical Groundwater Reports

Report	Author	Date of Report
Sparrows Point County Lands Summary Report	Rust Environment & Infrastructure	May 1, 1996
Description of Current Conditions (DCC) Report	Rust Environment & Infrastructure	January 1998
Site-Wide Investigation Work Plan - Groundwater Study	CH2M Hill	June 2000
Site-Wide Investigation Groundwater Study Report	CH2M Hill	July 2001
Site-Wide Investigation Release Site Characterization Study	CH2M Hill	June 2002
Site-Wide Investigation Report of Nature & Extent of Releases to Groundwater from the Special Study Areas	URS	January 2005
Site Assessment for Proposed Coke Point Dredged Material Containment Facility at Sparrows Point	EA Engineering, Science, and Technology, Inc.	Novemeber 2009
Parcel A1 (FedEx) Phase II ESA Report/RAP	Weaver Consultants Group	April 23, 2015
Pre-Design Investigation Summary Report - Former Coke Oven Area	Key Environmental, Inc	October 9, 2015 (Draft)
Phase I Offshore Investigation Report	EA Engineering, Science, and Technology, Inc.	March 2016
Parcel A3 Phase II Investigation Report	ARM Group, Inc.	June 10, 2016
Area B Groundwater Phase II Investigation Report	ARM Group, Inc.	September 30, 2016
Finishing Mills Groundwater Phase II Investigation Report	ARM Group, Inc.	November 30, 2016
Parcel B15 Phase II Investigation Report	ARM Group, Inc.	December 14, 2016
Parcel A2 Phase II Investigation Report	ARM Group, Inc.	December 19, 2016
Parcel A4 Phase II Investigation Report	ARM Group, Inc.	January 4, 2017
Parcel A8 Phase II Investigation Report	ARM Group, Inc.	January 11, 2017
Parcel A3 Phase II Investigation Report	ARM Group, Inc.	January 20, 2017
Parcel B8 Phase II Investigation Report	ARM Group, Inc.	February 7, 2017

Table 2
Comparison of Paired Sediment/Groundwater Toxic Unit Values

Surface Sediment Location	Constituents of Concern (TU>0.1) in Sediment	Sediment TU	Associated Groundwater TU Values					
1			**NA**					
	Naphthalene	0.22						
	TTU	**0.6**						
2			**CO28-PZM010**	**CO28-PZM048**				
	Fluoranthene	0.22	0.04	U				
	Naphthalene	1.02	3.2	23.9				
	Phenanthrene	0.16	0.07	0.05				
	Pyrene	0.1	U	U				
	TTU	**1.95**						
3A			**CO29-PZM010**	**CO29-PZM051**				
	Naphthalene	1.02	3.78	0.02				
	TTU	**1.38**						
3B								
	Anthracene	0.11	0.01	U				
	Benzo(a)anthracene	0.12	U	U				
	Benzo(b)fluoranthene	0.11	U	U				
	Fluoranthene	0.35	0.05	U				
	Naphthalene	106	3.78	0.02				
	Phenanthrene	0.27	0.09	U				
	Pyrene	0.17	0.02	U				
	TTU	**107**						
3C								
	Benzo(a)anthracene	0.1	U	U				
	Benzo(b)fluoranthene	0.12	U	U				
	Chrysene	0.1	U	U				
	Fluoranthene	0.28	0.05	U				
	Naphthalene	2.83	3.78	0.02				
	Pyrene	0.12	0.02	U				
	TTU	**3.95**						
4			**CO101-PZM**	**CO102-PZM**	**CO103-PZM**	**CO104-PZM**	**CO30-PZM015**	**CO30-PZM060**
	Benzo(a)anthracene	0.13	NA	NA	NA	NA	NA	NA
	Benzo(a)pyrene	0.11	NA	NA	NA	NA	NA	NA
	Benzo(b)fluoranthene	0.16	NA	NA	NA	NA	NA	NA
	Chrysene	0.13	NA	NA	NA	NA	NA	NA
	Fluoranthene	0.25	NA	NA	NA	NA	NA	NA
	Naphthalene	3.5	0.86	5.01	18.1	0.01	17.8	U
	Phenanthrene	0.18	NA	NA	NA	NA	NA	NA
	Pyrene	0.11	NA	NA	NA	NA	NA	NA
	TTU	**4.85**						
5			**CO32-PZM041**	**TS06-PPM008**	**CO101-PZM**			
	Anthracene	0.12	U	U	NA			
	Benz(a)anthracene	0.29	U	U	NA			
	Benzo(a)pyrene	0.11	U	U	NA			
	Benzo(b)fluoranthene	0.31	U	U	NA			
	Chrysene	0.26	U	U	NA			
	Fluoranthene	0.53	U	U	NA			
	Indeno(1,2,3-cd)pyrene	0.11	U	U	NA			
	Naphthalene	0.4	0.01	0.02	0.86			
	Phenanthrene	0.13	U	U	NA			
	Pyrene	0.26	U	U	NA			
	TTU	**2.62**						
6			**NA**					
	Acenaphthene	0.25						
	Anthracene	0.9						
	Benzo(a)anthracene	1.38						
	Benzo(a)pyrene	0.79						
	Benzo(b)fluoranthene	1.3						
	Benzo(ghi)perylene	0.4						
	Benzo(k)fluoranthene	0.77						
	Chrysene	1.44						
	Dibenzo(a,h)anthracene	0.2						
	Fluoranthene	1.9						
	Fluorene	0.12						
	Indeno(1,2,3-cd)pyrene	0.6						
	Naphthalene	1.14						
	Phenanthrene	0.85						
	Pyrene	0.99						
	TTU	**13.14**						

Table 2
Comparison of Paired Sediment/Groundwater Toxic Unit Values

Surface Sediment Location	Constituents of Concern (TU>0.1) in Sediment	Sediment TU	Associated Groundwater TU Values		
7			**CP05-PZM008**	**CP05-PZM019**	**CP05-PZM028**
	Acenaphthene	0.2	0.04	0.07	0.04
	Anthracene	0.74	0.01	0.01	0.02
	Benzo(a)anthracene	1.84	U	U	U
	Benzo(a)pyrene	1.19	U	U	U
	Benzo(b)fluoranthene	0.7	U	U	U
	Benzo(ghi)perylene	0.25	U	U	U
	Benzo(k)fluoranthene	0.57	U	U	U
	Chrysene	2.04	U	U	U
	Fluoranthene	4.24	0.03	0.02	0.07
	Indeno(1,2,3-cd)pyrene	0.38	U	U	U
	Naphthalene	0.56	0.18	0.68	0.45
	Phenanthrene	0.56	0.06	0.06	0.1
	Pyrene	0.59	U	U	0.03
	TTU	**14.09**			
8			**CP09-PZM010**	**CP09-PZM047**	
	Anthracene	0.11	U	U	
	Benzo(a)anthracene	0.21	U	U	
	Benzo(a)pyrene	0.16	U	U	
	Benzo(b)fluoranthene	0.22	U	U	
	Chrysene	0.21	U	U	
	Fluoranthene	0.36	U	0.04	
	Naphthalene	0.4	0.05	U	
	Phenanthrene	0.11	U	0.01	
	Pyrene	0.17	U	0.02	
	TTU	**2.27**			
9			**CP12-PZM012**	**CP12-PZM052**	
	Anthracene	0.15	0.02	U	
	Benzo(a)anthracene	0.37	U	U	
	Benzo(a)pyrene	0.34	U	U	
	Benzo(b)fluoranthene	0.38	U	U	
	Benzo(ghi)perylene	0.14	U	U	
	Benzo(k)fluoranthene	0.23	U	U	
	Chrysene	0.38	U	U	
	Fluoranthene	0.57	0.07	0.02	
	Indeno(1,2,3-cd)pyrene	0.2	U	U	
	Naphthalene	0.34	0.37	U	
	Phenanthrene	0.2	0.06	U	
	Pyrene	0.24	0.03	U	
	TTU	**3.68**			
10			**CP14-PZM009**	**CP14-PZM062**	
	Anthracene	0.13	0.01	U	
	Benzo(a)anthracene	0.35	U	U	
	Benzo(a)pyrene	0.25	U	U	
	Benzo(b)fluoranthene	0.3	U	U	
	Benzo(k)fluoranthene	0.2	U	U	
	Chrysene	0.35	U	U	
	Fluoranthene	0.73	0.04	U	
	Indeno(1,2,3-cd)pyrene	0.13	U	U	
	Naphthalene	0.31	0.2	0.01	
	Phenanthrene	0.19	0.06	U	
	Pyrene	0.35	U	U	
	TTU	**3.54**			
11			**NA**		
	Anthracene	0.15			
	Benzo(a)anthracene	0.4			
	Benzo(a)pyrene	0.26			
	Benzo(b)fluoranthene	0.3			
	Benzo(k)fluoranthene	0.19			
	Chrysene	0.36			
	Fluoranthene	0.79			
	Indeno(1,2,3-cd)pyrene	0.12			
	Naphthalene	1.49			
	Phenanthrene	0.21			
	Pyrene	0.37			
	TTU	**4.89**			

Table 2
Comparison of Paired Sediment/Groundwater Toxic Unit Values

Surface Sediment Location	Constituents of Concern (TU>0.1) in Sediment	Sediment TU	Associated Groundwater TU Values		
12			**CO58-PZM001**	**CO35-PZM013**	**CO35-PZM0056**
	Fluoranthene	0.13	NA	NA	NA
	Naphthalene	0.12	11.9	2.36	U
	TTU	**0.85**			
13A			**CO60-PZP001**	**CO26-PZM007**	**CO26-PZM032**
	Anthracene	0.13	NA	NA	U
	Benzo(a)anthracene	0.2	NA	NA	U
	Benzo(a)pyrene	0.13	NA	NA	U
	Benzo(b)fluoranthene	0.18	NA	NA	U
	Chrysene	0.18	NA	NA	U
	Fluoranthene	0.46	NA	NA	U
	Fluorene	0.1	NA	NA	U
	Naphthalene	1.08	10.4	17.1	0.004
	Phenanthrene	0.5	NA	NA	U
	Pyrene	0.22	NA	NA	U
	TTU	**3.49**			
13B					
	TTU	**0.29**			
13C					
	TTU	**0.23**			
14					
	TTU	**0.45**			

APPENDIX A

Groundwater Data Summary Table

APPENDIX A

Groundwater Data Summary Table

Coke Point Area
Area B Perimeter Groundwater Results

ID Event Date					SW-029-MWS 2/1/16		SW-30-MWS 2/1/2016		SW-031-MWS 2/1/16		SW-032-MWS 2/1/16		SW-033-MWS 2/1/16		SW13-PZM003 3/1/16		SW13-PZM025 2/1/16		SW13-PZM111 12/1/15		SW14-PZM004 3/1/16	
Parameter	**Category**	**PAL**	**FCV or SCV**	**Units**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**
Aluminum (D)	Inorganic	20000		µg/L	42.4	J	698		83.5		93.8		49.8	J	196		23.6	B	24.5	B	1850	
Aluminum (T)	Inorganic	20000		µg/L	56.1		766		320		266		881		206	J	23.7	J	1280		1740	
Antimony (D)	Inorganic	6		µg/L	6	U	6	U	6	U	2.4	B	6	U	6	U	6	U	6	U	6	U
Antimony (T)	Inorganic	6		µg/L	6	U	6	U	6	U	6	U	6	U	6	U	6	U	6	U	6	U
Arsenic (D)	Inorganic	10		µg/L	5	U	4.5	B	3.1	B	5	U	4.3	B	5	U	7.8		5	U	4.7	J
Arsenic (T)	Inorganic	10		µg/L	5	U	3.9	J	3.8	J	5	U	3.5	B	5	U	7.7		5	U	3.3	J
Barium (D)	Inorganic	2000		µg/L	85.8		21.6		29.4		57.6		47.1		65.7		121		52.5		164	
Barium (T)	Inorganic	2000		µg/L	84.3		22.6		30.1		62		53		64.2		123		70.7		162	
Beryllium (D)	Inorganic	4		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	0.63	B	1	U
Beryllium (T)	Inorganic	4		µg/L	1	U	1	U	1	U	1	U	0.34	J	1	U	1	U	1		1	U
Cadmium (D)	Inorganic	5		µg/L	3	U	3	U	3	U	3	U	3	U	3	U	0.62	B	0.66	J	3	U
Cadmium (T)	Inorganic	5		µg/L	0.73	J	3	U	3	U	3	U	3	U	3	U	0.81	J	3	U	3	U
Chromium (D)	Inorganic	100		µg/L	5	U	5	U	5	U	1.2	B	7.9		5	U	5	U	0.91	B	1.7	B
Chromium (T)	Inorganic	100		µg/L	0.87	B	5	U	1.4	J	3.3	J	8.8		5	U	0.98	B	17.4		1.1	J
Chromium VI (T)	Inorganic	0.035		µg/L	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U
Cobalt (D)	Inorganic	6		µg/L	1.9	B	5	U	5	U	5	U	5	U	5	U	2.5	B	1.7	B	5	U
Cobalt (T)	Inorganic	6		µg/L	2.9	J	5	U	5	U	5.2		5	U	5	U	2.5	B	3	J	5	U
Copper (D)	Inorganic	1300		µg/L	5	U	5	U	5	U	5	U	5	U	5	U	1.6	J	2.5	B	5	U
Copper (T)	Inorganic	1300		µg/L	5	U	1.9	B	5	U	5	U	2.5	J	5	U	2.1	J	11.5		2.1	B
Cyanide	Inorganic	200		µg/L	**1420**		64.6		6.1	J	32.4		81.1		9.9	J	10	U	10	U	10	U
Iron (D)	Inorganic	14000		µg/L	595		29.9	J	70	U	59.9	J	38.8	B	70	U	**36800**		**21000**		15.6	B
Iron (T)	Inorganic	14000		µg/L	678		131		346		1970		448		14.6	J	**37800**		**33700**		41.1	B
Lead (D)	Inorganic	15		µg/L	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U
Lead (T)	Inorganic	15		µg/L	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U
Manganese (D)	Inorganic	430		µg/L	183		0.92	J	40.4		98.6		2.3	B	5	U	**1060**		**1180**	J	5	U
Manganese (T)	Inorganic	430		µg/L	167		4.7	B	46.7		336		14.6		4.3	B	**1100**		**1340**		1.2	J
Mercury (D)	Inorganic	2		µg/L	0.2	U	0.2	UJ	0.2	UJ	0.2	UJ	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Mercury (T)	Inorganic	2		µg/L	0.2	U	0.2	UJ	0.2	UJ	0.2	UJ	0.2	U	0.2	U	0.2	U	0.06	B	0.2	U
Nickel (D)	Inorganic	390		µg/L	10	U	3.6	B	1.7	B	3	B	10	U	10	U	3.3	B	9	B	3.1	B
Nickel (T)	Inorganic	390		µg/L	10	U	1.6	B	2.8	B	4.6	B	1.2	B	10	U	3.3	B	12.6	J	3	J
Selenium (D)	Inorganic	50		µg/L	8	U	8	U	8	U	8	U	4.2	B	8	U	8	U	8	U	8	U
Selenium (T)	Inorganic	50		µg/L	6.8	B	8	U	8	U	8	U	4	B	6	J	8	U	8	U	8	U
Silver (D)	Inorganic	94		µg/L	6	UJ	6	U	6	U	6	U	6	U	6	U	6	U	6	U	6	U
Silver (T)	Inorganic	94		µg/L	6	U	6	U	6	U	6	U	6	U	6	U	6	U	6	U	6	U
Thallium (D)	Inorganic	2		µg/L	10	U	**4.8**	J	10	U	10	U	6.1	B	10	U	10	U	10	U	10	U
Thallium (T)	Inorganic	2		µg/L	10	U	10	U	10	U	10	U	**4.2**	J	10	U	10	U	3.4	B	**5.9**	J
Vanadium (D)	Inorganic	86		µg/L	4.6	J	39.6		6.2		6.1		26.3		0.85	B	5	U	1.3	B	**125**	
Vanadium (T)	Inorganic	86		µg/L	5	B	38.2		6.6		15.2		32.2		0.85	B	5	U	36.6		**118**	
Zinc (D)	Inorganic	6000		µg/L	43.6		2.2	B	3.9	B	10	U	1.5	B	1.3	B	1.8	B	24.6	J	0.64	J
Zinc (T)	Inorganic	6000		µg/L	2.4	B	6.9	B	2.8	B	2.7	B	3.7	B	0.72	B	10	U	48.1		10	U
Decachlorobiphenyl	PCB	0.044		µg/L	0.025	UJ	0.025	U	0.025	U	0.025	U	0.025	UJ	0.025	UJ	0.025	U	0.026	UJ	0.025	UJ
Dichlorobiphenyl	PCB	0.044		µg/L	0.005	UJ	0.005	U	0.005	U	0.005	U	0.005	UJ	0.005	UJ	0.005	UJ	0.005	UJ	0.005	UJ
Heptachlorobiphenyl	PCB	0.004		µg/L	0.015	UJ	0.015	U	0.015	U	0.015	U	0.015	UJ	0.015	UJ	0.015	U	0.015	UJ	0.015	UJ
Hexachlorobiphenyl	PCB	0.000004		µg/L	0.01	UJ	0.01	U	0.01	U	0.01	U	0.01	UJ	0.01	UJ	0.01	U	0.01	UJ	0.01	UJ
Monochlorobiphenyl	PCB	0.044		µg/L	0.005	UJ	0.005	U	0.005	U	0.005	U	0.005	UJ	0.005	UJ	0.005	U	0.005	UJ	0.005	UJ
Nonachlorobiphenyl	PCB	0.044		µg/L	0.025	UJ	0.025	U	0.025	U	0.025	U	0.025	UJ	0.025	UJ	0.025	U	0.026	UJ	0.025	UJ
Octachlorobiphenyl	PCB	0.044		µg/L	0.015	UJ	0.015	U	0.015	U	0.015	U	0.015	UJ	0.015	UJ	0.015	U	0.015	UJ	0.015	UJ

Coke Point Area
Area B Perimeter Groundwater Results

ID Event Date					SW-029-MWS 2/1/16		SW-30-MWS 2/1/2016		SW-031-MWS 2/1/16		SW-032-MWS 2/1/16		SW-033-MWS 2/1/16		SW13-PZM003 3/1/16		SW13-PZM025 2/1/16		SW13-PZM111 12/1/15		SW14-PZM004 3/1/16	
Parameter	**Category**	**PAL**	**FCV or SCV**	**Units**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**
PCBs (total)	PCB	0.5		µg/L	0.025	UJ	0.025	U	0.0927		0.025	U	0.025	UJ	0.08482		0.0965		0.026	UJ	0.025	UJ
PCBs (total)	PCB	0.5		µg/L	0.08554		0.09608		0.025	U	0.09598				0.025	UJ	0.025	U			0.07579	
Pentachlorobiphenyl	PCB	0.0000012		µg/L	0.01	UJ	0.01	U	0.01	U	0.01	U	0.01	UJ	0.01	UJ	0.01	U	0.01	UJ	0.01	UJ
Tetrachlorobiphenyl	PCB	0.0004		µg/L	0.01	UJ	0.01	U	0.01	U	0.01	U	0.01	UJ	0.01	UJ	0.01	U	0.01	UJ	0.01	UJ
Trichlorobiphenyl	PCB	0.044		µg/L	0.005	UJ	0.005	U	0.005	U	0.005	U	0.005	UJ	0.005	UJ	0.005	U	0.005	UJ	0.005	UJ
1,1-Biphenyl	SVOC	0.83	14	µg/L	1	U	1	U	1.1	U	1.1	U	1	U	**1.2**		1	U	1	U	**2.2**	
1,2,4,5-Tetrachlorobenzene	SVOC	1.7		µg/L	1	U	1	U	1.1	U	1.1	U	1	U	1	U	1	U	1	U	1	U
2,3,4,6-Tetrachlorophenol	SVOC	240		µg/L	1	U	1	U	1.1	U	1.1	U	1	U	1	U	1	U	1	U	1	U
2,4,5-Trichlorophenol	SVOC	1200		µg/L	2.5	U	2.6	U	2.6	U	2.6	U	2.5	U	2.5	U	2.5	U	2.5	U	2.6	U
2,4,6-Trichlorophenol	SVOC	4		µg/L	1	U	1	U	1.1	U	1.1	U	1	U	1	U	1	U	1	U	1	U
2,4-Dichlorophenol	SVOC	46		µg/L	1	U	1	U	1.1	U	1.1	U	1	U	1	U	1	U	1	U	1	U
2,4-Dimethylphenol	SVOC	360		µg/L	1	U	1	U	1.1	U	1.1	U	1	U	1	U	1	U	1	U	1	U
2,4-Dinitrophenol	SVOC	39		µg/L	2.5	U	2.6	U	2.6	U	2.6	U	2.5	U	2.5	U	2.5	U	2.5	U	2.6	U
2,4-Dinitrotoluene	SVOC	0.24		µg/L	1	U	1	U	1.1	U	1.1	U	1	U	1	U	1	U	1	U	1	U
2,6-Dinitrotoluene	SVOC	0.048		µg/L	1	U	1	U	1.1	U	1.1	U	1	U	1	U	1	U	1	U	1	U
2-Chloronaphthalene	SVOC	750		µg/L	1	U	1	U	1.1	U	1.1	U	1	U	1	U	1	U	1	U	1	U
2-Chlorophenol	SVOC	91		µg/L	1	U	1	U	1.1	U	1.1	U	1	U	1	U	1	U	1	U	1	U
2-Methylnaphthalene	SVOC	36		µg/L	0.35		0.1	U	0.022	J	0.11	U	0.04	J	12.2		0.1	U	0.1		12.8	J
2-Methylphenol	SVOC	930		µg/L	1	U	1	U	1.1	U	1.1	U	1	U	0.43	J	1	U	1	U	1	U
2-Nitroaniline	SVOC	190		µg/L	2.5	U	2.6	U	2.6	U	2.6	U	2.5	U	2.5	U	2.5	U	2.5	U	2.6	UJ
3&4-Methylphenol(m&p Cresol)	SVOC	930		µg/L	2	U	2.1	U	2.1	U	2.1	U	2	U	0.8	J	2	U	2	U	2.1	U
3,3'-Dichlorobenzidine	SVOC	0.12		µg/L	1	U	1	U	1.1	U	1.1	U	1	UJ	1	U	1	UJ	1	R	1	R
4-Chloroaniline	SVOC	0.36		µg/L	1	U	1	U	1.1	U	1.1	U	1	U	1	U	1	U	1	UJ	1	UJ
4-Nitroaniline	SVOC	3.8		µg/L	2.5	U	2.6	U	2.6	U	2.6	U	2.5	U	2.5	U	2.5	U	2.5	UJ	2.6	U
Acenaphthene	SVOC	530		µg/L	0.19		0.1	U	0.02	J	0.074	J	0.22		0.64		0.1	U	0.071	J	25.7	
Acenaphthylene	SVOC	530		µg/L	0.088	J	0.1	U	0.11	U	0.11	U	0.1	U	0.7		0.1	U	0.1	U	0.61	
Acetophenone	SVOC	1900		µg/L	0.45	J	1	U	1.1	U	1.1	U	1	U	6.2		1	U	1	U	1	U
Anthracene	SVOC	1800		µg/L	0.083	J	0.026	J	0.058	J	0.036	J	0.061	J	2.1		0.1	U	0.027	J	3.4	
Benz[a]anthracene	SVOC	0.03		µg/L	**0.066**	J	0.1	U	0.017	J	0.016	J	0.024	J	**0.33**		0.1	U	0.1	U	**0.33**	
Benzaldehyde	SVOC	1900		µg/L	1	U	1	U	1.1	U	1.1	U	1	U	1	U	1	U	1	U	1	UJ
Benzo[a]pyrene	SVOC	0.2		µg/L	**1.2**	J	0.1	U	0.11	U	0.11	U	0.011	J	0.04	J	0.1	U	0.1	U	0.035	J
Benzo[b]fluoranthene	SVOC	0.25		µg/L	2.7	B	0.1	U	0.11	U	0.11	U	0.016	J	0.11		0.1	U	0.1	U	0.089	J
Benzo[g,h,i]perylene	SVOC			µg/L	1.3	J	0.1	U	0.11	U	0.11	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Benzo[k]fluoranthene	SVOC	2.5		µg/L	1.3	B	0.1	U	0.11	U	0.11	U	0.012	J	0.11		0.1	U	0.1	U	0.088	J
bis(2-chloroethoxy)methane	SVOC	59		µg/L	1	U	1	U	1.1	U	1.1	U	1	U	1	U	1	U	1	U	1	U
bis(2-Chloroethyl)ether	SVOC	0.014		µg/L	1	U	1	U	1.1	U	1.1	U	1	U	1	U	1	U	1	U	1	U
bis(2-Chloroisopropyl)ether	SVOC	0.36		µg/L	1	U	1	U	1.1	U	1.1	U	1	U	1	U	1	U	1	U	1	U
bis(2-Ethylhexyl)phthalate	SVOC	6		µg/L	1	U	1	U	1.1	U	1.1	U	1	U	1	U	1	UJ	1.1		1	U
Caprolactam	SVOC	9900		µg/L	2.5	U	2.6	U	2.6	U	2.6	U	2.5	U	2.5	U	2.5	U	0.24	J	2.6	UJ
Carbazole	SVOC			µg/L	1	U	1	U	1.1	U	1.1	U	1	U	7.4		1	U	1	U	12.1	
Chrysene	SVOC	25		µg/L	0.048	B	0.1	U	0.0091	J	0.01	J	0.013	J	0.29		0.1	U	0.1	U	0.23	
Dibenz[a,h]anthracene	SVOC	0.025		µg/L	5.1	U	0.1	U	0.11	U	0.11	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Diethylphthalate	SVOC	15000		µg/L	1	U	1	U	1.1	U	1.1	U	1	U	1	U	1	U	1	U	1	U
Di-n-butylphthalate	SVOC	900		µg/L	1	U	1	U	1.1	U	1.1	U	1	U	1	U	0.1	J	1	U	1	U
Di-n-ocytlphthalate	SVOC	200		µg/L	1	U	1	U	1.1	U	1.1	U	1	U	1	U	1	UJ	1	U	1	U
Fluoranthene	SVOC	800		µg/L	0.091	J	0.1	U	0.038	J	0.046	J	0.088	J	3.5		0.1	U	0.04	J	6.8	J
Fluorene	SVOC	290		µg/L	0.079	J	0.1	U	0.026	J	0.05	J	0.12		2.5		0.1	U	0.082	J	11.4	

Coke Point Area
Area B Perimeter Groundwater Results

ID Event Date					SW-029-MWS 2/1/16		SW-30-MWS 2/1/2016		SW-031-MWS 2/1/16		SW-032-MWS 2/1/16		SW-033-MWS 2/1/16		SW13-PZM003 3/1/16		SW13-PZM025 2/1/16		SW13-PZM111 12/1/15		SW14-PZM004 3/1/16	
Parameter	**Category**	**PAL**	**FCV or SCV**	**Units**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**
Hexachlorobenzene	SVOC	1		µg/L	1	U	1	U	1.1	U	1.1	U	1	U	1	U	1	U	1	U	1	U
Hexachlorobutadiene	SVOC	0.14		µg/L	1	U	1	U	1.1	U	1.1	U	1	U	1	U	1	U	1	U	1	U
Hexachlorocyclopentadiene	SVOC	50		µg/L	1	U	1	U	1.1	U	1.1	U	1	U	1	U	1	U	1	U	1	U
Hexachloroethane	SVOC	0.33		µg/L	1	U	1	U	1.1	U	1.1	U	1	U	1	U	1	U	1	U	1	U
Indeno[1,2,3-c,d]pyrene	SVOC	0.25		µg/L	5.1	U	0.1	U	0.11	U	0.11	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Isophorone	SVOC	78		µg/L	1	U	1	U	1.1	U	1.1	U	1	U	1	U	1	U	1	U	1	U
Naphthalene*	SVOC	0.17	193.5	µg/L	**162**		0.027	B	0.037	B	0.086	B	0.1		**169**		0.1	U	0.14		**49.5**	
Nitrobenzene	SVOC	0.14		µg/L	1	U	1	U	1.1	U	1.1	U	1	U	1	U	1	U	1	U	1	U
N-Nitroso-di-n-propylamine	SVOC	0.011		µg/L	1	U	1	U	1.1	U	1.1	U	1	U	1	U	1	U	1	U	1	U
N-Nitrosodiphenylamine	SVOC	12		µg/L	1	U	1	U	1.1	U	1.1	U	1	U	1	U	1	U	1	U	1	U
Pentachlorophenol	SVOC	1		µg/L	2.5	U	2.6	U	2.6	U	2.6	U	2.5	U	2.5	U	2.5	U	2.5	U	2.6	U
Phenanthrene	SVOC			µg/L	0.08	J	0.1	U	0.12		0.099	J	0.24		9.7		0.017	J	0.19		27.5	
Phenol	SVOC	5800		µg/L	0.32	J	1	U	1.1	U	1.1	U	0.29	J	0.27	J	1	U	1	U	0.26	J
Pyrene	SVOC	120		µg/L	0.078	J	0.1	U	0.031	J	0.038	J	0.057	J	2.4		0.1	U	0.029	J	4.2	J
Diesel Range Organics	TPH/Oil and Grease	47		µg/L	**1810**	J	**214**	J	**694**	J	106	UJ	**99.6**	J	**539**	J	**49.4**	J	**134**	J	**522**	J
Gasoline Range Organics	TPH/Oil and Grease	47		µg/L	200	U	200	U	200	U	200	U	200	U	**267**		200	U	200	U	200	UJ
1,1,1-Trichloroethane	VOC	200	11	µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
1,1,2,2-Tetrachloroethane	VOC	0.076	610	µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
1,1,2-Trichloro-1,2,2-Trifluoroethane	VOC	55000		µg/L	50	U	50	U	50	U	50	U	50	U	50	U	50	U	50	U	50	U
1,1,2-Trichloroethane	VOC	5		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
1,1-Dichloroethane	VOC	2.7		µg/L	0.73	J	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
1,1-Dichloroethene	VOC	7		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
1,2,3-Trichlorobenzene	VOC	7		µg/L	2	U	2	UJ	2	UJ	2	UJ	2	U	2	U	2	U	2	U	2	U
1,2,4-Trichlorobenzene	VOC	70	110	µg/L	1	U	1	UJ	1	UJ	1	UJ	1	U	1	U	1	U	1	U	1	U
1,2-Dibromo-3-chloropropane	VOC	0.2		µg/L	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U
1,2-Dibromoethane	VOC	0.0075		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
1,2-Dichlorobenzene	VOC	600	14	µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
1,2-Dichloroethane	VOC	5		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
1,2-Dichloroethene (Total)	VOC	70		µg/L	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U	2	U
1,2-Dichloropropane	VOC	5		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
1,3-Dichlorobenzene	VOC		71	µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
1,4-Dichlorobenzene	VOC	75	15	µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
2-Butanone (MEK)	VOC	5600		µg/L	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U
2-Hexanone	VOC	38		µg/L	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U
4-Methyl-2-pentanone (MIBK)	VOC	1200		µg/L	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U
Acetone	VOC	14000		µg/L	10	R	10	U	10	U	10	U	10	R	10	R	10	U	10	R	10	R
Benzene	VOC	5	130	µg/L	3.6		1	U	1	U	1	U	1	U	**20.4**		1	U	1	U	1	U
Bromodichloromethane	VOC	0.13		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Bromoform	VOC	3.3	320	µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Bromomethane	VOC	7.5		µg/L	1	U	1	U	1	U	1	U	0.67	J	1	U	1	U	1	U	1	U
Carbon disulfide	VOC	810		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Carbon tetrachloride	VOC	5		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Chlorobenzene	VOC	100	64	µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Chloroethane	VOC	21000		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Chloroform	VOC	0.22		µg/L	1	U	1	U	1	U	**1.3**		1	U	**2.2**		1	U	1	U	1	U
Chloromethane	VOC	190		µg/L	1	U	1	UJ	1	UJ	1	UJ	1	U	1	U	1	U	1	UJ	1	U

Coke Point Area
Area B Perimeter Groundwater Results

ID Event Date					SW-029-MWS 2/1/16		SW-30-MWS 2/1/2016		SW-031-MWS 2/1/16		SW-032-MWS 2/1/16		SW-033-MWS 2/1/16		SW13-PZM003 3/1/16		SW13-PZM025 2/1/16		SW13-PZM111 12/1/15		SW14-PZM004 3/1/16	
Parameter	**Category**	**PAL**	**FCV or SCV**	**Units**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**	**Result**	**Final Flag**
cis-1,2-Dichloroethene	VOC	70		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
cis-1,3-Dichloropropene	VOC			µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Cyclohexane	VOC	13000		µg/L	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U
Dibromochloromethane	VOC	0.17		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Dichlorodifluoromethane	VOC	200		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Ethylbenzene	VOC	700	7.3	µg/L	1	U	1	U	1	U	1	U	1	U	2		1	U	1	U	1	U
Isopropylbenzene	VOC	450		µg/L	1	U	1	U	1	U	1	U	1	U	0.23	J	1	U	1	U	1	U
Methyl Acetate	VOC	20000		µg/L	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	R	5	U
Methyl tert-butyl ether (MTBE)	VOC	14		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Methylene Chloride	VOC	5		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Styrene	VOC	100		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Tetrachloroethene	VOC	5	98	µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	UJ
Toluene	VOC	1000	9.8	µg/L	0.49	J	1	U	1	U	1	U	1	U	35.6		1	U	1	U	1	U
trans-1,2-Dichloroethene	VOC	100		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
trans-1,3-Dichloropropene	VOC			µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Trichloroethene	VOC	5	47	µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Trichlorofluoromethane	VOC	1100		µg/L	1	UJ	1	U	1	U	1	U	1	UJ	1	U	1	U	1	U	1	U
Vinyl chloride	VOC	2		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Xylenes	VOC	10000	67	µg/L	3	U	3	U	3	U	3	U	3	U	47.7		3	U	3	U	3	U
1,4-Dioxane	VOC/SVOC	0.46		µg/L	0.045	J	0.1		0.11		0.18		0.18		0.14		0.1	U	0.1	U	0.27	

