ENVIRONMENTAL ALLIANCE

August 21, 2009

• ***Engineering***

• ***Remediation***

• ***Consulting***

Ms. Jenny Martin
Maryland Department of the Environment (MDE)
Oil Control Program
1800 Washington Blvd.
Baltimore, Maryland 21230

Re: Transmittal – Corrective Action Plan (CAP) Addendum
Wally's Citgo
19200 Middletown Road
Parkton, Maryland
MDE Case # 2006-0319-BA2

Dear Ms. Martin:

Environmental Alliance, Inc. (Alliance) on behalf of Carroll Independent Fuel Company (CIFC) is providing one hard copy of the above referenced CAP Addendum for the Wally's Citgo site as directed per MDE letters dated May 28, 2009 and July 23, 2009.

Should you have any questions regarding the transmitted items or any other project items, please give me a call at (302) 234-4400.

Sincerely,
ENVIRONMENTAL ALLIANCE, INC.

Andrew J. Applebaum
Geological Services Manager

Enclosure

C: Mr. Randy Childs, Carroll Independent Fuel Company (Electronic Copy)
Ms. Ellen Jackson, MDE (Hard Copy & CD)
Mr. Kevin Koepenick, Baltimore County – DEPRM (Hard Copy)
Mr. Dwight W. Stone, Whiteford, Taylor & Preston (Electronic Copy)

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CORRECTIVE ACTION PLAN ADDENDUM WALLY'S CITGO 19200 MIDDLETOWN ROAD PARKTON, MARYLAND

August 21, 2009

Prepared for:
Maryland Department of the Environment
Oil Control Program
1800 Washington Blvd.
Baltimore, Maryland 21230

Prepared by:
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ENVIRONMENTAL ALLIANCE

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APPENDICES

1.0 INTRODUCTION

Environmental Alliance, Inc. (Alliance) of Hockessin, DE, on behalf of Carroll Independent Fuel Company (CIFC), has prepared this Corrective Action Plan (CAP) Addendum for the Wally's Citgo (Site) located at 19200 Middletown Road in Parkton, Maryland. The Site is a retail gasoline service station located at the intersection of Middletown Road and Rayville Road that has been the subject of continuing environmental investigation activities under the oversight of the Maryland Department of the Environment Oil Control Program (MDE). Refer to the Site Location Map (topographic map) depicted on Figure 1-1 and Site Base Map depicted on Figure 1-2. On May 28, 2009 the MDE issued a directives letter to CIFC requesting that a CAP Addendum for the Site be submitted by July 10, 2009, which was later extended to August 21, 2009 as approved by MDE in their July 23, 2009 letter to account for the timing issues associated with property access, investigation work, remedial design work, information evaluation, and report submittal (refer to MDE letters dated May 28, 2009 and July 23, 2009 attached in Appendix I).

Site specific background information including Site description, historic investigation/Site activities, historic pilot testing/remedial activities, geology/hydrogeology summary, and soil/groundwater quality summary as well as risk assessment and remedial alternative analysis for the Wally's Citgo Site was provided in the CAP (Alliance; February 26, 2009) and will not be reiterated within this CAP Addendum. This CAP Addendum provides the following information towards implementing corrective action for the Site.

- Borehole geophysical investigation and results for the potable wells at 1606, 1608, & 1612 Rayville Road properties per Borehole Geophysical Testing Work Plan (Geophysical Work Plan) by Alliance; June 11, 2009 approved by MDE via letter dated June 18, 2009.
- Groundwater modeling report detailing model construction to simulate Site conditions and provide remedial design support work.

- Soil vapor extraction (SVE) point installation and subsequent pilot test data as approved in MDE's May 2009 directive letter.
- Conceptual design of a phased groundwater pump and treat (P&T) remedial system to address impacted groundwater. Design of a phased monitoring well network to evaluate groundwater quality and P&T system operation.
- Conceptual design of an SVE remedial system to address residual gasoline hydrocarbon impacts that were identified as part of the SVE Pilot Test.

Section 2.0 of this report presents the results of the borehole geophysical work. Section 3.0 provides the results of the SVE Pilot Test work. Section 4.0 presents the CAP includes the conceptual design of the pump and treat system design, monitoring well network, and SVE system design. Section 5.0 discusses CAP scheduling details.

★ Site Location

0 1,000 Feet

SOURCE:
USGS Topographic Map
New Freedom Quadrangle

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660 Yorklyn Road - Hockessin, DE 19707
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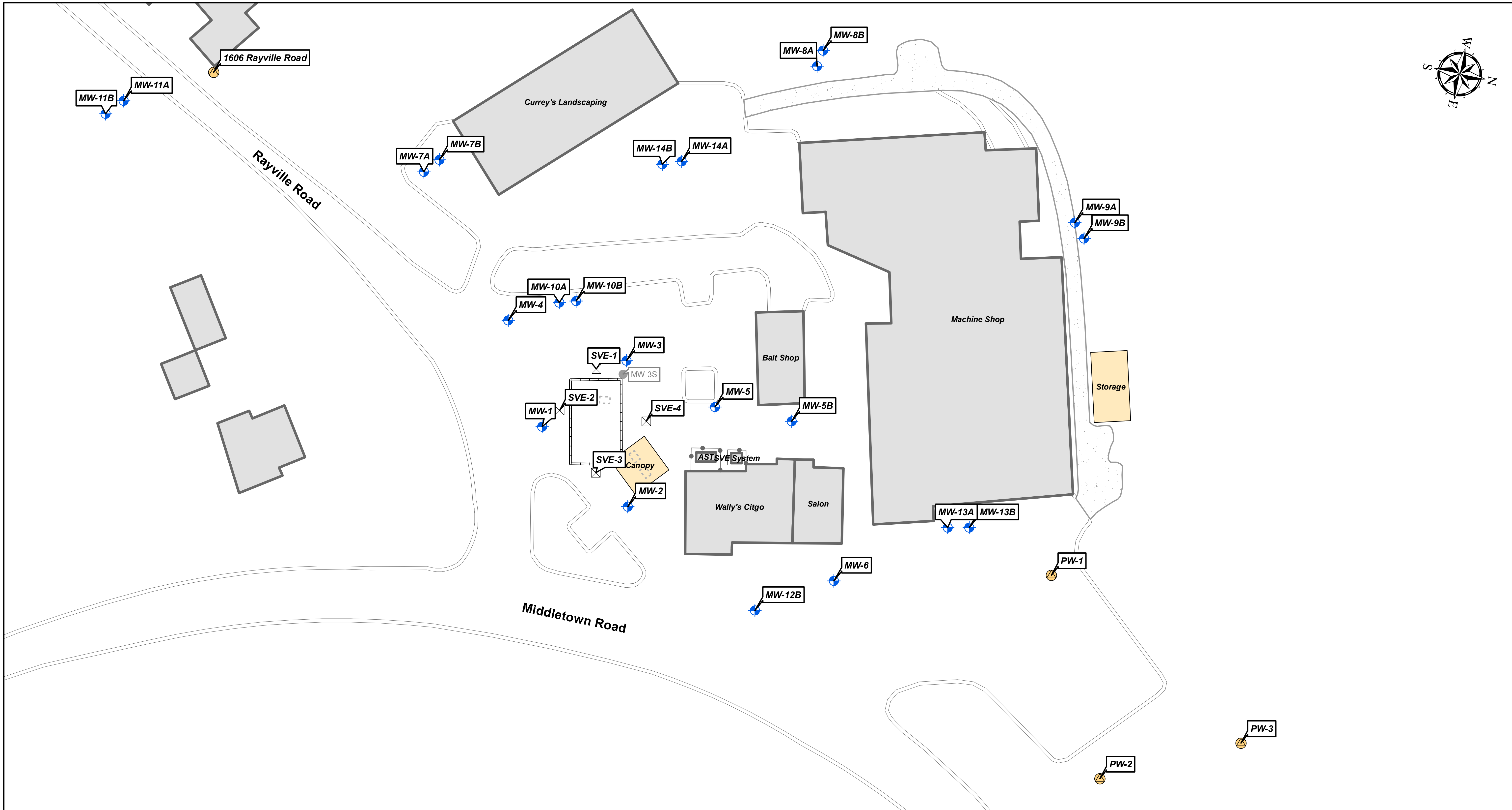
Wally's Citgo Station
19200 Middletown Road
Parkton, MD

Site Location Map

DRAWN BY: SKJ	FILE NAME: 1962-Topo Map	SCALE: SEE DRAWING	FIGURE NO: 1-1
APPROVED BY:	PROJECT NO: 2083	DATE: 02/17/2009	



Legend

Soil Vapor Extraction Point	Potable Well	Edge of Pavement
Monitoring Well	Abandoned Well	Fence
		Tank Field
Building	Dispenser	
Canopy	Gravel	

0 60 120 Feet

Source: Site features based on Baltimore County GIS data

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Wally's Citco Station
19200 Middletown Road
Parkton, Maryland

Site Base Map

DESIGNED BY:	DRAWN BY:	UPDATED BY:	FIGURE NO.:
AJA	AGG	SKJ	1-2
APPROVED BY:	PROJECT NO.: 1962	DATE: 08/18/2009	

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2.0 BOREHOLE GEOPHYSICAL ACTIVITIES

2.1 Borehole Geophysical Testing Preparation

Alliance secured signed access agreements for borehole geophysical testing on the 1606, 1608, and 1612 Rayville Road properties prior to proceeding with activities presented in the Geophysical Work Plan (refer to Figure 2-1 for locations). Maryland State Utility Locating Service (Miss Utilities) was utilized to mark-out subsurface utilities prior to excavation to unearth the potable well well-head at the 1606 Rayville Road property (top of well head was reported to be four to five feet below grade (bg). On Friday June 26, 2009 a meeting at the 1606 Rayville Road property was held with the property owners of the properties schedule for geophysical testing. The purpose of the meeting was to provide an overview of the activities to be conducted and then meet with property owners individually to address property specific items for geophysical testing implementation. The meeting was attended by property owners (Mr. Martin, Mr. Belt, and Ms. Fissel), property owner's counsel (Mr. Hill), CIFC (Mr. Childs), CIFC's counsel (Mr. Johansson), Alliance (Mr. Applebaum), and Alliance's subcontractor Carroll Water Systems, Inc. (Mr. Willet). Based on the meeting findings regarding the 1606 Rayville Road potable well location, Alliance contacted Baltimore County Department of Highways on June 26, 2009 to confirm requirements for signs and flag personnel for partial road closure. Alliance was informed that no permit was necessary for the activities to be conducted and that one flag person with a "Work Area Ahead" (or equivalent wording) sign for each direction of travel would be sufficient.

2.2 Potable Well Opening/Return to Service Activities

Carroll Water Systems, Inc. (Carroll Water) of Westminster, Maryland, under supervision of Alliance personnel, conducted potable well opening for borehole geophysical testing on June 30, 2009 and returned the open potable wells back to service on July 1, 2009. The well opening activities proceeded per the Borehole Geophysical Work Plan beginning at 1612 Rayville Road first, moving to 1606 Rayville Road, and finishing with 1608 Rayville Road.

Upon locating and excavating the well-head at 1606 Rayville Road using a backhoe (required partial road closure with traffic control as noted in Section 2.1), Carroll Water attached a sufficient length of steel well casing, welded the casing extension to the existing top of casing so the re-worked well-head was above grade to bring the well head in compliance with Baltimore County requirements as verbally agreed to by the property owner in the field and directed by CIFC. During the excavation activities at 1606 Rayville Road, two concrete paving slabs were disturbed when locating the well-head. Alliance has worked with the property owner towards restoration of his property. No other property disturbances were noted by Alliance or the property owners. The 1608 and 1612 Rayville Road property wells required standard pump and piping removal prior to geophysical testing.

After completion of borehole geophysical testing (discussed in Section 2.3) at the potable wells, Carroll Water completed the well and pumping system chlorination per county requirements for potable well opening work. The chlorination of all three property water systems was completed on June 30, 2009 so that all systems would remain chlorinated without use overnight (a time-period greater than eight hours specified in the Borehole Geophysical Work Plan) and on July 1, 2009, Alliance and Carroll Water completed pump-off of chlorinated water from the potable wells. The water pumped from each potable well was analyzed for chlorine in the field using a Hach total chlorine Kit. Pump-off of water was discontinued after achieving chlorine concentrations below 1 mg/L (EPA maximum contaminant level for chlorine).

The following are approximate volumes of chlorinated water removed from each well (total volume 1,975 gallons), which was transported and disposed of by Water Depot (refer to disposal documentation in Appendix II).

- 1606 Rayville Road – 560 gallons
- 1608 Rayville Road – 585 gallons
- 1612 Rayville Road – 830 gallons

Once chlorinated water pump-off was completed, the potable wells were returned to full service. After which, an outside hose bib with hose was turned on and allowed to run for approximately 30 and 60 minutes at the 1606 and 1612 Rayville Road properties, respectively. No hose bib was located by personnel on-Site at the 1608 Rayville Road, thus no water was run from the residence system at this property.