*Narcosis value used as SCV for naphthalene

Indicates exceedance of PAL

Indicates exceedance of FCV/SCV

Indicates exceedance of PAL and FCV/SCV

Coke Point Area
Coke Point Landfill Perimeter Groundwater Results

ID Event Date					CP05-PZM008 5/1/17		CP05-PZM019 11/1/17		CP05-PZM028 11/1/17		CP09-PZM010 11/1/17		CP09-PZM047 11/1/17		CP11-PZM010 11/1/17		CP12-PZM012 11/1/17		CP12-PZM052 11/1/17		CP14-PZM009 11/1/17		CP14-PZM062 11/1/17		CP15-PZM020 11/1/17		CP15-PZM042 11/1/17		CP16-PZM008 11/1/17		CP16-PZM035 11/1/17	
Parameter	**Category**	**PAL**	**FCV or SCV**	**Units**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**
Antimony (T)	Inorganic	6		µg/L	0.1	J	0.5	U	0.25	J	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.16	J	0.16	J	0.5	U	0.5	U	0.5	U
Arsenic (T)	Inorganic	10		µg/L	1.1		1		1.4		0.51		0.5	U	2		0.62		**13.9**		1.3		4.8		2.6		0.5	U	0.85		1.1	
Barium (T)	Inorganic	2000		µg/L	655		888		780		115		178		973		175		140		213		70.2		1150		213		1370		892	
Beryllium (T)	Inorganic	4		µg/L	0.2	U	0.2	U	0.2	U	0.2	U	1	UD3	0.2	U	10	UD3	10	U	0.2	U	1	UD3	0.2	U	1	UD3	0.2	U	0.2	U
Cadmium (T)	Inorganic	5		µg/L	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U
Calcium (T)	Inorganic			µg/L	560000	M1	756000		472000		647000		83000		812000		654000		103000		806000		47200		650000		44400		840000		949000	
Chromium (T)	Inorganic	100		µg/L	0.46	J	0.46	J	4		53.1		3.3		4.5		0.34	J	0.82		0.61		0.24	J	14.1		0.58		0.4	J	0.59	
Cobalt (T)	Inorganic	6		µg/L	0.069	J	0.5	U	0.5	U	0.5	U	1.5		0.5	U	0.5	U	0.18	J	0.5	U	0.21	J	0.5	U	0.35	J	0.5	U	0.5	U
Copper (T)	Inorganic	1300		µg/L	1	U	1	U	1.7		1.1		0.83	J	0.73	J	0.22	J	0.42	J	1	U	0.3	J	4.2		0.9	J	1	U	0.2	J
Iron (T)	Inorganic	14000		µg/L	102		102		153		30	J	**14200**		124		74.2		617		56.9		3370		30.6	J	1650		27.2	J	103	
Lead (T)	Inorganic	15		µg/L	0.1		0.072	J	0.9		4.1		0.4		0.63		0.094	JB	0.23	B	0.051	J	0.038	J	2.9		0.38		0.12	B	0.077	JB
Magnesium (T)	Inorganic			µg/L	39.2		85.7		2490		4420		404000								57.8		102000		90.5		383000					
Manganese (T)	Inorganic	430		µg/L			12.7		18.2		2		**1250**		6.7		2.7		420		9.2		**736**		2.3		182		4.1		8.8	
Mercury (T)	Inorganic	2		µg/L	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Nickel (T)	Inorganic	390		µg/L	5.7		9.2		8.6		1.6	B	0.48	JB	7.6		3.8		0.22	J	2.1		0.22	JB	6.9		0.5	U	3		11	
Potassium (T)	Inorganic			µg/L	72100	M1	88500		94800		116000		125000		98300		112000		80400		64700		55100		144000		120000		68000		70700	
Selenium (T)	Inorganic	50		µg/L	1.1	M1	0.46	J	0.91		0.48	J	0.22	J	1.2		25	UD3	25	U	0.45	J	0.5	U	1.1		0.5	U	0.33	J	0.33	J
Silver (T)	Inorganic	94		µg/L	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Sodium (T)	Inorganic			µg/L	363000	M1	980000		520000		2360000		3150000		377000		2590000		1930000		70200		1020000		226000		3170000		69900		132000	
Thallium (T)	Inorganic	2		µg/L	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Vanadium (T)	Inorganic	86		µg/L	2.4		1.4		11.8		12.8		5.4		0.63	J	4.8		2.4		0.72	J	1	U	0.4	J	0.29	J	0.35	J	0.4	J
Zinc (T)	Inorganic	6000		µg/L	3.2	J	3.3	J	10		1.7	J	3	J	1.9	JB	2.9	JB	3.2	JB	1.2	J	1.5	J	4.3	J	0.84	J	2.7	JB	3.7	JB
2,4,5-Trichlorophenol	SVOC	1200		µg/L	2.4	U1c	2.5	U1c	2.6	U	2.5	U	2.5	U	2.4	U1c	2.4	U1c	2.5	U1c	2.6	U	2.5	U	2.5	U	2.6	U	2.5	U1c	2.4	U1c
2,4,6-Trichlorophenol	SVOC	4		µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
2,4-Dichlorophenol	SVOC	46		µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
2,4-Dimethylphenol	SVOC	360		µg/L	1.8	1c	3.4	1c	3		1	U	1	U	9.4	1c	5.2	1c	0.99	U1c	0.82	J	1	U	12.6		1.1	U	4.6	1c	10.3	1c
2,4-Dinitrophenol	SVOC	39		µg/L	2.4	U1c	2.5	UCH1c	2.6	U	2.5	U	2.5	U	2.4	UCH1c	2.4	UCH1c	2.5	UCH1c	2.6	U	2.5	U	2.5	U	2.6	U	2.5	UCH1c	2.4	UCH1c
2,4-Dinitrotoluene	SVOC	0.24		µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
2,6-Dinitrotoluene	SVOC	0.048		µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	**0.15**	J1c	0.97	U1c	0.99	U1c	**0.16**	J	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
2-Chloronaphthalene	SVOC	750		µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
2-Chlorophenol	SVOC	91		µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
2-Methylnaphthalene	SVOC	36		µg/L	0.71	J1c	3.3	1c	0.97	J	0.13	J	1	U	2.7	1c	2.8	1c	0.99	U1c	0.35	J	1	U	5.6		1.1	U	0.25	J1c	1.1	1c
2-Methylphenol	SVOC	930		µg/L	0.28	J1c	0.75	J1c	0.64	J	0.16	J	1	U	4.3	1c	1.1	1c	0.99	U1c	0.68	J	1	U	8.6		1.1	U	0.99	1c	2.5	1c
2-Nitrophenol	SVOC			µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
3&4-Methylphenol(m&p Cresol)	SVOC	930		µg/L	2.5	1c	6.7	1c	6.2		1.1	J	2	U	12.6	1c	2.8	1c	2	U1c	1.5	J	2	U	23.2		2.1	U	6.9	1c	7.3	1c
3,3'-Dichlorobenzidine	SVOC	0.12		µg/L	0.98	UL21c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
4,6-Dinitro-2-methylphenol	SVOC			µg/L	2.4	U1c	2.5	UCH1c	2.6	U	2.5	U	2.5	U	2.4	UCH1c	2.4	UCH1c	2.5	UCH1c	2.6	U	2.5	U	2.5	U	2.6	U	2.5	UCH1c	2.4	UCH1c
4-Bromophenyl phenyl ether	SVOC		1.5	µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
4-Chloro-3-methylphenol	SVOC			µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
4-Chlorophenyl phenyl ether	SVOC			µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
4-Nitrophenol	SVOC			µg/L	0.98	UCH1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
Acenaphthene	SVOC	530		µg/L	2	1c	4.1	1c	2.1		1	U	0.29	J	2.6	1c	0.57	J1c	0.99	U1c	0.54	J	1	U	3.5		1.1	U	0.35	J1c	5.6	1c
Acenaphthylene	SVOC	530		µg/L	0.98	U1c	14.8	1c	16.9		1	U	1	U	0.98	U1c	0.24	J1c	0.99	U1c	1	U	1	U	1	U	1.1	U	5.2	1c	6.8	1c
Anthracene	SVOC	1800		µg/L	0.21	JL21c	0.17	J1c	0.33	J	1	U	1	U	0.52	J1c	0.42	J1c	0.99	U1c	0.2	J	1	U	0.74	J	1.1	U	0.12	J1c	1.4	1c
Benz[a]anthracene	SVOC	0.03		µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
Benzo[a]pyrene	SVOC	0.2		µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
Benzo[b]fluoranthene	SVOC	0.25		µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
Benzo[g,h,i]perylene	SVOC			µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
Benzo[k]fluoranthene	SVOC	2.5		µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
bis(2-chloroethoxy)methane	SVOC	59		µg/L	0.98	UL21c	0.19	J1c	0.16	J	1	U	1	U	0.72	J1c	0.97	U1c	0.99	U1c	1	U	1	U	0.93	J	1.1	U	0.98	U1c	0.97	U1c
bis(2-Chloroethyl)ether	SVOC	0.014		µg/L	0.98	UL21c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
bis(2-Chloroisopropyl)ether	SVOC	0.36		µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
bis(2-Ethylhexyl)phthalate	SVOC	6		µg/L	0.98	UCH1c	0.98	U1c	1	U	1	U	0.21	J	0.98	U1c	0.97	U1c	0.99	U1c	1	U	0.16	J	0.15	J	1.1	U	1.1	1c	0.97	U1c
Butylbenzylphthalate	SVOC			µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
Chrysene	SVOC	25		µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
Dibenz[a,h]anthracene	SVOC	0.025		µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
Dibenzofuran	SVOC		3.7	µg/L	0.39	J1c	1.1	1c	0.55	J	1	U	1	U	1.4	1c	0.2	J1c	0.99	U1c	0.18	J	1	U	1.6		1.1	U	0.13	J1c	1.6	1c
Diethylphthalate	SVOC	15000		µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
Dimethylphthalate	SVOC			µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
Di-n-butylphthalate	SVOC	900		µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
Di-n-ocytlphthalate	SVOC	200		µg/L	0.63	JB1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
Fluoranthene	SVOC	800		µg/L	0.24	J1c	0.17	J1c	0.53	J	1	U	0.29	J	1.4	1c	0.52	J1c	0.15	J1c	0.28	J	1	U	0.89	J	1.1	U	0.29	J1c	1.4	1c
Fluorene	SVOC	290		µg/L	0.43	JL21c	1.6	1c	0.93	J	1	U	1	U	1.2	1c	0.19	J1c	0.99	U1c	0.2	J	1	U	2.6		1.1	U	0.98	U1c	2.5	1c
Hexachlorobenzene	SVOC	1		µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
Hexachlorobutadiene	SVOC	0.14		µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
Hexachlorocyclopentadiene	SVOC	50		µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
Hexachloroethane	SVOC	0.33		µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
Indeno[1,2,3-c,d]pyrene	SVOC	0.25		µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c

Coke Point Area

Coke Point Landfill Perimeter Groundwater Results

ID Event Date					CP05-PZM008 5/1/17		CP05-PZM019 11/1/17		CP05-PZM028 11/1/17		CP09-PZM010 11/1/17		CP09-PZM047 11/1/17		CP11-PZM010 11/1/17		CP12-PZM012 11/1/17		CP12-PZM052 11/1/17		CP14-PZM009 11/1/17		CP14-PZM062 11/1/17		CP15-PZM020 11/1/17		CP15-PZM042 11/1/17		CP16-PZM008 11/1/17		CP16-PZM035 11/1/17	
Parameter	**Category**	**PAL**	**FCV or SCV**	**Units**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**
Isophorone	SVOC	78		µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
Naphthalene*	SVOC	0.17	193.5	µg/L	**35.3**		**131**		**87.5**		**9.1**		1	U	**90.5**		**70.9**		2	U	**37.9**		**1.1**	J	**125**		**0.87**	J	**12.9**		**113**	
Nitrobenzene	SVOC	0.14		µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
Pentachlorophenol	SVOC	1		µg/L	2.4	U1c	2.5	U1c	2.6	U	2.5	U	2.5	U	2.4	U1c	2.4	U1c	2.5	U1c	2.6	U	2.5	U	2.5	U	2.6	U	2.5	U1c	2.4	U1c
Phenanthrene	SVOC			µg/L	1.2	1c	1.1	1c	1.9		1	U	0.24	J	5	1c	1.1	1c	0.99	U1c	1.1		1	U	5.5		1.1	U	0.76	J1c	6.3	1c
Phenol	SVOC	5800		µg/L	2.5	1c	11.8	1c	9.5		1.1		1	U	9.3	1c	3.6	1c	0.99	U1c	1.9		1	U	25.2		1.1	U	2.8	1c	31.4	1c
Pyrene	SVOC	120		µg/L	0.98	U1c	0.98	U1c	0.32	J	1	U	0.18	J	0.89	J1c	0.35	J1c	0.99	U1c	1	U	1	U	0.57	J	1.1	U	0.24	J1c	0.64	J1c
Pyridine	SVOC			µg/L	0.98	U1c	0.65	J1c	0.45	J	0.26	J	1	U	2	1c	0.22	J1c	0.99	U1c	0.56	J	1	U	2		1.1	U	0.65	J1c	3.1	1c
1,1,1,2-Tetrachloroethane	VOC			µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
1,1,1-Trichloroethane	VOC	200	11	µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
1,1,2,2-Tetrachloroethane	VOC	0.076	610	µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
1,1,2-Trichloroethane	VOC	5		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
1,1-Dichloroethane	VOC	2.7		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
1,1-Dichloroethene	VOC	7		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
1,2,4-Trichlorobenzene	VOC	70	110	µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
1,2-Dibromo-3-chloropropane	VOC	0.2		µg/L	1	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U
1,2-Dibromoethane	VOC	0.0075		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
1,2-Dichlorobenzene	VOC	600	14	µg/L	0.98	U1c	1	U	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1	U	0.98	U1c	0.97	U1c
1,2-Dichlorobenzene	VOC	600	14	µg/L	1	U	0.98	U1c	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1.1	U	1	U	1	U
1,2-Dichloroethane	VOC	5		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
1,2-Dichloropropane	VOC	5		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
1,3-Dichlorobenzene	VOC		71	µg/L	0.98	U1c	0.98	U1c	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1.1	U	0.98	U1c	0.97	U1c
1,4-Dichlorobenzene	VOC	75	15	µg/L	1	U	0.98	U1c	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1.1	U	1	U	1	U
1,4-Dichlorobenzene	VOC	75	15	µg/L	0.98	U1c	1	U	1	U	1	U	1	U	0.98	U1c	0.97	U1c	0.99	U1c	1	U	1	U	1	U	1	U	0.98	U1c	0.97	U1c
2-Butanone (MEK)	VOC	5600		µg/L	5	U	4.6	J	3.1	J	1.8	J	10	U	6.7	J	1.7	J	10	U	2.7	J	10	U	10.2		10	U	3.3	J	5.7	J
2-Hexanone	VOC	38		µg/L	5	U	0.42	J	0.37	J	10	U	10	U	0.51	J	10	U	10	U	0.32	J	10	U	0.78	J	10	U	10	U	0.44	J
4-Methyl-2-pentanone (MIBK)	VOC	1200		µg/L	5	UL1	0.73	J	0.81	J	1.3	J	10	U	1.9	J	10	U	10	U	0.41	J	10	U	3.7	J	10	U	0.6	J	1	J
Acetone	VOC	14000		µg/L	51.8		34.2		20.1		24.9		4.3	J	105		15.6		4.3	J	22.6		2.9	J	213		4.2	J	52.7		46.5	
Benzene	VOC	5	130	µg/L	**9.4**		**41.9**		**33.2**		0.88	J	1	U	**14.1**		**55.7**		1	U	**102**		1	U	**8.5**		1	U	**83.2**		**228**	
Bromodichloromethane	VOC	0.13		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Bromoform	VOC	3.3	320	µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Bromomethane	VOC	7.5		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	UR1	1	U	1	U	1	U	1	U	1	U	1	U
Carbon disulfide	VOC	810		µg/L	1.9		1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1.1		1	U
Carbon tetrachloride	VOC	5		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Chlorobenzene	VOC	100	64	µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Chloroethane	VOC	21000		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Chloroform	VOC	0.22		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Chloromethane	VOC	190		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
cis-1,2-Dichloroethene	VOC	70		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
cis-1,3-Dichloropropene	VOC			µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Dibromochloromethane	VOC	0.17		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Ethylbenzene	VOC	700	7.3	µg/L	1	U	0.96	J	0.63	J	1	U	1	U	0.81	J	1		1	U	0.84	J	1	U	0.9	J	1	U	0.46	J	1.1	
Methyl tert-butyl ether (MTBE)	VOC	14		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Methylene Chloride	VOC	5		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Styrene	VOC	100		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	0.36	J	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Tetrachloroethene	VOC	5	98	µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Toluene	VOC	1000	9.8	µg/L	2.6		9.7		6.1		0.33	J	1	U	3.6		9.6		1	U	7		1	U	2.9		1	U	6.7		**16.7**	
trans-1,2-Dichloroethene	VOC	100		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
trans-1,3-Dichloropropene	VOC			µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Trichloroethene	VOC	5	47	µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Trichlorofluoromethane	VOC	1100		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Vinyl chloride	VOC	2		µg/L	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Xylenes	VOC	10000	67	µg/L	4		6.5		5.1		3	U	3	U	7.1		16.6		3	U	5.9		3	U	5.6		3	U	4.3		9.5	

*Narcosis value used as SCV for naphthalene

Indicates exceedance of PAL

Indicates exceedance of FCV/SVC

Indicates exceedance of PAL and FCV/SVC

Coke Point Area
Coke Oven Perimeter Groundwater Results

ID Event Date					CO101-PZM 9/12/17		CO102-PZM 12/1/17		CO103-PZM 12/1/17		CO104-PZM 12/1/17		CO10-PZM006 6/1/15		CO26-PZM007 12/1/17		CO26-PZM032 6/1/15		CO27-PZM046 12/1/17		CO27-PZM012 12/1/17		CO28-PZM010 6/1/15		CO28-PZM048 6/1/15		CO29-PZM010 6/1/15		CO29-PZM051 6/1/15		CO30-PZM015 12/1/17		CO30-PZM060 12/1/17		CO32-PZM041 6/1/15		CO35-PZM013 6/1/15		CO35-PZM056 6/1/15		CO36-PZM008 12/1/17		CO36-PZM043 12/1/17		CO37-PZM038 12/1/17		CO58-PZM001 12/1/17		CO60-PZP001 12/1/17		TS06-PPM008 6/1/15	
Parameter	**Category**	**PAL**	**FCV or SCV**	**Units**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**
2,4,5-Trichlorophenol	SVOC	1200		µg/L									2.6	U			2.5	U					2.6	U	2.6	U	2.6	U	2.5	U					2.8	U	2.6	U	2.6	U											2.8	U
2,4,6-Trichlorophenol	SVOC	4		µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
2,4-Dichlorophenol	SVOC	46		µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
2,4-Dimethylphenol	SVOC	360		µg/L									1	U			1	U					0.89	J	17.5		0.43	JH4H2	1	U					0.4	J	4.5	H21c	0.44	JR1											1.1	U
2,4-Dinitrophenol	SVOC	39		µg/L									2.6	U			2.5	U					2.6	U	2.6	U	2.6	U	2.5	U					2.8	U	2.6	U	2.6	U											2.8	U
2,4-Dinitrotoluene	SVOC	0.24		µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
2,6-Dinitrotoluene	SVOC	0.048		µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
2-Chloronaphthalene	SVOC	750		µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
2-Chlorophenol	SVOC	91		µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
2-Methylnaphthalene	SVOC	36		µg/L									1	U			1	U					4.3		30.1		12.1	H4H2	1	U					1.1	U	9	H21c	0.29	JM1											1.1	U
2-Methylphenol	SVOC	930		µg/L									1	U			1	U					1.5		30.3		0.25	JH4H2	1	U					0.49	J	5.5	H21c	0.63	J											1.1	U
2-Nitrophenol	SVOC			µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
3,3'-Dichlorobenzidine	SVOC	0.12		µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
4,6-Dinitro-2-methylphenol	SVOC			µg/L									2.6	U			2.5	U					2.6	U	2.6	U	2.6	U	2.5	U					2.8	U	2.6	U	2.6	U											2.8	U
4-Bromophenyl phenyl ether	SVOC		1.5	µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
4-Chloro-3-methylphenol	SVOC			µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
4-Chlorophenyl phenyl ether	SVOC			µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
4-Nitrophenol	SVOC			µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
Acenaphthene	SVOC	530		µg/L									1	U			1	U					0.59	J	2.5		0.74	JH4H2	1	U					1.1	U	2.5	H21c	0.25	JM1											1.1	U
Acenaphthylene	SVOC	530		µg/L									1	U			1	U					2.1		17.3		3.9	H4H2	1	U					1.1	U	3	H21c	1	U											1.1	U
Anthracene	SVOC	1800		µg/L									1	U			1	U					0.28	J	0.22	J	0.29	JH4H2	1	U					1.1	U	0.53	JH21c	1	U											1.1	U
Benz[a]anthracene	SVOC	0.03		µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
Benzo[a]pyrene	SVOC	0.2		µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
Benzo[b]fluoranthene	SVOC	0.25		µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
Benzo[g,h,i]perylene	SVOC			µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
Benzo[k]fluoranthene	SVOC	2.5		µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
bis(2-chloroethoxy)methane	SVOC	59		µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
bis(2-Chloroethyl)ether	SVOC	0.014		µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
bis(2-Chloroisopropyl)ether	SVOC	0.36		µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
bis(2-Ethylhexyl)phthalate	SVOC	6		µg/L									1	U			0.21	J					1	U	0.24	J	0.27	JH4H2	1	U					0.23	J	0.27	JH21c	1	U											1.1	U
Butylbenzylphthalate	SVOC			µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
Chrysene	SVOC	25		µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
Dibenz[a,h]anthracene	SVOC	0.025		µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
Dibenzofuran	SVOC		3.7	µg/L									1	U			1	U					0.71	J	3.5		1.2	H4H2	1	U					1.1	U	2	H21c	1	U											1.1	U
Diethylphthalate	SVOC	15000		µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
Dimethylphthalate	SVOC			µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
Di-n-butylphthalate	SVOC	900		µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
Di-n-ocytlphthalate	SVOC	200		µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
Fluoranthene	SVOC	800		µg/L									1	U			1	U					0.31	J	1	U	0.36	JH4H2	1	U					1.1	U	0.72	JH21c	0.22	JM1											1.1	U
Fluorene	SVOC	290		µg/L									1	U			1	U					0.88	J	3.1		1.6	H4H2	1	U					1.1	U	2.4	H21c	1	U											1.1	U
Hexachlorobenzene	SVOC	1		µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
Hexachlorobutadiene	SVOC	0.14		µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
Hexachlorocyclopentadiene	SVOC	50		µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
Hexachloroethane	SVOC	0.33		µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
Indeno[1,2,3-c,d]pyrene	SVOC	0.25		µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
Isophorone	SVOC	78		µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
Naphthalene*	SVOC	0.17	193.5	µg/L	**167**		**970**		**3510**		**1.1**	J	**1.9**	H4H21c	**3310**		**0.93**	J2c	**6970**		**863**		**627**		**4620**		**732**		**3**		**3440**		2	U	**1.2**		**457**		1	U	**283**		**812**		**1370**		**2310**		**2020**		**3.4**	J
Nitrobenzene	SVOC	0.14		µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
Pentachlorophenol	SVOC	1		µg/L									2.6	U			2.5	U					2.6	U	2.6	U	2.6	U	2.5	U					2.8	U	0.42	JL1H21c	2.6	U											2.8	U
Phenanthrene	SVOC			µg/L									1	U			1	U					1.3		0.97	J	1.7	H4H2	1	U					1.1	U	3.7	H21c	0.83	JM1											1.1	U
Phenol	SVOC	5800		µg/L									1	U			1	U					3.6		38.7		0.37	JH4H2	1.4	M1R1					1.1	U	0.34	JH21c	1	U											1.1	U
Pyrene	SVOC	120		µg/L									1	U			1	U					1	U	1	U	0.23	JH4H2	1	U					1.1	U	0.66	JH21c	1	U											1.1	U
Pyridine	SVOC			µg/L									1	U			1	U					1	U	13.4		1	U	1	U					1.1	U	3.1	H21c	0.57	J											1.1	U
1,1,1,2-Tetrachloroethane	VOC			µg/L	5	U	5	U	5	U	1	U	1	U	1	U	1	U	5	U	5	U	25	U	25	U	25	U	1	U	5	U	1	U	1	U	5	U	1	U	5	U	5	U	1	U	1	U	1	U	10	U
1,1,1-Trichloroethane	VOC	200	11	µg/L	5	U	5	U	5	U	1	U	1	U	1	U	1	U	5	U	5	U	25	U	25	U	25	U	1	U	5	U	1	U	1	U	5	U	1	U	5	U	5	U	1	U	1	U	1	U	10	U
1,1,2,2-Tetrachloroethane	VOC	0.076	610	µg/L	5	U	5	U	5	U	1	U	1	U	1	U	1	U	5	U	5	U	25	U	25	U	25	U	1	U	5	U	1	U	1	U	5	U	1	U	5	U	5	U	1	U	1	U	1	U	10	U
1,1,2-Trichloroethane	VOC	5		µg/L	5	U	5	U	5	U	1	U	1	U	1	U	1	U	5	U	5	U	25	U	25	U	25	U	1	U	5	U	1	U	1	U	5	U	1	U	5	U	5	U	1	U	1	U	1	U	10	U
1,1-Dichloroethane	VOC	2.7		µg/L	5	U	5	U	5	U	1	U	1	U	1	U	1	U	5	U	5	U	25	U	25	U	25	U	1	U	5	U	1	U	1	U	5	U	1	U	5	U	5	U	1	U	1	U	1	U	10	U
1,1-Dichloroethene	VOC	7		µg/L	5	U	5	U	5	U	1	U	1	U	1	U	1	U	5	U	5	U	25	U	25	U	25	U	1	U	5	U	1	U	1	U	5	U	1	U	5	U	5	U	1	U	1	U	1	U	10	U
1,2,4-Trichlorobenzene	VOC	70	110	µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
1,2-Dibromo-3-chloropropane	VOC	0.2		µg/L	5	U	25	U	25	U	5	U	2	U	5	U	2	U	25	U	25	U	50	U	50	U	50	U	2	U	25	U	5	U	2	U	10	U	2	U	25	U	25	U	5	U	5	U	5	U	20	U
1,2-Dibromoethane	VOC	0.0075		µg/L	5	U	5	U	5	U	1	U	1	U	1	U	1	U	5	U	5	U	25	U	25	U	25	U	1	U	5	U	1	U	1	U	5	U	1	U	5	U	5	U	1	U	1	U	1	U	10	U
1,2-Dichlorobenzene	VOC	600	14	µg/L	5	U	5	U	5	U	1	U	1	U	1	U	1	U	5	U	5	U	1	U	25	U	1	U	1	U	5	U	1	U	1.1	U	1	U	1	U	5	U	5	U	1	U	1	U	1	U	1.1	U
1,2-Dichlorobenzene	VOC	600	14	µg/L									1	U			1	U					25	U	1	U	25	U	1	U					1	U	5	U	1	U											10	U
1,2-Dichloroethane	VOC	5		µg/L	5	U	5	U	5	U	1	U	1	U	1	U	1	U	5	U	5	U	25	U	25	U	25	U	1	U	5	U	1	U	1	U	5	U	1	U	5	U	5	U	1	U	1	U	1	U	10	U
1,2-Dichloropropane	VOC	5		µg/L	5	U	5	U	5	U	1	U	1	U	1	U	1	U	5	U	5	U	25	U	25	U	25	U	1	U	5	U	1	U	1	U	5	U	1	U	5	U	5	U	1	U	1	U	1	U	10	U
1,3-Dichlorobenzene	VOC		71	µg/L									1	U			1	U					1	U	1	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
1,4-Dichlorobenzene	VOC	75	15	µg/L	5	U	5	U	5	U	1	U	1	U	1	U	1	U	5	U	5	U	1	U	1	U	25	U	1	U	5	U	1	U	1	U	5	U	1	U	5	U	5	U	1	U	1	U	1	U	10	U
1,4-Dichlorobenzene	VOC	75	15	µg/L									1	U			1	U					25	U	25	U	1	U	1	U					1.1	U	1	U	1	U											1.1	U
2-Butanone (MEK)	VOC	5600		µg/L	994		50	U	4.7	J	10	U	5	U	0.87	J	5	U	9	J	3.5	J	125	U	125	U	125	U	5	U	50	U	10	U	5	U	25	U	5	U	50	U	50	U	10	U	10	U	3.8	J	571	
2-Hexanone	VOC	38		µg/L	**109**		50	U	50	U	10	U	5	U	10	U	5	U	50	U	50	U	125	U	125	U	125	U	5	U	50	U	10	U	5	U	25	U	5	U	50	U	50	U	10	U	10	U	10	U	50	U
4-Methyl-2-pentanone (MIBK)	VOC	1200		µg/L	25	U	50	U	50	U	10	U	5	U	10	U	5	U	50	U	50	U	125	U	125	U	125	U	5	U	50	U	10	U	5	U	25	U	5	U	50	U	50	U	10	U	10	U	10	U	50	U
Acetone	VOC	14000		µg/L	6200		50	U	24.4	J	10	U	25	U	5.3	J	25	U	69.1		45.5	J	625	U	625	U	625	U	25	U	50	U	10	U	25	U	125	U	251		61.1		45.9	J	3.2	J	3.8	J	38.7		473	
Benzene	VOC	5	130	µg/L	**5690**		**22300**		**19700**		4.1		0.32	J	**366**		1	U	**117000**		**10900**		**20900**		**291000**		**15.1**	J	0.29	J	**67500**		**8.1**		1	U	**109**		**21.2**		**9510**		**30400**		**9170**		**238**		**310**		**7.3**	J
Bromodichloromethane	VOC	0.13		µg/L	5	U	5	U	5	U	1	U	1	U	1	U	1	U	5	U	5	U	25	U	25	U	25	U	1	U	5	U	1	U	1	U	5	U	1	U	5	U	5	U	1	U	1	U	1	U	10	U
Bromoform	VOC	3.3	320	µg/L	5	U	5	U	5	U	1	U	1	U	1	U	1	U	5	U	5	U	25	U	25	U	25	U	1	U	5	U	1	U	1	U	5	U	1	U	5	U	5	U	1	U	1	U	1	U	10	U
Bromomethane	VOC	7.5		µg/L	5	U	5	U	5	U	1	U	2	U	1	U	2	U	5	U	5	U	50	U	50	U	50	U	2	U	5	U	1	U	2	U	10	U	2	U	5	U	5	U	1	U	1	U	1	U	20	U
Carbon disulfide	VOC	810		µg/L	5	U	5	U	5	U	1	U	2	U	1	U	2	U	5	U	5	U	50	U	50	U	50	U	2	U	5	U	1	U	2	U	10	U	2	U	5	U	5	U	1	U	1	U	1	U	20	U
Carbon tetrachloride	VOC	5		µg/L	5	U	5	U	5	U	1	U	1	U	1	U	1	U	5	U	5	U	25	U	25	U	25	U	1	U	5	U	1	U	1	U	5	U	1	U	5	U	5	U	1	U	1	U	1	U	10	U
Chlorobenzene	VOC	100	64	µg/L	5	U	5	U	5	U	1	U	1	U	1	U	1	U	1.3	J	5	U	25	U	25	U	25	U	1	U	5	U	1	U	1	U	5	U	1	U	5	U	5	U	0.52	J	0.55	J	0.61	J	10	U
Chloroethane	VOC	21000		µg/L	5	U	5	U	5	U	1	U	1	U	1	U	1	U	5	U	5	U	25	U	25	U	25	U	1	U	5	U	1	U	1	U	5	U	1	U	5	U	5	U	1	U	1	U	1	U	10	U
Chloroform	VOC	0.22		µg/L	5	U	5	U	5	U	1	U	0.21	J	1	U	1	U	5	U	5	U	25	U	25	U	25	U	1	U	5	U	1	U	1	U	5	U	1	U	5	U	5	U	1	U	1	U	**0.32**	J	10	U
Chloromethane	VOC	190		µg/L	5	U	5	U	5	U	1	U	1	U	1	U	1	U	5	U	5	U	25	U	25	U	25	U	1	U	5	U	1.3		1	U	5	U	1	U	5	U	5	U	1	U	1	U	1	U	10	U
cis-1,2-Dichloroethene	VOC	70		µg/L	5	U	3.3	J	3.8	J	1	U	1	U	1	U	1	U	5	U	5	U	25	U	25	U	25	U	1	U	6		1	U	1	U	5	U	1	U	5	U	5	U	0.28	J	1	U	0.32	J	10	U
cis-1,3-Dichloropropene	VOC			µg/L	5	U	5	U	5	U	1	U	1	U	1	U	1	U	5	U	5	U	25	U	25	U	25	U	1	U	5	U	1	U	1	U	5	U	1	U	5	U	5	U	1	U	1	U	1	U	10	U
Dibromochloromethane	VOC	0.17		µg/L	5	U	5	U	5	U	1	U	1	U	1	U	1	U	5	U	5	U	25	U	25	U	25	U	1	U	5	U	1	U	1	U	5	U	1	U	5	U	5	U	1	U	1	U	1	U	10	U
Ethylbenzene	VOC	700	7.3	µg/L	5		**24**		**48.7**		1	U	1	U	**13.1**		1	U	**375**		**120**		**36.6**		**525**		25	U	1	U	**102**		1	U	1	U	2.8	J	6.3		**21.4**		**42.9**		**270**		**11.8**		**8.7**		10	U
Methyl tert-butyl ether (MTBE)	VOC	14		µg/L	5	U	5	U	5	U	1	U	1	U	1	U	1	U	5	U	5	U	25	U	25	U	25	U	1	U	5	U	1	U	1	U	5	U	1	U	5	U	5	U	0.2	J	1	U	1	U	10	U
Methylene Chloride	VOC	5		µg/L	5	U	5	U	5	U	1	U	2.2	BC9	1	U	2	U	5	U	5	U	**298**		**294**		**177**		2	BC9	5	U	1	U	2	U	27.9	B	2	U	5	U	5	U	1	U	1	U	1	U	57	B
Styrene	VOC	100		µg/L	5	U	8.3		10.1		1	U	1	U	77.5		1	U	44.7		**136**		25	U	**160**		25	U	1	U	15.5		1	U	1	U	3.4	J	4.6		5.7		7.5		**338**		34.3		45.6		10	U
Tetrachloroethene	VOC	5	98	µg/L	5	U	5	U	5	U	1	U	1	U	1	U	1	U	5	U	5	U	25	U	25	U	25	U	1	U	5	U	1	U	1	U	5	U	1	U	5	U	5	U	1	U	1	U	1	U	10	U
Toluene	VOC	1000	9.8	µg/L	**316**		**1470**		**1890**		0.27	J	1	U	**201**		1	U	**16900**		**3900**		**1080**		**34300**		25	U	1	U	**4720**		1	U	1	U	**23.5**		**15.8**		**1540**		**3400**		**6980**		**93.9**		**31**		2.9	J
trans-1,2-Dichloroethene	VOC	100		µg/L	5	U	5	U	5	U	1	U	1	U	1	U	1	U	5	U	5	U	25	U	25	U	25	U	1	U	5	U	1	U	1	U	5	U	1	U	5	U	5	U	1	U	1	U	1	U	10	U
trans-1,3-Dichloropropene	VOC			µg/L	5	U	5	U	5	U	1	U	1	U	1	U	1	U	5	U	5	U	25	U	25	U	25	U	1	U	5	U	1	U	1	U	5	U	1	U	5	U	5	U	1	U	1	U	1	U	10	U
Trichloroethene	VOC	5	47	µg/L	5	U	5	U	5	U	1	U	1	U	1	U	1	U	5	U	5	U	25	U	25	U	25	U	1	U	5	U	1	U	1	U	5	U	1	U	5	U	5	U	0.53	J	1	U	0.64	J	10	U
Trichlorofluoromethane	VOC	1100		µg/L	5	U	5	U	5	U	1	U	1	U	1	U	1	U	5	U	5	U	25	U	25	U	25	U	1	U	5	U	1	U	1	U	5	U	1	U	5	U	5	U	1	U	1	U	1	U	10	U
Vinyl chloride	VOC	2		µg/L	5	U	5	U	5	U	1	U	1	U	1	U	1	U	5	U	5	U	25	U	25	U	25	U	1	U	5	U	1	U	1	U	5	U	1	U	5	U	5	U	1	U	1	U	1	U	10	U
Xylenes	VOC	10000	67	µg/L	63.7		**292**		**813**		3	U	2	U	**281**		2	U	**4330**		**1060**		**436**		**6610**		50	U	2	U	**1440**		3	U	2	U	38.4		**70.1**		**631**		**675**		**2080**		**207**		**176**		20	U

*Narcosis value used as SCV for naphthalene

Indicates exceedance of PAL

Indicates exceedance of FCV/SCV

Indicates exceedance of PAL and FCV/SCV

APPENDIX B

Surficial Sediment Results

Table 4-4. Physical Characteristics of Surface Sediments Around the Coke Point Peninsula

Sparrows Point Site Assessment (2009), Baltimore, Maryland

				NORTHWESTERN SECTION							SOUTHWESTERN SECTION		
ANALYTE	**UNITS**	**Average RL**	**Background Concentration**[a]	**Location 1**	**Location 2**	**Location 3A**	**Location 3B**	**Location 3C**	**Location 4**	**Location 5**	**Location 6**	**Location 7**	**Location 8**
GRAVEL	%	--	0.343	0	1.6	6	0.2	0	0.3	5.4	0.2	7.3	0.6
SAND	%	--	6.7	1.1	73.7	68.3	15.7	15.1	15.4	68.7	24.8	57.8	38.4
SILT	%	--	75.5	80.1	22.8	11.7	67.6	80.9	67.4	21.5	48.1	25.9	50.1
CLAY	%	--	17.5	18.8	1.9	14	16.5	4	16.9	4.4	26.9	9	10.9
SILT+CLAY	%	--	93.0	98.9	24.7	25.7	84.1	84.9	84.3	25.9	75.0	34.9	61.0
MOISTURE CONTENT	%	0	--	404	61.8	80.1	176	181	111	71	134	89.2	161
PERCENT SOLIDS	%	1	24.5	18.3	66.1	56.9	36.1	31.5	54.7	61.6	41.3	49.4	36
TOTAL CYANIDE	MG/KG	1.19	1.08	2.7 U	**6.4**	0.88 U	**0.47 J**	**13.7**	**3.9**	**0.27 J**	**1.4 L**	**1.2 L**	1.4 UL
TOTAL ORGANIC CARBON	%	0.256	3.3	**5.76 K**	**28.0 K**	**29.7 K**	**22.9 K**	**22.5 K**	**9.3 K**	**42.0 K**	**5.87**	**8.39**	**10.0**

(a) Average concentration in surface sediment from Baltimore Harbor Channels. Source: EA 2009. *FY08 Evaluation of Dredged Material: Baltimore Harbor Federal Navigation Channels*

NOTE: Bold values represent detected concentrations
RL = Reporting Limit
J (inorganic) = compound was detected in the method blank

K = The reported value may be biased high, the actual value is expected to be lower than reported
L = The reported value may be biased low, the actual value is expected to be higher than reported
UL = Analyte was not detected. The reported quantitation limit is probably higher than reported
U = compound was analyzed, but not detected

Table 4-4. (continued)

ANALYTE	UNITS	Average RL	Background Concentration(a)	SOUTHERN SECTION			TURNING BASIN SECTION				
				Location 9	Location 10	Location 11	Location 12	Location 13A	Location 13B	Location 13C	Location 14
GRAVEL	%	--	0.343	0.4	1.9	0	0	28.5	0	0	0
SAND	%	--	6.7	40.8	34.3	25.2	50.2	56.7	7	4.6	11.7
SILT	%	--	75.5	47.9	60.3	69.6	41.2	12.2	83.2	87.4	80.3
CLAY	%	--	17.5	11	3.5	5.3	8.7	2.7	9.8	8	8
SILT+CLAY	%	--	93.0	58.9	63.8	74.9	49.9	14.9	93.0	95.4	88.3
MOISTURE CONTENT	%	0	--	92.1	121	123	91.5	37.1	--	342	321
PERCENT SOLIDS	%	1	24.5	51	40.5	42.3	50.2	76.3	26.8	22.4	23.8
TOTAL CYANIDE	MG/KG	1.19	1.08	**1.1 L**	**11.3 L**	**11.7 L**	**2.2 L**	**7.5 L**	**1.1 L**	**0.93 L**	**1.3 L**
TOTAL ORGANIC CARBON	%	2,560	3.3	**12.9**	**10.8**	**8.31**	**14.6**	**4.96**	**8.13**	**6.12**	**6.56**

(a) Average concentration in surface sediment from Baltimore Harbor Channels. Source: EA 2009. *FY08 Evaluation of Dredged Material: Baltimore Harbor Federal Navigation Channels*

NOTE: Bold values represent detected concentrations
RL = Reporting Limit
L = The reported value may be biased low, the actual value is expected to be higher than reported
-- = Not Tested

Table 4-5. Volatile Organic Compound Concentrations in Surface Sediments Around the Coke Point Peninsula

Sparrows Point Site Assessment (2009), Baltimore, Maryland

				NORTHWESTERN SECTION							SOUTHWESTERN SECTION		
ANALYTE	**UNITS**	**Average MDL**	**Background Concentration(a)**	**Location 1**	**Location 2**	**Location 3A**	**Location 3B**	**Location 3C**	**Location 4**	**Location 5**	**Location 6**	**Location 7**	**Location 8**
1,1,1-TRICHLOROETHANE	UG/KG	84.3	0.533	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
1,1,2,2-TETRACHLOROETHANE	UG/KG	84.3	0.886	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
1,1,2-TRICHLOROETHANE	UG/KG	84.3	1.34	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
1,1-DICHLOROETHANE	UG/KG	84.3	0.571	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
1,1-DICHLOROETHENE	UG/KG	84.3	1.16	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
1,2-DICHLOROBENZENE	UG/KG	84.3	1.83	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
1,2-DICHLOROETHANE	UG/KG	84.3	0.594	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
1,2-DICHLOROPROPANE	UG/KG	84.3	1.24	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
1,3-DICHLOROBENZENE	UG/KG	84.3	1.80	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
1,4-DICHLOROBENZENE	UG/KG	84.3	1.34	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
2-BUTANONE (MEK)	UG/KG	84.3	4.43	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
2-CHLOROETHYL VINYL ETHER	UG/KG	170	18.1	58 U	16 U	16 U	26 U	32 U	18 U	15 U	24 U	17 U	26 U
ACROLEIN	UG/KG	1,700	187	R	R	R	R	R	R	R	R	R	R
ACRYLONITRILE	UG/KG	1,700	52.375	580 U	160 U	160 U	260 U	320 U	180 U	150 U	240 U	170 U	260 U
BENZENE	UG/KG	146	1.08	29 U	**4 J**	7.8 U	13 U	16 U	8.8 U	**11**	12 U	8.3 U	13 U
BROMODICHLOROMETHANE	UG/KG	84.3	0.491	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
BROMOFORM	UG/KG	84.3	1.21	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
BROMOMETHANE	UG/KG	84.3	1.84	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
CARBON TETRACHLORIDE	UG/KG	84.3	0.491	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
CHLOROETHANE	UG/KG	84.3	1.86	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
CHLOROFORM	UG/KG	84.3	0.491	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
CHLOROMETHANE	UG/KG	84.3	0.570	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
CIS-1,3-DICHLOROPROPENE	UG/KG	84.3	0.570	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
DIBROMOCHLOROMETHANE	UG/KG	84.3	0.515	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
DICHLORODIFLUOROMETHANE	UG/KG	84.3	0.997	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
ETHYLBENZENE	UG/KG	84.3	1.84	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
METHYLENE CHLORIDE	UG/KG	84.3	12.5	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
TETRACHLOROETHENE	UG/KG	84.3	1.51	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
TOLUENE	UG/KG	84.3	1.16	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	**2.4 J**	12 U	8.3 U	13 U
TRANS-1,2-DICHLOROETHENE	UG/KG	84.3	1.29	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
TRANS-1,3-DICHLOROPROPENE	UG/KG	84.3	0.544	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
TRICHLOROETHENE	UG/KG	84.3	1.70	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
TRICHLOROFLUOROMETHANE	UG/KG	84.3	2.38	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U
VINYL CHLORIDE	UG/KG	84.3	1.30	29 U	8.2 U	7.8 U	13 U	16 U	8.8 U	7.5 U	12 U	8.3 U	13 U

(a) Average concentration in surface sediment from Baltimore Harbor Channels. Source: EA 2007. *FY05 Evaluation of Dredged Material: Baltimore Harbor Federal Navigation Channels*

NOTE: Bold values represent detected concentrations

MDL = method detection limit

R = Data was rejected by the validator and is unusable

J (organic) = compound was detected, but below the reporting limit (value is estimated)

U = compound was analyzed, but not detected

Table 4-5. (continued)

				SOUTHERN SECTION			TURNING BASIN SECTION				
ANALYTE	UNITS	Average MDL	Background Concentration(a)	Location 9	Location 10	Location 11	Location 12	Location 13A	Location 13B	Location 13C	Location 14
1,1,1-TRICHLOROETHANE	UG/KG	84.3	0.533	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U
1,1,2,2-TETRACHLOROETHANE	UG/KG	84.3	0.886	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U
1,1,2-TRICHLOROETHANE	UG/KG	84.3	1.34	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U
1,1-DICHLOROETHANE	UG/KG	84.3	0.571	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U
1,1-DICHLOROETHENE	UG/KG	84.3	1.16	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U
1,2-DICHLOROBENZENE	UG/KG	84.3	1.83	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U
1,2-DICHLOROETHANE	UG/KG	84.3	0.594	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U
1,2-DICHLOROPROPANE	UG/KG	84.3	1.24	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U
1,3-DICHLOROBENZENE	UG/KG	84.3	1.80	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U
1,4-DICHLOROBENZENE	UG/KG	84.3	1.34	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U
2-BUTANONE (MEK)	UG/KG	84.3	4.43	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U
2-CHLOROETHYL VINYL ETHER	UG/KG	170	18.1	19 U	25 U	21 U	19 U	13 U	37 U	42 U	42 U
ACROLEIN	UG/KG	1,700	187	R	R	R	R	R	R	R	R
ACRYLONITRILE	UG/KG	1,700	52.375	190 U	250 U	210 U	190 U	130 U	370 U	420 U	420 U
BENZENE	UG/KG	146	1.08	9.5 U	13 U	10 U	9.7 U	**79**	18 U	21 U	21 U
BROMODICHLOROMETHANE	UG/KG	84.3	0.491	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U
BROMOFORM	UG/KG	84.3	1.21	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U
BROMOMETHANE	UG/KG	84.3	1.84	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U
CARBON TETRACHLORIDE	UG/KG	84.3	0.491	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U
CHLOROETHANE	UG/KG	84.3	1.86	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U
CHLOROFORM	UG/KG	84.3	0.491	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U
CHLOROMETHANE	UG/KG	84.3	0.570	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U
CIS-1,3-DICHLOROPROPENE	UG/KG	84.3	0.570	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U
DIBROMOCHLOROMETHANE	UG/KG	84.3	0.515	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U
DICHLORODIFLUOROMETHANE	UG/KG	84.3	0.997	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U
ETHYLBENZENE	UG/KG	84.3	1.84	9.5 U	13 U	10 U	9.7 U	**4.9 J**	18 U	21 U	21 U
METHYLENE CHLORIDE	UG/KG	84.3	12.5	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U
TETRACHLOROETHENE	UG/KG	84.3	1.51	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U
TOLUENE	UG/KG	84.3	1.16	9.5 U	13 U	10 U	9.7 U	**57**	18 U	21 U	21 U
TRANS-1,2-DICHLOROETHENE	UG/KG	84.3	1.29	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U
TRANS-1,3-DICHLOROPROPENE	UG/KG	84.3	0.544	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U
TRICHLOROETHENE	UG/KG	84.3	1.70	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U
TRICHLOROFLUOROMETHANE	UG/KG	84.3	2.38	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U
VINYL CHLORIDE	UG/KG	84.3	1.30	9.5 U	13 U	10 U	9.7 U	6.6 U	18 U	21 U	21 U

(a) Average concentration in surface sediment from Baltimore Harbor Channels. Source: EA 2007. *FY05 Evaluation of Dredged Material: Baltimore Harbor Federal Navigation Channels*

NOTE: Bold values represent detected concentrations
MDL = method detection limit
R = Data was rejected by the validator and is unusable

J (organic) = compound was detected, but below the reporting limit (value is estimated)
U = compound was analyzed, but not detected

Table 4-6. Polycyclic Aromatic Hydrocarbon Concentrations in Surface Sediments Around the Coke Point Peninsula

Sparrows Point Site Assessment (2009), Baltimore, Maryland

				NORTHWESTERN SECTION							SOUTHWESTERN SECTION		
ANALYTE	UNITS(a)	Average MDL	Background Concentration(b)	Location 1	Location 2	Location 3A	Location 3B	Location 3C	Location 4	Location 5	Location 6	Location 7	Location 8
ACENAPHTHENE	MG/KG	0.237	0.0555	**0.073 J**	**1**	**0.83**	**5.9**	**3**	**0.58**	**3.3**	**4.2**	**4.6**	**0.76**
ACENAPHTHYLENE	MG/KG	0.237	0.118	**0.23**	**4.3**	**1.7**	**1.4**	**1.7**	**1.7**	**9.1**	**8.4**	**8.1**	**2**
ANTHRACENE	MG/KG	1.16	0.0374	**0.31**	**5**	**1.7**	**8.2**	**3.8**	**2.4**	**17**	**18**	**21**	**3.7**
BENZO(A)ANTHRACENE	MG/KG	0.325	0.0565	**0.68**	**7.6**	**4.4**	**11**	**9.3**	**4.8**	**48**	**32**	**61**	**8.1**
BENZO(A)PYRENE	MG/KG	0.300	0.108	**1.1**	**9.3**	**5.3**	**9.9**	**10**	**6**	**26**	**26**	**56**	**8.8**
BENZO(B)FLUORANTHENE	MG/KG	0.265	0.205	**1.3**	**9.3**	**5.5**	**10**	**11**	**6**	**53**	**31**	**24**	**8.8**
BENZO(GHI)PERYLENE	MG/KG	0.237	0.234	**0.95**	**6.3**	**3.9**	**7**	**7.2**	**4.2**	**16**	**20**	**18**	**5.4**
BENZO(K)FLUORANTHENE	MG/KG	0.237	0.403	**0.44**	0.130 U	0.130 U	0.190 U	0.210 U	0.130 U	0.130 U	**17**	**18**	**3.6**
CHRYSENE	MG/KG	0.325	0.229	**0.68**	**6.5**	**3.9**	**8.1**	**8.5**	**4.3**	**40**	**31**	**63**	**7.6**
DIBENZO(A,H)ANTHRACENE	MG/KG	0.237	0.137	**0.19**	**1.3**	0.130 U	**0.900 J**	**1.9**	**0.89**	0.130 U	**6.3**	**4.3**	**1.5**
FLUORANTHENE	MG/KG	1.63	0.215	**1.3**	**25**	**8.4**	**32**	**25**	**9**	**88**	**44**	**140**	**14**
FLUORENE	MG/KG	0.237	0.328	**0.2**	**3**	**0.69**	**3.5**	**1.9**	**1.3**	**2.5**	**2.5**	**2.4**	**0.61**
INDENO(1,2,3-CD)PYRENE	MG/KG	0.237	0.422	**0.74**	**5.3**	**3.5**	**6 J**	**6.1**	**3.7**	**25**	**19**	**17**	**4.9**
1-METHYLNAPHTHALENE	MG/KG	0.237	0.0609	**0.170 J**	**1.8**	**1.3**	**2.8**	**2.5**	**1.6**	**1.1**	**0.76**	**0.63**	**0.3**
2-METHYLNAPHTHALENE	MG/KG	1.40	0.181	**0.34**	**3.2**	**1.8**	**6.5**	**4.2**	**3.8**	**2.3**	**1.4**	**0.99**	**0.67**
NAPHTHALENE	MG/KG	5.34	0.282	**3.7**	**85**	**90**	**7,200**	**190**	**97**	**50**	**20**	**14**	**12**
PHENANTHRENE	MG/KG	0.663	0.232	**0.61**	**14**	**3.2**	**20**	**5.6**	**5.2**	**17**	**16**	**15**	**3.6**
PYRENE	MG/KG	0.337	0.368	**1.2**	**16**	**5.6**	**21**	**15**	**5.5**	**59**	**32**	**27**	**9.1**
TOTAL PAHs (ND=0)	MG/KG	--	3.24	**14.2**	**204**	**142**	**7,354**	**307**	**158**	**457**	**330**	**495**	**95.4**
TOTAL PAHs (ND=1/2MDL)	MG/KG	--	3.25	**14.2**	**204**	**142**	**7,354**	**307**	**158**	**457**	**330**	**495**	**95.4**
TOTAL PAHs (ND=MDL)	MG/KG	--	3.27	**14.2**	**204**	**142**	**7,354**	**307**	**158**	**458**	**330**	**495**	**95.4**

(a) Values were converted from µg/kg (as reported in laboratory analytical results).

(b) Average concentration in surface sediment from Baltimore Harbor Channels. Source: EA 2009. *FY08 Evaluation of Dredged Material: Baltimore Harbor Federal Navigation Channels*

NOTE: Bold values represent detected concentrations
MDL = method detection limit
J (organic) = compound was detected, but below the reporting limit (value is estimated)
U = compound was analyzed, but not detected

Table 4-6. (continued)

ANALYTE	UNITS[a]	Average MDL	Background Concentration[b]	SOUTHERN SECTION			TURNING BASIN SECTION				
				Location 9	Location 10	Location 11	Location 12	Location 13A	Location 13B	Location 13C	Location 14
ACENAPHTHENE	MG/KG	0.237	0.0555	**1.1**	**1.8**	**1.2**	**0.24**	**0.91**	**0.098**	**0.059 J**	**0.240 J**
ACENAPHTHYLENE	MG/KG	0.237	0.118	**3.5**	**3**	**1.6**	**0.95**	**1.5**	**0.2**	**0.110 J**	**0.200 J**
ANTHRACENE	MG/KG	1.16	0.0374	**6.5**	**4.9**	**4.3**	**1.2**	**2.2**	**0.28**	**0.160 J**	**0.390 J**
BENZO(A)ANTHRACENE	MG/KG	0.325	0.0565	**19**	**15**	**13**	**4.8**	**4**	**0.58**	**0.31**	**0.77**
BENZO(A)PYRENE	MG/KG	0.300	0.108	**25**	**15**	**12**	**5.5**	**3.6**	**0.63**	**0.31**	**0.73**
BENZO(B)FLUORANTHENE	MG/KG	0.265	0.205	**20**	**13**	**10**	**4.9**	**3.6**	**1.5**	**1.4**	**1.7**
BENZO(GHI)PERYLENE	MG/KG	0.237	0.234	**15**	**7.9**	**6**	**3.5**	**1.8**	**0.46**	**0.220 J**	**0.51**
BENZO(K)FLUORANTHENE	MG/KG	0.237	0.403	**11**	**8.1**	**5.9**	**3**	**1.8**	**0.35**	**0.190 J**	**0.29**
CHRYSENE	MG/KG	0.325	0.229	**18**	**14**	**11**	**4.8**	**3.3**	**0.64**	**0.31**	**0.88**
DIBENZO(A,H)ANTHRACENE	MG/KG	0.237	0.137	**4.9**	**2.6**	**1.9**	**1**	**0.53**	**0.086**	0.300 J	**0.120 J**
FLUORANTHENE	MG/KG	1.63	0.215	**29**	**31**	**26**	**7.5**	**8.9**	**1.1**	**0.59**	**1.7**
FLUORENE	MG/KG	0.237	0.328	**1**	**1.7**	**1.6**	**0.35**	**1.8**	**0.15**	**0.100 J**	**0.32**
INDENO(1,2,3-CD)PYRENE	MG/KG	0.237	0.422	**14**	**7.4**	**5.4**	**3.1**	**1.7**	**0.4**	**0.180 J**	**0.4**
1-METHYLNAPHTHALENE	MG/KG	0.237	0.0609	**0.35**	**0.59**	**0.76**	**0.18**	**0.83**	**0.14**	**0.070 J**	**0.170 J**
2-METHYLNAPHTHALENE	MG/KG	1.40	0.181	**0.61**	**0.68**	**1.6**	**0.37**	**1.6**	**0.28**	**0.140 J**	**0.32**
NAPHTHALENE	MG/KG	5.34	0.282	**13**	**9.9**	**37**	**5.3**	**16**	**1.7**	**0.77**	**1.5**
PHENANTHRENE	MG/KG	0.663	0.232	**8.1**	**6.4**	**5.6**	**1.7**	**7.9**	**0.53**	**0.31**	**0.86**
PYRENE	MG/KG	0.337	0.368	**17**	**21**	**17**	**5**	**6**	**0.79**	**0.43**	**1.2**
TOTAL PAHs (ND=0)	MG/KG	--	3.24	**207**	**164**	**162**	**53.4**	**68.0**	**9.91**	**5.67**	**12.3**
TOTAL PAHs (ND=1/2MDL)	MG/KG	--	3.25	**207**	**164**	**162**	**53.4**	**68.0**	**9.91**	**5.82**	**12.3**
TOTAL PAHs (ND=MDL)	MG/KG	--	3.27	**207**	**164**	**162**	**53.4**	**68.0**	**9.91**	**5.97**	**12.3**

(a) Values were converted from µg/kg (as reported in laboratory analytical results).

(b) Average concentration in surface sediment from Baltimore Harbor Channels. Source: EA 2009. *FY08 Evaluation of Dredged Material: Baltimore Harbor Federal Navigation Channels*

NOTE: Bold values represent detected concentrations

MDL = method detection limit

J (organic) = compound was detected, but below the reporting limit (value is estimated)

U = compound was analyzed, but not detected

Table 4-7. Metal Concentrations in Surface Sediments Around the Coke Point Peninsula

Sparrows Point Site Assessment (2009), Baltimore, Maryland

				NORTHWESTERN SECTION							SOUTHWESTERN SECTION		
ANALYTE	**UNITS**	**Average MDL**	**Background Concentration(a)**	**Location 1**	**Location 2**	**Location 3A**	**Location 3B**	**Location 3C**	**Location 4**	**Location 5**	**Location 6**	**Location 7**	**Location 8**
ANTIMONY	MG/KG	0.25	0.398	**1.6 J**	**0.39 J**	**0.47 J**	**1.1 J**	**2.3 J**	**0.8 J**	**0.58 J**	**1.1 L**	**0.96 L**	**1.3 L**
ARSENIC	MG/KG	0.125	20.6	**17.2**	**4.5**	**9.8**	**25.2**	**50.1**	**21.4**	**9.4**	**19.2**	**22.9**	**20**
BERYLLIUM	MG/KG	0.125	1.7	**1.9**	**0.5**	**0.98**	**1.3**	**1.4**	**0.93**	**0.96**	**1.4**	**1.6**	**1.6**
CADMIUM	MG/KG	0.125	1.38	**2.1**	**0.93**	**0.8**	**3.4**	**4.9**	**1.8**	**1**	**1.7 L**	**1.8 L**	**1.9 L**
CHROMIUM	MG/KG	0.25	125	**249**	**105**	**120**	**296**	**450**	**376**	**138**	**180**	**261**	**283**
COPPER	MG/KG	0.25	118	**139 L**	**50.1 L**	**44.5 L**	**177 L**	**595 L**	**81.7 L**	**51.7 L**	**97.3**	**87.7**	**129**
LEAD	MG/KG	0.202	109	**175**	**68.4**	**65.8**	**373**	**602**	**216**	**70.6**	**166**	**208**	**171**
MERCURY	MG/KG	0.0491	0.396	**0.47 L**	**0.33 L**	**0.24 L**	**0.7 L**	**1.1 L**	**0.34 L**	**0.24 L**	**0.5**	**0.43**	**0.44**
NICKEL	MG/KG	0.125	41.3	**56.2**	**17.7**	**24**	**37.9**	**51.6**	**34.9**	**28.7**	**36.4**	**35**	**47.5**
SELENIUM	MG/KG	0.626	3.11	**2.8 L**	**0.48 L**	**1.4 L**	**3.5 L**	**7.7 L**	**1.9 L**	**1.5 L**	**2.3**	**2.8**	**2.3**
SILVER	MG/KG	0.125	0.722	**1.4**	**0.34**	**0.3**	**1.8**	**2.8**	**0.61**	**0.3**	**0.86**	**0.71**	**0.93**
THALLIUM	MG/KG	0.125	0.354	**0.49**	**0.53**	**0.23**	**0.71**	**0.95**	**0.33**	**0.22**	**0.29**	**0.37**	**0.4**
ZINC	MG/KG	1.28	306	**861**	**373**	**279**	**1,070**	**1,790**	**838**	**418**	**498**	**617**	**597**

(a) Average concentration in surface sediment from Baltimore Harbor Channels. Source: EA 2009. *FY08 Evalution of Dredged Material: Baltimore Harbor Federal Navigation Channels*

NOTE: Bold values represent detected concentrations
MDL = method detection limit
J (inorganic) = compound was detected in the method blank
L = The reported value my be biased low, the actual value is expected to be higher than reported

Table 4-7. (continued)

				SOUTHERN SECTION			TURNING BASIN SECTION				
ANALYTE	UNITS	Average MDL	Background Concentration[(a)]	Location 9	Location 10	Location 11	Location 12	Location 13A	Location 13B	Location 13C	Location 14
ANTIMONY	MG/KG	0.25	0.398	**0.84 L**	**1.9 L**	**1.4 L**	**0.82 L**	**0.38 L**	**0.79 L**	**0.71 L**	**0.69 L**
ARSENIC	MG/KG	0.125	20.6	**12.5**	**46.8**	**34.1**	**12.6**	**7.8**	**13.6**	**14.8**	**13.3**
BERYLLIUM	MG/KG	0.125	1.7	**1**	**1.6**	**1.3**	**1**	**0.66**	**1.7**	**1.9**	**1.8**
CADMIUM	MG/KG	0.125	1.38	**1.4 L**	**7.4 L**	**4.4 L**	**1.9 L**	**0.61 L**	**1.8 L**	**1.9 L**	**1.9 L**
CHROMIUM	MG/KG	0.25	125	**156**	**200**	**235**	**107**	**178**	**127**	**124**	**137**
COPPER	MG/KG	0.25	118	**60.4**	**130**	**275**	**75.5**	**30.9**	**80.6**	**87.7**	**89.6**
LEAD	MG/KG	0.202	109	**146**	**1,150**	**567**	**268**	**87.2**	**167**	**169**	**166**
MERCURY	MG/KG	0.0491	0.396	**0.45**	**1.7**	**1.1**	**0.59**	**0.13**	**0.3**	**0.32**	**0.31**
NICKEL	MG/KG	0.125	41.3	**35.6**	**56.4**	**42.2**	**31.5**	**19**	**45**	**49.2**	**47.8**
SELENIUM	MG/KG	0.626	3.11	**1.5**	**7.8**	**5.1**	**1.6**	**0.32 J**	**2.4**	**2.6**	**2.4**
SILVER	MG/KG	0.125	0.722	**0.5**	**1.1**	**1.9**	**0.67**	**0.17**	**0.96**	**0.99**	**0.92**
THALLIUM	MG/KG	0.125	0.354	**0.25**	**0.85**	**0.76**	**0.4**	**0.41**	**0.65**	**0.68**	**0.65**
ZINC	MG/KG	1.28	306	**619**	**2,730**	**1,400**	**609**	**150**	**479**	**495**	**511**

(a) Average concentration in surface sediment from Baltimore Harbor Channels. Source: EA 2009. *FY08 Evaluation of Dredged Material: Baltimore Harbor Federal Navigation Channels*

NOTE: Bold values represent detected concentrations
MDL = method detection limit
J (inorganic) = compound was detected in the method blank
L = The reported value may be biased low, the actual value is expected to be higher than reported

APPENDIX C

Sediment Toxicity Calculations

SURFACE SEDIMENT PARTITIONING CALCULATIONS

					Location 1					Location 2					Location 3A					Location 3B				
Parameter	Units	KOC (L/kg)	Narcosis (ug/L)	FCV or SCV (ug/L)	Result	Cp (ug/kg)	Kp	Cd (ug/L)	Toxic Units	Result	Cp (ug/kg)	Kp	Cd (ug/L)	Toxic Units	Result	Cp (ug/kg)	Kp	Cd (ug/L)	Toxic Units	Result	Cp (ug/kg)	Kp	Cd (ug/L)	Toxic Units
Benzene	ug/kg	146	5300	130	29 U	-	8.4096	-	-	4 J	4	40.88	0.10	0.000018	7.8 U	-	43.362	-	-	13 U	-	33.434	-	-
Ethylbenzene	ug/kg	446	790	7.3	29 U	-	25.6896	-	-	8.2 U	-	124.88	-	-	7.8 U	-	132.46	-	-	13 U	-	102.13	-	-
Toluene	ug/kg	234	1600	9.8	29 U	-	13.4784	-	-	8.2 U	-	65.52	-	-	7.8 U	-	69.498	-	-	13 U	-	53.586	-	-
Acenaphthene	mg/kg	5030	55.85		0.073 J	73	289.728	0.25	0.004511	1	1000	1408.4	0.71	0.012713	0.83	830	1493.9	0.56	0.009948	5.9	5900	1151.9	5.12	0.091712
Acenaphthylene	mg/kg	5030	306.9		0.23	230	289.728	0.79	0.002587	4.3	4300	1408.4	3.05	0.009948	1.7	1700	1493.9	1.14	0.003708	1.4	1400	1151.9	1.22	0.003960
Anthracene	mg/kg	16400	20.73		0.31	310	944.64	0.33	0.015831	5	5000	4592	1.09	0.052525	1.7	1700	4870.8	0.35	0.016836	8.2	8200	3755.6	2.18	0.105326
Benzo(a)anthracene	mg/kg	177000	2.227		0.68	680	10195.2	0.07	0.029950	7.6	7600	49560	0.15	0.068859	4.4	4400	52569	0.08	0.037584	11	11000	40533	0.27	0.121861
Benzo(a)pyrene	mg/kg	587000	0.9573		1.1	1100	33811.2	0.03	0.033985	9.3	9300	164360	0.06	0.059107	5.3	5300	174339	0.03	0.031757	9.9	9900	134423	0.07	0.076933
Benzo(b)fluoranthene	mg/kg	599000	0.6774		1.3	1300	34502.4	0.04	0.055622	9.3	9300	167720	0.06	0.081856	5.5	5500	177903	0.03	0.045639	10	10000	137171	0.07	0.107620
Benzo(ghi)perylene	mg/kg	1950000	0.4391		0.95	950	112320	0.01	0.019262	6.3	6300	546000	0.01	0.026278	3.9	3900	579150	0.01	0.015336	7	7000	446550	0.02	0.035700
Benzo(k)fluoranthene	mg/kg	587000	0.6415		0.44	440	33811.2	0.01	0.020286	0.13 U	-	164360	-	-	0.13 U	-	174339	-	-	0.19 U	-	134423	-	-
Chrysene	mg/kg	180000	2.042		0.68	680	10368	0.07	0.032119	6.5	6500	50400	0.13	0.063158	3.9	3900	53460	0.07	0.035726	8.1	8100	41220	0.20	0.096232
Dibenzo(a,h)anthracene	mg/kg	1910000	0.2825		0.19	190	110016	0.00	0.006113	1.3	1300	534800	0.00	0.008605	0.13 U	-	567270	-	-	0.9 J	900	437390	0.00	0.007284
Fluoranthene	mg/kg	55400	7.109		1.3	1300	3191.04	0.41	0.057306	25	25000	15512	1.61	0.226706	8.4	8400	16454	0.51	0.071813	32	32000	12687	2.52	0.354810
Fluorene	mg/kg	9160	39.3		0.2	200	527.616	0.38	0.009645	3	3000	2564.8	1.17	0.029763	0.69	690	2720.5	0.25	0.006454	3.5	3500	2097.6	1.67	0.042457
Indeno(1,2,3-cd)pyrene	mg/kg	1950000	0.275		0.74	740	112320	0.01	0.023958	5.3	5300	546000	0.01	0.035298	3.5	3500	579150	0.01	0.021976	6 J	6000	446550	0.01	0.048859
1-Methylnaphthalene	mg/kg	2530	-		0.17 J	170	145.728	1.17	-	1.8	1800	708.4	2.54	-	1.3	1300	751.41	1.73	-	2.8	2800	579.37	4.83	-
2-Methylnaphthalene	mg/kg	2480	-		0.34	340	142.848	2.38	-	3.2	3200	694.4	4.61	-	1.8	1800	736.56	2.44	-	6.5	6500	567.92	11.45	-
Naphthalene*	mg/kg	1540	193.5	193.5	3.7	3700	88.704	41.71	0.215565	85	85000	431.2	197.12	1.018730	90	90000	457.38	196.77	1.016914	7200	7200000	352.66	20416.26	105.510413
Phenanthrene	mg/kg	16700	19.13		0.61	610	961.92	0.63	0.033149	14	14000	4676	2.99	0.156509	3.2	3200	4959.9	0.65	0.033726	20	20000	3824.3	5.23	0.273378
Pyrene	mg/kg	54300	10.11		1.2	1200	3127.68	0.38	0.037950	16	16000	15204	1.05	0.104090	5.6	5600	16127	0.35	0.034346	21	21000	12435	1.69	0.167045
Total PAHs	mg/kg	-	-		14.2	14200	-	-	-	204	204000	-	-	-	142	142000	-	-	-	7354	7354000	-	-	-
Total Organic Carbon	mg/kg				57600					280000					297000					229000				
FOC					0.06					0.28					0.30					0.23				
Total Toxic Units									0.60					1.95					1.38					107.04

Kow: Octanol-water partition coefficient

Koc: Organic carbon-water partition coefficient

FCV/SVC: Final/Secondary chronic value

Cp: Bulk sediment contaminant concentration

FOC: Fraction of organic carbon in sediment

Kp: Sediment-pore water partition coefficient = Koc * FOC

Cd: Pore water dissolved phase concentration = Cp/Kp

Exceeds toxic units criteria of 1

Exceeds toxic units criteria of 0.1

Exceeds FCV or SCV

FCV/SCV values from Table 3-1 "Developing Sediment Remediation Goals at Superfund Sites Based on Pore Water for the Protection of Benthic Organisms from Direct Toxicity to Non-ionic Organic Contaminants", EPA/600/R 15/289, October 2017

Koc values obtained from the RAIS Chemical Parameters search tool at https://rais.ornl.gov/cgi-bin/tools/TOX_search?select=chem_spef

*Narcosis value used as SCV for naphthalene

SURFACE SEDIMENT PARTITIONING CALCULATIONS

					Location 3C					Location 4					Location 5					Location 6				
Parameter	Units	KOC (L/kg)	Narcosis (ug/L)	FCV or SCV (ug/L)	Result	Cp (ug/kg)	Kp	Cd (ug/L)	Toxic Units	Result	Cp (ug/kg)	Kp	Cd (ug/L)	Toxic Units	Result	Cp (ug/kg)	Kp	Cd (ug/L)	Toxic Units	Result	Cp (ug/kg)	Kp	Cd (ug/L)	Toxic Units
Benzene	ug/kg	146	5300	130	16 U	-	32.85	-	-	8.8 U	-	13.578	-	-	11	11	61.32	0.18	0.000034	12 U	-	8.5702	-	-
Ethylbenzene	ug/kg	446	790	7.3	16 U	-	100.35	-	-	8.8 U	-	41.478	-	-	7.5 U	-	187.32	-	-	12 U	-	26.1802	-	-
Toluene	ug/kg	234	1600	9.8	16 U	-	52.65	-	-	8.8 U	-	21.762	-	-	2.4 J	2.4	98.28	0.02	0.000015	12 U	-	13.7358	-	-
Acenaphthene	mg/kg	5030	55.85		3	3000	1131.75	2.65	0.047462	0.58	580	467.79	1.24	0.022200	3.3	3300	2112.6	1.56	0.027969	4.2	4200	295.261	14.22	0.254695
Acenaphthylene	mg/kg	5030	306.9		1.7	1700	1131.75	1.50	0.004894	1.7	1700	467.79	3.63	0.011841	9.1	9100	2112.6	4.31	0.014035	8.4	8400	295.261	28.45	0.092699
Anthracene	mg/kg	16400	20.73		3.8	3800	3690	1.03	0.049677	2.4	2400	1525.2	1.57	0.075908	17	17000	6888	2.47	0.119057	18	18000	962.68	18.70	0.901968
Benzo(a)anthracene	mg/kg	177000	2.227		9.3	9300	39825	0.23	0.104859	4.8	4800	16461	0.29	0.130938	48	48000	74340	0.65	0.289934	32	32000	10389.9	3.08	1.382988
Benzo(a)pyrene	mg/kg	587000	0.9573		10	10000	132075	0.08	0.079092	6	6000	54591	0.11	0.114811	26	26000	246540	0.11	0.110164	26	26000	34456.9	0.75	0.788223
Benzo(b)fluoranthene	mg/kg	599000	0.6774		11	11000	134775	0.08	0.120486	6	6000	55707	0.11	0.159000	53	53000	251580	0.21	0.310996	31	31000	35161.3	0.88	1.301522
Benzo(ghi)perylene	mg/kg	1950000	0.4391		7.2	7200	438750	0.02	0.037372	4.2	4200	181350	0.02	0.052743	16	16000	819000	0.02	0.044491	20	20000	114465	0.17	0.397918
Benzo(k)fluoranthene	mg/kg	587000	0.6415		0.21 U	-	132075	-	-	0.13 U	-	54591	-	-	0.13 U	-	246540	-	-	17	17000	34456.9	0.49	0.769088
Chrysene	mg/kg	180000	2.042		8.5	8500	40500	0.21	0.102780	4.3	4300	16740	0.26	0.125793	40	40000	75600	0.53	0.259109	31	31000	10566	2.93	1.436797
Dibenzo(a,h)anthracene	mg/kg	1910000	0.2825		1.9	1900	429750	0.00	0.015650	0.89	890	177630	0.01	0.017736	0.13 U	-	802200	-	-	6.3	6300	112117	0.06	0.198907
Fluoranthene	mg/kg	55400	7.109		25	25000	12465	2.01	0.282123	9	9000	5152.2	1.75	0.245720	88	88000	23268	3.78	0.532004	44	44000	3251.98	13.53	1.903252
Fluorene	mg/kg	9160	39.3		1.9	1900	2061	0.92	0.023458	1.3	1300	851.88	1.53	0.038830	2.5	2500	3847.2	0.65	0.016535	2.5	2500	537.692	4.65	0.118308
Indeno(1,2,3-cd)pyrene	mg/kg	1950000	0.275		6.1	6100	438750	0.01	0.050557	3.7	3700	181350	0.02	0.074191	25	25000	819000	0.03	0.111000	19	19000	114465	0.17	0.603599
1-Methylnaphthalene	mg/kg	2530	-		2.5	2500	569.25	4.39	-	1.6	1600	235.29	6.80	-	1.1	1100	1062.6	1.04	-	0.76	760	148.511	5.12	-
2-Methylnaphthalene	mg/kg	2480	-		4.2	4200	558	7.53	-	3.8	3800	230.64	16.48	-	2.3	2300	1041.6	2.21	-	1.4	1400	145.576	9.62	-
Naphthalene*	mg/kg	1540	193.5	193.5	190	190000	346.5	548.34	2.833801	97	97000	143.22	677.28	3.500154	50	50000	646.8	77.30	0.399502	20	20000	90.398	221.24	1.143379
Phenanthrene	mg/kg	16700	19.13		5.6	5600	3757.5	1.49	0.077907	5.2	5200	1553.1	3.35	0.175021	17	17000	7014	2.42	0.126698	16	16000	980.29	16.32	0.853199
Pyrene	mg/kg	54300	10.11		15	15000	12217.5	1.23	0.121439	5.5	5500	5049.9	1.09	0.107728	59	59000	22806	2.59	0.255889	32	32000	3187.41	10.04	0.993027
Total PAHs	mg/kg	-	-		307	307000	-	-	-	158	158000	-	-	-	457	457000	-	-	-	330	330000	-	-	-
Total Organic Carbon	mg/kg				225000					93000					420000					58700				
FOC					0.23					0.09					0.42					0.06				
Total Toxic Units									3.95					4.85					2.62					13.14

Kow: Octanol-water partition coefficient
Koc: Organic carbon-water partition coefficient
FCV/SVC: Final/Secondary chronic value

Cp: Bulk sediment contaminant concentration
FOC: Fraction of organic carbon in sediment
Kp: Sediment-pore water partition coefficient = Koc * FOC

Cd: Pore water dissolved phase concentration = Cp/Kp

Exceeds toxic units criteria of 1
Exceeds toxic units criteria of 0.1
Exceeds FCV or SCV

FCV/SCV values from Table 3-1 "Developing Sediment Remediation Goals at Superfund Sites Based on Pore Water for the Protection of Benthic Organisms from Direct Toxicity to Non-ionic Organic Contaminants", EPA/600/R 15/289, October 2017
Koc values obtained from the RAIS Chemical Parameters search tool at https://rais.ornl.gov/cgi-bin/tools/TOX_search?select=chem_spef
*Narcosis value used as SCV for naphthalene

SURFACE SEDIMENT PARTITIONING CALCULATIONS

					Location 7					Location 8					Location 9					Location 10				
Parameter	Units	KOC (L/kg)	Narcosis (ug/L)	FCV or SCV (ug/L)	Result	Cp (ug/kg)	Kp	Cd (ug/L)	Toxic Units	Result	Cp (ug/kg)	Kp	Cd (ug/L)	Toxic Units	Result	Cp (ug/kg)	Kp	Cd (ug/L)	Toxic Units	Result	Cp (ug/kg)	Kp	Cd (ug/L)	Toxic Units
Benzene	ug/kg	146	5300	130	8.3 U	-	12.249	-	-	13 U	-	14.6	-	-	9.5 U	-	18.834	-	-	13 U	-	15.768	-	-
Ethylbenzene	ug/kg	446	790	7.3	8.3 U	-	37.419	-	-	13 U	-	44.6	-	-	9.5 U	-	57.534	-	-	13 U	-	48.168	-	-
Toluene	ug/kg	234	1600	9.8	8.3 U	-	19.633	-	-	13 U	-	23.4	-	-	9.5 U	-	30.186	-	-	13 U	-	25.272	-	-
Acenaphthene	mg/kg	5030	55.85		4.6	4600	422.02	10.90	0.195166	0.76	760	503	1.51	0.027053	1.1	1100	648.87	1.70	0.030354	1.8	1800	543.24	3.31	0.059328
Acenaphthylene	mg/kg	5030	306.9		8.1	8100	422.02	19.19	0.062540	2	2000	503	3.98	0.012956	3.5	3500	648.87	5.39	0.017576	3	3000	543.24	5.52	0.017994
Anthracene	mg/kg	16400	20.73		21	21000	1376	15.26	0.736231	3.7	3700	1640	2.26	0.108832	6.5	6500	2115.6	3.07	0.148211	4.9	4900	1771.2	2.77	0.133453
Benzo(a)anthracene	mg/kg	177000	2.227		61	61000	14850	4.11	1.844482	8.1	8100	17700	0.46	0.205490	19	19000	22833	0.83	0.373655	15	15000	19116	0.78	0.352350
Benzo(a)pyrene	mg/kg	587000	0.9573		56	56000	49249	1.14	1.187791	8.8	8800	58700	0.15	0.156602	25	25000	75723	0.33	0.344877	15	15000	63396	0.24	0.247162
Benzo(b)fluoranthene	mg/kg	599000	0.6774		24	24000	50256	0.48	0.704981	8.8	8800	59900	0.15	0.216876	20	20000	77271	0.26	0.382092	13	13000	64692	0.20	0.296652
Benzo(ghi)perylene	mg/kg	1950000	0.4391		18	18000	163605	0.11	0.250560	5.4	5400	195000	0.03	0.063066	15	15000	251550	0.06	0.135801	7.9	7900	210600	0.04	0.085429
Benzo(k)fluoranthene	mg/kg	587000	0.6415		18	18000	49249	0.37	0.569739	3.6	3600	58700	0.06	0.095602	11	11000	75723	0.15	0.226448	8.1	8100	63396	0.13	0.199171
Chrysene	mg/kg	180000	2.042		63	63000	15102	4.17	2.042915	7.6	7600	18000	0.42	0.206769	18	18000	23220	0.78	0.379625	14	14000	19440	0.72	0.352676
Dibenzo(a,h)anthracene	mg/kg	1910000	0.2825		4.3	4300	160249	0.03	0.094985	1.5	1500	191000	0.01	0.027800	4.9	4900	246390	0.02	0.070397	2.6	2600	206280	0.01	0.044617
Fluoranthene	mg/kg	55400	7.109		140	140000	4648.1	30.12	4.236896	14	14000	5540	2.53	0.355476	29	29000	7146.6	4.06	0.570808	31	31000	5983.2	5.18	0.728819
Fluorene	mg/kg	9160	39.3		2.4	2400	768.52	3.12	0.079462	0.61	610	916	0.67	0.016945	1	1000	1181.64	0.85	0.021534	1.7	1700	989.28	1.72	0.043726
Indeno(1,2,3-cd)pyrene	mg/kg	1950000	0.275		17	17000	163605	0.10	0.377850	4.9	4900	195000	0.03	0.091375	14	14000	251550	0.06	0.202382	7.4	7400	210600	0.04	0.127773
1-Methylnaphthalene	mg/kg	2530	-		0.63	630	212.27	2.97	-	0.3	300	253	1.19	-	0.35	350	326.37	1.07	-	0.59	590	273.24	2.16	-
2-Methylnaphthalene	mg/kg	2480	-		0.99	990	208.07	4.76	-	0.67	670	248	2.70	-	0.61	610	319.92	1.91	-	0.68	680	267.84	2.54	-
Naphthalene*	mg/kg	1540	193.5	193.5	14	14000	129.21	108.35	0.559970	12	12000	154	77.92	0.402698	13	13000	198.66	65.44	0.338183	9.9	9900	166.32	59.52	0.307617
Phenanthrene	mg/kg	16700	19.13		15	15000	1401.1	10.71	0.559626	3.6	3600	1670	2.16	0.112686	8.1	8100	2154.3	3.76	0.196546	6.4	6400	1803.6	3.55	0.185492
Pyrene	mg/kg	54300	10.11		27	27000	4555.8	5.93	0.586207	9.1	9100	5430	1.68	0.165764	17	17000	7004.7	2.43	0.240054	21	21000	5864.4	3.58	0.354197
Total PAHs	mg/kg	-	-		495	495000	-	-	-	95.4	95400	-	-	-	207	207000	-	-	-	164	164000	-	-	-
Total Organic Carbon	mg/kg				83900					100000					129000					108000				
FOC					0.08					0.10					0.13					0.11				
Total Toxic Units									14.09					2.27					3.68					3.54