2.3 Borehole Geophysical Testing

Borehole geophysical testing was conducted on June 30, 2009 by ARM Geophysics (ARM) of Hershey, Pennsylvania under the supervision of an Alliance geologist. The geophysical testing was initiated immediately after all down-hole equipment within a potable well was removed by Carroll Water. The geophysical testing was implemented per Borehole Geophysical Work Plan with a brief summary of the activities conducted in the field discussed below.

The potable wells geophysical testing started with 1612 Rayville Road, followed by 1606 Rayville Road and finishing with 1608 Rayville Road. The geophysical tools used at each potable well location consisted of an optical televiewer (OTV); an electrical log tool (includes natural gamma, fluid temperature, fluid resistivity, short & long resistivity, spontaneous potential, and single point resistance); caliper and acoustic televiewer (ATV). Decontamination of all down-hole equipment was performed between each potable well.

Due to the late delivery of the ATV tool to the Site and completion of geophysical testing with all other tools at 1612 Rayville Road, ARM mobilized to 1606 Rayville Road to initiate geophysical testing with the OTV tool. Upon ATV tool delivery to the Site, ARM completed OTV testing at 1606 Rayville Road and returned to 1612 Rayville Road to implement ATV testing. With the completion of all geophysical testing at 1612 Rayville Road, ARM mobilized back to 1606 Rayville Road to complete all geophysical testing at that location.

A detailed description of the geophysical tools used (including data type generated), presentation of the geophysical logs for each potable well, and a data summary with interpretation of the geophysical data (inclusive of geophysical data from 2006) is presented in ARM's August 3, 2009 letter report (August 2009 letter report) attached as Appendix III. The 2006 geophysical testing results were presented in the Results of Geophysical Well Logging letter report (ARM; November 7, 2006), which was included as Appendix III in the Hydrogeologic Investigation Update Report and Work Plan (Alliance; February 6, 2007) submitted to MDE. ARM has also provided geophysical data interpretation using only potable well data (ARM supplemental evaluation), which is also attached in Appendix III. A summary evaluation review of all geophysical data generated for the project is provided in Section 2.3.1.

2.3.1 Geophysical Data Evaluation

Fractures, which are typically a primary groundwater producing structure in a schist bedrock aquifer system, were identified in the three potable wells (1606, 1608, and 1612 Rayville Road on June 30, 2009) and six monitoring wells (MW-7A, MW-7B, MW-8A, MW-8B, MW-9A, and MW-9B on September 18 and 19 and October 13, 2006) tested. Foliations identified in the potable and monitoring wells are the alignment of minerals in metamorphic rocks into potential cleavage, which may provide a preferred direction for fracturing. The depth of the geophysical data collected below well casing at the nine wells tested range from 23 feet (1612 Rayville Road) to 242 feet (MW-7B and MW-9B) bg.

2.3.1.1 <u>2006 Geophysical Data</u>

ARM interpretation of the 2006 geophysical data indicated the following.

- Groundwater flow would be primarily influenced by the observed fractures and foliation.
- No significant hydraulic connection (vertical flow) between any water producing zones penetrated by the tested wells.
- Well MW-9B is the only well showing data deviations that would suggest the potential presence of water bearing zones. These zones were identified at 99, 141, 186, and 220 feet bg however, the yield of water production could not be attained by the testing.

Alliance's review of the 2006 geophysical data indicated additional data deviations that may also be considered water bearing zones in addition to those noted by ARM. These zones noted by Alliance correlating with identified fractures and/or foliations were identified at: MW-7A (46 and 51 feet bg), MW-8A (48, 53, and 62 feet bg), MW-8B (85 and 94 feet bg), and MW-9A (51 and 56 feet bg). Note only caliper and OTV logs were conducted at MW-7B due to the lack of groundwater in the well; therefore no comparison of data deviations using the electrical logs is possible. However, the observance of only two fractures at 101 and 216 feet bg in MW-7B and limited groundwater production observed indicates minimal groundwater production zones below 70 feet bg in the MW-7A and MW-7B area.

The planar features identified by 2006 geophysical testing indicated mean foliation and fracture orientation trends shown in Table 2-1 below. Refer to ARM's November 7, 2006 letter report (November 2006 letter report) presented in Appendix III and Section 3.2 in Hydrogeologic Investigation Update Report and Work Plan dated February 6, 2007 by Alliance for details.

Table 2-1 2006 Geophysical Data Mean Planar Feature Orientation			
Planar Features	**Dip (deg)**	**Dip Direction (deg)**	**Strike/Dip**
Foliations	24	291	N21E/24NW
Fracture Set #1	20	300	N30E/20NW
Fracture Set #2	56	293	N23E/56NW

From the mean of the 2006 geophysical data, the overall trend for all planar features identified is a strike orientation of northeast-southwest with a dip orientation to the NW.

2.3.1.2 2009 Geophysical Data

Construction details for the three potable wells tested are presented in Table 2-2 below.

Table 2-2 Potable Well Construction			
Property	**Pump Set Depth (ft. bg)**	**Steel Casing Bottom Depth**	**Well Bottom Depth**
1606 Rayville Road	110.3	27	135.7
1608 Rayville Road	79	44	84.7
1612 Rayville Road	95	23	114

The construction details of the three potables wells are similar to monitoring wells installed for the Site in terms of depth and length of open borehole.

From ARM's interpretation of the 2009 geophysical data, water bearing zones were interpreted at 1606 Rayville Road (43, 59, 62, and 74 feet bg), 1608 Rayville Road (45, 60, and 66 feet bg), and 1612 Rayville Road (63, 70, and 83 feet bg). In addition to the water bearing zones interpreted by ARM, Alliance has also noted what may be potential minor water bearing zones associated with fractures at 1606 Rayville Road (approximately 98 and 113 feet bg) and 1612 Rayville Road (approximately 96 and 101 feet bg).

The planar features identified by 2009 geophysical testing indicated mean foliation and fracture orientation trends shown in Table 2-3 below.

Table 2-3 2009 Geophysical Data Mean Planar Feature Orientation			
Planar Features	**Dip (deg)**	**Dip Direction (deg)**	**Strike/Dip**
Foliations	29	281	N11E/29NW
Fracture Set #1	24	286	N16E/24NW
Fracture Set #2	85	237	N33W/85SW

The 2009 geophysical data for the potable wells is comparable to 2006 geophysical data of the Site monitoring wells for mean planar feature orientation for foliations and fracture set #1 (low angle populations) with strike orientation (from dip direction using right hand rule) northeast-southwest and a northwest dip.

In order to provide a more statistically viable evaluation of the geophysical work conducted to date to be representative of the fractured bedrock in the area, ARM combined the data from the 2006 and 2009 geophysical testing events in the August 2009 letter report (refer to Appendix III). The planar features identified by 2006 and 2009 geophysical testing indicated mean foliation and fracture orientation trends shown in Table 2-4 below.

Table 2-4 Combined (2006 & 2009) Geophysical Data Mean Planar Feature Orientation			
Planar Features	**Dip (deg)**	**Dip Direction (deg)**	**Strike/Dip**
Foliations (44^)	27	281	N11E/27NW
Fractures (82^)	34	284	N14E/34NW

^ =Number of planar feature

The combination of planar structures identified by the combined geophysical work conducted show a mean foliation and fracture strike orientation of northeast-southwest with dip to the northwest.

2.4 Geophysical Testing Conclusions

To summarize, the following can be concluded from the geophysical testing data for the Site.

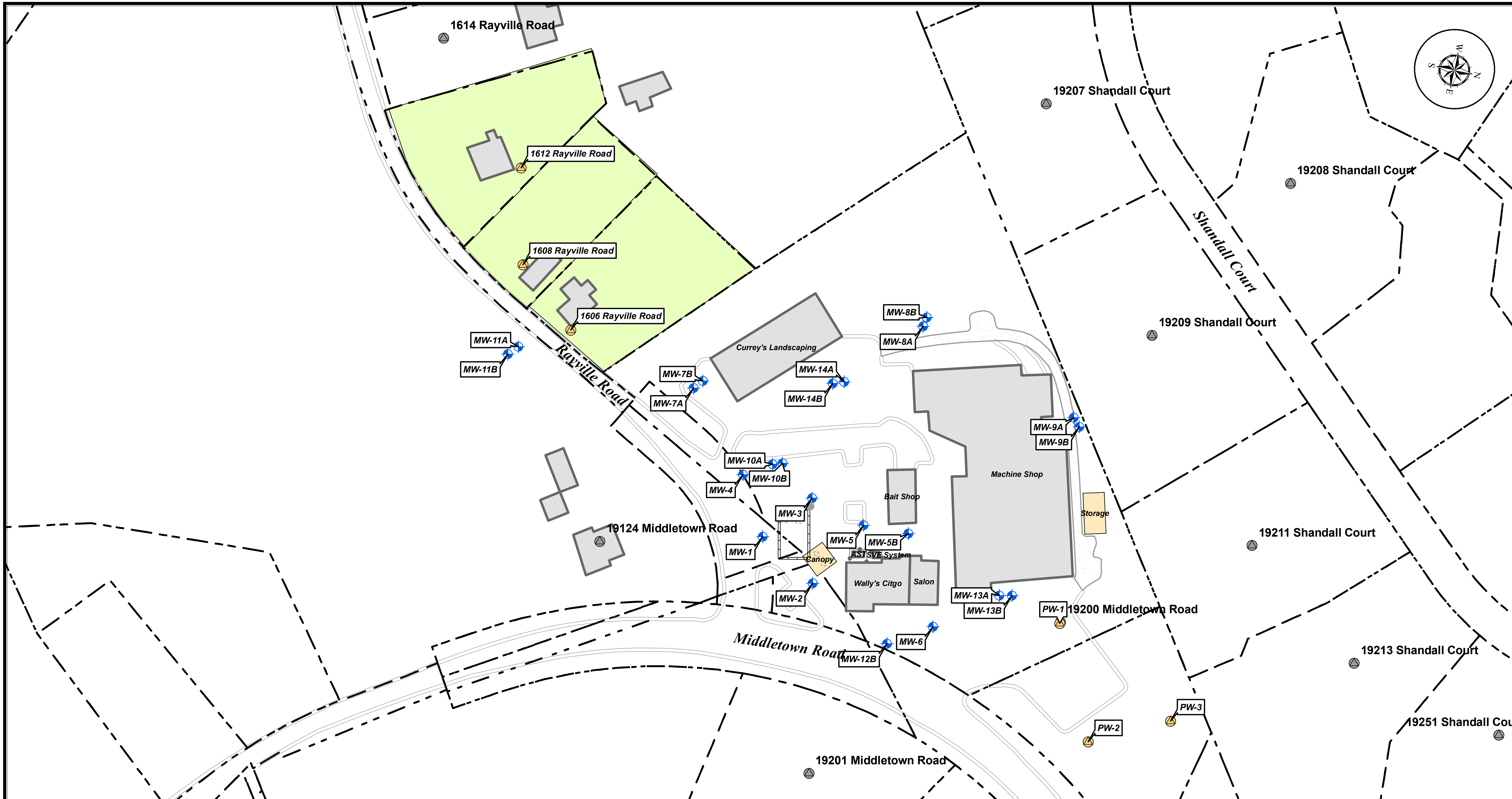
- Potable well construction of the 1606, 1608, and 1612 Rayville Road properties is similar to the monitoring well specifications for the Site.
- The combined 2006 and 2009 geophysical data set is consistent with 2006 geophysical data set.
- Interpreted potable well water bearing zones are consistent with interpreted water bearing zones intercepted by monitoring well network.
- A higher frequency of fracturing with interpreted water bearing zones was observed between approximately 40 to 80 feet bg with a reduced frequency of interpreted water bearing zones observed with increasing depth.
- Of the 28 fractures interpreted as being water bearing zones (regardless of depth), the majority of these fractures (i.e., 18) showed a northeast-southwest strike trend. The remaining 10 fractures showed a northwest-southeast strike trend).
- Geophysical data supports the geological/hydrogeological setting of Site conceptual model.

Overall, the geophysical data evaluation shows a mean northeast-southwest strike trend with a northwest dip trend of the bedrock structure. The mean northeast-southwest strike orientation of fractures and foliations noted by the geophysical data is supported by the pump test results presented in the Pump Testing Report (Alliance; July 30, 2007). The pump test results showed drawdown contours to exhibit a radial pattern with an extensive drawdown cone of depression centered at pumping well MW-10A. The drawdown contours are slightly elongated to the northeast and southwest, suggesting a horizontally anisotropic aquifer. This northeast-southwest elongation of the drawdown cone of depression is consistent with the mean strike orientation of the bedrock fractures and foliation.

The reduction of potential water bearing zones with increased depth interpreted from the geophysical testing is supported by packer test data presented in the Hydrogeologic Investigation Update Report, Groundwater Delineation Work Plan, and Soil Alternative Corrective Action Plan (Alliance; June 15, 2007). The packer test data showed little to no presence of groundwater with increasing depth based on:

- Inability of isolated fracture zones at depths greater than 70 feet bg to accept water added as part of aquifer (slug) testing (water level would show little to no decrease over time).
- Attempts to purge isolated zones at depths greater than 70 feet bg resulted in dewatering the groundwater column below the top packer to just above top of pump with little (typically less than 0.2 gallons per minute) to no recovery of groundwater.