Kow: Octanol-water partition coefficient

Koc: Organic carbon-water partition coefficient

FCV/SVC: Final/Secondary chronic value

Cp: Bulk sediment contaminant concentration

FOC: Fraction of organic carbon in sediment

Kp: Sediment-pore water partition coefficient = Koc * FOC

Cd: Pore water dissolved phase concentration = Cp/Kp

Exceeds toxic units criteria of 1

Exceeds toxic units criteria of 0.1

Exceeds FCV or SCV

FCV/SCV values from Table 3-1 "Developing Sediment Remediation Goals at Superfund Sites Based on Pore Water for the Protection of Benthic Organisms from Direct Toxicity to Non-ionic Organic Contaminants", EPA/600/R 15/289, October 2017

Koc values obtained from the RAIS Chemical Parameters search tool at https://rais.ornl.gov/cgi-bin/tools/TOX_search?select=chem_spef

*Narcosis value used as SCV for naphthalene

SURFACE SEDIMENT PARTITIONING CALCULATIONS

					Location 11					Location 12					Location 13A					Location 13B				
Parameter	Units	KOC (L/kg)	Narcosis (ug/L)	FCV or SCV (ug/L)	Result	Cp (ug/kg)	Kp	Cd (ug/L)	Toxic Units	Result	Cp (ug/kg)	Kp	Cd (ug/L)	Toxic Units	Result	Cp (ug/kg)	Kp	Cd (ug/L)	Toxic Units	Result	Cp (ug/kg)	Kp	Cd (ug/L)	Toxic Units
Benzene	ug/kg	146	5300	130	10 U	-	12.13	-	-	9.7 U	-	21.316	-	-	79	79	7.2416	10.91	0.002058	18 U	-	11.8698	-	-
Ethylbenzene	ug/kg	446	790	7.3	10 U	-	37.06	-	-	9.7 U	-	65.116	-	-	4.9 J	4.9	22.1216	0.22	0.000280	18 U	-	36.2598	-	-
Toluene	ug/kg	234	1600	9.8	10 U	-	19.45	-	-	9.7 U	-	34.164	-	-	57	57	11.6064	4.91	0.003069	18 U	-	19.0242	-	-
Acenaphthene	mg/kg	5030	55.85		1.2	1200	418	2.87	0.051403	0.24	240	734.38	0.33	0.005852	0.91	910	249.488	3.65	0.065308	0.098	98	408.939	0.24	0.004291
Acenaphthylene	mg/kg	5030	306.9		1.6	1600	418	3.83	0.012473	0.95	950	734.38	1.29	0.004215	1.5	1500	249.488	6.01	0.019590	0.2	200	408.939	0.49	0.001594
Anthracene	mg/kg	16400	20.73		4.3	4300	1363	3.16	0.152203	1.2	1200	2394.4	0.50	0.024176	2.2	2200	813.44	2.70	0.130466	0.28	280	1333.32	0.21	0.010130
Benzo(a)anthracene	mg/kg	177000	2.227		13	13000	14709	0.88	0.396871	4.8	4800	25842	0.19	0.083406	4	4000	8779.2	0.46	0.204590	0.58	580	14390.1	0.04	0.018099
Benzo(a)pyrene	mg/kg	587000	0.9573		12	12000	48780	0.25	0.256977	5.5	5500	85702	0.06	0.067038	3.6	3600	29115.2	0.12	0.129162	0.63	630	47723.1	0.01	0.013790
Benzo(b)fluoranthene	mg/kg	599000	0.6774		10	10000	49777	0.20	0.296570	4.9	4900	87454	0.06	0.082713	3.6	3600	29710.4	0.12	0.178875	1.5	1500	48698.7	0.03	0.045470
Benzo(ghi)perylene	mg/kg	1950000	0.4391		6	6000	2E+05	0.04	0.084324	3.5	3500	284700	0.01	0.027997	1.8	1800	96720	0.02	0.042383	0.46	460	158535	0.00	0.006608
Benzo(k)fluoranthene	mg/kg	587000	0.6415		5.9	5900	48780	0.12	0.188546	3	3000	85702	0.04	0.054567	1.8	1800	29115.2	0.06	0.096373	0.35	350	47723.1	0.01	0.011433
Chrysene	mg/kg	180000	2.042		11	11000	14958	0.74	0.360133	4.8	4800	26280	0.18	0.089446	3.3	3300	8928	0.37	0.181011	0.64	640	14634	0.04	0.021417
Dibenzo(a,h)anthracene	mg/kg	1910000	0.2825		1.9	1900	2E+05	0.01	0.042374	1	1000	278860	0.00	0.012694	0.53	530	94736	0.01	0.019804	0.086	86	155283	0.00	0.001960
Fluoranthene	mg/kg	55400	7.109		26	26000	4604	5.65	0.794427	7.5	7500	8088.4	0.93	0.130434	8.9	8900	2747.84	3.24	0.455607	1.1	1100	4504.02	0.24	0.034355
Fluorene	mg/kg	9160	39.3		1.6	1600	761.2	2.10	0.053485	0.35	350	1337.4	0.26	0.006659	1.8	1800	454.336	3.96	0.100810	0.15	150	744.708	0.20	0.005125
Indeno(1,2,3-cd)pyrene	mg/kg	1950000	0.275		5.4	5400	2E+05	0.03	0.121178	3.1	3100	284700	0.01	0.039595	1.7	1700	96720	0.02	0.063915	0.4	400	158535	0.00	0.009175
1-Methylnaphthalene	mg/kg	2530	-		0.76	760	210.2	3.61	-	0.18	180	369.38	0.49	-	0.83	830	125.488	6.61	-	0.14	140	205.689	0.68	-
2-Methylnaphthalene	mg/kg	2480	-		1.6	1600	206.1	7.76	-	0.37	370	362.08	1.02	-	1.6	1600	123.008	13.01	-	0.28	280	201.624	1.39	-
Naphthalene*	mg/kg	1540	193.5	193.5	37	37000	128	289.12	1.494167	5.3	5300	224.84	23.57	0.121821	16	16000	76.384	209.47	1.082522	1.7	1700	125.202	13.58	0.070171
Phenanthrene	mg/kg	16700	19.13		5.6	5600	1388	4.04	0.210938	1.7	1700	2438.2	0.70	0.036447	7.9	7900	828.32	9.54	0.498556	0.53	530	1357.71	0.39	0.020406
Pyrene	mg/kg	54300	10.11		17	17000	4512	3.77	0.372646	5	5000	7927.8	0.63	0.062383	6	6000	2693.28	2.23	0.220353	0.79	790	4414.59	0.18	0.017701
Total PAHs	mg/kg	-	-		162	162000	-	-	-	53.4	53400	-	-	-	68	68000	-	-	-	9.91	9910	-	-	-
Total Organic Carbon	mg/kg				83100					146000					49600					81300				
FOC					0.08					0.15					0.05					0.08				
Total Toxic Units									4.89					0.85					3.49					0.29

Kow: Octanol-water partition coefficient

Koc: Organic carbon-water partition coefficient

FCV/SVC: Final/Secondary chronic value

Cp: Bulk sediment contaminant concentration

FOC: Fraction of organic carbon in sediment

Kp: Sediment-pore water partition coefficient = Koc * FOC

Cd: Pore water dissolved phase concentration = Cp/Kp

Exceeds toxic units criteria of 1

Exceeds toxic units criteria of 0.1

Exceeds FCV or SCV

FCV/SCV values from Table 3-1 "Developing Sediment Remediation Goals at Superfund Sites Based on Pore Water for the Protection of Benthic Organisms from Direct Toxicity to Non-ionic Organic Contaminants", EPA/600/R 15/289, October 2017

Koc values obtained from the RAIS Chemical Parameters search tool at https://rais.ornl.gov/cgi-bin/tools/TOX_search?select=chem_spef

*Narcosis value used as SCV for naphthalene

SURFACE SEDIMENT PARTITIONING CALCULATIONS

					Location 13C					Location 14				
Parameter	Units	KOC (L/kg)	Narcosis (ug/L)	FCV or SCV (ug/L)	Result	Cp (ug/kg)	Kp	Cd (ug/L)	Toxic Units	Result	Cp (ug/kg)	Kp	Cd (ug/L)	Toxic Units
Benzene	ug/kg	146	5300	130	21 U	-	8.9352	-	-	21 U	-	9.5776	-	-
Ethylbenzene	ug/kg	446	790	7.3	21 U	-	27.295	-	-	21 U	-	29.2576	-	-
Toluene	ug/kg	234	1600	9.8	21 U	-	14.321	-	-	21 U	-	15.3504	-	-
Acenaphthene	mg/kg	5030	55.85		0.059 J	59	307.84	0.19	0.003432	0.24 J	240	329.968	0.73	0.013023
Acenaphthylene	mg/kg	5030	306.9		0.11 J	110	307.84	0.36	0.001164	0.2 J	200	329.968	0.61	0.001975
Anthracene	mg/kg	16400	20.73		0.16 J	160	1003.7	0.16	0.007690	0.39 J	390	1075.84	0.36	0.017487
Benzo(a)anthracene	mg/kg	177000	2.227		0.31	310	10832	0.03	0.012850	0.77	770	11611.2	0.07	0.029778
Benzo(a)pyrene	mg/kg	587000	0.9573		0.31	310	35924	0.01	0.009014	0.73	730	38507.2	0.02	0.019803
Benzo(b)fluoranthene	mg/kg	599000	0.6774		1.4	1400	36659	0.04	0.056377	1.7	1700	39294.4	0.04	0.063866
Benzo(ghi)perylene	mg/kg	1950000	0.4391		0.22 J	220	119340	0.00	0.004198	0.51	510	127920	0.00	0.009080
Benzo(k)fluoranthene	mg/kg	587000	0.6415		0.19 J	190	35924	0.01	0.008245	0.29	290	38507.2	0.01	0.011740
Chrysene	mg/kg	180000	2.042		0.31	310	11016	0.03	0.013781	0.88	880	11808	0.07	0.036496
Dibenzo(a,h)anthracene	mg/kg	1910000	0.2825		0.3 J	300	116892	0.00	0.009085	0.12 J	120	125296	0.00	0.003390
Fluoranthene	mg/kg	55400	7.109		0.59	590	3390.5	0.17	0.024478	1.7	1700	3634.24	0.47	0.065800
Fluorene	mg/kg	9160	39.3		0.1 J	100	560.59	0.18	0.004539	0.32	320	600.896	0.53	0.013551
Indeno(1,2,3-cd)pyrene	mg/kg	1950000	0.275		0.18 J	180	119340	0.00	0.005485	0.4	400	127920	0.00	0.011371
1-Methylnaphthalene	mg/kg	2530	-		0.07 J	70	154.84	0.45	-	0.17 J	170	165.968	1.02	-
2-Methylnaphthalene	mg/kg	2480	-		0.14 J	140	151.78	0.92	-	0.32	320	162.688	1.97	-
Naphthalene*	mg/kg	1540	193.5	193.5	0.77	770	94.248	8.17	0.042222	1.5	1500	101.024	14.85	0.076734
Phenanthrene	mg/kg	16700	19.13		0.31	310	1022	0.30	0.015855	0.86	860	1095.52	0.79	0.041036
Pyrene	mg/kg	54300	10.11		0.43	430	3323.2	0.13	0.012799	1.2	1200	3562.08	0.34	0.033322
Total PAHs	mg/kg	-	-		5.97	5970	-	-	-	12.3	12300	-	-	-
Total Organic Carbon	mg/kg				61200					65600				
FOC					0.06					0.07				
Total Toxic Units									0.23					0.45

Kow: Octanol-water partition coefficient

Koc: Organic carbon-water partition coefficient

FCV/SVC: Final/Secondary chronic value

Cp: Bulk sediment contaminant concentration

FOC: Fraction of organic carbon in sediment

Kp: Sediment-pore water partition coefficient = Koc * FOC

Cd: Pore water dissolved phase concentration = Cp/Kp

Exceeds toxic units criteria of 1

Exceeds toxic units criteria of 0.1

Exceeds FCV or SCV

FCV/SCV values from Table 3-1 "Developing Sediment Remediation Goals at Superfund Sites Based on Pore Water for the Protection of Benthic Organisms from Direct Toxicity to Non-ionic Organic Contaminants", EPA/600/R 15/289, October 2017

Koc values obtained from the RAIS Chemical Parameters search tool at https://rais.ornl.gov/cgi-bin/tools/TOX_search?select=chem_spef

*Narcosis value used as SCV for naphthalene

APPENDIX D

Groundwater Toxicity Calculations

AREA B

		SW-029-MWS				SW-030-MWS				SW-031-MWS				SW13-PZM025				SW13-PZM111			
Parameter	Narcosis (ug/L)	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units
Acenaphthene	55.85	0.19		0.00340	0.000665	0.1	U	-	-	0.02	J	0.00036	0.011706	0.1	U	-	-	0.071	J	0.00127	0.053390
Acenaphthylene	306.9	0.088	J	0.00029	0.000056	0.1	U	-	-	0.11	U	-	-	0.1	U	-	-	0.1	U	-	-
Anthracene	20.73	0.083	J	0.00400	0.000783	0.026	J	0.00125	1.000000	0.058	J	0.00280	0.091458	0.1	U	-	-	0.027	J	0.00130	0.054700
Benz(a)anthracene	2.227	0.066	J	0.02964	0.005792	0.1	U	-	-	0.017	J	0.00763	0.249529	0.1	U	-	-	0.1	U	-	-
Benzene	5300	3.6		0.00068	0.000133	1	U	-	-	1	U	-	-	1	U	-	-	1	U	-	-
Benzo(a)pyrene	0.9573	1.2	J	1.25353	0.245003	0.1	U	-	-	0.11	U	-	-	0.1	U	-	-	0.1	U	-	-
Benzo(b)fluoranthene	0.6774	2.7	B	-	-	0.1	U	-	-	0.11	U	-	-	0.1	U	-	-	0.1	U	-	-
Benzo(ghi)perylene	0.4391	1.3	J	2.96060	0.578654	0.1	U	-	-	0.11	U	-	-	0.1	U	-	-	0.1	U	-	-
Benzo(k)fluoranthene	0.6415	1.3	B	-	-	0.1	U	-	-	0.11	U	-	-	0.1	U	-	-	0.1	U	-	-
Biphenyl	190	1	U	-	-	1	U	-	-	1.1	U	-	-	1	U	-	-	1	U	-	-
Chrysene	2.042	0.048	B	-	-	0.1	U	-	-	0.0091	J	0.00446	0.145672	0.1	U	-	-	0.1	U	-	-
Ethylbenzene	790	1	U	-	-	1	U	-	-	1	U	-	-	1	U	-	-	1	U	-	-
Fluoranthene	7.109	0.091	J	0.01280	0.002502	0.1	U	-	-	0.038	J	0.00535	0.174730	0.1	U	-	-	0.04	J	0.00563	0.236306
Fluorene	39.3	0.079	J	0.00201	0.000393	0.1	U	-	-	0.026	J	0.00066	0.021626	0.1	U	-	-	0.082	J	0.00209	0.087628
m-Xylene	700	3	U	-	-	3	U	-	-	3	U	-	-	3	U	-	-	3	U	-	-
Naphthalene	193.5	162		0.83721	0.163634	0.027	B	-	-	0.037	B	-	-	0.1	U	-	-	0.14		0.00072	0.030386
Toluene	1600	0.49	J	0.00031	0.000060	1	U	-	-	1	U	-	-	1	U	-	-	1	U	-	-
Phenanthrene	19.13	0.08	J	0.00418	0.000817	0.1	U	-	-	0.12		0.00627	0.205049	0.017	J	0.00089	1.000000	0.19		0.00993	0.417122
Pyrene	10.11	0.078	J	0.00772	0.001508	0.1	U	-	-	0.031	J	0.00307	0.100231	0.1	U	-	-	0.029	J	0.00287	0.120468
Total				5	1			0	1			0	1			0	1			0	1

		SW-032-MWS				SW-033-MWS				SW13-PZM003				SW14-PZM004			
Parameter	Narcosis (ug/L)	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units
Acenaphthene	55.85	0.074	J	0.00132	0.041640	0.22		0.00394	0.035179	0.64		0.01146	0.003748	25.7		0.46016	0.100933
Acenaphthylene	306.9	0.11	U	-	-	0.1	U	-	-	0.7		0.00228	0.000746	0.61		0.00199	0.000436
Anthracene	20.73	0.036	J	0.00174	0.054576	0.061	J	0.00294	0.026279	2.1		0.10130	0.033130	3.4		0.16401	0.035975
Benz(a)anthracene	2.227	0.016	J	0.00718	0.225787	0.024	J	0.01078	0.096244	0.33		0.14818	0.048461	0.33		0.14818	0.032503
Benzene	5300	1	U	-	-	1	U	-	-	20.4		0.00385	0.001259	1	U	-	-
Benzo(a)pyrene	0.9573	0.11	U	-	-	0.011	J	0.01149	0.102619	0.04	J	0.04178	0.013665	0.035	J	0.03656	0.008019
Benzo(b)fluoranthene	0.6774	0.11	U	-	-	0.016	J	0.02362	0.210939	0.11		0.16239	0.053106	0.089	J	0.13138	0.028818
Benzo(ghi)perylene	0.4391	0.11	U	-	-	0.1	U	-	-	0.1	U	-	-	0.1	U	-	-
Benzo(k)fluoranthene	0.6415	0.11	U	-	-	0.012	J	0.01871	0.167058	0.11		0.17147	0.056078	0.088	J	0.13718	0.030089
Biphenyl	190	1.1	U	-	-	1	U	-	-	1.2		0.00632	0.002066	2.2		0.01158	0.002540
Chrysene	2.042	0.01	J	0.00490	0.153902	0.013	J	0.00637	0.056855	0.29		0.14202	0.046445	0.23		0.11263	0.024706
Ethylbenzene	790	1	U	-	-	1	U	-	-	2		0.00253	0.000828	1	U	-	-
Fluoranthene	7.109	0.046	J	0.00647	0.203352	0.088	J	0.01238	0.110550	3.5		0.49233	0.161012	6.8	J	0.95653	0.209809
Fluorene	39.3	0.05	J	0.00127	0.039983	0.12		0.00305	0.027269	2.5		0.06361	0.020804	11.4		0.29008	0.063626
m-Xylene	700	3	U	-	-	3	U	-	-	47.7		0.06814	0.022285	3	U	-	-
Naphthalene	193.5	0.086	B	-	-	0.1		0.00052	0.004615	169		0.87339	0.285630	49.5		0.25581	0.056111
Toluene	1600	1	U	-	-	1	U	-	-	35.6		0.02225	0.007277	1	U	-	-
Phenanthrene	19.13	0.099	J	0.00518	0.162637	0.24		0.01255	0.112042	9.7		0.50706	0.165827	27.5		1.43753	0.315313
Pyrene	10.11	0.038	J	0.00376	0.118122	0.057	J	0.00564	0.050351	2.4		0.23739	0.077635	4.2	J	0.41543	0.091122
Total				0	1			0	1			3	1			5	1

Exceeds toxic unit criteria of 1

Exceeds Narcosis value

COKE POINT

		CP05-PZM008				CP05-PZM019				CP05-PZM028				CP09-PZM010			
Parameter	Narcosis (ug/L)	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units
Acenaphthene	55.85	2	1c	0.03581021	0.10313804	4.1	1c	0.0734109	0.076477268	2.1		0.03760072	0.046342384	1	U	-	-
Acenaphthylene	306.9	0.98	U	-	-	14.8	1c	0.0482242	0.050238482	16.9		0.0550668	0.067869097	1	U	-	-
Anthracene	20.73	0.21	JL21c	0.01013025	0.029176423	0.17	J1c	0.0082007	0.008543214	0.33	J	0.01591896	0.019619905	1	U	-	-
Benzene	5300	9.4		0.00177358	0.005108155	41.9		0.0079057	0.008235877	33.2		0.00626415	0.007720483	0.88	J	0.000166	0.003502853
Dibenzofuran	170	0.39	J1c	0.00229412	0.006607357	1.1	1c	0.0064706	0.006740862	0.55	J	0.00323529	0.003987457	1	U	-	-
Ethylbenzene	790	1	U	-	-	0.96	J	0.0012152	0.001265948	0.63	J	0.00079747	0.000982869	1	U	-	-
Fluoranthene	7.109	0.24	J1c	0.03376002	0.097233246	0.17	J1c	0.0239133	0.024912201	0.53	J	0.07455338	0.091886056	1	U	-	-
Fluorene	39.3	0.43	JL21c	0.01094148	0.03151287	1.6	1c	0.0407125	0.042413012	0.93	J	0.02366412	0.029165717	1	U	-	-
Naphthalene	193.5	35.3		0.18242894	0.525419023	131		0.6770026	0.705280719	87.5		0.45219638	0.557326045	9.1		0.0470284	0.992145946
Phenanthrene	19.13	1.2	1c	0.0627287	0.180666792	1.1	1c	0.0575013	0.059903114	1.9		0.09932044	0.122411124	1	U	-	-
Pyrene	10.11	0.98	U	-	-	0.98	U	-	-	0.32	J	0.03165183	0.039010461	1	U	-	-
Toluene	1600	2.6		0.001625	0.004680211	9.7		0.0060625	0.006315728	6.1		0.0038125	0.004698856	0.33	J	0.0002063	0.004351201
Xylenes	700	4		0.00571429	0.016457884	6.5		0.0092857	0.009673575	5.1		0.00728571	0.008979546	3	U	-	-
Total				0	1			1	1			1	1			0	1

		CP09-PZM047				CP11-PZM010				CP12-PZM012				CP12-PZM052			
Parameter	Narcosis (ug/L)	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units
Acenaphthene	55.85	0.29	J	0.00519248	0.068021614	2.6	1c	0.0465533	0.040817551	0.57	J1c	0.01020591	0.016719362	0.99	U	-	-
Acenaphthylene	306.9	1	U	-	-	0.98	U	-	-	0.24	J1c	0.00078201	0.001281098	0.99	U	-	-
Anthracene	20.73	1	U	-	-	0.52	J1c	0.0250844	0.021993828	0.42	J1c	0.02026049	0.033190823	0.99	U	-	-
Benzene	5300	1	U	-	-	14.1		0.0026604	0.002332599	55.7		0.01050943	0.017216599	1	U	-	-
Dibenzofuran	170	1	U	-	-	1.4	1c	0.0082353	0.007220643	0.2	J1c	0.00117647	0.001927299	0.99	U	-	-
Ethylbenzene	790	1	U	-	-	0.81	J	0.0010253	0.00089899	1		0.00126582	0.002073676	1	U	-	-
Fluoranthene	7.109	0.29	J	0.04079336	0.534394027	1.4	1c	0.1969335	0.172669765	0.52	J1c	0.07314672	0.119829256	0.15	J1c	0.0211	1
Fluorene	39.3	1	U	-	-	1.2	1c	0.0305344	0.026772287	0.19	J1c	0.00483461	0.007920071	0.99	U	-	-
Naphthalene	193.5	1	U	-	-	90.5		0.4677003	0.410076032	70.9		0.36640827	0.600251564	2	U	-	-
Phenanthrene	19.13	0.24	J	0.01254574	0.164349499	5	1c	0.2613696	0.229166858	1.1	1c	0.05750131	0.094198882	0.99	U	-	-
Pyrene	10.11	0.18	J	0.01780415	0.23323486	0.89	J1c	0.0880317	0.077185483	0.35	J1c	0.03461919	0.056713301	0.99	U	-	-
Toluene	1600	1	U	-	-	3.6		0.00225	0.001972783	9.6		0.006	0.009829225	1	U	-	-
Xylenes	700	3	U	-	-	7.1		0.0101429	0.00889318	16.6		0.02371429	0.038848842	3	U	-	-
Total				0	1			1	1			1	1			0	1

Exceeds toxic unit criteria of 1

Exceeds Narcosis value

COKE POINT

		CP14-PZM009				CP14-PZM062				CP15-PZM020				CP15-PZM042			
Parameter	Narcosis (ug/L)	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units
Acenaphthene	55.85	0.54	J	0.00966876	0.027520417	1	U	-	-	3.5		0.062668	0.0481481	1.1	U	-	-
Acenaphthylene	306.9	1	U	-	-	1	U	-	-	1	U	-	-	1.1	U	-	-
Anthracene	20.73	0.2	J	0.00964785	0.027460923	1	U	-	-	0.74	J	0.035697	0.02742627	1.1	U	-	-
Benzene	5300	102		0.01924528	0.054778323	1	U	-	-	8.5		0.001604	0.00123219	1	U	-	-
Dibenzofuran	170	0.18	J	0.00105882	0.003013755	1	U	-	-	1.6		0.009412	0.00723112	1.1	U	-	-
Ethylbenzene	790	0.84	J	0.00106329	0.003026472	1	U	-	-	0.9	J	0.001139	0.00087529	1	U	-	-
Fluoranthene	7.109	0.28	J	0.03938669	0.112107314	1	U	-	-	0.89	J	0.125193	0.09618687	1.1	U	-	-
Fluorene	39.3	0.2	J	0.00508906	0.014485113	1	U	-	-	2.6		0.066158	0.05082941	1.1	U	-	-
Naphthalene	193.5	37.9		0.19586563	0.557497176	1.1	J	0.0056848	1	125		0.645995	0.49632177	0.87	J	0.004496	1
Phenanthrene	19.13	1.1		0.05750131	0.163667386	1	U	-	-	5.5		0.287507	0.22089303	1.1	U	-	-
Pyrene	10.11	1	U	-	-	1	U	-	-	0.57	J	0.05638	0.04331696	1.1	U	-	-
Toluene	1600	7		0.004375	0.01245267	1	U	-	-	2.9		0.001813	0.00139255	1	U	-	-
Xylenes	700	5.9		0.00842857	0.02399045	3	U	-	-	5.6		0.008	0.00614645	3	U	-	-
Total				0	1			0	1			1	1			0	1

		CP16-PZM008				CP16-PZM035			
Parameter	Narcosis (ug/L)	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units
Acenaphthene	55.85	0.35	J1c	0.00626679	0.027570349	5.6	1c	0.1002686	0.066626
Acenaphthylene	306.9	5.2	1c	0.01694363	0.074542482	6.8	1c	0.0221571	0.014723
Anthracene	20.73	0.12	J1c	0.00578871	0.025467091	1.4	1c	0.067535	0.044875
Benzene	5300	83.2		0.01569811	0.069062907	228		0.0430189	0.028585
Dibenzofuran	170	0.13	J1c	0.00076471	0.003364278	1.6	1c	0.0094118	0.006254
Ethylbenzene	790	0.46	J	0.00058228	0.002561699	1.1		0.0013924	0.000925
Fluoranthene	7.109	0.29	J1c	0.04079336	0.179467941	1.4	1c	0.1969335	0.130857
Fluorene	39.3	0.98	U	-	-	2.5	1c	0.0636132	0.042269
Naphthalene	193.5	12.9		0.06666667	0.293295998	113		0.5839793	0.38804
Phenanthrene	19.13	0.76	J1c	0.03972818	0.174781724	6.3	1c	0.3293257	0.218829
Pyrene	10.11	0.24	J1c	0.02373887	0.104437744	0.64	J1c	0.0633037	0.042064
Toluene	1600	6.7		0.0041875	0.018422655	16.7		0.0104375	0.006935
Xylenes	700	4.3		0.00614286	0.027025131	9.5		0.0135714	0.009018
Total				0	1			2	1

Exceeds toxic unit criteria of 1

Exceeds Narcosis value

COKE OVEN

		CO101-PZM				CO102-PZM				CO103-PZM				CO104-PZM			
Parameter	Narcosis (ug/L)	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units
Acenaphthene	55.85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	306.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	20.73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	5300	5690		1.0735849	0.481112548	22300		4.207547	0.397436	19700		3.71698113	0.1532091	4.1		0.000774	0.116731
Chlorobenzene	880	5	U	-	-	5	U	-	-	5	U	-	-	1	U	-	-
Dibenzofuran	170	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	790	5		0.0063291	0.002836307	24		0.03038	0.00287	48.7		0.06164557	0.0025409	1	U	-	-
Fluoranthene	7.109	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	39.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Xylene (Total)	700	63.7		0.091	0.040780419	292		0.417143	0.039402	813		1.16142857	0.0478726	3	U	-	-
Naphthalene	193.5	167		0.8630491	0.386763774	970		5.01292	0.473509	3510		18.1395349	0.7476878	1.1	J	0.005685	0.857806
Toluene	1600	316		0.1975	0.088506953	1470		0.91875	0.086783	1890		1.18125	0.0486896	0.27	J	0.000169	0.025464
Phenanthrene	19.13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	10.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichloroethene	1400	5	U	-	-	5	U	-	-	5	U	-	-	1	U	-	-
Total				2	1			11	1			24	1			0	1

		CO29-PZM051				CO30-PZM015				CO30-PZM060				CO32-PZM041			
Parameter	Narcosis (ug/L)	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units
Acenaphthene	55.85	1	U	-	-	-	-	-	-	-	-	-	-	1.1	U	-	-
Acenaphthylene	306.9	1	U	-	-	-	-	-	-	-	-	-	-	1.1	U	-	-
Anthracene	20.73	1	U	-	-	-	-	-	-	-	-	-	-	1.1	U	-	-
Benzene	5300	0.29	J	5.472E-05	0.003516834	67500		12.73585	0.357248	8.1		0.0015283	1	1	U	-	-
Chlorobenzene	880	1	U	-	-	5	U	-	-	1	U	-	-	1	U	-	-
Dibenzofuran	170	1	U	-	-	-	-	-	-	-	-	-	-	1.1	U	-	-
Ethylbenzene	790	1	U	-	-	102		0.129114	0.003622	1	U	-	-	1	U	-	-
Fluoranthene	7.109	1	U	-	-	-	-	-	-	-	-	-	-	1.1	U	-	-
Fluorene	39.3	1	U	-	-	-	-	-	-	-	-	-	-	1.1	U	-	-
Xylene (Total)	700	2	U	-	-	1440		2.057143	0.057704	3	U	-	-	2	U	-	-
Naphthalene	193.5	3		0.0155039	0.996483166	3440		17.77778	0.498677	2	U	-	-	1.2		0.006202	1
Toluene	1600	1	U	-	-	4720		2.95	0.082749	1	U	-	-	1	U	-	-
Phenanthrene	19.13	1	U	-	-	-	-	-	-	-	-	-	-	1.1	U	-	-
Pyrene	10.11	1	U	-	-	-	-	-	-	-	-	-	-	1.1	U	-	-
Trichloroethene	1400	1	U	-	-	5	U	-	-	1	U	-	-	1	U	-	-
Total				0	1			36	1			0	1			0	1

Exceeds toxic unit criteria of 1

Exceeds Narcosis value

COKE OVEN

		CO10-PZM006				CO26-PZM007				CO26-PZM032				CO27-PZM012			
Parameter	Narcosis (ug/L)	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units
Acenaphthene	55.85	1	U	-	-	-	-	-	-	1	U	-	-	-	-	-	-
Acenaphthylene	306.9	1	U	-	-	-	-	-	-	1	U	-	-	-	-	-	-
Anthracene	20.73	1	U	-	-	-	-	-	-	1	U	-	-	-	-	-	-
Benzene	5300	0.32	J	6.03774E-05	0.006111	366		0.069057	0.003897	1	U	-	-	10900		2.056604	0.19365
Chlorobenzene	880	1	U	-	-	1	U	-	-	1	U	-	-	5	U	-	-
Dibenzofuran	170	1	U	-	-	-	-	-	-	1	U	-	-	-	-	-	-
Ethylbenzene	790	1	U	-	-	13.1		0.016582	0.000936	1	U	-	-	120		0.151899	0.014303
Fluoranthene	7.109	1	U	-	-	-	-	-	-	1	U	-	-	-	-	-	-
Fluorene	39.3	1	U	-	-	-	-	-	-	1	U	-	-	-	-	-	-
Xylene (Total)	700	2	U	-	-	281		0.401429	0.022656	2	U	-	-	1060		1.514286	0.142585
Naphthalene	193.5	1.9	H4H21c	0.009819121	0.993889	3310		17.10594	0.965421	0.93	J2c	0.004806	1	863		4.459948	0.419948
Toluene	1600	1	U	-	-	201		0.125625	0.00709	1	U	-	-	3900		2.4375	0.229515
Phenanthrene	19.13	1	U	-	-	-	-	-	-	1	U	-	-	-	-	-	-
Pyrene	10.11	1	U	-	-	-	-	-	-	1	U	-	-	-	-	-	-
Trichloroethene	1400	1	U	-	-	1	U	-	-	1	U	-	-	5	U	-	-
Total				0	1			18	1			0	1			11	1

		CO35-PZM013				CO35-PZM056				CO36-PZM008				CO36-PZM043			
Parameter	Narcosis (ug/L)	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units
Acenaphthene	55.85	2.5	H21c	0.044762757	0.01508	0.25	JM1	0.004476	0.022292	-	-	-	-	-	-	-	-
Acenaphthylene	306.9	3	H21c	0.009775171	0.003293	1	U	-	-	-	-	-	-	-	-	-	-
Anthracene	20.73	0.53	JH21c	0.025566811	0.008613	1	U	-	-	-	-	-	-	-	-	-	-
Benzene	5300	109		0.020566038	0.006928	21.2		0.004	0.01992	9510		1.79434	0.348558	30400		5.735849	0.438661
Chlorobenzene	880	5	U	-	-	1	U	-	-	5	U	-	-	5	U	-	-
Dibenzofuran	170	2	H21c	0.011764706	0.003963	1	U	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	790	2.8	J	0.003544304	0.001194	6.3		0.007975	0.039714	21.4		0.027089	0.005262	42.9		0.054304	0.004153
Fluoranthene	7.109	0.72	JH21c	0.101280068	0.03412	0.22	JM1	0.030947	0.154115	-	-	-	-	-	-	-	-
Fluorene	39.3	2.4	H21c	0.061068702	0.020573	1	U	-	-	-	-	-	-	-	-	-	-
Xylene (Total)	700	38.4		0.054857143	0.018481	70.1		0.100143	0.498712	631		0.901429	0.175106	675		0.964286	0.073746
Naphthalene	193.5	457		2.361757106	0.795653	1	U	-	-	283		1.462532	0.284103	812		4.196382	0.320927
Toluene	1600	23.5		0.0146875	0.004948	15.8		0.009875	0.049178	1540		0.9625	0.18697	3400		2.125	0.162514
Phenanthrene	19.13	3.7	H21c	0.193413487	0.065159	0.83	JM1	0.043387	0.216069	-	-	-	-	-	-	-	-
Pyrene	10.11	0.66	JH21c	0.065281899	0.021993	1	U	-	-	-	-	-	-	-	-	-	-
Trichloroethene	1400	5	U	-	-	1	U	-	-	5	U	-	-	5	U	-	-
Total				3	1			0	1			5	1			13	1

Exceeds toxic unit criteria of 1

Exceeds Narcosis value

COKE OVEN

		CO27-PZM046				CO28-PZM010				CO28-PZM048				CO29-PZM010			
Parameter	Narcosis (ug/L)	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units
Acenaphthene	55.85	-	-	-	-	0.59	J	0.010564	0.001214682	2.5		0.044763	0.000404769	0.74	JH4H2	0.01325	0.003283
Acenaphthylene	306.9	-	-	-	-	2.1		0.006843	0.000786785	17.3		0.05637	0.000509729	3.9	H4H2	0.012708	0.003149
Anthracene	20.73	-	-	-	-	0.28	J	0.013507	0.001553075	0.22	J	0.010613	9.59652E-05	0.29	JH4H2	0.013989	0.003466
Benzene	5300	117000		22.07547	0.293087091	20900		3.943396	0.453423555	291000		54.90566	0.496486331	15.1	J	0.002849	0.000706
Chlorobenzene	880	1.3	J	0.001477	1.96132E-05	25	U	-	-	25	U	-	-	25	U	-	-
Dibenzofuran	170	-	-	-	-	0.71	J	0.004176	0.000480223	3.5		0.020588	0.00018617	1.2	H4H2	0.007059	0.001749
Ethylbenzene	790	375		0.474684	0.006302181	36.6		0.046329	0.005327061	525		0.664557	0.006009279	25	U	-	-
Fluoranthene	7.109	-	-	-	-	0.31	J	0.043607	0.005014029	1	U	-	-	0.36	JH4H2	0.05064	0.012548
Fluorene	39.3	-	-	-	-	0.88	J	0.022392	0.002574683	3.1		0.07888	0.000713279	1.6	H4H2	0.040712	0.010088
Xylene (Total)	700	4330		6.185714	0.082125222	436		0.622857	0.071617987	6610		9.442857	0.085387362	50	U	-	-
Naphthalene	193.5	6970		36.02067	0.478231861	627		3.24031	0.372580595	4620		23.87597	0.215899274	732		3.782946	0.937355
Toluene	1600	16900		10.5625	0.140234032	1080		0.675	0.07761353	34300		21.4375	0.193849334	25	U	-	-
Phenanthrene	19.13	-	-	-	-	1.3		0.067956	0.007813796	0.97	J	0.050706	0.000458508	1.7	H4H2	0.088866	0.02202
Pyrene	10.11	-	-	-	-	1	U	-	-	1	U	-	-	0.23	JH4H2	0.02275	0.005637
Trichloroethene	1400	5	U	-	-	25	U	-	-	25	U	-	-	25	U	-	-
Total				75	1			9	1			111	1			4	1

		CO37-PZM038				CO58-PZM001				CO60-PZP001				TS06-PPM008			
Parameter	Narcosis (ug/L)	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units	Result (ug/L)	Flag	Toxic Units	RG Toxic Units
Acenaphthene	55.85	-	-	-	-	-	-	-	-	-	-	-	-	1.1	U	-	-
Acenaphthylene	306.9	-	-	-	-	-	-	-	-	-	-	-	-	1.1	U	-	-
Anthracene	20.73	-	-	-	-	-	-	-	-	-	-	-	-	1.1	U	-	-
Benzene	5300	9170		1.730189	0.104942842	238		0.044906	0.003635246	310		0.058491	0.005425472	7.3	J	0.001377	0.066344
Chlorobenzene	880	0.52	J	0.000591	3.5841E-05	0.55	J	0.000625	5.05956E-05	0.61	J	0.000693	6.42982E-05	10	U	-	-
Dibenzofuran	170	-	-	-	-	-	-	-	-	-	-	-	-	1.1	U	-	-
Ethylbenzene	790	270		0.341772	0.020729844	11.8		0.014937	0.001209171	8.7		0.011013	0.001021513	10	U	-	-
Fluoranthene	7.109	-	-	-	-	-	-	-	-	-	-	-	-	1.1	U	-	-
Fluorene	39.3	-	-	-	-	-	-	-	-	-	-	-	-	1.1	U	-	-
Xylene (Total)	700	2080		2.971429	0.180228991	207		0.295714	0.023938945	176		0.251429	0.023322028	20	U	-	-
Naphthalene	193.5	1370		7.080103	0.4294365	2310		11.93798	0.966415116	2020		10.43928	0.968327098	3.4	J	0.017571	0.846353
Toluene	1600	6980		4.3625	0.26460302	93.9		0.058688	0.004750927	31		0.019375	0.001797188	2.9	J	0.001813	0.087303
Phenanthrene	19.13	-	-	-	-	-	-	-	-	-	-	-	-	1.1	U	-	-
Pyrene	10.11	-	-	-	-	-	-	-	-	-	-	-	-	1.1	U	-	-
Trichloroethene	1400	0.53	J	0.000379	2.29619E-05	1	U	-	-	0.64	J	0.000457	4.24037E-05	10	U	-	-
Total				16	1			12	1			11	1			0	1

Exceeds toxic unit criteria of 1

Exceeds Narcosis value

APPENDIX E

Health and Safety Plan

HEALTH AND SAFETY PLAN

SPARROWS POINT TERMINAL
SPARROWS POINT, MARYLAND

Prepared by:

EnviroAnalytics
Group

Environmental Engineers

January 2015

TABLE OF CONTENTS

ATTACHMENTS

1.0 INTRODUCTION

1.1 Background

The Sparrows Point Terminal site has historically been a steel making facility. It is located in Baltimore County, Maryland in the southeast corner of the Baltimore metropolitan area (approximately 9 miles from the downtown area), on the Sparrows Point Peninsula in the Chesapeake Bay watershed. The facility occupies the entire peninsula and is bounded to the west by Bear Creek; to the south by Patapsco River; and to the east by Jones Creek, Old Road Bay and residential areas of the City of Edgemere. The facility is bounded to the north by the Sparrows Point Country Club. The site is approximately 3,100 acres in size.

Pennsylvania Steel built the furnace at Sparrows Point in 1887 and the first iron was cast in 1889. Bethlehem Steel Corporation (BSC) purchased the facility in 1916 and enlarged it by building additional and plating facilities. BSC filed for bankruptcy in 2001. A series of entities has owned the site between then and now: the International Steel Group (ISG), Mittal Steel, ISG Sparrows Point, LLC, Severstal Sparrows Holding LLC, which was renamed to Severstal Sparrows Point, LLC, RG Steel Sparrows Point, LLC, and then a joint venture to Sparrows Point LLC (SP) and HRE Sparrows Point LLC. Most recently, in 2014, the property and assets were sold to Sparrows Point Terminal LLC (SPT). Environmental liability was retained by SP and work is currently being conducted by EnviroAnalytics Group, LLC (EAG) on behalf of SP.

- In addition to the current environmental investigation and remediation being conducted onsite by EAG and their consultants, there are other entities conducting work on the facility. Demolition of the remaining structures is currently ongoing at the site, and those contractors are being managed by SPT.
- The purpose of this document is to provide an overall health and safety plan (HASP) for EAG personnel and EAG directed contractors who are engaging in environmental investigation and remediation activities onsite. EAG directed contractors will also be expected to have their own Health and Safety Program, and they may opt to draft their own site specific HASP, provided it meets the requirements in this HASP.

1.2 Historic Operations

Steel manufacturing involves handling vast amounts of raw material including coke, iron ore, limestone and scrap steel, as well as recovering byproducts and managing waste materials. The operations listed below either were or are currently performed at the Sparrows Point Facility.

- Iron and steel production
- Coal chemical recovery system
- Other byproducts recovery systems
- Wastewater treatment systems
- Solid waste management
- Air pollution control

A number of site-specific environmental and hydrogeologic investigations have been prepared for the Sparrows Point facility. For the purposes of this HASP, information was obtained from the "Special Study Area Release Site Characterization" completed in 2001 by CH2MHill, as well as additional documents submitted since that time. There are five separate Special Study Areas as put forth in the Consent Decree:

- Humphrey Impoundment,
- Tin Mill Canal/Finishing Mills Areas,
- Coke Oven Area,
- Coke Point Landfill, and
- Greys Landfill.

Contaminated soils and groundwater may be present at the site. This plan was prepared based on an assessment of hazards expected to be present and a review of data from the previous site investigations and groundwater sampling events.

During the current investigations and remedial efforts, all related work will be performed in accordance with the requirements of this HASP and Occupational Safety and Health Administration (OSHA) regulations as defined in 29 Code of Federal Regulations (CFR) 1910.120 and 1926.65.

2.0 PURPOSE, SCOPE AND ORGANIZATION

This section describes the purpose, scope and organization of this HASP and the health and safety responsibilities of EAG, their employees, and their subcontractors involved in the field investigation and remediation activities at the Sparrows Point facility.

2.1 Scope

Field investigation and remediation activities for this project may include, but are not limited to:

- Groundwater sampling and monitoring,
- Groundwater and remediation well installation,
- Groundwater and remediation well repairs,
- Groundwater and remediation well closure and abandonment,
- Surface water sampling,
- Sediment sampling,
- Soil boring and subsurface soil sampling,
- Soil excavations for remedial purposes,
- Installation and operation of remediation systems for soil, soil vapor, and groundwater,
- Decommissioning and closure of remediation systems,
- Soil excavations for remedial purposes,
- Insitu soil mixing/soil stabilization,
- Exsitu soil mixing/soil stabilization,
- Dredging operations along Tin Mill Canal,
- Insitu chemical and/or biological injections, and
- Recovery of non-aqueous phase liquids (NAPL)

When EAG personnel are providing oversight of subcontractors, they will attend the safety and health briefings held by the contractor. EAG personnel will follow the requirements of this HASP, as well as any potentially more stringent requirements of the contractor's health and safety plan.

When EAG personnel are conducting tasks on their own, with or without subcontractors, they will follow the requirements of this HASP. EAG contractors, such as drillers, will also be required to follow the requirements of this HASP, as well as any more stringent requirements of the contractor's health and safety plan.

All EAG field personnel, including subcontractors to EAG, will be required to read and understand this HASP and agree to implement its provisions. All site personnel will sign the Acknowledgement Form included in **Attachment A** stating that they have read, understood, and agree to abide by the guidelines and requirements set forth in this plan.

2.2 Organization of Document

This HASP includes health and safety procedures for all generally anticipated project field activities. This plan also meets the OSHA requirements contained in the CFR, specifically 29 CFR 1910.120 and 29 CFR 1926, by including the following items:

- A description of staff organization, qualifications and responsibilities (Section 2.3),
- Hazard analysis (Section 3.0),
- Health hazard information (Section 4.0),
- Personal protective equipment (PPE), including available first aid, emergency, and safety equipment (Section 5.0),
- Employee and subcontractor training and standard safety procedures (section 6.0),
- Exposure monitoring plan (Section 7.0),
- Medical surveillance (Section 8.0),
- Site control measures and decontamination procedures for personnel and equipment (Section 9.0),
- Emergency response and contingency procedures (section 10.0), and
- Material Safety Data Sheets (MSDSs) for chemicals used on-site (**Attachment B**).

2.3 EAG Health and Safety Personnel

Personnel responsible for implementing this HASP include:

EAG Contacts for Sparrows Point Project Work	
VP Remediation, Russ Becker	(314) 686-5611
Senior Project Manager, James Calenda	(314) 620-3056
Senior Project Engineer, Elizabeth Schlaeger	(314) 307-1732
Josh Burke – Field Operations Manager	(314) 686-5623
Project Field Team Members, Jeff Wilson and Bill Trentzsch	(314) 620-3135, (314) 686-5598

3.0 HAZARD ANALYSIS

This section outlines the potential hazards related to the field activities listed in Section 2.1.

3.1 Hazard Analysis

The field activities planned for this project pose potential health and safety hazards for field team members. This section describes the hazards associated with the above-listed field activities. Detailed chemical, physical, and biological hazards information is provided in Section 4.0 (Health Hazard Information).

Hazards to which employees and subcontractors may be exposed to as a result of the above-listed activities include potential chemical exposures, lacerations, excessive noise, thermal stress, lifting of excessive weight or bulk, hand tools and heavy equipment, drilling and slips, trips and falls.

3.1.1 Chemical Hazards

Potential exposures to chemicals in the soil or groundwater include the possibility of dermal exposure (contact and/or absorption), inhalation of chemical contamination that may be encountered during sampling or during equipment decontamination activities, or ingestion of contaminants if good personal hygiene practices are not followed.

Benzene, naphthalene, and various metals are the major contaminants that have been identified in groundwater during previous investigations at the site In addition, light NAPL (LNAPL – benzene, in particular) and dense NAPL (DNAPL – naphthalene, in particular) have also been identified or are heavily suspected in various locations in the Coke Oven Area. Dissolved metals the chemicals of concern primarily located in the area of Tin Mill Canal and the Rod and Wire Mill Area. Treatment chemicals, such as sulfuric acid, are currently being used in remediation systems. All appropriate MSDS sheets will be reviewed that apply to the investigation or remedial tasks being conducted. MSDS sheets are located in **Attachment B**. It should be noted that this is a dynamic document: should any additional chemicals be introduced or discovered, the MSDS sheets will be added to **Attachment B**, as necessary.

3.1.2 Physical Hazards

The potential physical hazards associated with field activities include:

- Excessive lifting
- Slips, trips, and falls
- Working at heights
- Exposure to extreme outside temperatures and weather
- Equipment hazards
- Drilling Hazards
- Noise
- Dust and fumes
- Injury from tools, equipment, rotating parts
- Electrical hazards
- Buried and overhead hazards
- Work over water
- Driving to, from, and around the site (including working in trafficked areas)

Additional hazards may be encountered based on the various task at hand. It will be the responsibility of the site manager, with the help of field staff, to identify and address any additional hazards on a "per task or job" basis. A Job Safety Analyses (JSA) may need to be conducted prior to the start of various tasks. Safety meetings will be conducted with all staff in attendance, before the start of any new task or when any significant personnel or other changes (such as a swift change in weather, for example) occur. Updated information relating to physical hazards will be presented during these meetings in an effort to familiarize the crew with potential hazards, discuss new situations, and determine how the associated risks can be reduced. Further, good housekeeping practices will be enforced to preclude other risks resulting from clutter and inattention to detail. In addition, internal field audits will be randomly conducted to ensure adherence to all procedures are being followed.

3.1.3 Biological Hazards

Biological hazards that may be encountered when conducting field activities include the following:

- Poisonous snakes and spiders
- Ticks and tick-borne diseases
- Stinging insects such as chiggers, bees, wasps, etc.
- Various viruses and diseases spread via animal to human contact such as West Nile virus or rabies
- Various viruses and diseases spread via human to human contact such as colds or the flu
- Dermal contact with poison ivy, oak, and/or sumac
- Bloodborne pathogens when administering first aid

First aid kits will be available on-site. It is crucial to note that any site personnel who has significant allergies should communicate that information to the field team they are working with, along with the location of their auto-injector pen (such as an Epi-Pen) for use in case of going into anaphylactic shock from something that would cause such a reaction (like a bee sting, for example). Personnel who suffer from such allergies are responsible for providing their own auto-injector devices as those are typically prescription based as well as specific to their particular allergy.

4.0 HEALTH HAZARD INFORMATION

This section provides chemical hazard information for those potentially hazardous materials expected to be present at the facility. Potential physical and biological hazards are also discussed in this section.

4.1 Chemical Hazards

Exposure to chemicals through inhalation, ingestion, or skin contact may result in health hazards to field workers. Hazards associated with exposure will be evaluated using OSHA Permissible Exposure Limits (PELs) and the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs). Each of these values are 8-hour, time-weighted averaged (TWAs) above which an employee cannot be exposed. EAG may also use the National Institute of Occupational Safety and Health (NIOSH) Recommended Exposure Limits (RELs) where applicable. Although the OSHA PELs are the only exposure limits enforceable by law, the most stringent of exposure limits will be used as the EAG-enforced exposure criteria during field activities.

The following is a summary of the potential hazards created by the compounds that may be encountered during field activities. Data from sampling of groundwater wells was reviewed to identify potential contaminants at the site. Contaminants of concern may include benzene, toluene, ethylbenzene and xylenes (BTEX), polycyclic aromatic hydrocarbons (PAHs), phenols, metals and water treatment chemicals. Table 4-1 contains chemical information and exposure limits for various chemicals that may be expected to be present in the investigation and remediation efforts. During the recovery of NAPL, the major contaminants of concern are benzene and naphthalene. It is possible that carbon monoxide may also be encountered from the use of various internal combustion engines (vehicular or otherwise); however, it is anticipated that since any such engine will be used outdoors, it is not expected that concentrations of concern will accumulate. With the use of any such engine, the engine should be positioned such that site personnel are upwind of the engine exhaust.

If any chemicals are brought on-site, MSDS must be made available and added to **Attachment B**. Personnel must be trained in the hazards and use of chemicals.

Table 4-1
Chemical Contaminants of Potential Concern

Chemical Name Synonyms (trade name)	Exposure Limits	Characteristics	Route of Exposure	Symptoms of Exposure
Benzene	PEL: 1PPM REL: 0.1 CA TLV: 0.5PPM STEL: 1PPM (NIOSH) Skin: YES	Colorless to light-yellow liquid with aromatic odor. LEL: 1.2% UEL: 7.8% VP: 75mm Fl.P: 12°F	INH ABS ING CON	Irritation of eyes, skin, nose, respiratory system, giddiness, headache, nausea, fatigue, anorexia, dermatitis, bone marrow depression
Ethylbenzene	PEL: 100PPM REL: 100PPM TLV: 100PPM STEL: 125PPM IDLH: 800PPM Skin: NO	Colorless liquid with an aromatic odor. LEL: 0.85 UEL: 6.7% IP: 8.76EV VP: 7mm Fl.P: 55°F	INH ING CON	Irritation of eyes, skin, mucous membranes; headache; dermatitis
1,1 dichloroethane	PEL: 100PPM REL: 100PPM TLV: 100PPM STEL: NA IDLH: 3000PPM Skin: NO	Colorless, oily liquid with a chloroform-like odor. LEL: 6.2% UEL: 16% IP: 11.05EV Vp: 64mm Fl.P: 56°F	INH ING CON	Irritation of eyes, CNS depression, liver, kidney, lung damage
Phenol	PEL: 5PPM REL: 5PPM, 15.6PPM (C) TLV: 5PPM STEL: NA IDLH 250PPM Skin: YES	Colorless to light pink crystalline solid with a sweet, acrid odor. LEL: 1.8% UEL: 5.9% IP: 8.12EV Vp: 0.08mm Fl.P: 175°F	INH ING CON ABS	Irritated eyes, nose, throat, anorexia, weakness, muscular ache, pain, dark urine, cyanosis, liver, kidney damage, skin burns, dermatitis, tremor, convulsions, twitch
Naphthalene	PEL: 10PPM REL: 10PPM TLV: 10PPM STEL: 15PPM IDLH: 250PPM Skin: YES	Colorless to brown solid with an odor of mothballs LEL: 0.9% UEL: 5.9% IP: 8.12EV Vp: 0.08mm Fl.P: 174°F	INH ABS ING CON	Irritation of eyes, headache, confusion, excitement, malaise, nausea, vomiting, abdominal pain, irritated bladder, profuse sweating, jaundice, hematuria, renal shutdown, dermatitis, optical neuritis, corneal damage
Toluene	PEL: 200PPM, 300PPM (C) REL: 100PPM TLV: 20PPM STEL: 150PPM IDLH: 500PPM Skin: YES	Colorless liquid with a sweet, pungent benzene-like odor. LEL: 1.1% UEL: 7.1% IP: 8.82EV VP: 21MM Fl.P: 40°F	INH ABS ING CON	Irritation of eyes, nose, fatigue, weakness, confusion, euphoria, dizziness, headache, dilated pupils, lacrimation, nervousness, muscle fatigue, insomnia, dermatitis, liver, kidney damage
Xylenes	PEL: 100PPM REL: 100PPM TLV: 100PPM STEL: 150PPM IDLH: 900PPM Skin: NO	Colorless liquid with an aromatic odor. LEL: 0.9% UEL: 6.7% IP: 8.40EV VP: 5MM Fl.P: 88°F	INH ABS ING CON	Irritated eyes, nose, respiratory system, headache, fatigue, dizziness, confusion, malaise, drowsiness, incoherence, staggering gait, corneal vacuolization, anorexia, nausea, vomiting, abdominal pain, dermatitis

Chemical Name Synonyms (trade name)	Exposure Limits	Characteristics	Route of Exposure	Symptoms of Exposure
Styrene	PEL: 100PPM, 200PPM (C) REL: 50PPM TLV: 20PPM STEL: 40PPM IDLH: 700PPM Skin: NO	Colorless to yellow, oily liquid with a sweet, floral odor. LEL: 0.9% UEL: 6.8% IP: 8.40eV VP: 5MM Fl.P: 88°F	INH ABS ING CON	Irritated eyes, nose, respiratory system, headache, fatigue, dizziness, confusion, malaise, drowsiness, weakness, narcosis, dermatitis
Chlorodiphenyl (54% chlorine) (11097-69-1)	PEL: 0.5mg/m^3 REL: 0.001mg/m^3 TLV: 0.5mg/m^3 STEL: N/A IDLH: 5mg/m^3(CA) Skin: YES	Colorless to pale yellow viscous liquid with a mild hydrocarbon odor. LEL: NA UEL: NA IP: UNKNOWN VP: 0.00006MM Fl.P: NA	INH ABS ING CON	Irritated eyes, chloracne, liver damage, reproductive effects (carcinogen)
Polynuclear aromatic hydrocarbons (PAHs) (coal tar pitch volatiles) (65996-93-2)	PEL: 0.2mg/m^3 REL: 0.1mg/m^3 TLV: 0.2 mg/m^3 STEL: N/A IDLH: 80mg/m^3(CA) Skin: NO	The pitch of coal tar is black or dark brown amorphous residue that remains after the redistillation process. LEL: N/A UEL: N/A IP: VARIES VP: VARIES Fl.P: VARIES	INH CON	Direct contact or exposure to vapors may be irritating to the eyes. Direct contact can be highly irritating to the skin and produce dermatitis. Exposure to vapors may cause nausea and vomiting. A potential human carcinogen.
Arsenic (inorganic)	PEL: 0.01mg/m^3 REL: NONE TLV: 0.5 mg/m^3 STEL: N/A IDLH: 5mg/m^3 (CA) Skin: NO	Silver-gray or tin-white brittle odorless solid. Air odor threshold: N/D.	INH ABS CON ING	Symptoms include ulceration of nasal septum, gastrointestinal disturbances, respiratory irritation and peripheral neuropathy. Potential occupational carcinogen.
Barium	PEL: 0.5mg/m^3 REL: 0.5mg/m^3 TLV: 0.5mg/m^3 STEL: N/A IDLH: 50mg/m^3 Skin: NO	White, odorless solid. Air odor threshold: N/D.	INH ING CON	Irritated eyes, skin, upper respiratory system, skin burns, gastroenteritis, muscle spasm, slow pulse, cardiac arrhythmia
Cadmium (elemental)	PEL: 0.005mg/m^3 REL: CA TLV: 0.01mg/m^3 STEL: N/A IDLH: 9mg/m^3 (CA) Skin: NO	Silver-white, blue-tinged lustrous, odorless solid. Air odor threshold: N/D.	INH ING	Symptoms include pulmonary edema, cough, tight chest, head pain, chills, muscle aches, vomiting and diarrhea. Potential occupational carcinogen.
Chromium (Metal)	PEL: 1.0mg/m^3 REL: 0.5mg/m^3 TLV: 0.5mg/m^3 STEL: N/A IDLH: 250mg/m^3 Skin: NO	Blue-white to steel-gray lustrous, brittle, hard odorless solid. Air odor threshold: N/D.	INH ING CON	Symptoms may include irritated eyes and skin, lung fibrosis.
Chromium (Chromium III inorganic compounds)	PEL: 0.5mg/m^3 REL: 0.5mg/m^3 TLV: 0.5mg/m^3 STEL: N/A IDLH: 25mg/m^3 Skin: NO	Varies depending on specific compound.	INH ING CON	Irritation of eyes, sensitivity dermatitis

Chemical Name Synonyms (trade name)	Exposure Limits	Characteristics	Route of Exposure	Symptoms of Exposure
Copper	PEL: 1mg/m^3 REL: 1mg/m^3 TLV: 1mg/m^3 STEL: N/A IDLH: 100mg/m^3 Skin: NO	Reddish, lustrous, malleable, odorless solid	INH ING CON	Irritation of eyes, nose, pharynx, nasal septum perforations, metallic taste, dermatitis
Lead (Elemental & Inorganic as Pb)	PEL: 0.05mg/m^3 REL0.1mg/m^3 TLV: 0.05mg/m^3 STEL: N/A IDLH: 100mg/m^3 Skin: NO	A heavy, ductile soft gray solid. Air odor threshold: N/D.	INH ING CON	Accumulative poison may cause weakness, insomnia, facial pallor, anorexia, malnutrition, constipation, abdominal pain, anemia, gingival lead line, paralysis of wrists and ankles, hypertension and kidney disease.
Nickel	PEL: 1mg/m^3 REL: 0.015mg/m^3 (Ca) TLV: 0.1mg/m^3 STEL: N/A IDLH: 10mg/m^3 Skin: NO	Lustrous, silvery, odorless solid. Air odor threshold: N/A VP: 0mm	INH CON ING	Sensitivity dermatitis, allergic asthma, pneumonitis
Vanadium pentoxide dust	PEL: 0.5mg/m^3 (C) REL: 0.05mg/m^3 (C) TLV: 0.05mg/m^3 STEL: N/A IDLH: 35mg/m^3 Skin: NO	Yellow-orange powder or dark gray, odorless flakes dispersed in air. VP: 0mm	INH ING CON	Irritated eyes, skin, throat, green tongue, metallic taste, eczema, cough, fine rales, wheezing, bronchitis
Zinc oxide	PEL: 5mg/m^3 REL: 5mg/m^3 TLV: 2mg/m^3 STEL: 10mg/m^3 IDLH: 500mg/m^3 Skin: NO	White, lustrous solid	INH	Metal fume fever, chills, muscular ache, nausea, fever, dry throat, cough, weakness, metallic taste, headache, blurred vision, low back pain, vomiting, fatigue, malaise
Sulfuric Acid (water treatment chemical)	PEL: 1mg/m^3 TLV: 0.2mg/m^3 Skin: YES	Oily, colorless to slightly yellow, clear to turbid liquid	IHN ABS ING CON	Can cause irritation or corrosive burns to the upper respiratory system, lung irritation, pulmonary edema, burns to mouth throat and stomach, erode teeth, skin lesions
Antiscale (water treatment chemical)	PEL: 1mg/m^3 TLV: 0.2mg/m^3 Skin: YES	Liquid, colorless, clear	IHN ABS ING CON	May cause severe skin burns and eye damage, can cause cancer, fatal if inhaled, may damage organs through prolonged exposure
Antifoam (water treatment chemical)	N/E	Liquid emulsion, white, opaque	IHN ABS ING CON	May be harmful to skin, if inhaled and if swallowed
Gases				
Carbon Monoxide	PEL: 50PPM REL: 35PPM TLV: 25PPM STEL: 200PPM (C) IDLH: 1200PPM Skin: NO	Colorless, odorless gas LEL: 12.5% UEL: 74% IP: 14.01eV VP: >35atm FI.P: N/A	INH	Headache, rapid breathing, nausea, tiredness, dizziness, confusion

NOTES:

OSHA PEL	Occupational Safety and Health administration Final Rule Limits, Permissible Exposure Limit for an eight=hour, time-weighted average
ACGIH TLV	American Conference of Governmental Industrial Hygienists, Threshold Limit Value for eight-hour, time-weighted average
STEL	Short-term Exposure Limit for a 15-minute, time-weighted average
NIOSH IDLH	National Institute for Occupational Safety and Health, Immediately Dangerous to Life or Health concentration
PPM	Part of vapor or gas per millions parts of air by volume at 25°Celsius and 760mm Hg mg/m³ (milligram of substance per cubic meter of air)
CA	NIOSH has identified numerous chemicals that it recommends to be treated as potential or confirmed human carcinogens.
(C)	The (ceiling) concentration that should not be exceed during any part of the working exposure.
Skin	Refers to the potential contribution to the overall exposure by the cutaneous (absorption) route, including mucous membranes and eye, either by airborne or more particularly by direct contact with the substance.
UEL	Upper Explosive Limit – the highest concentration of a material in air that produces an explosion in fire or ignites when it contacts an ignition source.
LEL	Lower Explosive Limit – the lowest concentration of the material in air that can be detonated by spark, shock, fire, etc.
INH	Inhalation
ABS	Skin absorption
ING	Ingestion
CON	Skin and/or eye contact

4.2 Physical Hazards

Field employees and subcontractors may be exposed to a number of physical hazards during this project. Physical hazards that may be encountered include the following:

- Heat and cold stress
- Lifting hazards
- Slips, trips and falls
- Working around heavy equipment
- Drilling hazards
- Noise
- Use of hand and power tools
- Buried hazards
- Electrical hazards
- Underground and overhead utilities
- Working over water
- Travel to and from site

4.2.1 Heat Stress

Local weather conditions may produce an environment that will require restricted work schedules in order to protect employees from heat stress. The Project Manager or the Field Lead Team Member will observe workers for any potential symptoms of heat stress. Adaptation of work schedules and training on recognition of heat stress conditions should help prevent heat-related illnesses from occurring. Heat stress controls will be stated at 70°F for personnel in protective clothing and at 90°F for personnel in regular work clothing. Heat stress prevention controls include:

- Allow workers to become acclimatized to heat (three to six days)
- Provide rest breaks in a shaded or air-conditioned break area
- Provide sun screen to prevent sun burn
- Provide drinking water and electrolyte-replenishing fluids
- Keep ice readily available to rapidly cool field team members

The following Heat Stress Index should be used as a guide to evaluate heat stress situations. If the Heat Stress exceeds 105 degrees Fahrenheit, contact the project manager prior to conducting work for detailed guidance.

Heat Stress Index

Temp. °F	**Relative Humidity**								
	10%	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**
105	98	104	110	120	132				
102	97	101	108	117	125				
100	95	99	105	110	120	132			
98	93	97	101	106	110	125			
96	91	95	98	104	108	120	128		
94	89	93	95	100	105	111	122		
92	87	90	92	96	100	106	114	122	
90	85	88	90	92	96	100	106	114	122
88	82	86	87	89	93	95	100	106	115
86	80	84	85	87	90	92	96	100	109
84	78	81	83	85	86	89	91	95	99
82	77	79	80	81	84	86	89	91	95
80	75	77	78	79	81	83	85	86	89
78	72	75	77	78	79	80	81	83	85
76	70	72	75	76	77	77	77	78	79
74	68	70	73	74	75	75	75	76	77

NOTES: Add 10° F when protective clothing is being used; Add 10° F when in direct sunlight

HSI Temp	**Category**	**Injury Threat**
Above 130° F	**Extreme Danger**	No work unless emergency exists. Contact Cardno ATC RSC and Corporate Risk Management Department prior to proceeding. Heat cramps or exhaustion likely, heat stroke possible if exposure is prolonged and there is physical activity.
105° to 130° F	**Danger**	Contact RSC prior to proceeding. Requires strict adherence to ACGIH Heat Stress Guidelines, including use of on-site WBGT equipment. Heat cramps or exhaustion likely, heat stroke possible if exposure is prolonged and there is physical activity.
90° to 105° F	**Extreme Caution**	Heat cramps or exhaustion likely, heat stroke possible if exposure is prolonged and there is physical activity.
80° to 90° F	**Caution**	Heat cramps or exhaustion likely, heat stroke possible if exposure is prolonged and there is physical activity.
Below 80° F	**Normal Range**	Typical conditions for time of year. Little or no danger under normal circumstances. As always, anticipate problems and work safely.

4.2.2 Cold Stress

Frostbite and hypothermia are two types of cold injury that personnel must be protected against during the performance of field duties. The objective is to prevent the deep body temperature from falling below 96.8° F and to prevent cold injury to body extremities. Two factors influence the development of a cold injury the ambient temperature, and wind velocity. Reduced body temperature will very likely result in reduced mental alertness, reduction in rational decision making, and/or loss of consciousness with the threat of death.

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Use appropriate cold weather clothing when temperatures are at or below 40° F as exposed skin surfaces must be protected. These protective items can include facemask, hand wear, and foot wear. Workers handling evaporative solvents during cold stress conditions will take special precautions to avoid soaking gloves and clothing because of the added danger of prolonged skin contact and evaporative cooling. Personnel will wear protective clothing appropriate for the level of cold and planned physical activity. The objective is to protect all parts of the body, with emphasis on the hands and feet. Eye protection against glare and ultraviolet light should be worn in snowy and icy conditions.

The work rate should not be so great as to cause heavy sweating that could result in wet clothing. If heavy work must be done, opportunities for rest breaks will be provided where workers have the opportunity to change into dry clothing. Conversely, plan work activities to minimize time spent sitting or standing still. Rest breaks should be taken in a warm, dry area. Windbreaks can also be used to shield the work area from the cooling effects of wind.

If extreme cold-related weather conditions occur, EAG field personnel and subcontractors will take the following precautions:

- Wear adequate insulated clothing when the air temperature drops below 40°F
- Reduce work periods in extreme conditions to allow adequate rest periods in a warm area
- Change clothes when work clothes become wet
- Avoid caffeine (which has diuretic and circulatory effects)

4.2.3 Lifting Hazards

Field personnel may be exposed to injury caused by lifting heavy objects and various pieces large or unwieldy pieces of equipment. All field team members will be trained in the proper methods for lifting heavy and/or large equipment and are cautioned against lifting objects that are too heavy or too big for one person. Proper lifting techniques include the following:

- Keep feet approximately shoulder width apart
- Bend at the knees
- Tighten abdominal muscles
- Lift with the legs
- Keep the load close to the body
- Keep the back upright
- Use the buddy system for larger or heavy pieces of equipment

All drums will be staged using an approved drum dolly or other appropriate equipment. Proper care will be taken in the use of this equipment. Healthy employees with no medical restrictions may lift and carry a maximum of 50 pounds using proper lifting and carrying techniques. This recommended weight limit may be reduced depending on physical and workplace factors.

4.2.4 Slips, Trips and Falls

The most common hazards that will be encountered during field activities will be slips, trips and falls. Field team members are trained to use common sense to avoid these hazards such as using work boots/safety shoes with nonskid soles. When working on slippery surfaces, tasks will be planned to decrease the risk of slipping via avoiding the slippery areas, if possible, or utilizing engineering controls. Engineering controls may involve the placement of supplemental material such as boards, gravel, or ice melt should be utilized to mitigate slippery conditions. Other engineering controls may involve the use of footgear traction control devices. Employees and subcontractors will avoid slippery surfaces, use engineering controls as appropriate, not hurry, and maintain good housekeeping.

4.2.5 Buried Hazards

Whenever the ground is penetrated, the potential for contacting buried hazards exists. During the planning/mobilization phase, prior to drilling or other excavation activities, EAG personnel and/or their contractors will establish the location of underground utility lines (gas, electrical, telephone, fiber optic cable, etc.) and/or substructures or other potential buried hazardous items. This may be conducted by review of historic utility and substructure maps, private utility locates, ground penetrating radar, or other technologies. If there is any evidence of utilities or subsurface objects/structures, drilling or excavation activities may be offset. If activities cannot be offset, measures will be taken to remove, disconnect, and/or protect the utilities and/or subsurface structures and/or objects. Every reasonable effort will be made to clear the area of intrusive work prior to fieldwork being started.

4.2.6 Electrical Hazards

It may be possible that overhead power lines will be in proximate locations during drilling or excavation activities. At least a 20 foot clearance must be maintained from overhead power lines. No equipment such as drill rigs or dump trucks can be moved while masts or buckets are in the upright position. Field personnel and subcontractors performing electrical work are required to be appropriately trained to work on the electrical systems in question prior to start of work. Authorization from project management personnel is required prior to any electrical work or work near overhead power lines. . When using extension cords, all field workers will ensure that they are in good working condition, are correctly rated for use, and do not contain abrasions such that bare wires could be exposed to the environment. Extension cords will not be used in wet areas without plugging the extension cord into a ground fault circuit interrupter (GFCI). GFCIs will detect a short circuit and cut power.

4.2.7 Heavy Equipment Operations

Heavy equipment must be operated in a safe manner and be properly maintained such that operators and ground personnel are protected.

Requirements for Operators

- Only qualified, trained, and authorized operators are allowed to operate equipment
- Seat belts will be used at all times in all equipment and trucks
- Operators will stop work whenever ground personnel or other equipment enter their work area; work will resume only when the area has been cleared
- No personnel may ride on equipment other than the Authorized Operator
- No personnel may be carried or lifted in the buckets or working "arms" of the equipment
- Spotters will be used when ground personnel are in the vicinity of heavy equipment work areas and/or when an operator is backing equipment near other structures or congested area

Requirements for Ground Personnel

- All ground personnel must wear orange protective vests in work areas with any operating heavy equipment
- Ground personnel will stay outside of the swing zone or work area of any operating equipment
- Ground personnel may only enter the swing or work area of any operating equipment when:
  -They have attracted the operators attention and made eye contact
  -The operator has idled the equipment down and grounded all extensions
  -The operator gives the ground personnel permission to approach
- Ground personnel shall never walk or position themselves between any fixed object and running equipment or between two running pieces of equipment

Equipment

- Maintain operations manuals at the site for each piece of equipment that is present and in use
- Ensure operators are familiar with the manual for the equipment and operate the equipment within the parameters of the manual
- Ensure all equipment is provided with roll-over protection systems
- Verify that seatbelts are present and functional in all equipment
- Prohibit the use of equipment that has cab glass which is broken or missing
- Ensure that backup alarms are functional on all trucks and equipment
- Require all extensions such as buckets, blades, forks, etc. to be grounded when not in use
- Require brakes to be set and wheels chocked (when applicable) when not in use

Daily inspections of equipment are required using a Daily Heavy Equipment Safety Checklist. Equipment deemed to be unsafe as a result of daily inspection will not be used until required repairs or maintenance occurs. During maintenance/repair, ensure that motors are turned off, all extensions are grounded or securely blocked, controls are in a neutral position, and the brakes are set.

4.2.8 Drilling and Excavation Safety

Prior to any intrusive work, as previously mentioned, the location of underground utilities, such as sewer, telephone, gas, water and electric lines must be determined and plainly staked. Necessary arrangements must be made with the utility company or owner for the protection, removal or relocation of the underground utilities. In such circumstances, excavation will be done in a manner that does not endanger the field personnel engaged in the work or the underground utility. Utilities left in place will be protected by barricading, shoring, suspension or other measures, as necessary.

The use of unsafe or defective equipment is not permitted. Equipment must be inspected regularly. If found to be defective, equipment must be immediately removed from use and either repaired or replaced prior to resuming work with that equipment. Field personnel will be familiar with the location of first-aid kits and fire extinguishers. Telephone numbers for emergency assistance must be prominently posted and kept current.

Good housekeeping conditions will be observed in and around the work areas. Suitable storage places will be provided for all materials and supplies. Pipe, drill rods, etc. must be securely stacked on solid, level sills. Work surfaces, platforms, stairways, walkways, scaffolding, and access ways will be kept free of obstructions. All debris will be collected and stored in piles or containers for removal and disposal.

The area of the site to undergo intrusive activity must be walked over with the drillers and/or heavy equipment operators to identify all work locations, as well as making sure all marked utilities are seen by those doing the intrusive work.

<u>Drilling Specific Concerns</u>:

In areas where utilities have been identified or may be suspected, pre-drilling clearance such hand-augering, hand excavation (with shovels or post-hole diggers), or air-knifing to a depth of at least 5' below ground surface (BGS) may be required. The Project Manager will provide guidance in those instances on what has been determined as an acceptable means of clearing drilling locations. It should be noted that if the soil lithology changes to gravel within those 5 feet, that may be an indication of a utility trench and extreme caution should be taken OR the drilling location should be offset 5 horizontal feet from the original location. Should 3 consecutive attempts be made without success to offset a particular drilling location, the field personnel should stop and contact the Project Manager for further instruction.

Special precaution must be taken when using a drill rig on a site within the vicinity of electrical power lines and other overhead utilities. Electricity can shock, burn and cause death. When overhead electrical power lines exist at or near a drilling site, all wires will be considered dangerous.

A check will be made for sagging power lines before a site is entered. Power lines will not be lifted to gain entrance. The appropriate utility company will be contacted and a request will be made that it lift or raise cut off power to the lines.

The area around the drill rig will be inspected before the drill rig mast (derrick) is raised at a site in the vicinity of power lines. The minimum distance from any point on the drill rig to the nearest power line will be determined when the mast is raised or is being raised. The mast will not be raised and the drill rig will not be operated if this distance is less than 20 feet, because hoist lines and overhead power lines can be moved toward each other by the wind.

Before the mast is raised, personnel will be cleared from the immediate area, with the exception of the operator and a helper, when necessary. A check will be made to ensure safe clearance from energized power lines or equipment (minimum 20-foot clearance). Unsecured equipment must be removed from the mast and cables, mud lines and catline ropes must be adequately secured to the mast before raising. After it is raised, the mast must be secured to the rig in an upright position with steel pins.

Excavation Specific Concerns:

For excavation work, entry into an excavated area or trench will only be allowed when:

- Shoring, sloping, and spoil pile placement is in conformance with 29 CFR 1926 Subpart P, and
- Personal protection and monitoring, as detailed in this HASP, has been implemented.

All excavation contractors are required to provide an OSHA trained and certified Competent Person. Daily inspections of excavations, the adjacent areas, and protective systems shall be made by the Competent Person for evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection shall be conducted by the Competent Person prior to the start of work and as needed throughout each shift. Inspections shall also be made after every rainstorm or other hazard increasing occurrence. All inspections made by the Competent Person should be recorded in the field log book. No personnel shall perform work in a trench or excavation that contains accumulated water (any accumulated water will need to be either pumped out until the trench/excavation is dry, or the accumulated water is allowed to disperse naturally). Each employee in an excavation shall be protected from cave-ins by an adequate protective system except when excavations are made entirely in stable rock or the excavation is less than 5 feet in depth and examination by the Competent Person provides no indication of a potential cave-in. Protective systems consist of sloping or benching, use of trench boxes or other shielding mechanisms, or the use of a shoring system in accordance with the regulations.

When mobile equipment is operated adjacent to an excavation and the operators/drivers do not have a clear and direct view of the edge of the excavation, a warning system such as barricades, hand or mechanical signals, or spotters are required.

Adequate protection shall be provided to protect employees from loose rock or soil that could pose a hazard to personnel in the excavation. All temporary spoil piles shall be kept at least 2 feet away from the edge of the excavation. Spoil piles should be placed to channel rainwater or other run-off water away from the excavation.

All excavations deeper than 4 feet deep and which have the potential to have a hazardous atmosphere or oxygen deficient atmospheres (less than 19.5% oxygen) must be tested to ensure safe working conditions, prior to entry.

4.2.9 Use of Hand Tools and Portable Power Tools

Hand tools will be kept in good repair and used only for their designed purposes. Proper protective eyewear will be worn when using hand tools and portable power tools. Unguarded sharp-edged or pointed tools will not be carried in field personnel's pockets. The use of tools with mushroomed heads, split or defective handles, worn parts, or other defects will not be permitted. Inspect all tools prior to start-up or use to identify any defects. Tools that have become unsafe will be reconditioned before reissue or they will be discarded and replaced. Throwing or dropping of tools from one level to another will not be permitted; rather, containers and hand lines will be used for transporting tools from one level to another if working at heights.

Non-sparking tools will be used in atmospheres where sources of ignition may cause fire or explosion. Electric-powered shop and hand tools will be of the double-insulated, shockproof type, or they will be effectively grounded. Power tools will be operated only by designated personnel who are familiar and trained with their use. When not in use, tools will not be left on scaffolds, ladders or overhead working surfaces.