This structure trend in conjunction with current chemical characterization data that continues to show MTBE mass of contamination to trend towards the southwest on-Site and off-Site, indicates the developed Site conceptual model is valid.



Legend

- Monitoring Well
- Potable Well
- Abandoned Well
- Approximate Potable Well Location*
- Potable Well Borehole Geophysical Locations
- Building
- Canopy
- Dispenser
- Gravel
- Property Boundary
- Edge of Pavement
- Fence
- Tank Field

0 100 200 Feet

Note:
- Exact locations of offsite Potable Wells are unknown, shown locations are approximate.
- Exact locations will be determined in the field.

Source:
-Site features based on Baltimore County GIS data.

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MDE Directed Potable Well Borehole Geophysical Locations

DRAWN BY: SKJ	FILE NAME: 1962_MDE Directed Potable Wells.mxd	SCALE: SEE DRAWING	FIGURE NO:
APPROVED BY:	PROJECT NO: 1962	DATE: 06/08/2009	**2-1**

3.0 SVE PILOT TEST

In the May 28, 2009 MDE directives letter, the MDE approved proceeding with SVE pilot test activities proposed in the February 2009 CAP. This section presents the SVE pilot test activities conducted and their results.

3.1 SVE Point Installation

Before initiation of SVE point installation activities, the State subsurface utility mark-out service (Miss Utility) was contacted to identify public utilities at the Site and surrounding areas. As the SVE points were to be constructed above groundwater, no well permits were necessary from the Baltimore County Health Department. Four points were installed June 15, 2009 using the air rotary drilling technology (Schramm T450W drill rig) by Eichelbergers, Inc. under the supervision of an Alliance geologist. SVE points SVE-1 through SVE-4 were installed at the four sides of the existing underground Storage Tank (UST) field to evaluate the potential for SVE to address the potential presence of adsorbed or vapor phase contaminants in the unsaturated zone beneath the depth where soil was excavated as part of the 2008 UST removal and replacement. The four SVE points were all constructed using 4-inch diameter schedule 40 PVC casing and 0.01-inch screen to the completion depth of 37 feet bg. The annulus of each point was constructed using #2 gravel pack, hydrated bentonite hole-plug, and cement in which a flush-mount manhole was installed. Refer to Figure 1-2 for point locations and Appendix IV for soil boring/well logs providing field observations and point construction details.

Drill cuttings were screened during point installation with a photo-ionization detector (PID). Field screening PID results presented in the soil boring/well logs for each point were below instrument detection (<0.1 ppmv PID units) with the exception of the 29 to 30 foot bg at SVE-1 (0.5 ppmv PID units). Note that this depth correlates with the saprolite/schist interface identified during drilling. Drill cuttings were collected, and placed into drums (19 drums total), for off-Site disposal through Subsurface Technologies, Inc. of New Windsor, Maryland to Clean

Venture/Cycle Chem of Lewisberry, Pennsylvania (refer to Appendix II for disposal documentation).

3.2 SVE Pilot Test Activities

The SVE test was conducted at soil vapor extraction points SVE-1, SVE-2, SVE-3, and SVE-4 as per the work scope presented in the February 2009 CAP. In addition to these four locations, monitoring well MW-5 was also evaluated as part of the pilot test. Soil vapor extraction points were installed to a depth of 37 feet bg and screened up to 22 feet bg, while monitoring well MW-5 is installed to a depth of 50.5 feet bg and screened up to 20 feet bg. The test was conducted by connecting a 5 HP regenerative blower to each point, individually, and operating the blower at various vacuums and flow rates. While operating the SVE pilot test equipment, vacuum responses were measure at Site monitoring wells MW-1, MW-2, MW-3, MW-4, MW-5, and each of the three remaining SVE monitoring point not being used as an extraction point at that time. Note, while Alliance attempted to collect vacuum response data from MW-1, MW-2, MW-3 and MW-4, the construction of these wells precluded the collection of representative and consistent data. The screened interval of each of these wells starts at a depth at or below the total depth of the pilot SVE points (i.e., 37 feet bg). The pilot test piping included necessary instrumentation, valves and access ports to allow for the control and measurement of flow rate and vacuum. The flow rate of gas in the piping was measured using a Kurz hot wire anemometer and vacuums were measured using a Magnahelic gauge. Hydrocarbon concentrations were monitored with a MiniRAE photoionization detector (PID) and a Tedlar bag sample of the extracted soil gas was collected during the pilot test from each test point for laboratory analysis of total petroleum hydrocarbons (TPH) (C_1 through C_4 and C_4 through C_{10}) and benzene, toluene, ethylbenzene and total xylenes (BTEX) and methyl tertiary-butyl ether (MTBE).

3.2.1 SVE Pump Test

As discussed above, the pilot test was conducted by operating the SVE blower at varying vacuums and flow rates at each of the five locations evaluated. At each vacuum applied to the SVE point, the flow rate of soil gas extracted was measured. A plot of flow rate versus vacuum provides the specific capacity for soil vapor extraction for the Site, and is used for specification of the soil vent blower. Table 3-1 summarizes the data collected from each location evaluated during the SVE pilot tests.

The plot of the pump test data for each pilot test point should show a linear relationship between the flow rate extracted and vacuum applied. This plot is presented as Figure 3-1 – SVE Pilot Test Air Flow Graph. As indicated in Figure 3-1, the plot of flow rate versus vacuum correlates very closely to a straight line. The correlation coefficients for these data range from 96.22% to 99.96%. Thus, one may reasonably predict the flow rate one may extract at a given vacuum from a given location.

3.2.2 SVE Radius of Influence

While operating the SVE pilot test equipment at each of the individual vacuums and flow rates described above, the vacuum response was measured in each of the monitoring points and monitoring wells installed surrounding the pilot test points. The vacuum response data from all of the operating vacuums tested are presented in the following tables along with the distance each monitoring point was from the pilot test point.

The vacuum response data collected from the pilot test is presented below in Table 3-2 through Table 3-6.

Table 3-2 SVE-01 Radius of Influence Data						
Monitoring Point	**Distance from SVE-01 (ft)**	**Vacuum Influence ("H_2O)**				
		20"H_2O	**30 "H_2O**	**40 "H_2O**	**60"H_2O**	**80"H_2O**
SVE-02	40	-0.08	-0.14	-0.18	-0.28	-0.34
SVE-04	40.9	-0.16	-0.28	-0.22	-0.58	-0.76
SVE-03	59.8	-0.06	-0.1	-0.12	-0.26	-0.3
MW-05	74.7	0	-0.2	-0.28	-0.4	-0.6

Table 3-3 SVE-02 Radius of Influence Data					
Monitoring Point	**Distance from SVE-02 (ft)**	**Vacuum Influence ("H_2O)**			
		20"H_2O	**40 "H_2O**	**60 "H_2O**	**80"H_2O**
SVE-03	33.1	-0.06	-0.2	-0.3	-0.42
SVE-01	40	-0.04	-0.06	-0.1	-0.16
SVE-04	59.6	-0.02	-0.06	-0.1	-0.16
MW-05	98.1	0.0	0.0	0.0	-0.12

Table 3-4 SVE-03 Radius of Influence Data				
Monitoring Point	**Distance from SVE-03 (ft)**	**Vacuum Influence ("H_2O)**		
		20"H_2O	**40 "H_2O**	**80 "H_2O**
SVE-02	33.1	-0.04	-0.1	-0.26
SVE-04	50.5	0.0	-0.04	-0.14
SVE-01	59.8	0.0	-0.04	-0.10
MW-05	87.9	0.0	0.0	0.0

Table 3-5 SVE-04 Radius of Influence Data					
Monitoring Point	**Distance from SVE-04 (ft)**	**Vacuum Influence ("H_2O)**			
		20"H_2O	**40 "H_2O**	**60 "H_2O**	**80"H_2O**
MW-05	38.1	-0.22	-0.68	-1.0	-1.4
SVE-01	40.9	-0.12	-0.34	-0.52	-0.70
SVE-03	50.5	-0.04	-0.20	-0.30	-0.48
SVE-02	59.6	0.0	-0.08	-0.38	-0.38

Table 3-6 MW-05 Radius of Influence Data			
Monitoring Point	**Distance from MW-03 (ft)**	**Vacuum Influence ("H_2O)**	
		20"H_2O	**60 "H_2O**
SVE-04	38.1	-0.28	-0.7
SVE-01	74.7	-0.17	-0.28
SVE-03	87.9	--	-0.1
SVE-02	98.1	-0.32	-1.0

Determination of the soil vent radius of influence typically involves plotting the $\log_{10}$ of the vacuum response at the monitoring probes versus the distance of the monitoring point from the extraction point at each operating vacuum. This was done for each of the pilot tests completed at each location. For pilot tests completed in a uniform homogeneous environment, one can produce radius of influence graphs with a linear response with a high degree of correlation. However, in a more heterogeneous environment, such as weathered and/or fractured bedrock (as is present at this Site), the result can be less uniform. The following briefly discusses the results of the pilot tests at each location.

- Figure 3-2 presents the plotted data for the pilot test completed at SVE-01. As indicated on this figure, the data does not correlate closely to a straight line for any of the operating conditions tested. However, the empirical data collected (as presented in Table 3-2 above) demonstrated that meaningful vacuum influences (i.e., vacuums exceeding 0.1 inch of water) were measured at each of the monitoring locations, especially at the higher operating vacuums (i.e., greater than 40 inches of water operating vacuum).
- Figure 3-3 presents the plotted data for the pilot test completed at SVE-02. This figure demonstrates a more typical graph of influence results, with the measured vacuum influence decreasing with increasing distance from the test location. Using 0.1 inch of water as the indication of vacuum influence, the predicted radius of influence ranges from approximately 25 feet at an operating vacuum of 20 inches of water to over 100 feet at an operating vacuum of 80 inches of water.
- Figure 3-4 presents the plotted data for the pilot test completed at SVE-03. As with the results for SVE-02, this figure demonstrates a more typical graph of influence results;

with the measured vacuum influence decreasing with increasing distance from the test location (data was available for two operating conditions). Using 0.1 inch of water as the indication of vacuum influence, the predicted radius of influence ranges from approximately 30 feet at an operating vacuum of 40 inches of water to approximately 75 feet at and operating vacuum of 80 inches of water.

- Figure 3-5 presents the plotted data for the pilot test completed at SVE-04. As with the results for SVE-02 and SVE-03, this figure demonstrates a more typical graph of influence results, with the measured vacuum influence decreasing with increasing distance from the test location. Using 0.1 inch of water as the indication of vacuum influence, the predicted radius of influence ranges from approximately 40 feet at an operating vacuum of 20 inches of water to approximately 80 feet at and operating vacuum of 80 inches of water.
- Figure 3-6 presents the plotted data for the pilot test completed at MW-5. Only the data collected at an operating vacuum of 60 inches of water produced a typical response of decreasing vacuum with distance from the pilot test point. Using 0.1 inch of water as the indication of vacuum influence, a radius of influence of approximately 90 feet was measured at the operating vacuum of 60 inches of water.

3.2.3 Air Emissions Monitoring

During the course of the SVE test, VOC concentrations in the extracted air were monitored with a PID and a Tedlar bag sample was obtained from each pilot test point. Table 3-7 and Table 3-8 present the PID response data and air bag laboratory analytical table below for each pilot test point.

The data indicates that minimal gasoline constituents were recovered during the SVE process on pilot test points SVE-01, SVE-02 and SVE-03. Higher concentrations of gasoline constituents were reported for the gasses extracted from SVE-04 and MW-5. In particular, benzene and MTBE were not detected in any of the tedlar bag samples collected. The dominant hydrocarbons detected were identified in the C4 to C10 hydrocarbon range, at a maximum concentration of 694 mg/m^3 from MW-5.

Based on the air bag data and the flow rate at which the SVE system was operating when the air bag sample was collected, the mass extraction rate for SVE-01 was approximately 0.023 pounds of gasoline per day, SVE-02 was approximately 0.065 pounds of gasoline per day, SVE-03 was approximately 0.084 pounds of gasoline per day, SVE-04 was approximately 2.93 pounds of gasoline per day, and MW-05 was approximately 1.58 pounds of gasoline per day. Appendix V contains the laboratory report for the Tedlar bag analysis.

The highest, and most meaningful, concentrations of hydrocarbons were measured at SVE-04 and MW-05. SVE-04 is located on the north side of the former tank field. MW-05 is located approximately 50 feet to the north of SVE-04. MW-05 has historically reported elevated concentrations of gasoline hydrocarbons in the groundwater sampled from this well. During the installation of MW-5, the supervising geologist noted the presence of gasoline odors and PID responses were also reported. Thus, the reported presence of gasoline hydrocarbons in the soil gasses extracted during the pilot tests completed on SVE-04 and MW-05 are consistent with the presence of gasoline hydrocarbons in the unsaturated zone from the former tank field towards MW-05.