4.2.10 Noise

Exposure to high levels of noise may occur when working near drill rigs or other heavy equipment. Also, depending upon where the work is being performed, local equipment (e.g., airports, factory machines, etc.) may produce high levels of noise. A good indication of the need for hearing protection is when verbal communication is difficult at a distance of 2-3 feet. Personnel will be provided with ear plugs and/or earmuffs when exposed to noise levels in excess of the 8-hour Permissible Exposure Limit (PEL) of 90 decibels.

4.2.11 Work Zone Traffic Control

Personnel will exercise caution when working near areas of vehicular traffic. Work zones will be identified by the use of delineators (traffic cones, flags, vehicles, DOT approved devices, temporary or permanent fencing, and/or safety barrier tape). Personnel will wear reflective vests when working in these areas. Depending on frequency, proximity, and nature of traffic, a flag person may also be utilized.

4.2.12 Work Over Water

If personnel will be working near, above or immediately adjacent to or within 6 feet of water that is 3 feet or more deep or where water presents a drowning hazard (e.g., fast-moving stream, water body with a soft bottom), employees are required to a U.S. Coast Guard (USCG) approved personal flotation device (PFD). All PFDs must have reflective tape on them to facilitate visibility. Employees must inspect PFDs daily before use for defects. Do no use defective PFDs.

4.2.13 Vehicle Use

Personnel must use caution when driving to, from, and across the site, paying special attention to other site traffic, as well as weather and road conditions. Heavy equipment should be transported during non-rush hour traffic.

4.3 Biological Hazards

Site activities on this Site may expose workers to other hazards such as poisonous plants, insects, animals, and indigenous pathogens. Protective clothing and respiratory protection equipment, and being capable of identifying poisonous plants, animals, and insects, can greatly reduce the chances of exposure. Thoroughly washing any exposed body parts, clothing, and equipment will also protect against infections. Avoiding contact with biological hazards is the best way to prevent potential adverse health effects. Recognition of potential hazards is essential. When avoidance is impractical or impossible, PPE, personal hygiene, good general health and awareness must be used to prevent adverse effects. If working in wooded/grassy areas, use appropriate insect repellants (containing DEET and/or Permethrin) and apply them per the manufacturers' directions. The following is a list of biological hazards that may be encountered while performing field activities at the project site and surrounding areas:

BIOLOGICAL HAZARD and LOCATION	CONTROL MEASURES
Snakes typically are found in underbrush and tall grassy areas.	If you encounter a snake, stay calm and look around; there may be other snakes. Turn around and walk away on the same path you used to approach the area. If a person is bitten by a snake, wash and immobilize the injured area, keeping it lower than the heart if possible. Seek medical attention immediately. **DO NOT** apply ice, cut the wound or apply a tourniquet. Carry the victim or have him/her walk slowly if the victim must be moved. Try to identify the snake: note color, size, patterns and markings.
Poison ivy, poison oak and poison sumac typically are found in brush or wooded areas. They are more commonly found in moist areas or along the edges of wooded areas.	Become familiar with the identity of these plants. Wear protective clothing that covers exposed skin and clothes. Avoid contact with plants and the outside of protective clothing. If skin contacts a plant, wash the area with soap and water immediately. If the reaction is severe or worsens, seek medical attention.
Exposure to **bloodborne pathogens** may occur when rendering first aid or CPR, or when coming into contact with medical or other potentially infectious material or when coming into contact with landfill waste or waste streams containing such infectious material.	Training is required before a task involving potential exposure is performed. Exposure controls and personal protective equipment (PPE) area required. Hepatitis B vaccination must be offered before the person participates in a task where exposure is a possibility.
Bees, spiders and other stinging insects may be encountered almost anywhere and may present a serious hazard particularly to people who are allergic.	Watch for and avoid nests. Keep exposed skin to a minimum. Carry a kit if you have had allergic reactions in the past and inform the Project Manager and/or the buddy. If a stinger is present, remove it carefully with tweezers. Watch for allergic reaction; seek medical attention if a reaction develops.
Ticks typically are in wooded areas, bushes, tall grass and brush. Ticks are black, black and red or brown and can be up to one-quarter inch in size.	Avoid tick areas. Wear tightly woven, light-colored clothing with pants tucked into boots or socks. Spray outside of clothing with insect repellent containing permethrin. Check yourself for ticks often. If bitten, carefully remove tick with tweezers. Report the bit to the Project Manager. Look for symptoms of Lyme

	disease that include a rash that looks like a bulls eye and chills, fever, headache, fatigue, stiff neck or bone pain. If symptoms appear, seek medical attention.

5.0 PERSONAL PROTECTIVE EQUIPMENT

PPE ensembles are used to protect employees and subcontractors from potential contamination hazards while conducting project field activities. Level D is expected to be used for most activities at the site. The following subsections describe the PPE requirements for the field activities.

5.1 Level D Protection

When the atmosphere contains no known hazards and work functions preclude splashes, immersions or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals, Level D protection may be used. Level D does not provide respiratory protection and only provides minimal dermal protection. The Level D ensemble consists of the following:

- Work clothes that may consist of a short or long-sleeved cotton shirt and cotton pants, cotton overalls, or disposal overalls such as Tyvek™
- Steel-toe/steel-shank work boots
- Safety glasses with side shields
- Hearing protection, as necessary
- Hand protection, as appropriate
- Hard hat when working around overhead equipment such as a drilling rig
- Reflective vests when working around heavy equipment or near roadways
- Body harness and life vests when working on or within 6 feet of bulkheads, at heights, or in 3 feet or more of standing water (such as in Tin Mill Canal)

5.2 Modified Level D Protection

This is the level of protection that may be needed for material handling, sampling operations, and operation of remediation equipment when splash hazards are present. Modified Level D protection consists of the following:

- Disposable overalls such as polyethylene-coated Tyvek™
- Latex, vinyl, or nitrite inner gloves when handling liquids/fluids
- Nitrile outer gloves (taped to outer suit)
- Chemical-protective over-boots (taped to outer suit)
- Steel-toe/steel-shank, high-ankle work boots
- Hard hat with face shield
- Safety glasses with side shields or goggles
- 5ʣăű a l·ăʅ
- Hearing protection, as necessary

5.3 Level C Protection

Level C protection will be used when site action levels are exceeded and respiratory protection is required. The Level C ensemble consists of Modified Level D with the following modifications:

- Half or full-face air-purifying respirator (APR) equipped with appropriate cartridges/filters
- Chemical resistant clothing such as poly-coated Tyvek™
- Inner and outer nitrile gloves
- Chemical-resistant safety boots or boot covers to go over safety boots

Upgrading or downgrading the level of protection used by EAG employees and subcontractors is a decision made by EAG based on the air monitoring protocols presented in Section 7.0 for respiratory protection, the potential for inhalation exposure to toxic chemicals, and the need for dermal protection during the activity.

5.4 First Aid, Emergency and Safety Equipment

The following first aid, emergency and safety equipment will be maintained onsite at the work area:

- A portable eye wash
- Appropriate ABC-type fire extinguishers (minimum of 10 pounds; remediation systems to house individual 20 pound extinguishers) carried in every vehicle used during field operations
- Industrial first-aid kit (one 16-unit that complies with American National Standards Institute (ANSI) Z308A for every 25 persons or less)
- Bloodborne pathogen precaution kit with CPR mouth shield
- Instant cold packs
- Soap or waterless hand cleaner and towels
- American Red Cross First Aid and CPR Instruction Manuals

6.0 PERSONNEL TRAINING AND STANDARD SAFETY PROCEDURES

Employees must have received, at the time of project assignment, a minimum of 40 hours of initial OSHA health and safety training for hazardous waste site operations. Personnel who have not met the requirements for the initial training will not be allowed in the Exclusion Zone (EZ) or Contamination Reduction Zone (CRZ) of any active work area. A copy of each subcontractor site worker's 40-hour training certificate must be sent to the Project Manager for review prior to the start of the site work.

The 8-hour refresher training course must be taken at a minimum of once per year. At the time of the job assignment, all site workers must have received 8 hours of refresher training within the past year. This course is required of all field personnel to maintain their qualifications for hazardous waste site work. A copy of each subcontractor site worker's most recent 8-hour refresher training certificate must be sent to the Project Manager for review prior to the start of the site work.

A site-specific safety orientation will be conducted by EAG for all EAG employees and subcontractors engaged in fieldwork.

6.1 Onsite Safety, Health and Emergency Response Training

The OSHA 1910.120 standard requires that site safety and health training be provided by a trained, experienced supervisor. “Trained” is defined to mean an individual that has satisfactorily completed the OSHA 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) course and 8-hour site supervisor training. Training will be offered at the time of the initial task assignment and/or whenever new chemicals are introduced into the workplace. Training will include all applicable regulatory requirements, location of the program, inventory and MSDSs, chemicals used and their hazards (chemical, physical, and health), how to detect the presence or release of chemicals, safe work practices and methods employees can take to protect themselves from hazards, how to read MSDSs and site or project specific information on hazard warnings and labels in use at that location. All training will be documented and training certificates will be kept in the employee’s permanent training file. All applicable training will also require annual refreshers.

EAG qualified personnel must also provide safety meetings.

6.2 Standard Safety Procedures

This section describes the standard safety procedures that EAG requires all onsite personnel to follow during site activities.

6.2.1 General Safety Work Practices

All onsite employees and subcontractors will observe the following general safety work practices:

- Health and safety tailgate briefings will occur to introduce new activities, any new safety issues, and emergency egress routes for work areas; any significant change (added personnel, change in scope, or change in field conditions) will trigger a second (or more) tailgate meeting to address whatever change occurred
- No food, drink, or tobacco products will be allowed in the Exclusion and Contamination Reduction Zones
- Loose clothing, hair, and/or jewelry will not be permitted around moving or rotating equipment
- The “buddy system” will be implemented as necessary whereby a pair of co-workers watches out for each other while in proximity of potential physical work hazards
- Good housekeeping of all work areas will be maintained on an ongoing basis

6.2.2 Hand Safety

This standard is intended to protect employees from activities that may expose them to injury. This standard provides information on recognizing those conditions that require personal protective equipment (PPE) or specific work practices to reduce the risk of hand injury.

Appropriate gloves must be worn when persons work with materials or equipment that presents the potential for hand injury due to sharp edges, corrosives, flammable and irritating materials, extreme temperatures, splinters, etc.

<u>Guidelines for Working With and Around Equipment (Hand Tools, Portable Powered Equipment)</u>:

- Employees should be trained in the use of all tools.
- Keep hand and power tools in good repair and use them only for the task for which they were designed.

- Inspect tools before use and remove damaged or defective tools from service.
- Operate tools in accordance with manufacturer's instructions.
- Do not remove or bypass a guarding device for any reason.
- Keep surfaces and handles clean and free of excess oil to prevent slipping.
- Wear proper PPE, including gloves, as necessary.
- Do not carry sharp tools in pockets.
- Clean tools and return to the toolbox or storage area upon completion of a job.
- Before applying pressure, ensure that wrenches have a good bite.
- Brace yourself by placing your body in the proper position so you will not fall if the tool slips.
- Make sure hands and fingers have sufficient clearance in the event the tool slips.
- Always pull on a wrench, never push.
- When working with tools overhead, place tools in a holding receptacle when not in use.
- Do not throw tools from place to place or from person to person, or drop tools from heights.
- Inspect all tools prior to start-up or use to identify any defects.
- Powered hand tools should not be capable of being locked in the ON position.
- Require that all power-fastening devices be equipped with a safety interlock capable of activation only when in contact with the work surface.
- Do not allow loose clothing, long hair, loose jewelry, rings, and chains to be worn while working with power tools.
- Do not use cheater pipes.
- Make provisions to prevent machines from restarting through proper lockout/tagout.

Guidelines for using Cutting Tools:

- Always use the specific tool for the task. Tubing cutters, snips, self- retracting knives, concealed blade cutters, and related tools are task specific and minimize the risk of hand injury. For more information about cutting tools, see Supplemental Information A.
- Fixed open-blade knives (FOBK) are prohibited from use. Examples of fixed open-blade knives include pocket knives, multitools, hunting knives, and standard utility knives.
- When utilizing cutting tools, personnel will observe the following precautions to the fullest extent possible:
- Use the correct tool and correct size tool for the job.
- Cut in a direction away from yourself and not toward other workers in the area.
- Maintain the noncutting hand and arm toward the body and out of the direction of the cutting tool if it were to slip out of the material being cut.
- Ensure that the tool is sharp and clean; dirty and dull tools typically cause poor cuts and more hazard than a sharp, clean cutting tool.
- Store these tools correctly with covers in place or blades retracted, as provided by the manufacturer.
- On tasks where cutting may be very frequent or last all day (e.g., liner samples), consider Kevlar® gloves in the PPE evaluation for the project.
- Do not remove guards on paper cutters.

6.2.3 Respiratory Protection

Based on air monitoring, an upgrade to Level C protection may be indicated. Half or full-face APRs will be utilized for protection against organic vapors and particulates. All employees required to wear respirators will be need to be medically cleared, in writing to do so by a qualified Occupational Physician.

All respirator users must be trained before they are assigned a respirator, annually thereafter, whenever a new hazard or job is introduces and whenever employees fail to demonstrate proper use or knowledge. Training will include, at a minimum:

- Why the respirator is necessary and what conditions can make the respirator ineffective.
- What limitation and capabilities of the respirators area.
- How to inspect, put on and remove and check the seals of the respirator.
- What respirator maintenance and storage procedures are.
- How to recognize medicals signs and symptoms that may limit or prevent effective use of the respirator.
- The engineering and administrative controls being used and the need for respirators.
- The hazards and consequences of improper respirator use.
- How to recognize and handle emergency situations.

Training will be documented and training certificated will be kept in the employee's permanent training file.

6.2.4 Personal Hygiene Practices

The field team must pay strict attention to sanitation and personal hygiene requirements to avoid personal contamination. The following instructions will be discussed and must be followed:

- During field activities, never put anything in the mouth, including fingers
- All employees must wash their hands, forearms, face, and neck before eating drinking, smoking or using the restroom
- Smoking is prohibited except in designated areas outside the work zone
- At the end of the day, all employees will shower upon returning home or to their hotel

6.2.5 Electrical Safety

All extension cords used onsite must be heavy-duty variety and must be properly grounded. All temporary circuitry must incorporate the use of GFCI devices. Refer to electrical safety in Section 4.2.6, Electrical Hazards.

6.2.6 Fire Safety

All flammable liquids will be used only for their intended purpose and stored and handled only in approved containers. Portable containers must be the approved red safety containers equipped with flame arresters and self-closing lids. All transfers of flammable liquids must be made with the containers grounded or bonded. Also, gasoline containers will be clearly labeled and storage areas (if applicable) will be posted with “No Smoking” signs. Fire extinguishers will be stalled in all areas that contain flammable liquids.

6.2.7 Illumination

All work is planned for daylight hours. No special requirements are anticipated. However, should any work take place outdoors after daylight hours, suitable lighting will be required. In addition, suitable lighting is to be provided in each remediation system building or enclosure.

6.2.8 Sanitation

Potable water and toilet facilities will be provided in compliance with the OSHA 1926.51 standard. Any container used to distribute drinking water shall be clearly marked and not used for any other purpose. Single drinking cups will be supplied, both a sanitary container for the unused cups and a receptacle for disposed of the used cups will also be provided. Port-a-johns will be provided since there are no sanitary sewers on the job site.

7.0 EXPOSURE MONITORING PLAN

This section describes air and personnel monitoring protocols, sampling methods, and instrumentation to be used, as well as the methods and frequency of sampling instrument calibration and action levels for potential work site hazards. When engaged in air monitoring, EAG personnel and subcontractors must use the forms to record air monitoring data and air monitoring instrument calibration records. All monitoring records/forms are to be maintained in the project file by the EAG Project Manager.

7.1 Air Monitoring

The surveillance program is established to detect changes in the ambient air at the work site and to ensure the continuing safety of the work zones and adequacy of the level of worker protection. During field activities, the designated field team member will monitor the work site for combustible gas concentrations and organic vapors. Calibration of all monitoring equipment will be performed in accordance with the manufacturers’ procedures by trained EAG employees and subcontractors. The Project Manager, Project Field Team Leader or representative will be notified immediately of any contaminant levels that could trigger an upgrade in PPE or cause a suspension of site activities.

- One or more of the following direct-reading instruments may be used to aid in this determination. Photoionization Detectors (PID) and Flame Ionization Detectors (FID) will measure non-specific organic gases and vapors. Combustible Gas Indicators (CGI) will detect explosive atmospheres. Oxygen (O2) meters will detect fluctuations in oxygen concentrations. These instruments should be calibrated or bump tested daily and whenever the readings may be erratic. All readings should be recorded in the field log books.

Air monitoring results obtained from the breathing zone during field activities will be recorded in field log books. All such records will also include the location, date/time, weather conditions, person monitored, background concentration, and identification of specific contaminant whenever possible. Air monitoring information will be utilized to evaluate personnel exposure and assess the appropriateness of PPE for Site conditions.

7.1.1 Combustible Gas and Oxygen Deficiency/Excess Monitoring

Explosive gas concentrations are not expected to exceed 10% of the lower explosive level (LEL). Should the need be indicated for monitoring, action guidance for the CGI/O2 meter responses is contained in **Table 7-1**.

Table 7-1

CGI/Oxygen Meter Action Levels	
Meter Response	**Action**
CGI response 0%-10% LEL	Continue normal operations
CGI initial response >10% and <20% LEL	Eliminate all sources of ignition from the work area; temporarily retreat from work area for 15-30 minutes and then monitor area again
CGI response after 15-30 minute retreat >10% and <20% LEL	Retreat from work area; notify Project Manager
CGI response >20%	Discontinue operations; retreat from work area
Oxygen level <19.5%	Retreat from work area; notify Project Manager
Oxygen level >23.5%	Retreat from work area; notify Project Manager

7.1.2 Organic Vapor Concentrations

Real-time monitoring for organic vapor concentrations in the breathing zone and down hole will be conducted during field operations (installation of groundwater monitoring and groundwater sampling by EAG and EAG subcontractor personnel) with a PID equipped with a 10.2- or 11.7-electron volt (eV) probe. The PID will be taken into the field and operated during site activities where contaminated soil and/or groundwater may be present. Air monitoring will be conducted during well installation and when a well is opened for groundwater measurements. Measurements will be made at the well head and personnel breathing zones where activities are being performed. The instrument will be calibrated using ultra-high purity air and isobutylene vapor of known concentration before and after use each day. Air calibration measurements will be documented in writing and kept in the project file. Action guidance for PID responses is contained in **Table 7-2**.

Table 7-2

Action Levels for General Site Work	
Meter Response in Breathing Zone (minimum of 3 minutes)	**Action Required**
<5ppm above background	Use Level D PPE
>5ppm above background	Level C PPE, including half or full-face APR with organic vapor cartridges/P100 filters
>50ppm above background	Stop work
Action Levels for Handling NAPL	
Meter Response in Breathing Zone (minimum of 3 minutes)	**Action Required**
<1ppm above background	Use Modified Level D PPE
>1ppm to <10ppm	Level C PPE, including half or full-face APR with organic vapor cartridges
>10ppm above background	Immediately withdraw; monitoring will continue until action levels will allow safe re-entry

If air concentrations of organic vapors are greater than 5 ppm above background in the breathing zone for a 3-minute period, personnel will stop work, retreat from site, and allow time (at least 15 minutes) for vapors to dissipate. If monitoring indicates that concentrations still exceed 5 ppm, workers will upgrade to Level C PPE. If monitoring indicates that concentrations exceed 50 ppm, work will be stopped until site conditions can be re-evaluated.

These action levels are based on the assumption that the major component of free product being recovered will be benzene or naphthalene.

Work involving NAPL recovery from monitoring wells will be conducted in Level C PPE. This level may be downgraded based on air monitoring data and actual field conditions. Downgrading of PPE must be approved by the PM and HSE staff. If ventilation is conducted, additional air monitoring will be performed to the resumption of work to determine the level of PPE required.

7.2 Physical Conditions Monitoring

Site workers will be monitored by the Project Manager for signs of weather-related symptoms from exposure to excessive heat or cold.

Whenever the air temperature exceeds 70°F for personnel wearing chemical protective clothing or 90°F for personnel wearing regular work clothes, the Project Manager will assess conditions that may cause heat stress in site workers.

8.0 MEDICAL SURVEILLANCE

This section discusses the medical surveillance program, how the results are reviewed by a physician and how participation is documented.

8.1 Medical Surveillance Program

All personnel who will be performing any task where potential exposure to hazardous material exists will undergo medical surveillance as outlined in OSHA 29 CFR 1910.120(f). All personnel performing tasks in the Exclusion Zone or Contamination Reduction Zone will be required to have passed the EAG medical surveillance examination (or equivalent), performed by a licensed Occupational Physician. The Project Manager will verify that all EAG and subcontractor personnel meet applicable OSHA medical surveillance requirements.

Applicable field employees will undergo an annual comprehensive medical examination, including a comprehensive health history, blood chemistry with complete blood count and differential, urinalysis, medical history, required chest x-rays, audiogram, pulmonary function testing, testing for heavy metals (as needed), and a physician's interpretation of each employee's medical surveillance examination, including the ability of the employee to wear a respirator. A comprehensive medical examination will be performed if an employee develops signs or symptoms indicating possible overexposure to hazardous substances and/or heat or cold stress.

8.2 Physician Review

All medical surveillance and examination results are reviewed by a licensed physician who is certified in Occupational Medicine by the American Board of Preventive Medicine. EAG employee participation in the medical surveillance program is a part of their permanent medical record maintained in the employee's home office. A copy of the current medical clearance signed by the occupational health physician for all EAG employees must be maintained at the home office.

9.0 SITE CONTROL MEASURES AND DECONTAMINATION

To provide for the protection of public health and safety and minimize the possibility of transferring hazardous substances from the site, contamination control procedures are required. These procedures consist of site control measures (which entail the delineation of work zones, communications, and site security) and decontamination procedures (which are necessary for both personnel and equipment). Contaminants that may be uncovered during sampling operations must not be transferred outside the work zone unless properly containerized, and must be removed from clothing, personnel, and equipment prior to relocation from that zone. This section discusses site control measures and decontamination procedures to be used during the collection of samples, the installation of soil borings and/or groundwater monitoring/remediation wells, excavations, and other intrusive work where contact with impacted soils and groundwater could occur by EAG and/or EAG subcontractor personnel.

9.1 Site Control Measures

Site control can be achieved by effectively delineating the work zone, providing appropriate communication, and establishing site security.

9.1.1 Work Zone Delineation

To minimize the transfer of hazardous substances from the site and to ensure proper protection of employees and subcontractors, work zones will be established by the Field Project Team Leader. Applicable site work and the associated requirement for work zones will be determined by the Project Manager. The work area will be divided into an Exclusion Zone (EZ), a Contamination Reduction Zone (CRZ), and a Support Zone (SZ). A typical work zone delineation setup is shown as **Figure 9-1**, below.

Exclusion Zone (EZ)

Contamination does or could exist in this zone. Only properly authorized and trained individuals (refer to Section 6.0) wearing appropriate PPE will be allowed to enter and work in this zone. All people entering the EZ must wear, at a minimum, Level D protection. An entry and exit point for personnel and equipment will be established at the periphery of the EZ (between the EZ and the CRZ) to regulate the flow of personnel and equipment.

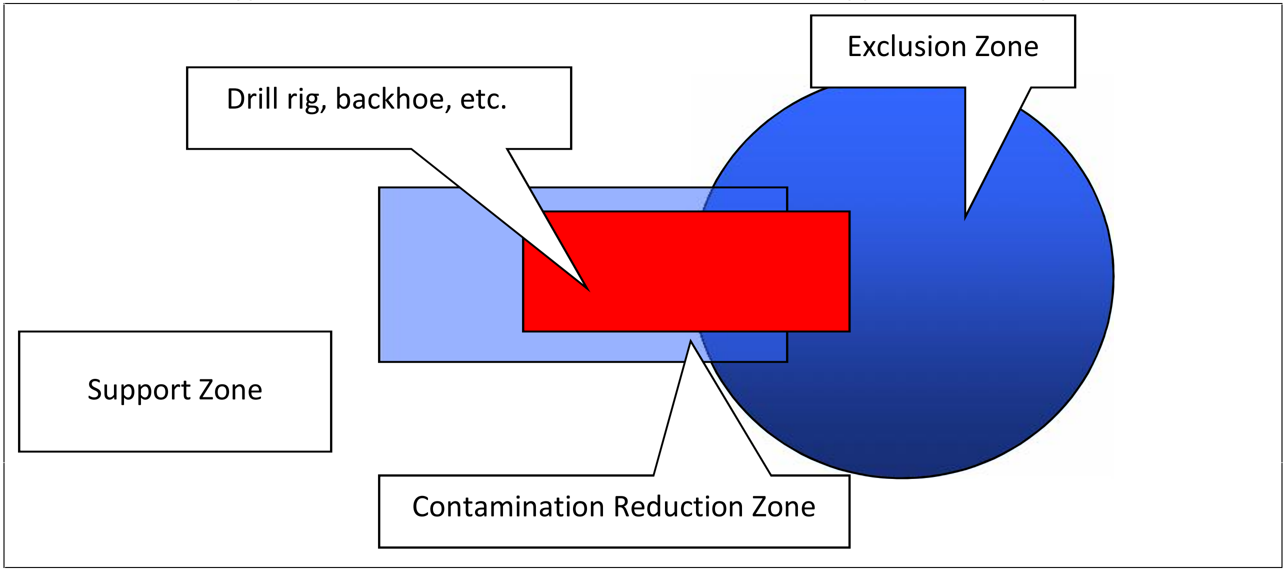
Contamination Reduction Zone (CRZ)

Between the EZ and the SZ will be the CRZ, which will provide a transition between the potentially contaminated EZ and the clean SZ. The CRZ (located upwind of the EZ, if possible) will be a corridor leading from the EZ and will serve as a buffer to further reduce the probability of the SZ becoming contaminated. Exit from the EZ will only be allowed through this CRZ. The CRZ will provide additional assurance that the physical transfer of contaminating substances on people, equipment, and/or in the air will be limited through a combination of decontamination and zone restrictions. Within this zone, employees and subcontractors may perform personal decontamination (e.g., face and hand washing), and certain PPE and small equipment decontamination. Buckets or wash basins for boot washing and equipment decontamination will be stationed on a sheet of plastic (a minimum of 8 feet by 8 feet), the boundaries of which will constitute the CRZ.

Support Zone (SZ)

The Support Zone will be considered a non-contaminated area. The location of support facilities in the SZ will be upwind of the EZ (where possible) and readily accessible to the nearest road. The field office/support facilities, equipment vehicles, a first aid station and a visitors/personnel entry and exit log for the work site will be located in this zone. Potentially contaminated personal clothing, equipment and samples are not permitted in this zone unless properly containerized.

Figure 9-1
Typical Exclusion, Contamination Reduction, and Support Zone setups



9.1.2 Communications

A loud and clear form of communication should be made available for Site personnel entering the work zones. Site communication may be in the form of hand signals, voice, or other communication devices. All forms of communication should be understood by all workers on the Site prior to starting work. Offsite communications may be conducted with mobile phones or walkie-talkies only if the atmosphere has been deemed non-explosive, and the person using the mobile device is in the SZ while placing the call, or inside the cab of a stationary vehicle.

9.1.3 Site Security

The Sparrows Point facility is not open to the public, and there is a strictly monitored main entrance with a security guard on duty at all times who only allows authorized personnel onto the Site. This limited access to the facility should eliminate the need for many requirements for specific site security except those needed to maintain work zone integrity, such as visible barriers around open excavations or EZs and CRZs. No site visitors will be allowed to travel unescorted by EAG or subcontractor personnel around the facility.

Once site visitors arrive at their intended work zone, they must check in with the Field Team Lead. If visitors are authorized to enter the CRZ and/or the EZ, they must have completed OSHA 1910.120 medical surveillance and training requirements (refer to Section 8.0 and Section 6.0). Visitors must wear appropriate PPE before they will be allowed to enter the CRZ and/or the EZ. They must also be taken through this HASP during a brief tail-gate meeting and sign the Acknowledgement page in the back prior to engaging in any activities inside the CRZ or the EZ. All site visitors must follow the same site control measures and decontamination procedures as EAG personnel and subcontractors. The Project Manager must also be informed of each visitor's name, purpose for their visit, time of entry (and exit), location of tasks they wish to perform, whether they completed their intended task(s), and any other relevant information pertaining to their visit.

9.2 Decontamination Procedures

Decontamination of employees, subcontractors, and equipment leaving the EZ will be performed to minimize human exposure to hazardous substances and to minimize the spread of contamination to surrounding areas. The purpose of the CRZ is to provide a location to perform limited personnel decontamination and certain PPE and small equipment decontamination.

9.2.1 Personnel Decontamination

Persons leaving the EZ must pass through the CRZ and follow decontamination procedures before entering the SZ. Hand tools and other sampling equipment used in the EZ and reusable PPE (boots, safety glasses, etc.) will be appropriately cleaned prior to removal from the site each day. The step-by-step sequence for personnel decontamination is as follows:

- Remove boot covers (if used) at the boot washing station and place them in the disposal container provided
- Wash outer gloves and chemical resistant boots (if used) at the boot washing station
- Remove wrist tape (if used) and outer gloves and place them in the disposal container provided
- Remove ankle tape (if used) and disposable coveralls (if used) and place them in the disposal container provided
- Remove respirators (if used) and place each in designated locations in the CRZ
- Remove inner gloves and discard in the disposal container provided
- Wash hands and face and proceed to the SZ

Respirators must be fully decontaminated after each use by the personnel who previously wore them. All project employees and subcontractors are required to take a thorough soap and water shower in their home or motel room at the end of each workday. If monitoring or a general exposure assessment indicates that an employee has become contaminated, the employee or subcontractor will notify the EAG Project Manager and the Field Team Lead as soon as the contaminated state has been discovered.

9.2.2 Equipment Decontamination

All equipment leaving the EZ must be decontaminated either within the CRZ or at the central decontamination area. Small equipment, such as hand tools, will be thoroughly decontaminated within the CRZ before being placed in the SZ. The field tools may be scrubbed visually clean using a detergent solution (Alconox/Liquinox) with water and a stiff, long-bristled scrub brush. Following the solution scrubbing, the tools may be rinsed with distilled water or isopropyl alcohol. Any vehicle working in an EZ will be decontaminated before leaving the site. The vehicle will be cleaned by sweeping excess soil and debris off the wheels. A high-pressure sprayer will then be used to wash the wheels, if necessary.

Each piece of equipment will be inspected after cleaning for any soil remaining on the tires or elsewhere. All vehicles will be cleaned to the satisfaction of the Field Team Lead or a designated assistant prior to entering the SZ or leaving the site. Employees or subcontractors performing decontamination shall wear the appropriate level of PPE (refer to Section 5.0).

9.2.3 Waste Management

The Project Manager and the Field Team Leads will be responsible for overseeing the containerization and disposal of any field derived wastes. Contaminated or suspected contaminated field derived wastes shall be disposed of in accordance with all local, state, and/or federal regulations. Field derived wastes include decontamination rinse waters and other related decontamination generated wastes.

Soils and groundwater expected to be encountered during any sampling or intrusive work not to be contaminated, based on existing data, may be discharged to the ground surface in the immediate vicinity of the monitoring well. However, any known or suspected to be contaminated soil (in small quantities) or groundwater will be containerized for future removal, likely in 55-gallon drums or other approved storage vessels. Depending on the suspected contaminants, the recovered groundwater may be sent through one of the onsite groundwater treatment units. However, the treatment unit must be designed to address the contaminants of concern in the groundwater being treated. Otherwise, the liquid must be staged onsite for eventual offsite disposal at an approved facility.

Impacted soil, if in drums, will be staged in an area designated by the Project Manager or Field Team Lead for eventual disposal. For large excavations, where excavated soil is stockpiled, it may be necessary to place soils on plastic and cover with plastic to prevent any potential leachable runoff. The Project Manager and/or Field Team Lead will provide the proper guidance necessary for handling bulk soil piles.

Any NAPL recovered via remediation systems or manual recovery efforts will be properly containerized and either disposed of offsite as a recyclable material, if possible, or as a hazardous waste. The receiving facility must be an approved facility.

10.0 EMERGENCY RESPONSE AND CONTINGENCY PROCEDURES

The objective of emergency response and contingency procedures is to ensure that effective actions are implemented in a timely manner to minimize or control the effects of adverse events (e.g., potential chemical exposures, personal injuries, fires/explosions, and spills/releases). The following subsections describe the basic emergency responses required should an emergency take place during field investigation or remedial effort activities.

10.1 Emergency Phone Numbers

Emergency telephone numbers are listed in **Table 10-1**.

Table 10-1
Emergency Telephone Numbers and Agencies

Agency	Telephone Number
Security (Sparrows Point facility)	(410) 388-7761
Ambulance	911
Fire	911
Occupational Health Clinic	(410) 633-3600
Hospital	(410) 550-0100 (general) (410) 550-0350 (emergency)
National Response Center	(800) 424-8802
Poison Control Center - Maryland	(800) 222-1222
EAG Main Contact	
VP Remediation, Russ Becker	(314) 686-5611
Project Manager, James Calenda	(314) 620-3056

10.2 Injury/Illness Treatment

In the event of illness or injury, the following steps will be taken:

- Evaluate the extent of injuries or seriousness of illness.
- When employees require urgent medical attention, call for emergency assistance. First aid should be administered while awaiting an ambulance or paramedics. All emergency medical treatment, other than first aid, will be administered by the local paramedics. **Table 10-1** lists site emergency telephone numbers. In all cases, critical injuries must be immediately referred for professional medical attention.
- For a non-critical injury/illness, first aid will be administered by onsite personnel. Anyone sustaining a non-critical injury/illness who continues to work will be monitored by the Field Team Lead for any signs of worsening condition, if it is deemed that the person can return to work by the Team Lead and Project Manager. Injured personnel who later suffer any worsening change in status are to immediately notify the Team Lead or the Project Manager.

10.3 Occupational Health Clinic and Hospital Information

Occupational Health Clinic

The Concentra Medical Center, located at 1833 Portal Street, Baltimore, MD, is the closest occupational health clinic, just over 6 miles away. A map to the clinic in included as **Figure 10-1**. The clinic should be used for non-emergency injuries and illnesses.

Directions:
From Sparrow's Point Road, turn left onto Wharf Road;
Turn left onto MD-158 W/Bethlehem Blvd. (0.4 mile);
Turn right onto MD-157 N/Peninsula Expy. (2.7 miles);
Turn slight left onto Merritt Ave. (0.1 mile);
Merritt Ave. becomes Sollers Point Rd. (0.3 mile);
Turn left to stay on Sollers Point Rd (0.6 mile);
Turn left onto Williams Ave. (0.2 mile);
Turn right onto Dundalk Ave. (<0.1 miles);
Turn left onto Chandlery St. (0.1 mile);
Turn left onto Portal St.

Figure 10-1: Health Clinic (Non-Emergency) Map

Hospital

The Johns Hopkins Bayview Hospital is the closest emergency facility, just over 9 miles away. The hospital is located at 4940 Eastern Avenue in Baltimore, MD. **Figure 10-2** is a map to this hospital. Maps are also included in **Attachment E**.

Directions:

From the Sparrows Point Industrial Complex, go north on Route 151 for approximately one mile.

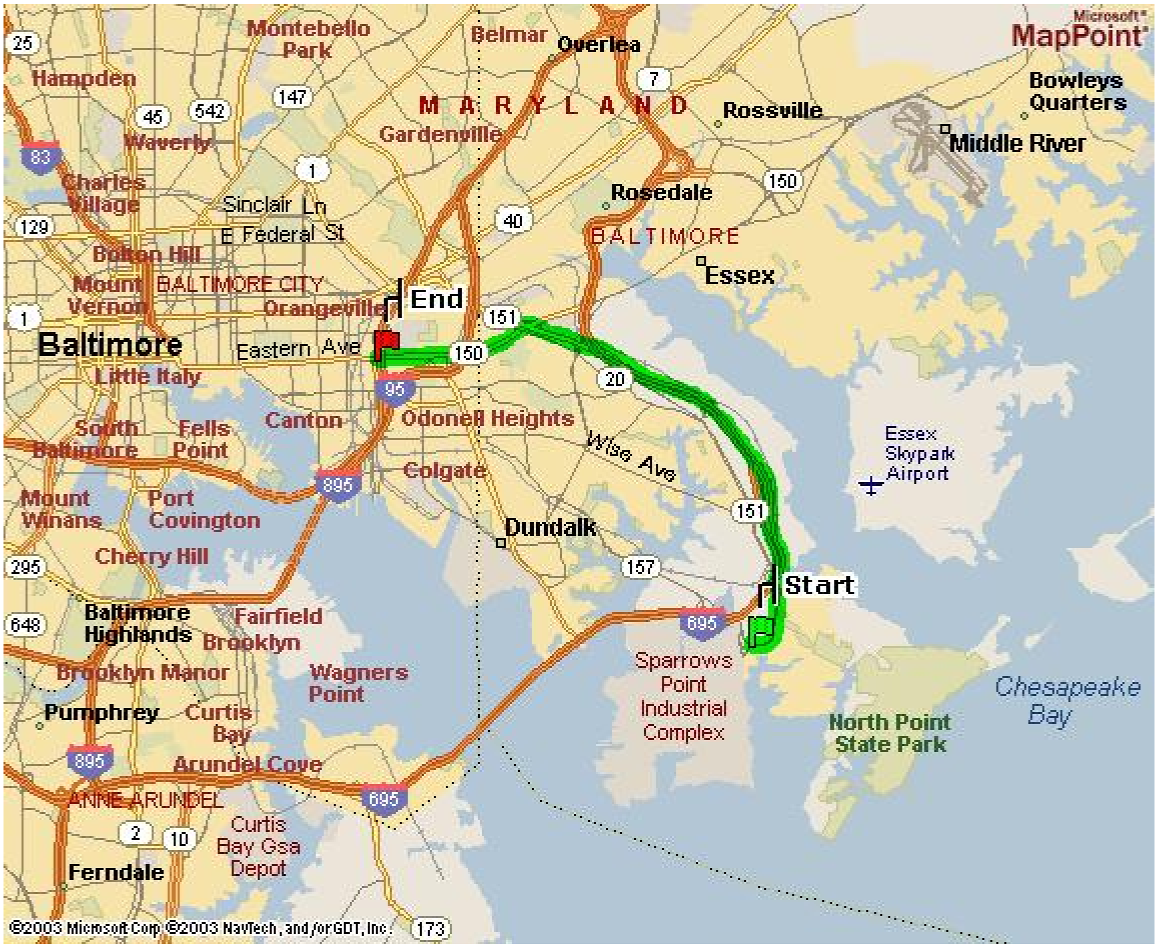
Take ramp (right) onto I-695 towards I-695/Essex.

At exit 40, take ramp (right) onto Route 151/North Point Boulevard North/MD 150;

Take ramp (right) onto Route 150 (Eastern Avenue).

Continue on Eastern Avenue to hospital on right.