Based on the results of the SVE pilot study, the conceptual design of a full scale SVE system is described in Section 4.0.

TABLE 3-1
SVE Pilot Test Flow Data
Wally's Citgo
Parkton, MD

	Applied Vacuum (Inches of H_2O)				
	20	30	40	60	80
	Average Flow Rate (SCFM)				
Location					
SVE-01	15.27	24.00	32.36	46.54	62.54
SVE-02	10.18	--	14.91	24.72	35.63
SVE-03	6.54	--	10.91	--	27.63
SVE-04	9.45	--	32.00	53.81	65.45
MW-05	8.73	--	--	25.45	--

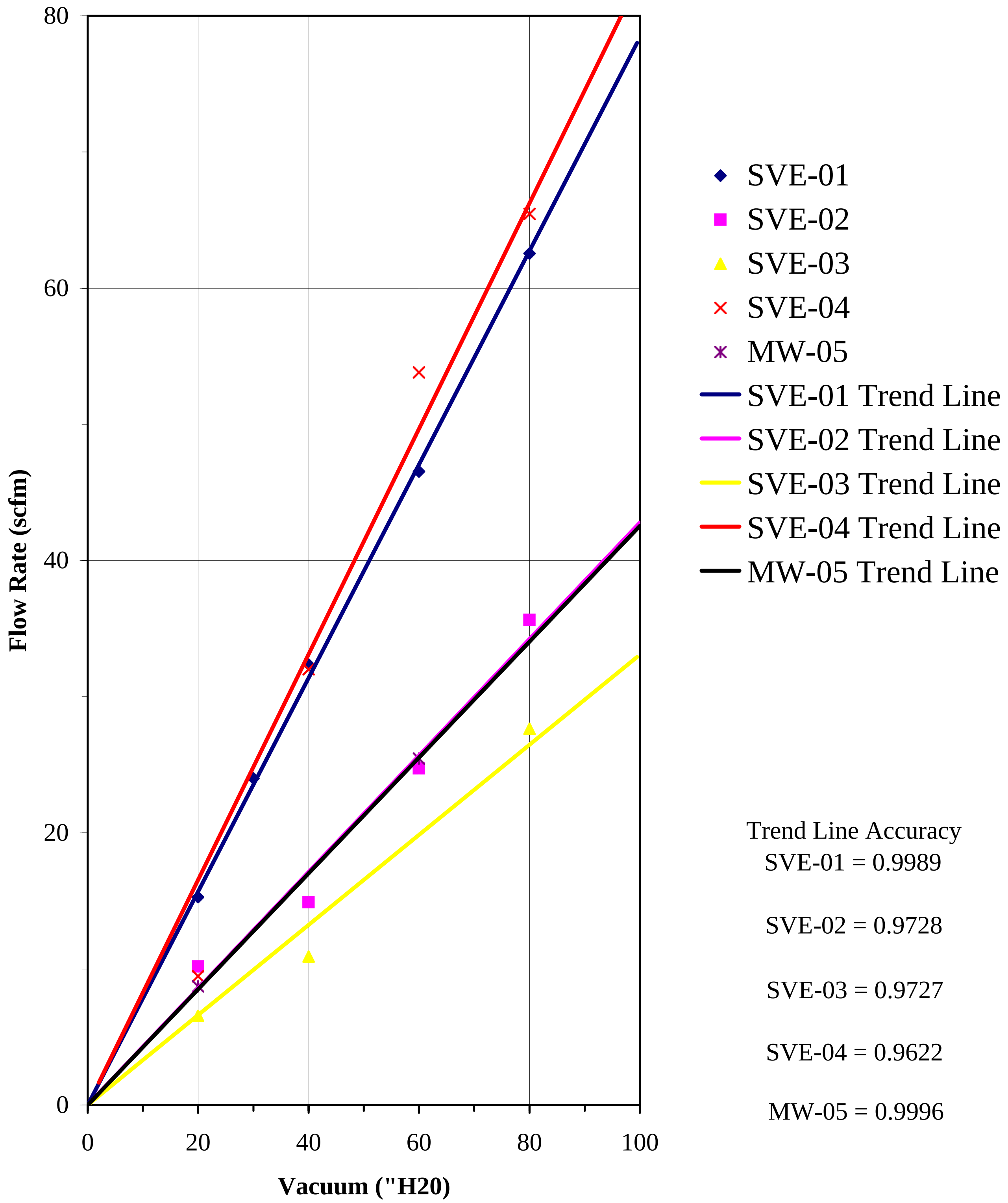
TABLE 3-7
SVE Pilot Test PID Response Data
Wally's Citgo
Parkton, MD

	SVE-01		SVE-02		SVE-03		SVE-04		MW-05	
Vacuum (“H2O)	Flow (SCFM)	Average PID (PID Units)	Flow (SCFM)	Average PID (PID Units)	Flow (SCFM)	Average PID (PID Units)	Flow (SCFM)	Average PID (PID Units)	Flow (SCFM)	Average PID (PID Units)
20	15.27	0.0	10.18	0.0	6.54	0.0	9.45	115.6	8.73	137.2
30	24	0.0	--	--	--	--	--	--	--	--
40	32.36	0.0	14.91	0.0	10.91	0.0	32	72.2	--	--
60	46.54	0.0	24.72	0.0	--	--	53.81	126.9	25.45	248.3
80	62.54	0.0	35.63	0.0	27.63	0.0	65.45	92.8	--	--

TABLE 3-8
SVE Pilot Test Laboratory Analytical Data
Wally's Citgo
Parkton, MD

Analyte	SVE-01 (mg/m^3)	SVE-02 (mg/m^3)	SVE-03 (mg/m^3)	SVE-04 (mg/m^3)	MW-05 (mg/m^3)
Benzene	<0.65	<0.65	<1.4	<0.62	<0.65
Ethylbenzene	<0.88	<0.88	<1.9	4.86	8.83
Toluene	4.21	<0.77	<1.7	46.7	83.5
m&p-Xylene	<1.8	<1.8	<3.8	34.9	76.8
o-Xylene	<0.88	<0.88	<1.9	13.2	26.9
Total BTEX	4.21	<4.98	<10.7	99.66	196.03
MTBE	<0.73	<0.73	<1.6	<0.7	<0.73
THC as C_1 - C_4	4.11	6.89	5.04	5.14	<3.1
THC as Gas	43.4	20.4	33.9	499	694

Figure 3-1
SVE Pilot Test Air Flow Graph
Wally's Citgo
Parkton, MD



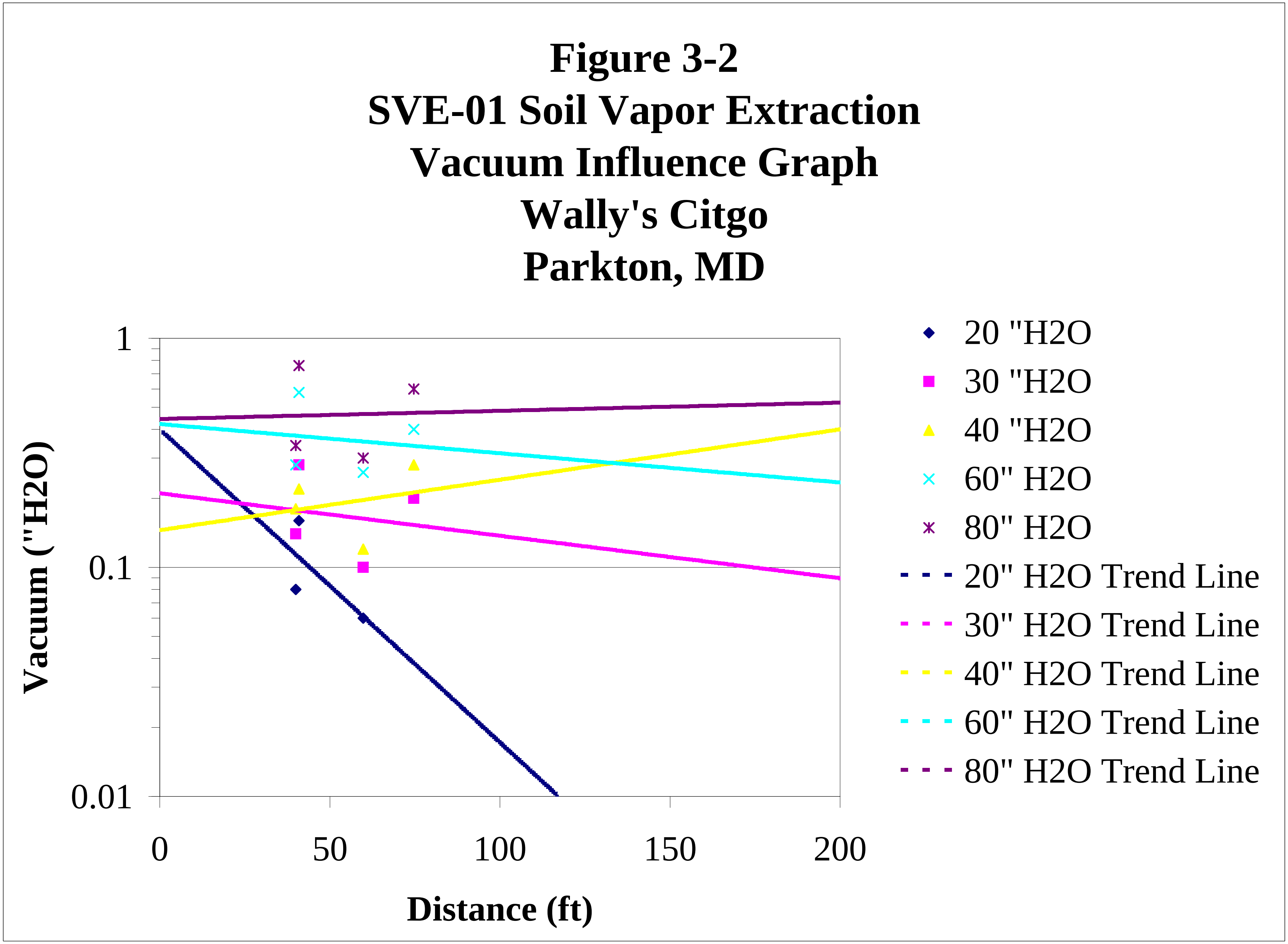


Figure 3-2
SVE-01 Soil Vapor Extraction
Vacuum Influence Graph
Wally's Citgo
Parkton, MD
Vacuum ("H2O)
1
0.1
0.01
0
50
100
150
200
Distance (ft)
20 "H2O
30 "H2O
40 "H2O
60" H2O
80" H2O
20" H2O Trend Line
30" H2O Trend Line
40" H2O Trend Line
60" H2O Trend Line
80" H2O Trend Line

Figure 3-3
SVE-02 Soil Vapor Extraction
Vacuum Influence Graph
Wally's Citgo
Parkton, MD

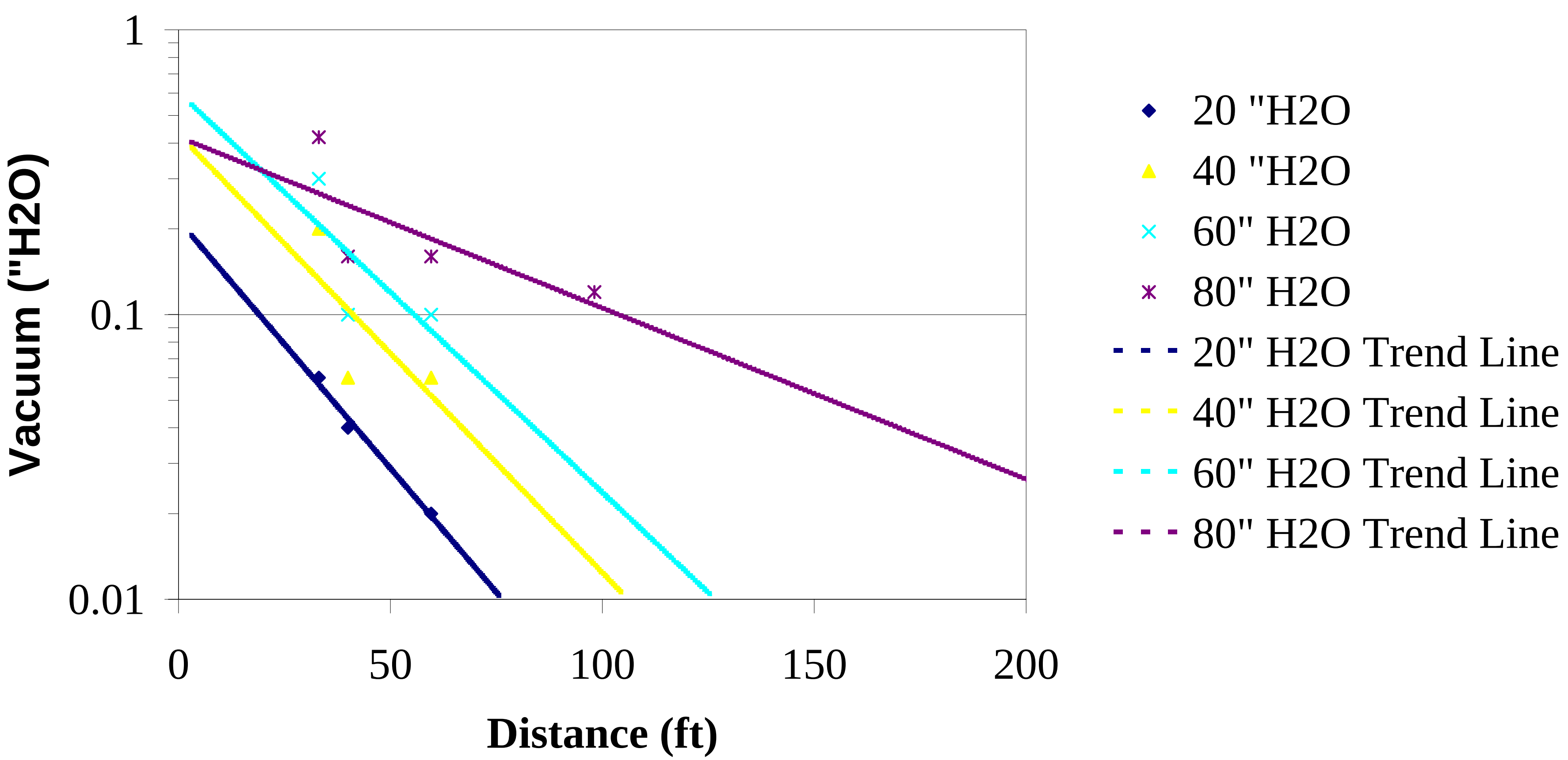
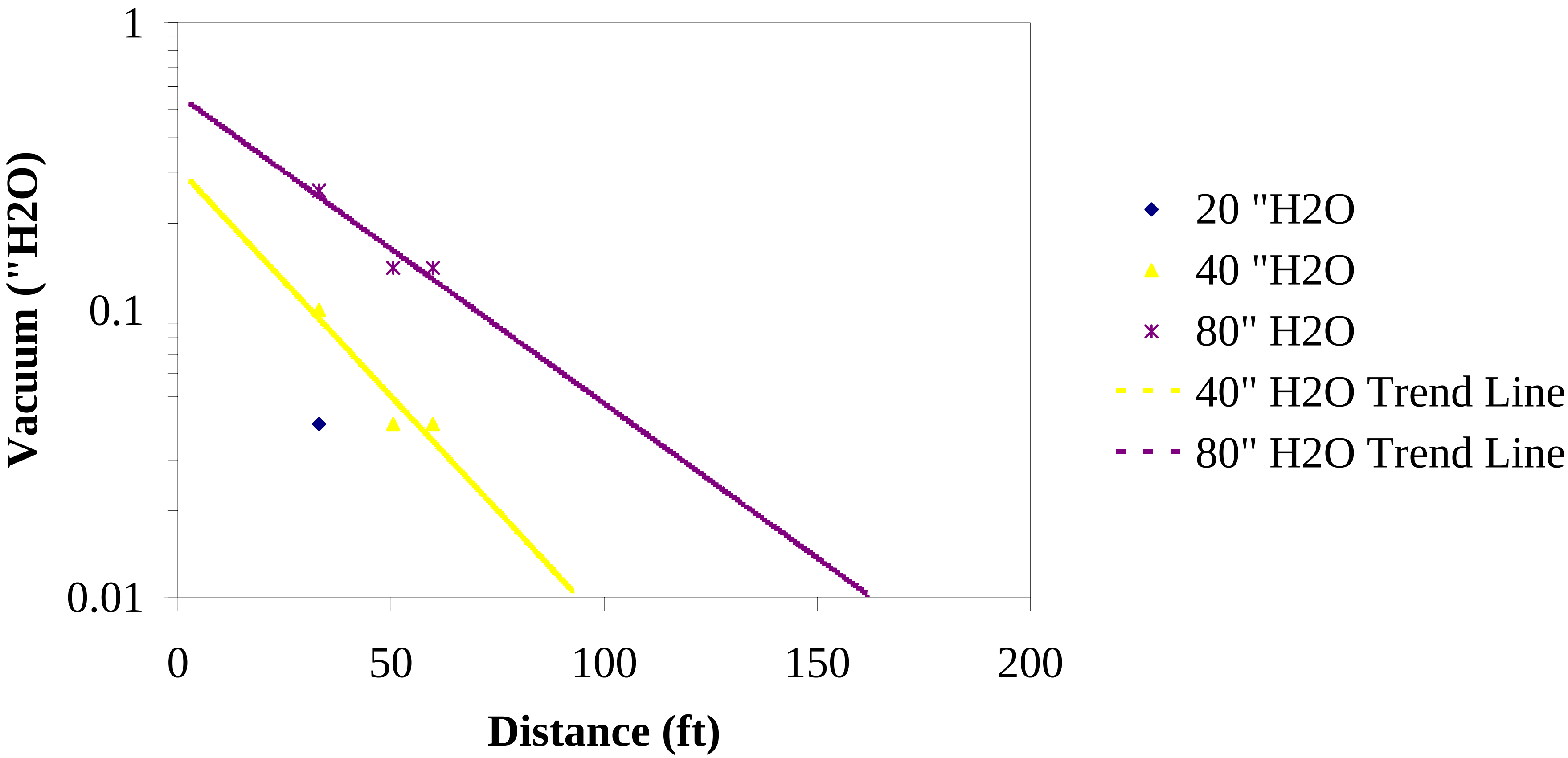


Figure 3-4
SVE-03 Soil Vapor Extraction
Vacuum Influence Graph
Wally's Citgo
Parkton, MD



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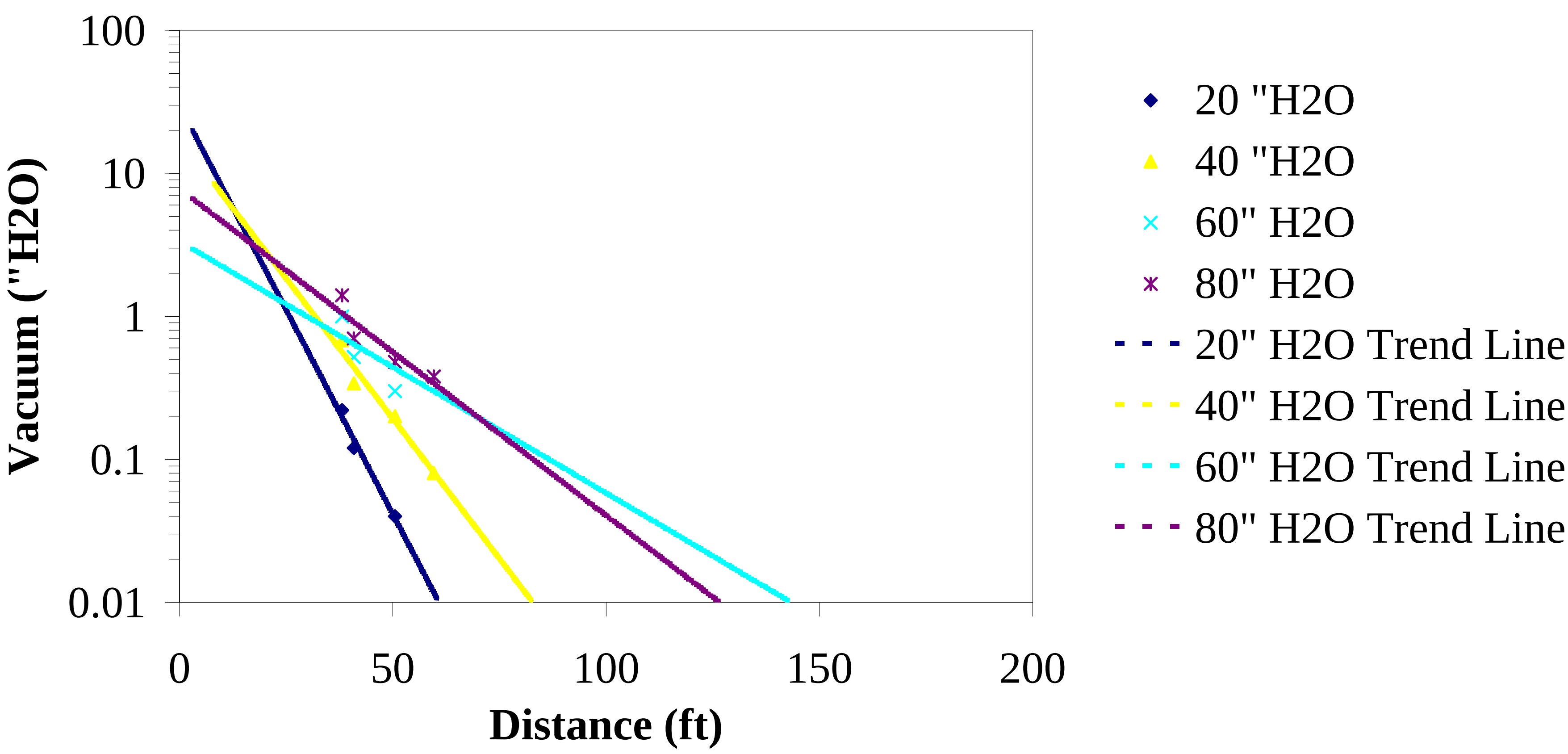
ENVIRONMENTAL ALLIANCE

Figure 3-5
SVE-04 Soil Vapor Extraction
Vacuum Influence Graph
Wally's Citgo
Parkton, MD



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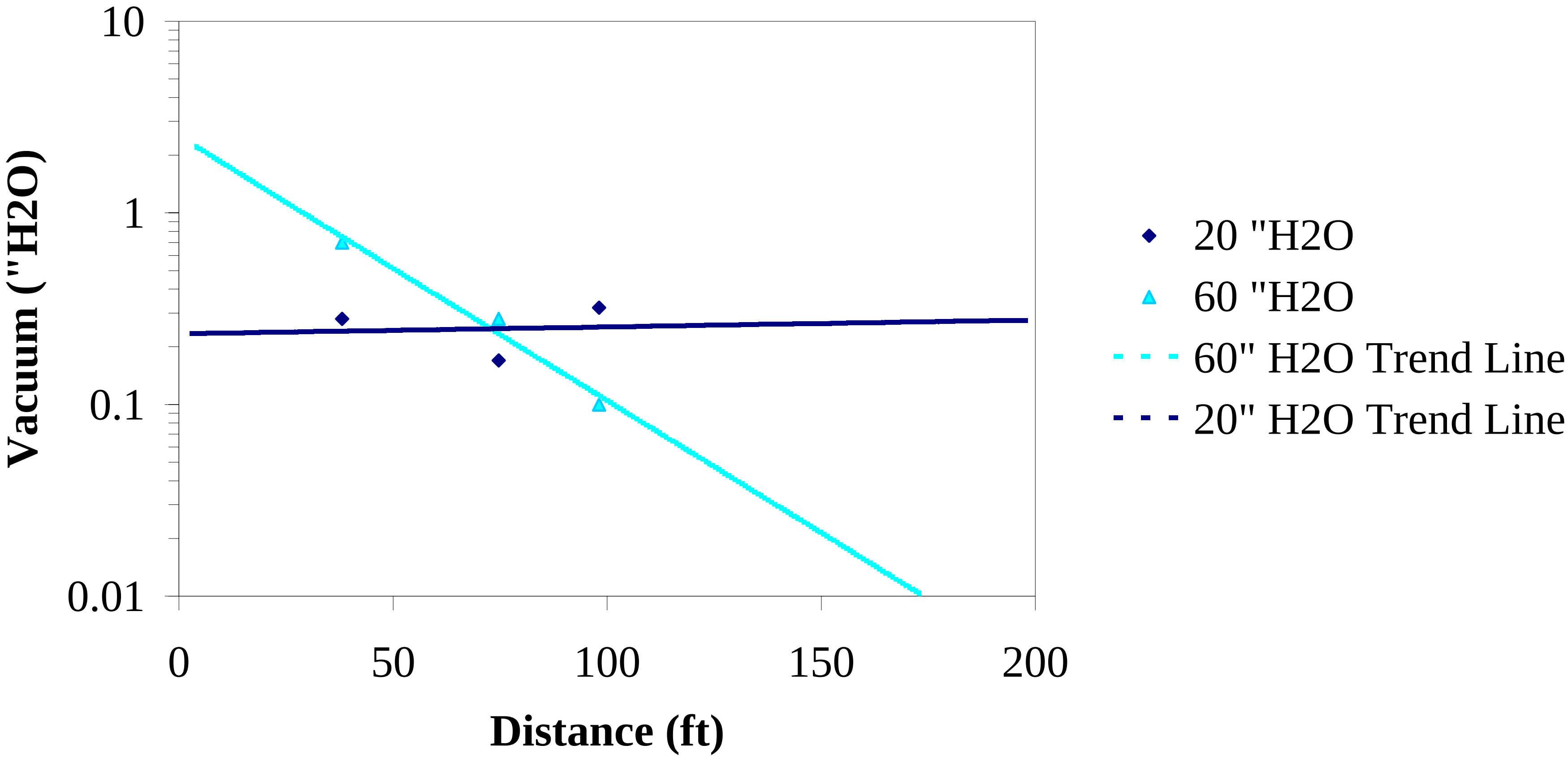
ENVIRONMENTAL ALLIANCE

Figure 3-6
MW-05 Soil Vapor Extraction
Vacuum Influence Graph
Wally's Citgo
Parkton, MD



ENVIRONMENTAL ALLIANCE

4.0 CORRECTIVE ACTION PLAN

As described in the February 2009 CAP for the Site, both pump and treat and SVE were selected as recommended remedial techniques to explore further. The February 2009 CAP presented a conceptual design for a pump and treat system and described additional work that should be performed before finalizing the design and installation of the full scale system. MDE's May 28, 2009 directive letter requested further additional work be performed prior to implementing any remedial actions. As a result of this work, and further discussions with MDE, the conceptual design of the pump and treat system has been refined and is presented in this section. Further, as described previously, the SVE pilot test did produce recoverable hydrocarbons from the unsaturated zone in a limited area of the Site. As such, a full time SVE system will be installed and operated as part of the CAP.