Figure 10-2: Hospital Map



Prior to the start of field activities, the Project Field Team Leader will call to verify the telephone numbers and directions for the clinic and hospital, and then distribute location maps and the emergency telephone list to workers and vehicles.

10.4 Accident and Emergency Medical Response

All field team members will be aware of the location of a first aid kit kept onsite. All vehicles used to transport injured persons to an offsite medical facility will be provided with directions and a map to the medical facility.

If treatment beyond first aid is required, emergency response personnel will be contacted for assistance and transport. Before beginning site activities, the Project Field Team Leader will ensure that each field team member knows where the nearest emergency medical facilities are and how to get there. The closest hospital will be used in cases of life-threatening emergencies at the direction of the Project Field Team Leader. The telephone numbers of the local emergency services will be available in the SZ, and the Project Field Team Leader will brief the field team on the procedures for calling for help in an emergency.

Site personnel will inform the Project Manager of any medications, allergies, or other medical information that may be applicable for their medical treatment. The Project Manager will supply this information to emergency response personnel, and will accompany the victim to the hospital, if possible.

10.4.1 Chemical Exposure

In case of accidental overexposure to a hazardous material (groundwater, soil, and/or off-gas materials), guidelines shown in **Table 10-2** will be used.

Table 10-2
Chemical Exposure Guidelines

Type of Overexposure	First Aid Guidelines
Skin Contact	Skin: Wash/rinse the affected area thoroughly with copious amounts of soap and water.
	Eyes: Eyes should be rinsed for at least 15 minutes following chemical contamination.
	Contact emergency response personnel if required, or transport victim to the hospital.
Inhalation	Move the victim to fresh air.
	Contact emergency response personnel if required, or transport victim to the hospital.
Ingestion	Contact Poison Control Center.
	Contact emergency response personnel, or transport victim to the hospital.

10.4.2 Decontamination During a Medical Emergency

For minor medical problems or injuries, regular decontamination procedures will be followed. If emergency, life-saving first aid and/or medical treatment are required, regular decontamination procedures may need to be abbreviated or omitted:

- Do not attempt to wash or rinse an unresponsive victim unless the victim has been contaminated with an extremely toxic or corrosive chemical that may cause injury or loss of life to emergency response personnel.
- Outer garments can be removed if it does not cause a delay, interfere with treatment, or aggravate the problem.

- PPE can be cut away and respiratory protective equipment must always be removed.
- If contaminated clothing cannot be safely removed, then the victim should be wrapped in a blanket or plastic sheeting to prevent contamination to the inside of the ambulance and/or emergency response personnel.

The Project Manager or Field Team Lead will advise the medical staff as to the type of contamination possibly involved.

10.4.3 Small or Incipient Fire

A small fire is defined as a fire that can be extinguished with an available 20 pound type ABC fire extinguisher. An incipient fire is a fire that is small because it has just started. In the event of a small or incipient fire, the following minimum actions will be taken:

- Evacuate nearby personnel from the area, if possible, to an upwind location or to an area not affected by smoke or hazardous decomposition products if an upwind location is not feasible.
- Attempt to extinguish fire using portable fire extinguisher or by smothering.
- Contact emergency response personnel, as needed, for any injuries or exposures to hazardous decomposition products, or if fire cannot be put out.
- After the fire has been extinguished, or emergency response personnel have been contacted, notify the following project personnel:
  The Project Manager

10.4.4 Large Fire or Explosion

An explosion, large fire or a small fire which cannot be extinguished is beyond the first line capabilities of EAG personnel. Professional emergency response personnel would be needed to provide emergency assistance for these types of incidents. In the event of a large fire, explosion or a small fire that cannot be extinguished, the following minimum actions will be taken:

- Evacuate all personnel from the site, if possible, to an upwind location, or to an area not affected by smoke or hazardous decomposition products if an upwind location is not feasible
- Perform a quick role call to account for all site personnel
- Contact the fire department
- Contact emergency response personnel, as needed, for any injuries or exposures to hazardous decomposition products
- After emergency response personnel have been contacted, notify the following project personnel:
  The Project Manager

10.4.5 Adverse Weather Conditions

In the event of adverse weather conditions, the Project Manager will determine if work can continue without sacrificing the health and safety of site personnel. Threatening weather conditions will be monitored by the Project Manager and possibly the Team Lead via radio, television, internet, and/ or calls to the National Weather Service. Some of the conditions to be considered include:

- Potential for heat or cold stress
- Limited visibility

- Electrical storms
- Treacherous weather-related working conditions (i.e., heavy rainfall, icy conditions causing slippery footing hazards, etc.).

10.4.6 First Aid for Heat Stress/Cold Stress

First aid treatment for **heat cramps** includes shade, rest and fluid replacement. If available, the individual should drink electrolyte replacement fluids (e.g., Gatorade, Squincher or 10-K). The individual should recover within half an hour.

First aid treatment for **heat exhaustion** includes cooling the victim, elevating the feet and fluid replacement. If the individual has not recovered within half an hour, then transport the victim to the hospital for medical attention.

Heat stroke is a medical emergency, requiring the immediate cooling of the victim and transport to the hospital for medical treatment immediately.

First aid treatment for **frost nip** and **frostbite** includes covering the affected area with warmth and retreating to a warm area. If the individual has not recovered within half an hour, then transport the victim to the hospital for medical attention.

Frozen tissue is a medical emergency and the victim must receive medical attention immediately. Contact emergency response personnel immediately or transport the victim to the hospital.

First aid treatment of **mild hypothermia** includes using heat to raise the individual's body temperature. Heat may be applied to the victim in the form of heat packs, hot water bottles and blankets. If the individual has not recovered within half an hour, then transport the victim to the hospital for medical attention.

Severe hypothermia is a medical emergency and the victim must be transported to the hospital immediately. First aid treatment for severe hypothermia includes handling the victim very gently; rough handling may set off of an irregular heartbeat. ***DO NOT*** attempt to re-warm the severely hypothermic victim; re-warming may cause the development of an irregular heartbeat.

10.4.7 Snake Bites

If bitten, lower the extremity below the heart to reduce the poison's dissemination through the body. Remain calm, try to keep the heart rate reduced and seek medical attention immediately. Do not cut the wound or attempt to suck out the venom. Note any physical features (e.g., shape of head and color or pattern on body) of the snake.

10.4.8 Animal Bites

All bites should be treated as contaminated soft tissue injuries. Bites should be washed immediately with large amounts of soap and water. If soap is not available, flush the wound with water. The severity and onset of any infection is dependent upon the number of organisms (viruses or bacteria) introduced into the wound. Washing saliva out of the wound immediately will reduce the number of bacteria or viruses that can enter the tissue. Medical attention must be sought if rabies is suspected or the individual has not had a recent tetanus booster.

10.4.9 Insect Bites and Stings

Emergency care for insect bites and stings depends on the individual's reaction. To treat a sting that results in a minor reaction, remove the stinger by gently scraping it off the skin. Do not try to grasp the sac or stinger, because this forces the remaining venom into the skin. Once the stinger has been removed, clean the wound and surrounding area. Apply cold packs to slow the absorption of the venom and reduce pain and swelling. The treatment for a severe reaction to insect stings includes the following:

- Confirm with the victim whether they are highly allergic to the insect that stung them
    - If victim has gone into anaphylactic shock, retrieve their epi pen or other auto-injector and administer per the directions as hastily as possible
- Assuming the victim remains conscious, ask them to refrain from moving around, and to lie down
- Immobilize the injured area immediately
- If an extremity is involved, remove any rings or watch
- Keep the affected part low, below the level of the heart
- Apply cold compresses to the affected area
- If possible, try to identify the type of insect that inflicted the sting
- Transport the victim to a medical facility immediately, continuing supportive measures en route.

All employees and subcontractors must report severe reactions to insect stings prior to the beginning of work to both the Project Manager and Field Team Lead.

10.4.10 Poisonous Plants

Decontamination: Wash the skin immediately after contact with the plant. Proper washing may not be practical in the middle of the woods, but a product such as Technu or a small wash-up kit with prepackaged, alcohol-based cleansing tissues can be effective. Employees and subcontractors should not forget to wash contaminated clothing and clean up contaminated equipment prior to re-use.

Treatment: Options are as follows:

- Home treatment: Calamine lotion and an oatmeal bath (one cup to a tub full of water) can help relieve itching. To prevent secondary skin infection, scratching is not helpful and the fingernails should be cut to avoid damage to the skin. Over-the-counter hydrocortisone cream can decrease inflammation and itching; however, the label should be read and the cream used according to directions.
- When to see the doctor: Severe cases may require further treatment. A physician should be seen if the rash appears infected, is on the face or other sensitive body areas, or is too extensive to be easily treated at home.

10.4.11 Ticks

To remove an attached tick:

- Use fine-tipped tweezers or a "tick tool" to grasp the tick at the surface of the skin
- If tweezers are not available, use a tissue to protect the fingers (exposure to the tick's body fluid may lead to transmission of disease)
- With a steady motion, pull the tick straight out

Disinfect the bite site and the tweezers. Wash your hands thoroughly with soap and water. Save the tick if you can by placing it in a Ziploc bag in the freezer; this may help with diagnosis in the future.

If flu-like symptoms such as fatigue, headache, neck-stiffness or jaw discomfort begin following a tick bite, seek medical attention.

APPENDICES

EnviroAnalytics
Group

Environmental Engineers

ATTACHMENT A

COMPLIANCE AGREEMENT

EAG HEALTH AND SAFETY PLAN

ACKNOWLEDGEMENT FORM

I, ________________________________, have read (or had read to me), EAG's health and safety plan.
(Print Name)
I understand my responsibilities as they are defined in this plan and will abide by these rules and procedures, as well as any regulations or otherwise governing safety. When in doubt concerning safe job performance, I will speak to my immediate supervisor and/or Project Manager.

I understand EAG reserves the right to change or amend the HASP at any time.

I understand any violation to the plan policies or procedures will be cause for disciplinary action up to and including termination.

____ ____________________________
Employee Signature Date

____ ____________________________
EAG Supervisor/Project Manager Signature Date

ATTACHMENT B

Material Safety Data Sheets (MSDSs)

APPENDIX F

Laboratory SOPs

Analysis of Parent and Alkylated Polynuclear Aromatic Hydrocarbons, Selected Heterocyclic Compounds, Steranes, Triterpanes and Triaromatic Steroids by GC / MS – SIM

References:	Federal Register 2003, 40 CFR, Chapter I – EPA. Part 300: National Oil and Hazardous Substances Pollution Contingency Plan, Appendix C to Part 300, Chemical Analysis of Oil Composition, May 28, 2003.
	USEPA, Method 8270D Semivolatile Organic Compounds by Gas Chromatography / Mass Spectrometry (GC/MS)" in Test Methods for Evaluating Solid Waste, SW846, Third Edition (USEPA Office of Solid Waste and Emergency Response, Washington, DC, September 1994).
	ASTM, Method D7363 - 07 Standard Test Method for Determination of Parent and Alkyl Polycyclic Aromatics in Sediment Pore Water Using Solid-Phase Microextraction and Gas Chromatography/Mass Spectrometry in Selected Ion Monitoring Mode.

1. Scope and Application

Matrices: Extracts from water, soil, sediment, tissue, sludges and petroleum products.

Definitions: Refer to Alpha Analytical Quality Manual.

This method is applicable to the analysis of sample extracts for parent and alkylated polynuclear aromatic hydrocarbons (PAHs), selected heterocyclic compounds, steranes, triterpanes and triaromatic steroids by gas chromatography / mass spectrometry with selected ion monitoring (GC/MS-SIM). Target analytes listed in Tables IA and IB are determined and measured in the concentration range of 10 to 20,000 parts per trillion (ng/L) for water samples, 1 to 2,000 parts per billion (ug/Kg) for soil and sediment samples, 2 to 4,000 parts per billion (ug/Kg) for tissue samples, and 2 to 4,000 parts per million (mg/Kg) in petroleum product samples. Analytes detected over these ranges will be diluted and re-analyzed for accurate quantitation. Lower detection limits can be achieved if large volume injection (LVI, from 1uL to 50uL volume injections) techniques are employed. This technique requires client and project specific requests.

This method is intended to assist in the identification or "fingerprinting" of source material against a potentially contaminated site and can also provide information to assist in the identification of petrogenic or pyrogenic contamination.

The data report packages present the documentation of any method modification related to the samples tested. Depending upon the nature of the modification and the extent of intended use, the laboratory may be required to demonstrate that the modifications will produce equivalent results for the matrix. Approval of all method modifications is required by one or more of the following laboratory personnel before performing the modification: Area Supervisor, Department Supervisor, Laboratory Director, or Quality Assurance Officer.

This method is restricted to use by or under the supervision of analysts experienced in the operation of the GC/MS and in the interpretation of GC/MS data. Each analyst must demonstrate the ability to generate acceptable results with this method by performing an initial demonstration of capability.

2. Summary of Method

An aliquot of a well mixed, homogeneous aqueous, solid, tissue or petroleum sample is accurately measured or weighed for sample preparation (Generally, 1L of water sample, 15-30g of soil, sediment or tissue sample, and 0.1g of petroleum sample). Please refer to the appropriate Alpha Analytical SOPs for extraction methods and sample preparation information:

- Method 3510C – *Extraction of Water Samples by Separatory Funnel* (SOP/2165),
- *Tissue Preparation and Homogenization* (SOP/2166) and *Tissue Extraction* (SOP/2264)
- *Shaker Table Extraction* (SOP/2261)
- *Organic Waste Dilution* (SOP/2265)

Water, soil/sediment, tissue and petroleum samples are spiked with surrogate compounds and extracted using methylene chloride. Sample extracts are concentrated and preliminarily screened for oil content following Alpha Analytical SOP *Gravimetric Determination* (SOP/2263). Gravimetric screening is essential at times to ensure the analytical equipment, as well as the cleanup columns, are not overloaded with oil laden samples. Samples may be cleaned by *Alumina Column Cleanup* (SOP/2260), or they may then be exchanged into hexane for optional cleanup and/or fractionation into saturated (F1) and aromatic (F2) fractions prior to analysis. See the SOP *Silica Fractionation and Cleanup* (SOP/2267) for additional sample cleanup information and details. After cleanup, the extracts are concentrated to an appropriate final volume based on oil content as determined by gravimetric weighing and spiked with internal standards for GC/MS-SIM analysis.

Analytes are introduced into the GC/MS by injecting a known volume of the calibration standards, quality control samples, and sample extracts into the GC equipped with a narrow-bore capillary column. The GC column is temperature programmed to separate the analytes, which are then detected with a mass spectrometer operating in the selective ion mode. Identification of target analytes is accomplished by comparing retention times and mass spectra with the retention times and electron impact spectra of the calibration standards. Concentrations are determined using mean relative response factors from a multi-level calibration curve. Response factors for target analytes and surrogate compounds are determined relative to the internal standards. Multi-component analytes (alkylated PAHs) are assigned the response factors of their unsubstituted, parent compounds. Sterane and Steroid compounds are assigned the response factor of the compound 5B(H)-Cholane. Triterpane compounds are assigned the response factor of the compound 17A(H), 21B(H)-Hopane-C30H52.

2.1 Method Modifications from Reference

The continuing calibration verification %D for each calibrated PAH must be below 25%, with no more than 10% of all compounds greater than 25% but less than 35%. Each CCV must be analyzed within 24 hours of the previous CCV.

The surrogate recovery limits are 50%-130%.

The duplicate RPD limit is 30%.

The PFTBA tuning is done once before each initial calibration.

The internal standard compounds used for this method are Acenaphthene-d10 and Chrysene-d12.

The confirmation ions listed in Table II are recommended and may be included or excluded based on project requirements.

3. Reporting Limits

Reporting limits for individual alkylated PAH and biomarker compounds are 2 mg/Kg (ppm) for petroleum products, 0.667and 1.0 µg/Kg (ppb) for soil/sediment samples per project requirements, 2.67 µg/Kg (ppb) for tissue samples, and 10ng/L (ppt) for water samples.

4. Interferences

Contaminants in solvents, reagents, glassware, and other sample processing hardware may cause interferences that lead to discrete artifacts and/or elevated baselines in the ion current profiles. Demonstrate that all of these materials are free from interferences under the conditions of the preparation and analysis by extracting and analyzing a laboratory method blank with each batch of up to 20 samples.

Contaminants coextracted from the sample may cause matrix interferences. The extent of matrix interferences will vary considerably from sample to sample, depending upon the nature of the environment being investigated. An interference which is unique to SIM techniques can arise from the presence of a coeluting compound which contains the quantification mass ion. This event results in a positive interference to the reported value for the compound of interest. Interferences are controlled to some degree by acquiring data for a confirmation ion. If the ion ratios between the quantification ion and the confirmation ion are not within the specified limits, then interferences may be present. Quantification and confirmation ions should agree within +/- 20% of the calibration standard ion ratios. However, the stability of confirmatory/primary ion abundance ratios may decrease as the IDL is approached.Analysts must apply judgment in evaluating apparent interferencesas SIM provides less mass spectral information compared to a full-scan method. Recommended confirmation ions are listed in Table II.

The presence of a large amount of a single alkyl homolog group without the presence of the other related groups may be indicative of an interference. For example, the presence of an apparent C_2 - Naphthalenes in the absence of C_1 - Naphthalenes or C_3 - Naphthalenes may be an analytical interference. The analyst should use the retention times of major peaks and pattern recognition when determining whether to select a homolog group.

5. Health and Safety

The toxicity or carcinogenicity of each reagent and standard used in this method is not fully established; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. A reference file of material safety data sheets is available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available in the Chemical Hygiene Plan.

All personnel handling environmental samples known to contain or to have been in contact with municipal waste must follow safety practices for handling known disease causative agents.

All relevant Material Safety Data Sheets (MSDSs) are kept alphabetically in the centrally located file storage.

6. Sample Collection, Preservation, Shipping and Handling

6.1 Sample Collection

Aqueous samples are collected in 1L amber glass bottles.

Soil/sediment and tissue samples are collected in glass soil jars. For soil/sediment matrices the amount of sample needed is 5-30 grams, for tissues 5-15grams, and for petroleum products the amount of sample needed is 0.1 grams.

Additional sample is needed (approximately 3X the minimum amount) if MS/MSD analyses are to be performed.

6.2 Sample Preservation

Aqueous samples are stored without preservative at 4°C. Soil/sediment and tissue samples are stored at 4°C, or if desired, frozen.

6.3 Sample Shipping

Refer to the Sample Receipt and Login SOP/1559 for sample shipping requirements.

6.4 Sample Handling

The hold time for this method is 7 days for the extraction of aqueous samples and 14 days for the extraction of soil/sediment and tissue samples. There is no extraction holding time applied to petroleum product samples. If sediment or tissue samples are frozen, this suspends the holding time until removal from the freezer. All extracts must be analyzed within 40 days of the extraction date.

7. Equipment and Supplies

7.1 Gas Chromatograph: Model Agilent/HP6890 or equivalent. The instrumentation includes a temperature-programmable gas chromatograph and all required accessories including syringes, analytical columns, and gases. The injection port is designed for split or splitless injection onto a capillary column. The injection port includes a Phenomenex drilled uniliner with a hole on the top and contains a small plug of silanized glass wool. The injector port will require maintenance on an as needed basis if degradation or contamination is apparent.

7.2 Column: Restek or Phenomenex 60-m x 0.25 mm ID, 0.25 um film thickness, fused-silica capillary column with RTX-5 or ZB-5 bonded phase, or equivalent.

7.3 Mass Spectrometer – Agilent/HP5973, or equivalent. The mass spectrometer must operate at 70ev (nominal) electron energy in the electron impact ionization mode and be tuned to optimize the sensitivity of the instrument to the mass range being monitored (30 - 550 amu). The GC capillary column is fed directly into the ion source of the mass spectrometer. The source will require cleaning and/or filament replacement on an as needed basis. Please refer to the instrument hardware manual for detailed procedures, located in the laboratory next to the instrument.

7.4 Auto sampler: Agilent/HP 7683 series autosampler and tray, or equivalent.

7.5 Computer: with Windows NT version 4.0 operating software utilizing Agilent/HP Enviroquant G1701BA Version E.02.00 software, or equivalent/higher versions.

7.6 Helium: Ultra high purity grade (99.9999% pure).

8. Reagents and Standards

Use reagent grade chemicals for all reagents. Deionized (DI) water is ASTM Type II laboratory reagent grade water.

All stock standard solutions are purchased from commercial vendors as ampulated certified solutions or prepared in house from neat materials. Standards are stored according to the vendor recommendations. When an ampulated stock solution is opened, or prepared fresh from neat materials, it must be transferred into a PTFE-lined screw capped vial. All working standard solutions are stored at -10°C or less, away from light, when not in use. They are discarded after 1 year unless the vendor expiration date states otherwise or if breakdown is observed.

8.1 Methylene Chloride, ACS approved, Pesticide grade, see Alpha Analytical SOP Reagent, Solvent and Standard Control (SOP/1816) for additional details regarding solvent purity.

8.2 Hexane, ACS approved, Pesticide grade, see Alpha Analytical SOP Reagent, Solvent and Standard Control (SOP/1816) for additional details regarding solvent purity.

8.3 Acetone, ACS approved, Pesticide grade, see Alpha Analytical SOP Reagent, Solvent and Standard Control (SOP/1816) for additional details regarding solvent purity.

8.4 Methanol, Purge and Trap grade, see Alpha Analytical SOP Reagent, Solvent and Standard Control (SOP/1816) for additional details regarding solvent purity.

8.5 Custom Mix Calibration Standard prepared by Supelco which contains the parent PAH and Heterocyclic compounds at 1000ug/mL.

8.6 5B(H)-Cholane (CAS# 80373-86-0) and 17A(H), 21B(H)-Hopane (CAS# 13849-96-2): Obtained from Chiron AS Norway at 1000ug/mL. These compounds are used for calibration and quantitation of all steranes, triterpanes and triaromatic steroids, and 5B(H)-Cholane is also used as a surrogate compound.

8.7 Surrogates:

8.7.1 **Surrogates:** Naphthalene-d8, Phenanthrene-d10, Benzo(b)fluoranthene-d12 and Benzo(a)pyrene-d12 from AccuStandard custom mix in Methylene Chloride with a concentration of 2000ug/mL. Take 500uL of stock solution into 100mL of Methylene Chloride for a spiking solution at 10ug/mL. This solution must be assayed for use by analysis before release to the preparation lab. All compounds must be within 10% of their true value. A manager's approval is needed for all surrogate spiking solutions prior to use. 100uL of solution is spiked into each QC and field sample. This amount may be adjusted to meet project specific requirements, or if a sample is suspected to contain high concentration PAHs or oil is observed.

8.7.2 **Alternate Surrogates:** This solution may be used for some programs. 2-Methylnaphthalene-d10, Pyrene-d10, and Benzo(b)fluoranthene-d12 from Restek, custom mix in Methylene Chloride with a concentration of 2000ug/mL. Take 500uL of stock solution into 100mL of Methylene Chloride for a spiking solution at 10ug/mL. This solution must be assayed for use by analysis before release to the preparation lab. All compounds must be within 10% of their true value. A manager's approval is needed for all surrogate spiking solutions prior to use. 100uL of solution is spiked into each QC and field sample. This amount may be adjusted to meet project specific requirements, or if a sample is suspected to contain high concentration PAHs or if oil is observed.

8.7.3 Biomarker surrogate: 5B(H)-Cholane from Chiron AS Norway solution at 1000ug/mL in iso-octane. Take 1,000uL of stock solution into 100mL of Methylene Chloride for a spiking solution at 10ug/mL. This solution must be assayed for use by analysis before release to the preparation lab. All compounds must be within 10% of their true value. A manager's approval is needed for all surrogate spiking solutions prior to use. 100uL of solution is spiked into each QC and field sample. This amount may be adjusted to meet project specific requirements, or if a sample is suspected to contain high concentration PAHs or oil is observed.

8.8 Internal Standards (IS): Acenaphthene-d10 and Chrysene-d12 from Restek, custom mix in Methylene Chloride with a concentration of 2000ug/mL. Prepare a 250ug/mL intermediate solution by spiking 3125uL into 25mL Methylene Chloride. Then prepare a working solution by adding 2000uL to 100mL for a 5ug/mL solution. 100uL is spiked into each 1mL of QC sample or field sample, for a concentration of 500ng/uL on column.

8.9 Laboratory Control Spike and Matrix Spike (LCS/LCSD/MS/MSD): A solution of 17 priority pollutant parent PAH's from Restek, or equivalent, at 1000ug/mL. This solution is from a separate source than the calibration solutions. Prepare the spike mix by adding 250uL of the solution to 25mL of Methylene Chloride for a 10ug/mL LCS/LCSD/MS/MSD spiking solution. The solution must be assayed for use by analysis before release to the preparation lab. All compounds must be within 10% of their true value. 100uL is spiked into the LCS/LCSD and each designated MS/MSD field sample. This amount may be adjusted to meet project specific concentrations, as needed.

8.10 Alaska North Slope Crude Oil (ANS): Weigh approximately 0.5g neat oil, add 10mL each PAH and biomarker surrogates, and 200uL internal standard stock solution into 100mL of Methylene Chloride for a working solution of approximately 5mg/mL (with surrogates at 1.0µg/mL and internals at 0.5µg/mL).

8.11 Independent Calibration Verification (ICV): Prepared as below in Section 8.13 at 0.5ug/mL, but from a different source, lot, or vendor. Independent Check analyses must agree within 20% of their true value.

8.12 SRM 1941b, 1944 – PAH's in sediment, SRM 1974a – PAH's in Tissue and SRM 1582 PAHs' in Crude Oil: From the National Institute of Standards & Technology (NIST). Please refer to the individual certifications for the assigned true values. These SRMs may be extracted and analyzed with sample batches as part of the overall QC evaluation if requested by the client. Other certified SRMs may be used on a project specific basis.

8.13 Working Stock Standard: Prepare the Working Stock Standard (all resulting concentrations at 5µg/mL) in 50mL of Methylene Chloride (CH_2Cl_2) as follows. (**Note:** The following is just one way an analyst may make up calibration standards. Limitations may exist that would cause the method to be adjusted. Problems with standard availability, solubility, or expiration may affect how the following 6 level calibration standards are prepared.)

Component	Volume Added	Final Volume in (CH_3Cl_2)
Custom Supelco Mix (PAH)	250 µL of 1000 µg/mL	50 mL
5B(H)-Cholane	250 µL of 1000 µg/mL	50 mL
Custom Deuterated Surr Mix	125 µL of 2000 µg/mL	50 mL

7 Level Curve Preparation for Individual Components

Calibration Level	**Volume of Working Std. Added (5 ug/mL)**	**Volume of IS Stock added**	**Final Volume in (CH_3Cl_2)**
Level 1 - 10 ng/mL	200 µL	200 uL	100 mL
Level 2 - 25 ng/mL	500 µL	200 uL	100 mL
Level 3 - 100 ng/mL	2000 µL	200 uL	100 mL

Calibration Level	**Volume of Custom PAH mix Std. Added (1000 ug/mL)**	**Volume of IS Stock added**	**Final Volume in (CH_3Cl_2)**
Level 4 – 500 ng/mL	25 µL	100 uL	50 mL
Level 5 - 5,000 ng/mL	125 uL	50 uL	25 mL
Level 6 - 10,000 ng/mL	250 uL	50 uL	25 mL
Level 7 - 20,000 ng/mL	500 uL	50 uL	25 mL

Note: A minimum of a 5-level curve must be analyzed, but more levels may be analyzed and evaluated.

9. Quality Control

The laboratory must maintain records to document the quality of data that is generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method.

Quality Control (QC) samples are necessary to monitor both the sample extraction and instrument analysis procedures. The Quality Control samples described below are considered the method defaults, and are the minimum requirements, except where noted. Client and Project specific Data Quality Objectives (DQOs) supersede the requirements in this section where applicable. Client or Project specified DQOs shall be included, or referenced, in the final report to the client. Quality control exceedances are documented on the *Alkylated PAH Report Checklist (Form/11442).*

9.1 Blank(s)

A method blank must be extracted (spiked with surrogates and internal standards) and analyzed once per every 20 samples or per extraction batch, whichever is more frequent.

Acceptance Criteria: Method Blanks must not contain any individual compound at or above the concentration of the reporting limit. If a blank does contain target compounds greater than the reporting limit, they should be less than 10% of any sample results for the same compound(s). Individual compounds may be detected in the blank below the reporting limit. Associated sample results are flagged with a “B” qualifier if the concentration of the analyte in the sample is less than 10x the concentration in the blank.

Corrective Action: If the blank does not meet the above criteria, all efforts must be made to identify and eliminate any source of contamination, and all samples associated with the contaminated blank should be re-extracted and reanalyzed. Exceptions may be made with the approval of the Department Supervisor. Any exceedances are noted in the case narrative.

9.2 Laboratory Control Sample and Laboratory Control Sample Duplicate (LCS/LCSD)

The laboratory control samples (LCS/LCSD) contain 17 priority pollutant parent PAHs. The spiking solution is from a second/separate source, to verify the accuracy of the calibration curve. The LCS/LCSD are extracted along with the samples. An LCS/LCSD must be extracted and analyzed once per every 20 samples or per extraction batch, whichever is more frequent.

Acceptance Criteria: All LCS/LCSD compound recoveries must be between 50-130% of the true values, with <30%RPD.

Corrective Action: If the LCS/LCSD do not meet the QC limits, check to see if an analytical or spiking error has occurred. If the LCS/LCSD recoveries are still out of control, re-extraction of the entire extraction set may be necessary. If the samples are also associated with a matrix spike and matrix spike duplicate that are in control, re-extraction may not be necessary, as this demonstrates an isolated problem pertaining to the LCS/LCSD only. Exceptions may be made with the approval of the Department Supervisor. Any exceedances are noted in the case narrative.

9.3 Initial Calibration Verification (ICV)

The analysis of an ICV standard must follow the initial calibration curve.

After final processing, calculate the percent recovery of each PAH by using the following calculation:

% Recovery = Found Amount / True Value x 100

Acceptance Criteria: All recoveries must be +/- 20% of the true values.

Corrective Action: If the ICV fails, perform instrument maintenance and repeat the initial calibration..

9.4 Continuing Calibration Verification (CCV)

A continuing calibration verification (CCV) standard, at the concentration of a mid-level initial calibration standard, must be analyzed at the beginning and end of every analytical sequence, and every 24 hours within the sequence, to confirm instrument stability, via response factor, for each calibrated PAH. Only the parent PAH compounds are monitored for %D and the following acceptance criteria.

Acceptance Criteria: Compare the CCV response factor(RF) against the average RF for the initial calibration for each calibrated PAH. The %D for each calibrated PAH must be below 25%, with no more than 10% of all compounds greater than 25% but less than 35%. If multiple CCVs are analyzed within an analytical sequence, each CCV must be analyzed within 24 hours of the previous CCV. Each CCV, including the ending CCV must meet the acceptance criteria.

Corrective Action: If the CCV does not meet the acceptance criteria for each calibrated PAH, perform instrument maintenance and repeat the continuing calibration. Re-analyze all affected samples. Reported results for the failing CCV may be "J" qualified; including all alkylated compounds quantified using the suspect response. If the failure of the suspect response appears related to a loss in MS sensitivity, instrument maintenance and repeat analysis of the continuing calibration, and all affected samples, must be performed. Exceptions may be made with the approval of the Department Supervisor. Any exceedances are noted in the case narrative.

9.5 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Matrix spike and matrix spike duplicate analyses are performed per client request and may only be performed if sufficient sample is supplied. It is preferable to extract samples that have been selected specifically by the client. If none have been assigned than the laboratory analyst must choose a representative sample.

Acceptance Criteria: All matrix spike/matrix spike duplicate compound recoveries must be between 50-150% of the true values, with <30%RPD.

Corrective Action: If the MS/MSD do not meet the QC limits, check to see if an analytical or spiking error has occurred. If the recovery still exceeds the control limits, re-extraction of the set may be necessary. If the associated LCS/LCSD is within control, re-extraction may not be necessary, as this demonstrates that there may be matrix effects on the accuracy of the affected results as evidenced by the matrix spike and matrix spike duplicate exceedance. Exceptions may be made with the approval of the Department Supervisor. Any exceedances are noted in the case narrative.

9.6 Sample Duplicate

A sample duplicate (DUP) is extracted per client request.

Acceptance Criteria: The QC limit is 30% RPD for target compounds found above 5 times the reporting limit.

Corrective Action: If the %RPD exceeds the 30% control limit, checkto see if an analytical or spiking error has occurred. Also check sample preparation notes for heterogeneity comments or for possible calculation errors. If the RPD still exceeds the control limits, re-extraction of the set may be necessary. If the associated LCS/LCSD is within control, re-extraction may not be necessary, as this demonstrates that there may be matrix effects on the precision of the affected results as evidenced by the sample and duplicate exceedance. Exceptions may be made with the approval of the Department Supervisor. Any exceedances are noted in the case narrative.

9.7 Method-specific Quality Control Samples

9.7.1 Surrogates

Acceptance Criteria: All surrogate recoveries must be between 50-130% of the true values.

Corrective Action: If the surrogate does not fall within the QC limits, check to see if an analytical or spiking error has occurred. If only one surrogate falls below the 50% recovery limit, but is above 10% recovery, re-extraction may not be necessary. If all surrogates are recovered below the 50% limit, re-extract the sample and report the re-extract results along with the original results, if re-extraction occurred beyond the holding time, and the re-extract surrogates are within the QC limits. If the surrogates are recovered below 50% in the re-extract, this confirms suspected matrix interference on the surrogates, and only the original analysis needs to be reported. If the chromatogram shows obvious matrix interference, no re-analysis or re-extraction is necessary.

9.7.2 Internal Standards

Internal standards are added to every field sample, QC sample, and method blank.

Acceptance Criteria: The acceptance limits are 50-200% of the internal standard response (or area) of the daily continuing calibration verification standard.

Corrective Action: If the internal standard areas fall outside the QC limits, check to see if an analytical, dilution or spiking error occurred.

- If internal standards are low and surrogate recoveries are acceptable reanalyze the extract.
- If internal standards are low and surrogate recoveries are high, there may have been a spiking error; re-spike a pre-internal standard extract with internals and re-analyze.
- If internal standards are high and surrogate recoveries are low, there may have been a spiking error; re-spike a pre-internal standard extract with internals and re-analyze.
- If internal standards are high and surrogate recoveries are acceptable, the extract may have concentrated while on the instrument, then:
    - If no obvious interference is present, re-analyze the extract. If internal standards are now within the acceptance limits, report only the re-analysis, as long as the re-analysis occurred within the 40-day analytical hold time. If the re-analysis occurred outside of the 40-day analytical hold time, both the original and re-analysis must be reported. If the internal standards again are outside the acceptance limits, and either within or outside of the 40-day hold time, try re-analyzing at a 1:5 or greater dilution (see below).
    - If the chromatogram shows obvious matrix interference that cannot be avoided when integrating, a re-analysis at a 1:5 or greater dilution may be helpful in minimizing the interference while ensuring better quantitation.

Exceptions may be made with the approval of the Department Supervisor. Any exceedances are noted in the case narrative.

9.7.3 Standard Reference Materials (SRMs)

Standard reference materials (SRM) are available from the National Institute of Standards and Technology (NIST) and are extracted and analyzed with samples on a project specific basis. These are not used as controls, but to evaluate potential matrix effects in associated samples for the target compounds being evaluated.

Acceptance Criteria: Acceptance criteria for SRM analysis will vary from project to project depending upon client data quality objectives (DQOs). Generally, ± 35% difference (%D) based on the true certified values of the target compounds of interest, or 65% - 135% recovery, serve as advisory acceptance criteria.

Corrective Action: Repeat analysis and/or check to see if an analytical error has occurred. If the % recovery or %D still exceeds the control limits, re-extraction of the set may be necessary. If the associated LCS/LCSD and/or MS/MSD are within control, re–extraction may not be necessary as this may be isolated to this sample as evidenced by the LCS/LCSD and/or MS/MSD acceptance. Exceptions may be made with the approval of the Department Supervisor. Any exceedances are noted in the case narrative.

9.8 Method Sequence

Samples are prioritized for analysis by the Department Supervisor or GC/MS Team Leader based on client due date and sample analytical hold time. Samples are retrieved from the sample storage refrigerator.

The sequence is prepared and run using the Enviroquant software. Printouts of all sequences are kept in a three-ring binder for each instrument. The sequence printouts are used to document analytical runs; notations are manually added of any reruns or dilutions that will need to be performed.

10. Procedure

10.1 Equipment Set-up

Prior to the analysis of any standards or samples, the instrument acquisition and process methods must be set up. This includes the GC run parameters and the SIM mode acquisition ion entries into the different SIM acquisition retention time windows. The mass spectrometer must be tuned to the meet the abundance criteria for PFTBA (then DFTPP if required per client request or project specific DQOs) and an initial calibration must be analyzed to establish linearity of the instrument.

10.1.1 PFTBA Manual Tuning

10.1.1.1 Prior to initial calibration, tune the mass spectrometer using PFTBA (Perfluorotributylamine - calibration gas) to maximize the sensitivity of the instrument in the mass range of interest, 35-525 amu.

10.1.1.2 The following PFTBA mass intensity criteria must be met:

PFTBA Ion	Relative Abundance
m/e 69	Base Peak with > 200,000 counts
m/e 219	30% to 60% of Base Peak
m/e 502	5% to 11% of Base Peak

10.1.2 GC Instrumental Conditions

Inject an aliquot of 1uL into the capillary column of the gas chromatograph at the following conditions. Larger injection volumes (to 50uL using the Large Volume Injector, LVI) will be dictated by project specific DQOs.

GC Parameter	Setting
Injector Temp:	300 °C
Transfer Line Temp:	300 °C
Initial Oven Temp:	40 °C
Initial Hold Time:	1 minute
Ramp Rate:	6 °C / minute
Final Temperature:	315 °C
Final Hold Time:	30 minutes
Total runtime:	76 minutes
Mode:	Splitless / Constant Flow 1.0ml/min
Purge:	20 mL / minute – on at 1.0 minutes
MS Temperature	300

10.1.3 Mass Spectrometer Conditions

The effluent from the GC capillary column is fed directly into the ion source of the mass spectrometer. The MS is operated in the SIM mode using appropriate retention time windows to include the quantification and confirmation ions for each PAH and Biomarker compound as shown in Table II. For each retention time window the ions 191, 217, and 218 are included for sterane and triterpane quantification, if requested by the client.

10.1.4 Data Acquisition Parameters

10.1.4.1 SIM Windows must be set up that bracket the expected retention times for each target analyte. These windows include the quantitation (primary) and confirmation ions for each parent PAH and Alkyl homolog group. To establish the expected retention time window ranges, the mid-level calibration standard must be analyzed in full scan mode. The resulting full scan analysis will dictate the windows in which the selected ions will be monitored. Depending upon the length of the analytical GC column, the time each window is selectively monitored may vary. The retention time windows must be shifted accordingly, when instrument maintenance is performed, (*i.e.,* the column is clipped).

10.1.4.2 The “dwell” time for each window should be set to 18, and the resolution should be set to “high”. Each window must contain a total of 28 ions, and must contain the appropriate quantification ions, and if possible, confirmation ions, as determined by full scan analysis of the mid-level standard from 10.1.4.1, Specific projects may require the addition of ions to one or more SIM windows; in these instances it is acceptable to remove confirmation ions as necessary to keep the total number of ions in each window at 28 and the dwell time per ion at 18.