The selected remedial techniques are applicable for addressing the impacted subsurface environment based on the developed Site conceptual model. The conceptual model for the Site was be supported by physical and chemical characterization data and other information collected through July 2009. A summary of the Site conceptual model is provided below.

Petroleum contaminants dispersed from the Site underground storage tank (UST) system through the subsurface environment generally follows the path of water (i.e. precipitation infiltration) downward through the regolith material to intercept the groundwater system. As there are no known utilities in the area of the UST system below an approximate three foot depth, the movement of petroleum constituents below this depth would not be affected by subsurface utilities. The permeability of soil and saprolite comprising the regolith in the Site area would likely cause increased lateral dispersion of the petroleum constituents. However, the overall movement of constituents would follow a downward path to the underlying schist bedrock as no groundwater is shown to collect in the regolith. Upon encountering the reduced permeability of the schist bedrock, the petroleum constituents would collect and/or disperse along the bedrock surface while also penetrating into bedrock fractures/bedding planes/foliations. The petroleum constituents would follow these preferential pathways vertically and laterally through the bedrock with negligible penetration of the constituents through the bedrock matrix material (primary porosity).

Upon encountering groundwater stored in the fractures/foliation partings of the bedrock (secondary porosity features), the petroleum constituents would continue to disperse through the bedrock groundwater system. The orientation of the bedrock secondary porosity features in conjunction with the natural vertical and horizontal hydraulic gradients would control the flow of contaminants through the groundwater system. Operation of potable wells in the Site area would locally draw groundwater along the secondary porosity features, diverting the flow of groundwater from the natural direction (believed to be gravity controlled by the general topographic gradient of the area). Consistent demand of bedrock groundwater from the limited storage available to the potable wells would limit lateral dispersion of the petroleum constituents outside the secondary porosity features. The potable wells along the identified preferred groundwater flow orientation of fracture strike would acts as sumps collecting groundwater. Potable wells outside of the secondary porosity orientation would likely draw groundwater from areas other than impacted groundwater from the immediate Site area. Therefore, a potable well at distance from the Site and/or outside of the secondary porosity orientation would be less likely to draw impacted groundwater from the Site. The vertical distribution of the impacted groundwater in the aquifer system would likely be limited too, as minimal groundwater bearing zones have been identified at depth in the bedrock (i.e., below 120 feet).

Based on the above conceptual model for the Site, the work associated with the implementation of both the pump and treat system and the SVE system proposed for the Site is described in the following sections.

4.1 Discussion of Groundwater Pump and Treat and Soil Vapor Extraction

4.1.1 Pump and Treat Technology

Pump and treat typically involves the placement of vertical pumping wells, horizontal pumping wells, or pumping trenches within the source area of a contaminant plume to capture contaminated groundwater and mitigate further migration to potential down gradient groundwater receptors. Pump and treat is typically considered a reliable and trusted technology for intercepting contaminated groundwater. The extracted groundwater is then treated ex-situ through one of a variety of methods. The treated groundwater can then be either re-injected into the aquifer to further enhance aquifer remediation or discharged to a surface water body or storm drainage feature. The re-injection of the treated water is also a method to promote the sustainability of the remedial design by minimizing the wasted water resource that can assist in protection of a low yield aquifer during high use periods as compared to direct discharge to a surface water body. The performance of a pump and treat system can be monitored in a relatively simple fashion by measuring hydraulic heads and groundwater concentrations.

4.1.2 SVE Technology

SVE is a technique whereby VOCs are extracted from unsaturated soil by inducing a vacuum and extracting soil-gas from the subsurface. This process physically captures volatilized constituents that migrate to the vadose zone. The permeability of the vadose zone material controls the effectiveness of air flow through an SVE system. Higher permeability soils are generally more effective for the application of an SVE system. The primary advantage of this remedial option for this specific Site is that gasoline is a petroleum product that is naturally very volatile. Gasoline is composed of individual chemicals that have a relatively low molecular weight and a high vapor pressure. Therefore, gasoline releases are most favorably treated by remedial alternatives that exploit the volatile nature of the gasoline to remove it from the subsurface soil.

4.2 Conceptual Design of Pump and Treat System

4.2.1 Recovery Well Placement

The conceptual design of the pump and treat system involves the placement of three recovery wells on-Site to mitigate the off-Site migration of groundwater with dissolved phase petroleum hydrocarbons. As discussed further in the following sections, it is envisioned that the timing for implementation of the pump and treat system may require the implementation/initiation of the on-Site recovery wells first, with the off-Site recovery well(s) being added to the system as property access and timing issues allow and verification of off-Site pumping well design through the monitoring and evaluation of the performance of the on-Site pumping wells.

4.2.2 On-Site Pumping Well Strategy

The pump and treat system will involve the installation of three recovery wells (designated RW-1 through RW-3) on the Site. The proposed locations of these three recovery wells are the MW-7A/MW-7B area, the MW-10A/MW-10B area, and the northeast corner area of the building west of MW-14A/MW-14B as depicted on Figure 4-1. The exact location of the recovery wells will be based upon field conditions.

To illustrate the predicted capture zones of the three proposed on-Site recovery wells shown on Figure 4-2, the drawdown cone-of-depression from the May 2007 pumping test of MW-10A (refer to Pumping Test Report (Alliance; July 30, 2007)) was superimposed on the projected three recovery well locations to simulate effects under the proposed pumping scheme. The interpolation software SURFER (Golden Software, Inc.) was utilized to project the observed drawdown around each proposed recovery well location. Using the principle of superposition, drawdown values were added where the cones overlapped with each other. The combined drawdown surface was then subtracted from the interpolated groundwater potentiometric surface data for the upper bedrock wells from the May 2009 groundwater sampling event to obtain a simulated potentiometric surface assuming each recovery well was pumping at a rate similar to the May 2007 pumping test of MW-10A (approximately 2 to 2.5 gpm). A kriging scheme was utilized in SURFER to interpolate and extrapolate the drawdown and potentiometric surfaces. Finally, a flownet was drawn assuming isotropic conditions (which dictates that flowlines are perpendicular to equipotential lines) to delineate the projected capture zones of each recovery well.

The use of the flownet provides an overall understanding/interpretation of groundwater movement under pumping conditions. The presence of a fracture control groundwater system such as this Site cannot be fully projected with a high degree of accuracy and precision, but the overall flownet should provide an adequate simulation to understand groundwater flow under pumping conditions. Actual flow could travel in a convoluted and twisted path through the water bearing zones in bedrock locally, but the final outcome as depicted on the flownet should provide a reasonable projection.

Since the bedrock aquifer at the Site is anisotropic based on pump test results (as discussed in Section 2.4), the actual capture zones would be more elongate in the direction of strike (northeast-southwest) than shown on Figure 4-2. This analysis assumes that all extracted groundwater is discharged outside the zone of influence of the pumping wells (after treatment) and that no treated water is injected into the aquifer. The projected capture zones suggest that the three proposed on-Site recovery wells would overlap to capture most impacted groundwater at the Site, and also capture a portion of the groundwater extending onto the 1606 Rayville Road property.

To provide a confirmation of the effectiveness of the recovery well locations based on the pump test data, Alliance also utilized a groundwater model developed for the Site to project the effectiveness of the proposed recovery well locations. A Groundwater Modeling Report dated April 15, 2009 by Alliance is provided in Appendix VI detailing groundwater model details. The groundwater model output for the capture and hydraulic control of on-Site recovery wells located at similar locations shown on Figure 4-2 indicates that the majority of the Site, including the

UST field and dispenser island and a portion of the 1606 Rayville Road property would be influenced (refer to Figure 4-3). Though the modeling has limitation when utilized in a anisotropic conditions such as a fractured bedrock setting, the overall interpretation is valuable in supporting the pump test results, geophysical testing, and contaminant migration pathways as evidenced by actual concentration data. To effectively understand the Site conditions and project the potential benefits of the conceptual corrective action strategy of the pump and treat system, the entire Site data set and evaluations were utilized to provide the remedial pump and treat strategy presented.

In conclusion, it is proposed to install and operate three recovery wells on-Site at the approximate locations indicated on Figure 4-1. Both the empirical data collected as part of the pumping test on MW-10A and the results of the groundwater model predict that these three recovery wells will mitigate the migration of groundwater with dissolved phase hydrocarbons off-Site. As part of the long term operation of the pump and treat system, groundwater chemistry and hydrogeology will be evaluated to monitor the performance of the pump and treat system. If necessary, the configuration of the recovery wells may be adjusted in the future to react to Site specific conditions documented as part of the monitoring program.

4.2.3 Monitoring Well and Recovery Well Placement

As described above, it is also proposed to install additional wells off-Site to the southwest of the Site as part of continued delineation activities and for remediation monitoring purposes. Five additional monitoring wells are proposed (refer to Figure 4-1 for the approximate proposed locations). Each location is described further as follows.

- One well (to be designated MW-15) is proposed on the 1608 Rayville Road property approximately between the 1608 and 1612 Rayville Road property houses. As discussed with MDE, this well could possibly be used as a recovery well as part of the pump and treat system or may be used as a replacement potable well for this property (dependent upon analytical testing). If the new well were to be converted into a potable well, the existing potable well at 1608 Rayville Road could be used as a recovery well for the pump and treat system.

- A well cluster (to be designated MW-16A/MW-16B) is proposed for installation on the 1614 Rayville Road property adjacent to the 1606 Rayville Road property for delineation purposes to the west of the Site.
- Another well cluster (to be designated MW-17A/MW-17B) is proposed in the orchard across Rayville Road from the 1614 Rayville Road property for delineation purposes per MDE's request to evaluate conditions in this area.

The exact location of the monitoring wells will be pending property access and field conditions.

4.2.4 Recovery Well and Monitoring Well Installation

The proposed recovery wells and monitoring wells will be installed using the air-rotary drilling methodology and constructed as open borehole wells with the following specifications.

- RW-1 through RW-3 and MW-15 will be constructed with nominal 6-inch steel casing set to approximately 40 feet bg and open borehole to 120 feet bg. The recovery wells are designed to intercept the shallow more frequent water bearing fractures in the upper 70 to 80 feet of the formation which tend to have a moderate groundwater yield and typically report higher contaminant concentrations. The depth of the recovery wells to 120 feet also allows for the interception of the less frequent and less productive water bearing zones identified below 70 feet. As previously discussed, very limited to no water production is evident at depths below 120 feet. The recovery well design is consistent with the construction of the potable wells at 1606, 1608, and 1612 Rayville Road.
- MW-16A and MW-17A will be constructed with nominal 6-inch steel casing set to approximately 40 feet bg and open borehole to 65 feet bg, which is comparable to current Site monitoring wells intercepting upper groundwater. These wells are designed to intercept the shallow more frequent interpreted water bearing fractures having a moderate groundwater yield with typically higher contaminant concentrations.

- MW-16B and MW-17B will be constructed with nominal 6-inch steel casing set to 70 feet bg and open borehole to 120 feet bg, which is comparable to current Site monitoring wells intercepting lower groundwater. These wells are designed to intercept the less frequent and less productive water bearing zones identified below 70 feet.

Modification in the construction of these wells will be dependent on field conditions encountered. Prior to installation of these wells, well permits will be obtained from Baltimore County Health Department and the State subsurface utility mark-out service (Miss Utility) will be contacted to identify public utilities at the Site and surrounding area. Additionally, notification of the schedule for well installation activities will be provided to MDE, Site personnel, and other appropriate parties.

During installation activities, appropriate handling and containment of soil and groundwater generated will be implemented to facilitate transport for off-Site disposal. Monitoring of the drilling activities with a PID will be conducted as a qualitative screen of drill cuttings and provide appropriate health and safety monitoring for personnel on-Site. Upon completion, the monitoring wells will be developed to clear sediment from the borehole for better groundwater flow in preparation for continuing investigation activities. Groundwater generated by the development activities will be appropriately contained for off-Site transport and disposal. Additionally, the top of casing of the completed monitoring well locations will be surveyed to the established geodetic datum for the Site.

Drilling operations for the recovery wells and monitoring wells will be implemented as described below with field conditions observed by the supervising geologist ultimately determining the construction of the wells.

- Advance drill to approximate depth of casing set with nominal 10-inch drill bit.
- Set nominal 6-inch steel casing to the bottom of the open borehole and fill the annulus between the steel casing and the open borehole with bentonite-cement (5% bentonite -

95% cement) grout via tremie pipe from total depth of the 10-inch borehole to the surface.

- Allow grout at least 24 hours to cure before continuing borehole advancement with nominal 6-inch bit through the steel casing.
- Complete the well to target depth as an open borehole.
- Complete the well head with a flush mount manhole set in concrete.

4.2.5 Pump and Treat System Conceptual Design

Upon agreement with MDE on the overall conceptual design for the corrective measure for the Site, more detailed engineering specifications for the equipment and construction of the corrective measures will be prepared and provided to MDE if desired. However, based upon the results of the pump test, the design anticipates that each of the pumping wells will be fitted with submersible pumps capable of pumping 2 gallons per minute to the treatment compound. The location of the treatment compound will likely be behind the convenience store at the Site. Each well will be individually piped to the treatment compound to a single manifold. The piping from each well will be fitted with its own valve and flow meter to allow for the control and monitoring of the flow rate from each well. If the pump and treat system is installed in phases (i.e., the three onsite pumping wells are installed and operated first, prior to confirming the configuration of any offsite pumping wells), then the ability to incorporate additional pumping wells will be accommodated in the design and construction of the system. Specifically, piping, electrical and control conduits will be laid from the treatment compound to a strategic location (near the property line of the Site with 1606 Rayville Road) such that additional pumping wells can be easily added in the future as necessary. It is envisioned that enough piping (access by road box) and excess water treatment capability to accommodate two additional off-Site pumping wells will be installed during the initial corrective measure installation. As described in the February 2009 CAP, the groundwater pumped from the extraction wells will be treated by a sediment filter, treated for VOCs via an air stripper followed by a granular activated carbon (GAC) polishing unit.

Flow and pressure gauges and sampling ports will be positioned in strategic locations throughout the system piping to monitor overall system performance. Mechanical equipment including pumps and the blower will be equipped with interlock devices causing complete system shutdown in the event of a failure. An overall system pressure interlock will also be installed to shut down the system should system pressures get too high or too low. A control panel will be installed to allow for manual or automated pump control and a telemetry system will be installed to alert the user in the case that a system interlock is triggered.

Figure 4-4 depicts the Pump and Treat System Line Diagram Schematic showing the major components of the pump and treat system. A detailed Process and Instrumentation Diagram (P&ID) will be developed upon finalizing discharge requirements for the pump and treat remedy for the Site.

Equipment and instrumentation for the groundwater pump and treat system will be housed in a prefabricated structure or a mobile trailer to be positioned in an unobtrusive location on-Site. Proper permits will be obtained for the placement of the structure or trailer.

4.2.6 Treated Water Discharge

Alliance has researched the available options to discharge the treated water produced by the pump and treat process. The storm sewer immediately adjacent to the Site along Middletown Road was determined to discharge to an un-suitable location. Further research into the storm sewers in the vicinity of the Site located a storm sewer that originates where Middletown Road intersects Rayville Road north of the Site. This storm sewer collects the storm water that originates north of the Site along Middletown Road along with storm water that originates from properties adjacent to Rayville Road and Ellen's Choice Way. According to Baltimore County's records, this storm water discharges to a drainage easement behind the property located at 1515 Rayville Road. This drainage easement discharges to what is identified as an existing swale. The ultimate discharge location of this drainage swale appears to be Owl Branch.

Alliance has discussed with Baltimore County the potential to discharge the treated water from the pump and treat system to this storm sewer (a conceptual flow rate of 10 to 20 gallons per minute). Baltimore County has indicated that this will be acceptable to them (a contractor licensed to make this connection will be required to perform this work).

A National Pollutant Discharge Elimination System (NPDES) permit will be required for the discharge of treated groundwater. The MDE has a general permit for the "discharge of treated groundwater from petroleum contaminated groundwater sources to surface or ground waters of the state". Upon approval of this CAP Addendum by MDE and formal approval from Baltimore County for the discharge of the treated water to the storm sewer, Alliance will submit the appropriate General Permit application to MDE for the NPDES permit. MDE will provide the discharge requirements for the process at this Site. Typically, the discharge requirements require the water to be treated to drinking water quality standards. The permit will also dictate specific monitoring and reporting requirements for this Site.

Upon approval of the CAP, Alliance will work with MDE and Baltimore County to formalize a discharge location which is anticipated to be the discharge location discussed above. At this time it is assumed that this discharge location will ultimately prove to be viable for this system. If for some reason it is later determined that this is not a viable discharge location, then an alternative location will have to be identified (and this will impact the schedule to implement the pump and treat system). As discussed previously with MDE, the potential use of this discharge location obviates the need to consider the reinjection of the treated groundwater at this time. However, after the pump and treat system has been operational for an extended period, and its performance has been documented, it may be prudent to reconsider the reinjection of a portion of the treated groundwater on Site in an effort to accelerate the remediation of the Site and to re-utilize the groundwater resource and to promote the environmental sustainability of the overall design.

4.2.7 *Air Emissions Treatment*

Air emissions will be permitted and treated consistent with the MDE's "General Permit to Construct Application Package for Groundwater Air Strippers and Soil Vapor Extraction Systems" (January 9, 2008). The specific details of the permit application will be pending the approval of this CAP Addendum and final design details. However, as per this General Permit, air emissions from the air stripper will likely be treated via activated carbon during its initial operations. Monitoring will occur at the frequency required in the General Permit and air emissions treatment will continue until MDE provides permission to remove the treatment device.

4.3 System Installation, Start-Up, and Monitoring

This section generally describes installation and monitoring activities for the anticipated pump and treat system only. Further details will be available after the conceptual design has been approved, the discharge location for the treated water has been finalized and the discharge requirements provided. It is expected that the final details on the monitoring and reporting requirements will be developed and approved separately. The following sections describe they typical procedures for these systems.

4.3.1 *Construction of Remedial System*

Prior to construction, the location of the treatment building/trailer will be selected and any necessary permits obtained for the structure. Electric service availability and connections will also be arranged with the local utility company. The initial and most intensive phase of construction will be to trench plumbing and electric lines from extraction wells RW-1 through RW-3 (plus plumbing and electrical lines for two additional recovery wells should system expansion be necessary) to the location of the treatment building. Plumbing and electric lines will be installed according to code at an approximate depth of 2 ½ feet below ground. Prior to excavation, a one call to miss utility will be made. Following utility mark-out, a backhoe or equivalent will be used to excavate the plumbing/electric trenches to each well. The trench will be completed by saw cutting the existing Site asphalt and excavating only the length that can be piped and backfilled in one day (i.e., trenches will not be left open when work is not being completed). Soil will be positioned adjacent to the trench during excavation activities. Once piping is placed in the trench it will be covered with six inches of pea gravel. Native soil will be backfilled into the remaining trench and compacted, any soil spoils will remain on-Site. The completed trench will be backfilled to match adjacent material such as asphalted, concrete, or soil. The trench will be compacted/smoothed with a roller unless directed otherwise by the Site owner. Old asphalt, concrete, and/or soil will be properly disposed. The three groundwater extraction pipes and electric conduits for pump control will be stubbed-up at grade in the area of the remediation building.

Extraction pumps will be positioned approximately ten feet off of the bottom of the well. Plumbing, electric, control, and a safety tether line will be connected to the pump prior to lowering it down the well. The plumbing line will be connected from the pump to the trench piping through a pitless adapter installed in the steel casing of each extraction well. A 2 feet by 2 feet by 2 feet metal road box will be set atop the well casing and electrical junction box, set in concrete, and finished to grade. The down-well electric line will be connected to the electric cable in the electric junction within the well head road box which will be connected to the remediation shed.

The building (or trailer) will be delivered to the Site and positioned over the plumbing and electric stub-ups. Pump and treat system equipment (e.g., filter, air stripper, blower, transfer pump, carbon vessels, etc.) will then be positioned within the shed. All necessary plumbing and electric connections will be made to enable the functioning of the treatment system. Note that the pump and treat remediation system may come pre-installed in a trailer, in which case the only connections necessary will be to plumbing and electric stub-ups, an electric source from the local utility company, and water discharge piping.

4.3.2 System Start-Up and Shake-Down

For any remedial system, the first several weeks to one month of operation are the most dynamic. Frequent Site visits (daily for first week then weekly visits thereafter) will be made during the first month of operation. Immediately following startup, liquid levels will be measured in each recovery well and surrounding monitoring wells and pumping rates may be adjusted to optimize groundwater capture. During each Site visit, the following measurements will likely be taken:

- Depth to water at select monitoring wells.
- Groundwater flow rates from each extraction well.
- Total gallons of groundwater extracted.
- System piping and equipment pressures.
- Air stripper influent (from blower) or effluent (post carbon and before discharge stack) air flow rate and PID readings.
- PID readings for pre- and post-vapor phase treatment.

Laboratory analytical samples of system performance will also be obtained at a pre-set interval (e.g., during the first week of operation and after a month of operation). Groundwater samples will be collected pre-and post- air stripper treatment and post-GAC discharge and analyzed as specified in Section 4.4.2. Additionally, air samples will be collected pre- and post- vapor GAC discharge and analyzed as specified in Section 4.4.3.

Following the installation and start up of the process, Alliance proposes to submit a brief report to the MDE describing the as-built installation and construction activity at the Site and to inform the MDE of any discrepancies between the finalized design and final installed system.

4.4 Routine Maintenance and Monitoring

4.4.1 Pump and Treat System Monitoring

Once the shake-down of the process equipment has been completed, the pump and treat system will move into a period of routine maintenance and monitoring. System operational parameters will be monitored routinely (e.g., semi-monthly) for the field parameters described in the start-up and shake-down section. Routine laboratory analytical monitoring will also occur (e.g., on a monthly basis). Groundwater samples will be collected pre-and post-air stripper treatment and post-GAC discharge.

4.4.2 NPDES Monitoring

A NPDES permit will be required for the discharge of treated groundwater. The MDE has a general permit for the "discharge of treated groundwater from petroleum contaminated groundwater sources to surface or ground waters of the state". This permit typically will stipulate bi-monthly monitoring (unless a reduced frequency is granted) of the treatment system effluent. Discharge limits are typically 100 parts per billion (ppb) for total BTEX, 5 ppb for benzene, and 15 parts per million for TPH. This monitoring will be conducted as post-GAC groundwater sampling as specified in the final NPDES permit.

4.4.3 Quarterly Groundwater Sampling

As required by the MDE, groundwater samples will be collected quarterly from the Site monitoring well network. Purge water generated by the groundwater sampling activity will be managed as it is under the current monitoring program or will be treated via the air stripper once it is in operation. Quarterly sampling will continue according to the schedule established for the Site. Potable well sampling will also continue according to the current schedule established for the Site, unless modified with MDE approval. Following the first year of sampling after system start-up, a reduction in sampling scope may be requested dependent upon conditions.

4.4.4 Reporting

After the receipt of the analytical results from the quarterly groundwater monitoring, a summary report on a quarterly basis will be prepared for submission to the MDE. The report will include a summary of all field and laboratory data obtained during the quarter and an evaluation of the results of the groundwater sampling event and treatment system performance monitoring. Upon achieving the remediation goals for the project, a closure petition will be prepared for review by the MDE to initiate post remediation monitoring.

4.5 SVE System Conceptual Design

Based on the results of the SVE pilot test, an SVE system will be installed and operated at the Site. As described Section 3.0, the SVE pilot test determined that the only location where meaningful hydrocarbons could be recovered from the unsaturated zone was in the vicinity of SVE-04 and MW-5. As described previously, during the installation of MW-5, hydrocarbon odors and PID responses were noted by the supervising geologist. Thus, it is proposed to utilize SVE-04 and a new extraction point installed in the vicinity of MW-5 (SVE-05) as part of a full scale SVE system. SVE-05 will be constructed similar to SVE-04. The location will be installed via air rotary drilling techniques to total depth of approximately 37 feet. The point will be constructed with 4 inch diameter well screen and casing. Based on the observations made during the installation MW-5, it is anticipated that SVE-05 will be screened from approximately 10 feet below grade to its total depth.

Based on the results of the Pilot Test, at an operating vacuum of 40 inches of water a flow rate of approximately 32 SCFM is anticipated at each of these two SVE locations. Based on the pilot test data for SVE-4, it is estimated that each location will have a radius of influence (defined as at least a vacuum of 0.1 inches of water) of approximately 60 feet. Figure 4-5 presents the proposed location for SVE-5 (approximate location, to be field determined) and the estimated radius of influence of each location assuming the operation of the system at 40 inches of water.