10.2 Initial Calibration

10.2.1 Before analysis of sample extracts, establish a multi-point response factor calibration curve showing the linear range of the analysis for all target analytes in Table IA and IB. Use standard concentrations of 10, 25, 100, 500, 5000, 10,000 and 20,000 ng/mL to construct the curve. See Section 8.13 for the preparation of the standard solutions for the initial calibration curve.

10.2.2 Run a sequence with the initial calibration standards and the retention time standard.

- Create a processing method from a previous method on that instrument. Set retention time windows using a mid level standard.

- Quantify and QEDIT the initial calibration standards. Update the response factors for each level of the method with these standards. Use each parent PAH compound response for any associated homolog group. Use hopane response for associated triterpane biomarkers and 5B(H)cholane response for associated sterane and triaromatic steroid biomarkers.

  Acceptance Criteria: 25% RSD for 90% of all target compounds, with the exception for 10% to be between 25%RSD and 35%RSD. All calibration standards must be analyzed within 24 hours.

10.2.3 Initial Calibration Verification (ICV)

- The analysis of an ICV standard must follow the initial calibration curve.

- After final processing, calculate the percent recovery of each PAH by using the following calculation:

% Recovery = Found Amount / True Value x 100

- Acceptance Criteria: All recoveries must be +/- 20% of the true values.

10.2.4 If the initial calibration fails, perform instrument maintenance and repeat.

10.2.5 Alaska North Slope Crude Reference Oil (ANS)

- The ANS crude oil reference standard is analyzed following each initial calibration curve. Analysis of this reference oil is to establish the integration patterns of the Alkyl PAH homolog groups, and to establish the current instrument quantitation and confirmation ion ratios. Analysis of this standard following the initial calibration ensures the retention time windows in the SIM mode of acquisition have been set up properly.

- The analysis of the ANS standard is for reference. If instrument maintenance is performed, such as removing a significant section of the analytical column consisting of one “loop” or more, the ANS must be analyzed to update and/or confirm the SIM acquisition windows.

- The ANS reference standard is processed against the completed initial calibration curve method. See Section 11.1 for information regarding manual integration of the Alkyl PAH homolog clusters. This standard will be used for reference when processing field samples for this method, until such a time that a new ANS standard needs to be analyzed. Other project/client specific source oils may be used. These specific oils will likely display patterns that differ from ANS, but will aid analysts in pattern identification of the related field samples.

10.2.6 ICALs are documented on the *Alkylated PAH ICAL Checklist (Form/11443)* . The initial calibration must be secondary reviewed before analyzing samples.

10.3 Equipment Operation and Sample Processing

10.3.1 Daily PFTBA Tuning is not required. See Section 10.1.1 for details.

10.3.2 If the on-column concentration of any single peak PAH compound exceeds the calibration range of 20,000 ng/mL, the sample must be diluted and re-analyzed.

10.4 Continuing Calibration

A continuing calibration verification (CCV) standard, at the concentration of a mid-level initial calibration standard, must be analyzed at the beginning and end of every analytical sequence, and every 24 hours within the sequence, to confirm instrument stability, via response factor, for each calibrated PAH.

10.4.1 Quantitate and QEDIT the continuing calibration standard. **Note:** The Alkyl homolog groups may be deleted from the report. Only the parent PAH compounds are monitored for %D and the following acceptance criteria.

10.4.2 Acceptance Criteria: Compare the CCV response factor(RF) against the average RF for the initial calibration for each calibrated PAH. The %D for each calibrated PAH must be below 25%, with no more than 10% of all compounds greater than 25% but less than 35%. If multiple CCVs are analyzed within an analytical sequence, each CCV must be analyzed within 24 hours of the previous CCV. Each CCV, including the ending CCV must meet the acceptance criteria.

10.4.3 If the CCV does not meet the criteria for each calibrated PAH, the following *corrective actions* are recommended:

- Perform instrument maintenance and repeat the continuing calibration, and re-analyze all affected samples, OR,
- Qualify all results reported for the failing CCV with an appropriate qualifier, including all alkylated compounds quantified using the suspect response, and any non-detects. If the failure of the suspect response appears related to a loss in MS sensitivity, instrument maintenance and repeat analysis of the continuing calibration, and all affected samples, must be performed.

The choice of corrective action must be made in consultation with the Department Manager, Project Manager and/or the client. The reasoning for choosing the second option must be documented in the project narrative to the client.

10.5 Preventive Maintenance

If performing any maintenance on any piece of equipment it must be documented in the *Instrument Maintenance Logbook* located in the laboratory specific to each instrument. Specific instrumentation service contracts or warranties differ from each instrument. See the Department Manager for specific instrument details.

Injection Port and Column Maintenance: Maintenance should be done when the daily CCV starts to demonstrate degradation. The type of samples analyzed will have an effect on how soon maintenance should be performed. The injection port can be cleaned using cotton swabs and DCM until no contamination is observed. Generally maintenance is performed by trimming

6 cm off the front of the column. The column is then installed into the injection port liner and the inlet nut is tightened. After cleaning the instrument must be checked for any air leaks while cool. The first injection should be a primer to remove any active sites and to check if any of the windows need updating.

Merlin Maintenance: The Merlin High Pressure Microseal (Part #410 Phenomenex) should be replaced when it cannot hold back pressure. A septum may be used as a backup or for troubleshooting.

11. Data Evaluation, Calculations and Reporting

11.1 Identification of the priority pollutant PAH compounds is based on gas chromatographic relative retention times (RRTs) from the analysis of a mid-level initial calibration standard. For these compounds, manual quantitations may be performed, if necessary, by integrating the area of the quantitation ion or peak. For *alkylated* PAHs, the homolog groupings (*i.e.,* C_3-Naphthalenes) appear in the extracted ion current profiles (EICPs) as a cluster of isomers. Integrate peaks within the cluster by straight-line integration to the baseline, taking into account background noise in the EICPs. Reference the Alaska North Slope Crude Oil pattern book, for a cluster by cluster example of each integration for each alkylated PAH homolog group. Table II, in Section 16, lists the representative ion(s) used for quantitation and confirmation of each parent PAH and alkylated PAH homolog group.

Note: Manual integration is not to be used solely to meet QC criteria, nor is it to be used as a substitute for corrective action on the chromatographic system.

11.2 From EICP of the quantification (primary) mass ions and the confirmatory mass ions, identify all target analytes according to the following criteria:

- The characteristic masses of each analyte of interest should maximize in the same, or within one scan of each other.
- The retention time should fall within ± 10 seconds of the retention time of the parent PAH from the preceding CCV. **Note:** When evaluating alkyl homolog groups, the retention time of the most intense peak within the group may not have the exact retention time of the most intense peak in the ANS reference standard. Analyst judgement and referral to each homolog groups' retention time window is essential for identification. Apply analyst judgment regarding corrective action when this criterion is not met.
- The relative peak heights of the primary ion compared to the confirmation or secondary ion masses for parent compounds should fall within ± 50 percent of the relative intensities of these masses in the reference mass spectrum (*i.e.,* the mid-level of the initial calibration curve and/or the Alaska North Slope Crude Oil).

Note: The relative intensities of the primary and secondary ions may vary widely within a given group of alkyl homologs (*i.e.,* C_3 - Naphthalenes). Thus, the pattern of each alkyl homolog cluster, and the retention time window for the cluster, will be the primary identification criteria for alkyl homologs. In some instances, a parent compound that does not meet secondary ion confirmation criteria may still be determined to be present in a sample after close inspection of the data by the experienced mass spectrometrist. Supportive data includes the presence of the secondary ion, but ratio value greater than ± 50 percent of the primary ion, may be caused by an interference of the secondary ion.

11.3 To calculate the ***Relative Standard Deviation*** (RSD) of all target analytes and surrogate compounds for the initial calibration use the formula below. The RSD of each target compound and surrogate must be below 25% with the exception for 10% to be between 25%RSD and 35%RSD. Additionally, use the initial seven-point calibration and determine ***Relative Response Factors*** (RRF_Is) at each concentration level. Average the RRF_Is, to generate mean RRF_Is, for quantification of all target analytes and surrogate compounds. The RRF_Is are based on the internal standard compounds, and are calculated using the formula below. (The relative response factors for the continuing calibration verifications (RRF_Cs) are calculated using the same formula). See Section 16, Table IA and Table IB, for the listing of target compounds and their associated internal standards for quantification.

$$\mathbf{RSD = SD\ /\ mean\ RRF_I \times 100}$$

where:

SD = Standard deviation between the five points, for that target analyte.

$$\mathbf{RRF_I = (A_c \times C_{IS})\ /\ (A_{IS} \times C_c)}$$

where:

A_c = Area of the characteristic ion for the standard compound to be measured.
A_{IS} = Area of the characteristic ion for the representative internal standard compound.
C_{IS} = Concentration of the representative internal standard compound (ng/mL).
C_c = Concentration of the standard compound to be measured (ng/mL).

Note: Assign the response factor of the parent compound to the alkyl homolog cluster.

11.4 Based on the mean RRF_Is, calculate the ***Sample Extract Amount*** for each target analyte and surrogate in the extracts using the following formula:

$$\mathbf{Q_e = (A_a \times Q_{IS})\ /\ (A_{IS} \times RRF_I)}$$

where:

Q_e = Sample extract amount (ng) of target analyte, from quantitation report.
A_a = Area of the characteristic ion for the target analyte.
A_{IS} = Area of the characteristic ion for the representative internal standard compound.
Q_{IS} = Amount of internal standard compound added to each extract (ng).

11.5 Calculate the ***Sample Concentration*** (C) for each compound by the following formula:

$$\mathbf{C = (Q_e\ /\ V_s) \times DF}$$

where:

C = Concentration in sample (ng/L water, ug/Kg sediment/tissue, or mg/Kg product).

V_s = Original volume or weight of sample extracted.

DF = Dilution factor or fraction of the original extract to which internal standard added.

11.6 If the response of any individual target compound in a sample exceeds the linear response range, as defined by the initial calibration standards in Section 10.2.1, dilute the extract so that the concentrations of all individual target compounds fall within the range of the calibration curve. If that compound is also part of an alkyl homolog group, the group is considered to exceed the calibration range and thus, would also require dilution. Reported concentrations that are above the highest standard concentration in the initial calibration are qualified with an “E”. If the response of any target compound in a sample exceeds the MDL but is below the reporting limit (RL), qualify the reported concentration with a “J”. If any target compound is found in the associated sample(s) at or below 10x the concentration of the method blank, qualify the reported concentration with a “B”.

11.7 Compare response factors for each compound in the ***Continuing Calibration Verification*** (CCV), to those of the initial calibration curve by determining the percent difference.

$$\textbf{Percent Difference (\%D)} = ([RRF_I - RRF_C] / RRF_I) \times 100$$

where:

RRF_I = Mean response factor from initial calibration.

RRF_C = Response factor from CCV.

11.8 All results must be reported to three significant figures. All solids including soils, sediments, and sludges must be reported on a dry-weight basis. Tissue results may be reported in wet-weight depending upon client request. Petroleum results are reported “as received” or on a wet-weight basis.

11.9 The analyst does data entry, or upload of the data, into the LIMS system. The LIMS is linked to the instrument, so the analyst must choose the sample(s) to be reported from that instrument’s analytical sequence. All associated preparation and instrumental QC samples and dilutions are also chosen. Once the data/samples have been selected and with the proper QC samples, the batched data set is reported.

11.10 The laboratory generates two types of data packages from the LIMS: “Standard” for routine projects and “CLP-like” for fully data validated projects. A standard package consists of sample results and the associated QC sample results. A CLP-like package includes all sample results, all preparation and instrumental QC results, and the associated supporting raw data. A secondary review is performed on all data.

11.11 Procedures for data and record management must adhere to the Quality Systems Manual, other subordinate documents covering record keeping, and the *Document Control* SOP (1729). All records shall be stored in such a manner as to be safe and accessible for at least 10 years.

11.12 Notebooks: Laboratory notebooks are designed to accommodate the specific analysis. Instrument printouts are used to document run sequences, and each sequence printout is filed in a three-ring binder. Each sequence notebook page is numbered. If a sample requires re-analysis or re-extraction for any reason, a notation is made next to the sample entry on the sequence log. The sequence run log is permanently bound, assigned an internal ID number, and filed accordingly. Such files shall be archived so as to remain available for at least 10 years. All laboratory notebooks must follow the specifications in the *Laboratory Notebook Usage* Work Instructions, WI 1556, and all record keeping and document control practices.

11.13 Electronic records: All data files from computers, attached to instruments, shall be backed up daily onto the proper directory on the server. The backups shall be stored so as to be accessible for 10 years. Movement of the data files to the server is the responsibility of the primary analyst. Server backup and storage is the responsibility of the IT department.

12. Contingencies for Handling Out-of-Control Data or Unacceptable Data

All Alkylated PAH-SIM results are reportable without qualification if analytical holding times are met, preservation requirements (including cooler temperatures) are met, and all QC criteria defined in the table below are met. If any of the below QC parameters are not met, all associated samples must be evaluated for re-analysis or re-extraction. See Sections 9, 10.2, 10.3 and 10.4 for additional QC discussion including corrective actions for any QC outliers.

QC Parameter	Acceptance Criteria
Initial Calibration Curve	≤ 25%D for all target analytes with exception for 10% of target analytes can be >25%, but ≤ 35%
Independent Calibration Verification	+/- 20% recovery of the true values
Continuing Calibration Verification	Analyzed every 10 samples or 24 hours, ≤ 25%D for all target analytes with exception for 10% of target analytes can be >25%, but ≤ 35%
Method Blank	No analyte at or above the RL, “B” qualify analyte if detected in the samples ≤ 10x the concentration in the blank
Laboratory Control Sample/Laboratory Control Sample Duplicate	50-130%R for all target analytes, <30%RPD between duplicates
Matrix Spike / Matrix Spike Duplicate	50-150%R for all target analytes, <30% RPD between the duplicates.
Sample / Sample Duplicate	<30% RPD between the duplicates, for compounds >5X RL.
Surrogates	50% - 130% recovery
Internal Standards	50% - 200% of the daily CCV area for the Internal Standards
SRM	+/- 35% D or 65% - 135% recovery

Section 9, Quality Control, defines the corrective actions that must be taken in instances where QC outliers exist.

If non-compliant Alkylated PAH-SIM results are to be reported, the Department Manager and/or the Laboratory Director must approve the reporting of these results. The laboratory Project Manager shall be notified, and may chose to relay the non-compliance to the client, for approval, or other corrective action, such as re-sampling and re-analysis. The analyst or Department Manager performing the secondary review initiates the project narrative, and the narrative must clearly document the non-compliance and provide a reason for acceptance of these results.

13. Method Performance

13.1 Method Detection Limit Study (MDL) / Limit of Detection Study (LOD) / Limit of Quantitation (LOQ)

The laboratory follows the procedure to determine the MDL, LOD, and/or LOQ as outlined in Alpha SOP/1732. These studies performed by the laboratory are maintained on file for review.

13.2 Demonstration of Capability Studies

Refer to Alpha SOP/1739 for further information regarding IDC/DOC Generation.

13.2.1 Initial (IDC)

The analyst must make an initial, one-time, demonstration of the ability to generate acceptable accuracy and precision with this method, prior to the processing of any samples.

13.2.2 Continuing (DOC)

The analyst must make a continuing, annual, demonstration of the ability to generate acceptable accuracy and precision with this method.

14. Pollution Prevention and Waste Management

Refer to Alpha’s Chemical Hygiene Plan and Waste Management and Disposal SOP for further pollution prevention and waste management information.

15. Referenced Documents

Chemical Hygiene Plan

SOP/1732 MDL/LOD/LOQ Generation

SOP/1739 IDC/DOC Generation

Hazardous Waste and Sample Disposal SOP/1797

SOP/1729 Document Control

Logbook Useage Work Instructions, WI/1556

16. Attachments

Table IA: PAH, Alkyl PAH, and Heterocyclic Target Compounds Internal Standard Reference

Table IB: Sterane and Triterpane Target Compounds Internal Standard Reference

Table II: PAH, Alkyl PAH, Sterane and Triterpane Quantification Primary and Confirmation Ions

Table IA: PAH, Alkyl PAH, and Heterocyclic Target Compounds Internal Standard Reference

Compound	IS Reference	Compound	IS Reference
cis/trans-Decalin	1	Fluoranthene	1
C_1-Decalins	1	Benzo(b)fluorene	1
C_2-Decalins	1	Pyrene	1
C_3-Decalins	1	C_1-Fluoranthrenes/Pyrenes	1
C_4-Decalins	1	C_2-Fluoranthrenes/Pyrenes	1
Naphthalene	1	C_3-Fluoranthrenes/Pyrenes	1
C_1-Naphthalenes	1	C_4-Fluoranthrenes/Pyrenes	1
C_2-Naphthalenes	1	Naphthobenzothiophenes	1
C_3-Naphthalenes	1	C_1-Naphthobenzothiophenes	1
C_4-Naphthalenes	1	C_2-Naphthobenzothiophenes	1
2-Methlynaphthalene	1	C_3-Naphthobenzothiophenes	1
1-Methlynaphthalene	1	C4-Naphthobenzothiophenes	1
Benzothiophene	1	Benz[a]anthracene	2
C_1-Benzo(b)thiophenes	1	Chrysene/Triphenylene	2
C_2-Benzo(b)thiophenes	1	C_1-Chrysenes	2
C_3-Benzo(b)thiophenes	1	C_2-Chrysenes	2
C_4-Benzo(b)thiophenes	1	C_3-Chrysenes	2
Biphenyl	1	C_4-Chrysenes	2
2,6-Dimethylnaphthalene	1	Benzo[b]fluoranthene	2
Dibenzofuran	1	Benzo[j]+[k]fluoranthene	2
Acenaphthylene	1	Benzo[a]fluoranthene	2
Acenaphthene	1	Benzo[e]pyrene	2
2,3,5-Trimethylnaphthalene	1	Benzo[a]pyrene	2
Fluorene	1	Perylene	2
C_1-Fluorenes	1	Indeno[1,2,3-c,d]pyrene	2
C_2-Fluorenes	1	Dibenz[ah]+[ac]anthracene	2
C_3-Fluorenes	1	Benzo[g,h,i]perylene	2
Dibenzothiophene	1	C_1-Dibenzothiophene isomers	1
C_1-Dibenzothiophenes	1	C_1-Phenanthrenes/Anthracene isomers	1
C_2-Dibenzothiophenes	1	**Surrogate Compounds**	
C_3-Dibenzothiophenes	1	Naphthalene-d_8	1
C_4-Dibenzothiophenes	1	Phenanthrene-d_{10}	1
Phenanthrene	1	Benzo(b)flouranthene-d12	2
C_1-Phenanthrenes/Anthracenes	1	Benzo(a)pyrene-d_{12}	2
C_2-Phenanthrenes/Anthracenes	1	5B(H) - Cholane	2
C_3-Phenanthrenes/Anthracenes	1	Methylnaphthalene-d10	1
C_4-Phenanthrenes/Anthracenes	1	Pyrene-d10	1
Anthracene	1		
Retene	1	**Internal Standards**	
Carbazole	1	Acenapthene-d_{10}	1
1-Methylphenanthrene	1	Chrysene-d_{12}	2

Table IB: Sterane and Triterpane Target Compounds Internal Standard Reference

Compound	IS Reference	Compound	IS Reference
C23 Tricyclic Terpane	2	30,31-Trishomohopane-22S	2
C24 Tricyclic Terpane	2	30,31-Trishomohopane-22R	2
C25 Tricyclic Terpane	2	Tetrakishomohopane-22S	2
C24 Tetracyclic Terpane	2	Tetrakishomohopane-22R	2
C26 Tricyclic Terpane-22S	2	Pentakishomohopane-22S	2
C26 Tricyclic Terpane-22R	2	Pentakishomohopane-22R	2
C28 Tricyclic Terpane-22S	2	13b(H),17a(H)-20S-Diacholestane	2
C28 Tricyclic Terpane-22R	2	13b(H),17a(H)-20R-Diacholestane	2
C29 Tricyclic Terpane-22S	2	13b,17a-20S-Methyldiacholestane	2
C29 Tricyclic Terpane-22R	2	14a(H),17a(H)-20S-Cholestane/ 13b(H),17a(H)-20S-Ethyldiacholestane	2
18a-22,29,30-Trisnorneohopane-TS	2	14a(H),17a(H)-20R-Cholestane/ 13b(H),17a(H)-20R-Ethyldiacholestane	2
C30 Tricyclic Terpane-22S	2	Unknown sterane	2
C30 Tricyclic Terpane-22R	2	13a,17b-20S-Ethyldiacholestane	2
17a(H)-22,29,30-Trisnorhopane-TM	2	14a,17a-20S-Methylcholestane	2
17a/b,21b/a 28,30-Bisnorhopane	2	14a,17a-20R-Methylcholestane	2
17a(H),21B(H)-25-Norhopane	2	14a(H),17a(H)-20S-Ethylcholestane	2
30-Norhopane	2	14a(H),17a(H)-20R-Ethylcholestane	2
18a(H)-30-Norneohopane-C29Ts	2	14b(H),17b(H)-20R-Cholestane	2
17a(H)-Diahopane	2	14b(H),17b(H)-20S-Cholestane	2
30-Normoretane	2	14b,17b-20R-Methylcholestane	2
18a(H)&18b(H)-Oleananes	2	14b,17b-20S-Methylcholestane	2
17a(H),21B(H)-hopane-C30H52 or Hopane	2	14b(H),17b(H)-20R-Ethylcholestane	2
Moretane	2	14b(H),17b(H)-20S-Ethylcholestane	2
30-Homohopane-22S	2	C26,20R- +C27,20S- triaromatic steroid	2
30-Homohopane-22R	2	C28,20S-triaromatic steroid	2
Gammacerane/C32-diahopane	2	C27,20R-triaromatic steroid	2
30,31-Bishomohopane-22S	2	C28,20R-triaromatic steroid	2
30,31-Bishomohopane-22R	2		

Table II: PAH, Alkyl PAH, Sterane and Triterpane Quantification Primary and Recommended Confirmation Ions

Compound	**Quantification & Confirmation Ions**	**Compound**	**Quantification & Confirmation Ions**
cis/trans-Decalin	138, 96	Fluoranthene	202, 101
C_1-Decalins	152	Benzo(b)fluorene	216, 215
C_2-Decalins	166	Pyrene	202, 101
C_3-Decalins	180	C_1-Fluoranthrenes/Pyrenes	216, 215
C_4-Decalins	194	C_2-Fluoranthrenes/Pyrenes	230, 215
Naphthalene	128, 127	C_3-Fluoranthrenes/Pyrenes	244, 229
C_1-Naphthalenes	142, 141	C_4-Fluoranthrenes/Pyrenes	258
C_2-Naphthalenes	156, 141	Naphthobenzothiophene	234, 189
C_3-Naphthalenes	170, 155	C_1-Naphthobenzothiophenes	248
C_4-Naphthalenes	184, 169, 183	C_2-Naphthobenzothiophenes	262
2-Methylnaphthalene	142, 141	C_3-Naphthobenzothiophenes	276
		C4-Naphthobenzothiophenes	290
1- Methylnaphthalene	142, 141	Benz[a]anthracene	228, 226
Benzothiophene	134	Chrysene/Triphenylene	228, 226
C1-Benzo(b)thiophenes	148	C_1-Chrysenes	242, 241
C2-Benzo(b)thiophenes	162	C_2-Chrysenes	256, 241
C3-Benzo(b)thiophenes	176	C_3-Chrysenes	270, 255
C4-Benzo(b)thiophenes	190	C_4-Chrysenes	284, 269
Biphenyl	154, 153	Benzo[b]fluoranthene	252, 253
2,6-Dimethylnaphthalene	156, 155	Benzo[j]+[k]fluoranthene	252, 253
Dibenzofuran	168, 139, 169	Benzo[a]fluoranthene	252, 253
Acenaphthylene	152, 153	Benzo[e]pyrene	252, 253
Acenaphthene	153, 154	Benzo[a]pyrene	252, 253
2,3,5-Trimethylnaphthalene	170, 155	Perylene	252, 253
Fluorene	166, 165	Indeno[1,2,3-c,d]pyrene	276, 138, 277
C_1-Fluorenes	180, 165	Dibenz[ah]+[ac]anthracene	278, 139, 279
C_2-Fluorenes	194, 179,195	Benzo[g,h,i]perylene	276, 277
C_3-Fluorenes	208, 197	**Biomarker Compounds**	
		17a(H),21B(H)-hopane-C30H52 or Hopane	191, 177
Dibenzothiophene	184, 152	Triterpanes	191
C_1-Dibenzothiophene isomers	198, 197		
C_1-Dibenzothiophenes	198, 197	Steranes	217, 218
C_2-Dibenzothiophenes	212, 197	Triaromatic steroids	231
C_3-Dibenzothiophenes	226, 211	**Surrogate Compounds**	
C4-Dibenzothiophenes	240, 225	2-Methylnaphthalene-d_{10}	152, 150
Phenanthrene	178, 176	Pyrene-d_{10}	212, 211
C_1-Phenanthrenes/Anthracene isomers	192, 191		
C_1-Phenanthrenes/Anthracenes	192, 191	Benzo(b)fluoranthene-d_{12}	264, 260
C_2-Phenanthrenes/Anthracenes	206, 191, 207	Naphthalene-d_8	136, 134

C_3-Phenanthrenes/Anthracenes	220, 205	Phenanthrene-d_{10}	188, 184
C_4-Phenanthrenes/Anthracenes	234, 219	Benzo(a)pyrene-d_{12}	264, 260
Anthracene	178, 176	5B(H) - cholane	217, 218
Retene	234, 219	**Internal Standards**	
Carbazole	167, 139	Acenapthene-d_{10}	164, 162
1-Methylphenanthrene	192, 191	Chrysene-d_{12}	240, 241

APPENDIX G

Laboratory Reporting Limits and MDL Study

Date Created: 12/20/17
Created By: Sue ONeil
File: PM4346-2
Page: 1

EMAP 34 PAHs - EPA 8270D-SIM(M) (SOIL) SOP 2172

Holding Time: 14 days
Container/Sample Preservation: 1 - Glass 120ml/4oz unpreserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Naphthalene	91-20-3	0.001005	0.000288837	mg/kg	50-130	30	50-150	30	30			
C1-Naphthalenes	91-20-3C1	0.001005	0.000288837	mg/kg	50-130	30	50-150	30	30			
C2-Naphthalenes	91-20-3C2	0.001005	0.000288837	mg/kg	50-130	30	50-150	30	30			
C3-Naphthalenes	91-20-3C3	0.001005	0.000288837	mg/kg	50-130	30	50-150	30	30			
C4-Naphthalenes	91-20-3C4	0.001005	0.000288837	mg/kg	50-130	30	50-150	30	30			
Acenaphthylene	208-96-8	0.001005	0.000191754	mg/kg	50-130	30	50-150	30	30			
Acenaphthene	83-32-9	0.001005	0.000177148	mg/kg	50-130	30	50-150	30	30			
Fluorene	86-73-7	0.001005	0.000268067	mg/kg	50-130	30	50-150	30	30			
C1-Fluorenes	86-73-7C1	0.001005	0.000268067	mg/kg	50-130	30	50-150	30	30			
C2-Fluorenes	86-73-7C2	0.001005	0.000268067	mg/kg	50-130	30	50-150	30	30			
C3-Fluorenes	86-73-7C3	0.001005	0.000268067	mg/kg	50-130	30	50-150	30	30			
Phenanthrene	85-01-8	0.001005	0.00033299	mg/kg	50-130	30	50-150	30	30			
C1-Phenanthrenes/Anthracenes	PHENANTHC1	0.001005	0.00033299	mg/kg	50-130	30	50-150	30	30			
C2-Phenanthrenes/Anthracenes	PHENANTHC2	0.001005	0.00033299	mg/kg	50-130	30	50-150	30	30			
C3-Phenanthrenes/Anthracenes	PHENANTHC3	0.001005	0.00033299	mg/kg	50-130	30	50-150	30	30			
C4-Phenanthrenes/Anthracenes	PHENANTHC4	0.001005	0.00033299	mg/kg	50-130	30	50-150	30	30			
Anthracene	120-12-7	0.001005	0.000207164	mg/kg	50-130	30	50-150	30	30			
Fluoranthene	206-44-0	0.001005	0.000319322	mg/kg	50-130	30	50-150	30	30			
Pyrene	129-00-0	0.001005	0.000264315	mg/kg	50-130	30	50-150	30	30			
C1-Fluoranthenes/Pyrenes	FLUORPYRC1	0.001005	0.000264315	mg/kg	50-130	30	50-150	30	30			
Benz(a)anthracene	56-55-3	0.001005	0.000204886	mg/kg	50-130	30	50-150	30	30			
Chrysene/Triphenylene	218-01-9/217-59-4	0.001005	0.000203144	mg/kg	50-130	30	50-150	30	30			
C1-Chrysenes	218-01-9C1	0.001005	0.000203144	mg/kg	50-130	30	50-150	30	30			
C2-Chrysenes	218-01-9C2	0.001005	0.000203144	mg/kg	50-130	30	50-150	30	30			
C3-Chrysenes	218-01-9C3	0.001005	0.000203144	mg/kg	50-130	30	50-150	30	30			
C4-Chrysenes	218-01-9C4	0.001005	0.000203144	mg/kg	50-130	30	50-150	30	30			
Benzo(b)fluoranthene	205-99-2	0.001005	0.000261367	mg/kg	50-130	30	50-150	30	30			
Benzo(j)+(k)Fluoranthene	205-82-3/207-08-9	0.001005	0.000199459	mg/kg	50-130	30	50-150	30	30			
Benzo(e)Pyrene	192-97-2	0.001005	0.000207365	mg/kg	50-130	30	50-150	30	30			
Benzo(a)pyrene	50-32-8	0.001005	0.000286894	mg/kg	50-130	30	50-150	30	30			
Perylene	198-55-0	0.001005	0.000193965	mg/kg	50-130	30	50-150	30	30			
Indeno(1,2,3-cd)Pyrene	193-39-5	0.001005	0.000272757	mg/kg	50-130	30	50-150	30	30			
Dibenz(a,h)+(a,c)anthracene	215-58-7/53-70-3	0.001005	0.000271484	mg/kg	50-130	30	50-150	30	30			
Benzo(ghi)perylene	191-24-2	0.001005	0.000266995	mg/kg	50-130	30	50-150	30	30			
Naphthalene-d8	*1146-65-2*									*50-130*		
Phenanthrene-d10	*1517-22-2*									*50-130*		
Benzo(a)pyrene-d12	*63466-71-7*									*50-130*		

Please Note that the RL information provided in this table is calculated using a 100% Solids factor. (Soil/Solids only)
Please Note that the information provided in this table is subject to change at anytime at the discretion of Alpha Analytical, Inc.

Determination of Method Detection Limits

Alpha Analytical Inc.
Mansfield, MA

Approved

Page 1 of 1	
Analyst:	SR
Date:	2/18 - 2/22//2013
Instrument ID:	PAH8, PAH3, PAH2, PAH14, PAH12
Column ID:	ZB5
Prep Method:	EPA 3510C
Prep Chemist:	DB, CK, AK

Method: EPA 8270D(M)-SIM 2013

GC/MS **Alkylated PAH** **Liquid**

Table (MDL)		Instrument ID	PAH 8	PAH 8	PAH3	PAH3	PAH2	PAH2	PAH14	PAH14	PAH12	PAH12	T value used for calculating MDL: 2.821					
		Data File	MDL 01	MDL 02	MDL 03	MDL 04	MDL 05	MDL 06	MDL 07	MDL 08	MDL 09	MDL 10						
		Date Analyzed	2/19/2013	2/19/2013	2/18/2013	2/18/2013	2/19/2013	2/19/2013	2/19/2013	2/19/2013	2/22/2013	2/22/2013						
No.	Analytes	Target conc. (ng/mL)	(ng/mL)	(ng/mL)	(ng/mL)	(ng/mL)	(ng/mL)	(ng/mL)	(ng/mL)	(ng/mL)	(ng/mL)	(ng/mL)	Mean (ng/mL)	Mean Accuracy	Standard Deviation	Calc. MDL (ng/mL)	Current RL (ng/mL)	Comment
1	trans-Decalin	4.00	3.37	4.21	3.11	4.28	3.97	4.22	3.59	3.58	3.97	3.90	3.82	96%	0.392	1.11	5.00	
2	cis-Decalin	4.00	3.81	3.88	4.26	4.76	4.10	4.09	3.69	3.04	3.42	3.56	3.86	97%	0.478	1.35	5.00	
3	Naphthalene	8.00	7.97	9.06	7.05	7.89	8.96	8.63	8.58	8.36	8.96	9.42	8.49	106%	0.699	1.97	10.0	
4	2-Methylnaphthalene	8.00	7.23	8.27	7.08	7.84	8.02	8.18	6.45	5.95	8.13	8.15	7.53	94%	0.816	2.30	10.0	
5	1-Methylnaphthalene	8.00	7.42	8.03	6.97	8.16	8.48	8.33	7.05	6.48	8.29	8.05	7.73	97%	0.691	1.95	10.0	
6	Benzothiophene	8.00	7.21	8.04	6.88	8.40	8.10	8.17	7.14	7.43	8.13	8.13	7.76	97%	0.539	1.52	10.0	
7	Biphenyl	8.00	7.19	7.94	6.02	7.16	7.90	8.61	7.24	6.48	8.34	8.10	7.50	94%	0.826	2.33	10.0	
8	2,6-Dimethylnaphthalene	8.00	7.88	8.19	6.74	7.06	7.44	7.86	6.54	5.35	7.53	7.31	7.19	90%	0.826	2.33	10.0	
9	Dibenzofuran	8.00	7.60	8.54	6.48	7.43	8.28	8.12	7.12	6.93	7.86	7.89	7.62	95%	0.644	1.82	10.0	
10	Acenaphthylene	8.00	7.41	8.27	6.41	6.87	7.66	7.67	6.14	6.25	6.82	6.60	7.01	88%	0.709	2.00	10.0	
11	Acenaphthene	8.00	7.58	8.42	7.33	7.36	7.73	7.88	7.12	6.76	7.71	7.66	7.55	94%	0.452	1.28	10.0	
12	2,3,5-Trimethylnaphthalene	8.00	7.64	8.67	7.38	7.11	7.55	7.68	7.16	6.89	7.01	6.88	7.40	92%	0.536	1.51	10.0	
13	Fluorene	8.00	8.11	8.72	7.42	7.47	8.15	8.19	6.67	6.86	7.71	7.59	7.69	96%	0.629	1.77	10.0	
14	Dibenzothiophene	8.00	7.99	8.63	7.30	7.53	8.19	8.36	7.13	7.15	7.88	7.77	7.79	97%	0.517	1.46	10.0	
15	Phenanthrene	8.00	8.28	9.07	7.53	8.03	8.47	8.43	8.84	8.56	8.21	8.32	8.37	105%	0.425	1.20	10.0	
16	Retene	8.00	8.30	8.83	8.70	7.99	6.68	6.61	7.94	7.44	6.43	6.09	7.50	94%	0.994	2.80	10.0	
17	Anthracene	8.00	7.39	7.72	6.93	7.39	7.16	7.38	6.64	6.04	6.18	5.93	6.88	86%	0.642	1.81	10.0	
18	Carbazole	8.00	6.30	7.11	6.68	6.65	7.34	6.93	6.18	6.84	5.84	5.68	6.55	82%	0.545	1.54	10.0	
19	1-Methylphenanthrene	8.00	7.53	8.20	6.92	7.69	7.56	7.13	8.01	7.40	7.01	6.90	7.44	93%	0.452	1.27	10.0	
20	Fluoranthene	8.00	7.98	8.94	7.24	8.12	7.23	7.18	8.19	8.24	7.33	7.04	7.75	97%	0.631	1.78	10.0	
21	Benzo(b)fluorene	8.00	8.02	8.30	6.37	6.67	6.45	6.25	7.32	7.10	5.68	5.38	6.75	84%	0.940	2.65	10.0	
22	Pyrene	8.00	8.30	9.25	7.28	7.57	7.22	7.38	8.02	7.96	7.41	7.21	7.76	97%	0.646	1.82	10.0	
23	Naphthobenzothiophene	8.00	8.12	8.71	7.28	6.92	7.18	7.19	7.10	7.04	7.04	7.01	7.36	92%	0.583	1.64	10.0	
24	Benz[a]anthracene	8.00	7.19	7.52	7.41	7.08	7.21	7.30	6.80	6.48	6.50	6.41	6.99	87%	0.411	1.16	10.0	
25	Chrysene/Triphenylene	8.00	8.06	8.84	8.50	7.67	8.17	8.35	8.34	8.32	7.46	7.53	8.12	102%	0.447	1.26	10.0	
26	Benzo[b]fluoranthene	8.00	7.35	7.90	8.18	8.30	7.83	8.08	8.28	8.03	7.14	6.78	7.79	97%	0.520	1.47	10.0	
27	Benzo[j]+[k]fluoranthene	8.00	7.35	8.09	8.16	8.35	7.82	8.08	7.75	7.63	6.79	6.93	7.69	96%	0.528	1.49	10.0	
28	Benzo[e]pyrene	8.00	7.25	7.64	7.86	8.05	7.84	8.15	7.65	7.76	7.05	6.67	7.59	95%	0.466	1.31	10.0	
29	Benzo[a]pyrene	8.00	7.24	7.70	7.92	8.41	7.72	8.20	7.36	6.90	6.49	5.98	7.39	92%	0.763	2.15	10.0	
30	Perylene	8.00	7.12	7.27	7.13	7.63	7.41	7.35	7.33	6.82	5.81	5.80	6.97	87%	0.648	1.83	10.0	
31	Indeno[1,2,3-cd]pyrene	8.00	5.09	5.27	7.39	7.10	7.14	6.30	6.68	6.11	5.53	5.24	6.18	77%	0.871	2.46	10.0	
32	Dibenz[ah]+[ac]anthracene	8.00	5.66	5.70	8.46	7.49	7.12	6.80	6.21	6.54	5.37	5.16	6.45	81%	1.04	2.94	10.0	
33	Benzo[g,h,i]perylene	8.00	6.58	7.10	8.10	7.98	8.32	8.29	6.96	7.78	6.16	5.69	7.30	91%	0.938	2.65	10.0	
34	Hopane (T19)	8.00	10.2	11.5	9.87	11.4	10.3	10.4	9.51	10.3	9.21	9.16	10.2	127%	0.803	2.27	10.0	
35	5B(H)Cholane	16.0	14.6	13.6	16.0	15.9	13.7	13.7	15.3	15.8	12.0	11.9	14.2	89%	1.53	4.32	15.0	
	Surrogates																	
1	Naphthalene-d8	1000	869	963	834	829	899	901	954	906	914	902	897	90%				
2	Phenanthrene-d10	1000	985	1053	864	876	974	982	941	935	926	920	945	95%				
3	Benzo[b]fluoranthene-d12	1000	893	924	965	948	934	942	932	873	888	877	918	92%				
4	Benzo[a]pyrene-d12	1000	914	940	970	969	970	987	946	917	861	836	931	93%				

Comments: ______________________

Form No.: 08-66 3/30/2009

Technical Director: ________ Date Effective: 10/24/13