Two inch PVC piping will be utilize within individual trenches to connect each of these SVE points/locations back to the treatment compound (the same location as the pump and treat system). Each SVE line will be individually valved and connected to the SVE blower system to allow for proper adjustment of flow rate and vacuum to maximize hydrocarbon removal. The SVE equipment will consist of a water separator connected to a blower capable of delivering a vacuum of approximately 40 inches of water to each SVE point and a total flow rate of approximately 64 SCFM. The SVE will also be instrumented with interlocks to shut down the system in case of certain failures (high or low vacuum, high water in knock out tank, etc.). A telemetry system will notify Alliance immediately of a shut down such that a site visit can be scheduled to address the situation.

Air emissions from the SVE system will be permitted and treated consistent with the MDE's "General Permit to Construct Application Package for Groundwater Air Strippers and Soil Vapor Extraction Systems" (January 9, 2008). The specific details of the permit application will be pending the approval of this CAP Addendum and final design details. However, as per this General Permit, air emissions from the SVE system will likely be treated via activated carbon during its initial operations. Monitoring will occur at the frequency required in the General Permit and air emissions treatment will continue until MDE provides permission to remove the treatment device. Based on the results of the pilot test, the estimated mass removal rate will initially be approximately five pounds per day, and it is expected that this mass removal rate will decrease fairly quickly with continuous operation of the system.

The SVE will be operated and monitored on a similar schedule as the pump and treat system. Monitoring of an SVE system typically consists of:

- Monitoring of the vacuum, flow and PID response of each SVE point.
- Monitoring of the total flow rate, and PID response of the system.
- Measurement of the concentration of hydrocarbons influent and effluent the air treatment device (when in use).
- Collection of air bag samples for laboratory analysis to provide quantitation of the mass removal rate, typically on a monthly to bi-monthly basis.

Legend

- Monitoring Well
- Potable Well
- Abandoned Well
- Approximate Potable Well Location*
- Edge of Pavement
- Fence
- Tank Field
- Building
- Canopy
- Dispenser
- Gravel
- Property Boundary
- Proposed Cluster Monitoring Well Area
- Proposed Monitoring Well (Potential Recovery/ Potable Replacement Well Area
- Proposed Recovery Well Area

0 100 200 Feet

Note:
- Exact locations of offsite Potable Wells are unknown, shown locations are approximate.
- Exact locations will be determined in the field.

Source:
-Site features based on Baltimore County GIS data.

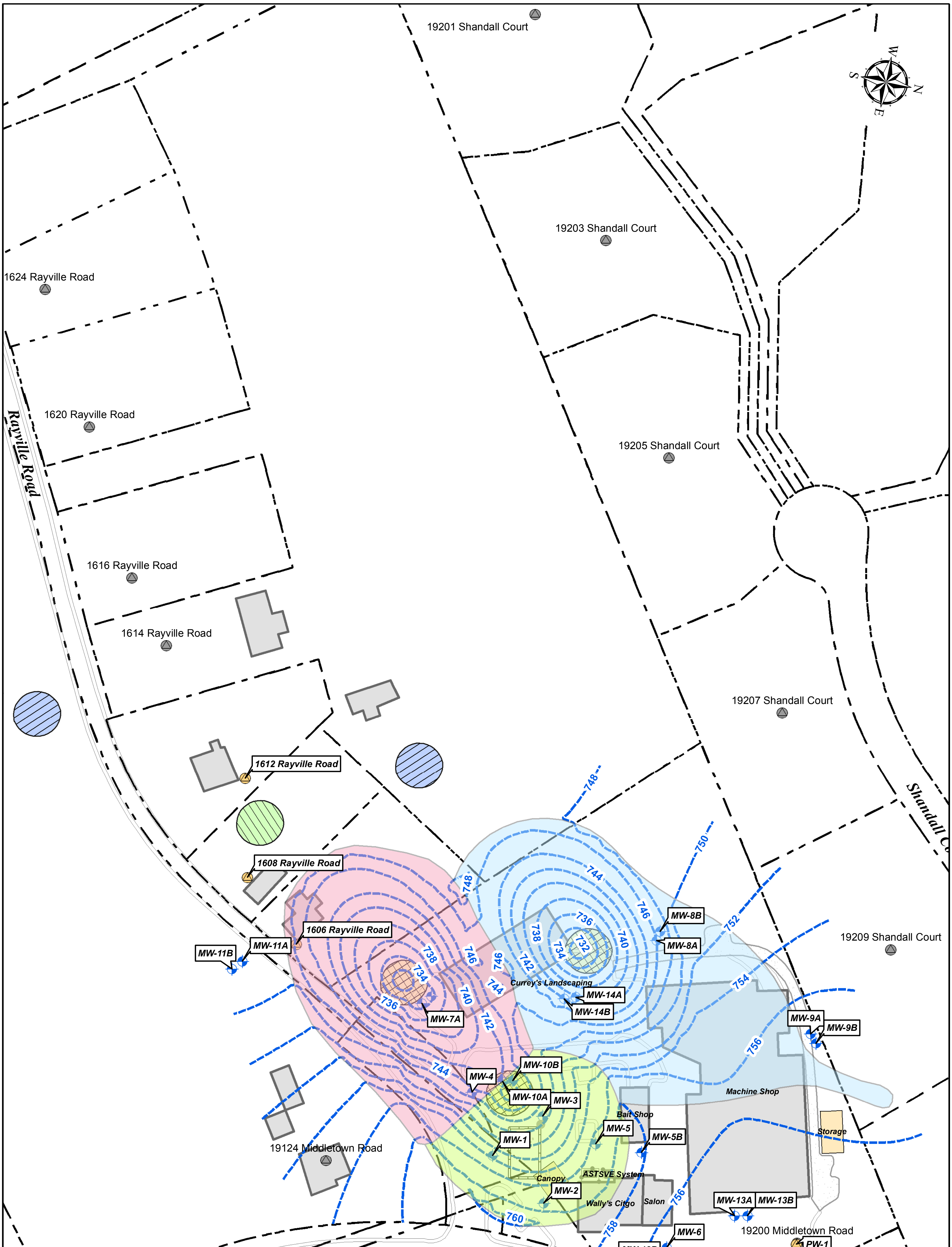
Environmental Alliance, Inc.
660 Yorklyn Road, Hockessin, DE 19707
Phone: (302) 234-4400 - Fax: (302)234-1535

Wally's Citgo Station
19200 Middletown Road
Parkton, MD

Proposed Monitoring And Recovery Well Locations

DESIGNED BY: AJA	DRAWN BY: SKJ	UPDATED BY: -- --	FIGURE NO.: 4-1
APPROVED BY:	PROJECT NO.: 1962	DATE: 08/11/2009	

Tuesday, August 11, 2009 1:09:03 PM • G:\EAI Projects\PCG Projects\Carroll Fuel\1962-Parkton\1962-Maps\2009-06\1962_Proposed_MW_Locs(6-09).mxd



***Notes:**

* Drawdown projected based on May 2007 pumping test of MW-10A
* Projected drawdown subtracted from May 2009 groundwater potentiometric surface for upper bedrock wells
* Drawdown and potentiometric surface contours interpolated using a kriging algorithm
* Projected capture zones drawn assuming an isotropic flownet
* Exact locations of offsite Potable Wells are unknown, shown locations are approximate.
* Exact locations will be determined in the field.

Legend

Projected Capture Zones

Projected GW Potentiometric Surface Upper BR w/3 Recovery Wells

Monitoring Well

Potable Well

Abandoned Well

Approximate Potable Well Location*

Edge of Pavement

Fence

Tank Field

Building

Canopy

Dispenser

Gravel

Property Boundary

Proposed Cluster Monitoring Well Area

Proposed Monitoring Well (Potential Recovery/ Potable Replacement Well Area

Proposed Recovery Well Area

0 100 200 Feet

Source:
-Site features based on Baltimore County GIS data.

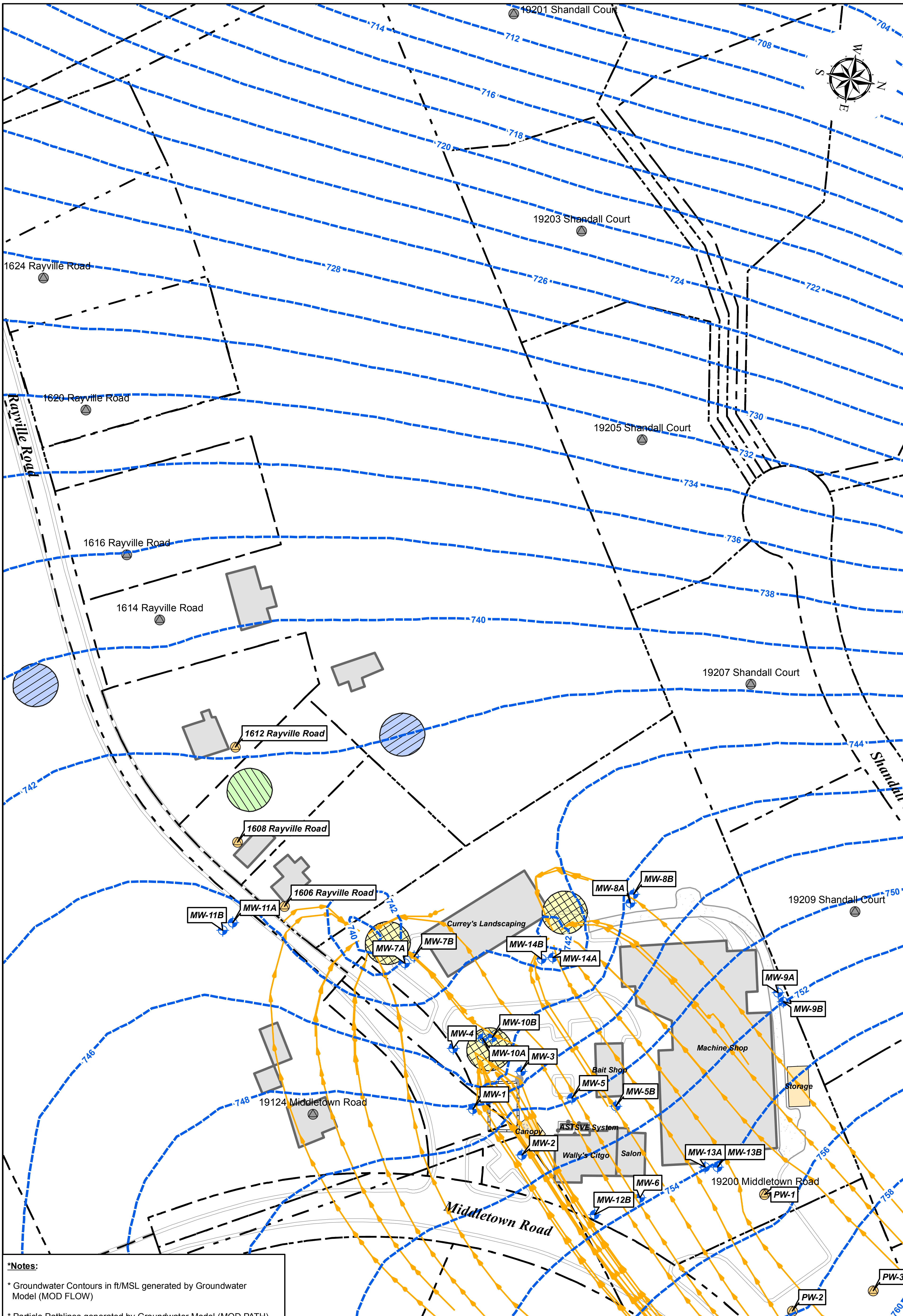
Environmental Alliance, Inc.
660 Yorklyn Road, Hockessin, DE 19707
Phone: (302) 234-4400 - Fax: (302)234-1535

Wally's Citgo Station
19200 Middletown Road
Parkton, MD

PROJECTED CAPTURE ZONES
3 ON-SITE RECOVERY WELLS

DESIGNED BY: JE	DRAWN BY: AGG	UPDATED BY: -- --	FIGURE NO.: 4-2
APPROVED BY:	PROJECT NO.: 1962	DATE: 08/19/2009	

Thursday, August 20, 2009 11:56:48 AM • G:\EAI Projects\PCG Projects\Carroll Fuel\1962-Parkton\1962-Maps\2009-08\1962_Proposed_Football_Contours.mxd



***Notes:**

* Groundwater Contours in ft/MSL generated by Groundwater Model (MOD FLOW)

* Particle Pathlines generated by Groundwater Model (MOD PATH)

Legend

- Groundwater Contours (ft/MSL)
- Particle Pathline One Year Time Between Arrows
- Monitoring Well
- Potable Well
- Abandoned Well
- Approximate Potable Well Location*
- Edge of Pavement
- Fence
- Tank Field
- Building
- Canopy
- Dispenser
- Gravel
- Property Boundary
- Proposed Cluster Monitoring Well Area
- Proposed Monitoring Well (Potential Recovery/ Potable Replacement Well Area
- Proposed Recovery Well Area

0 100 200 Feet

Source:
-Site features based on Baltimore County GIS data.

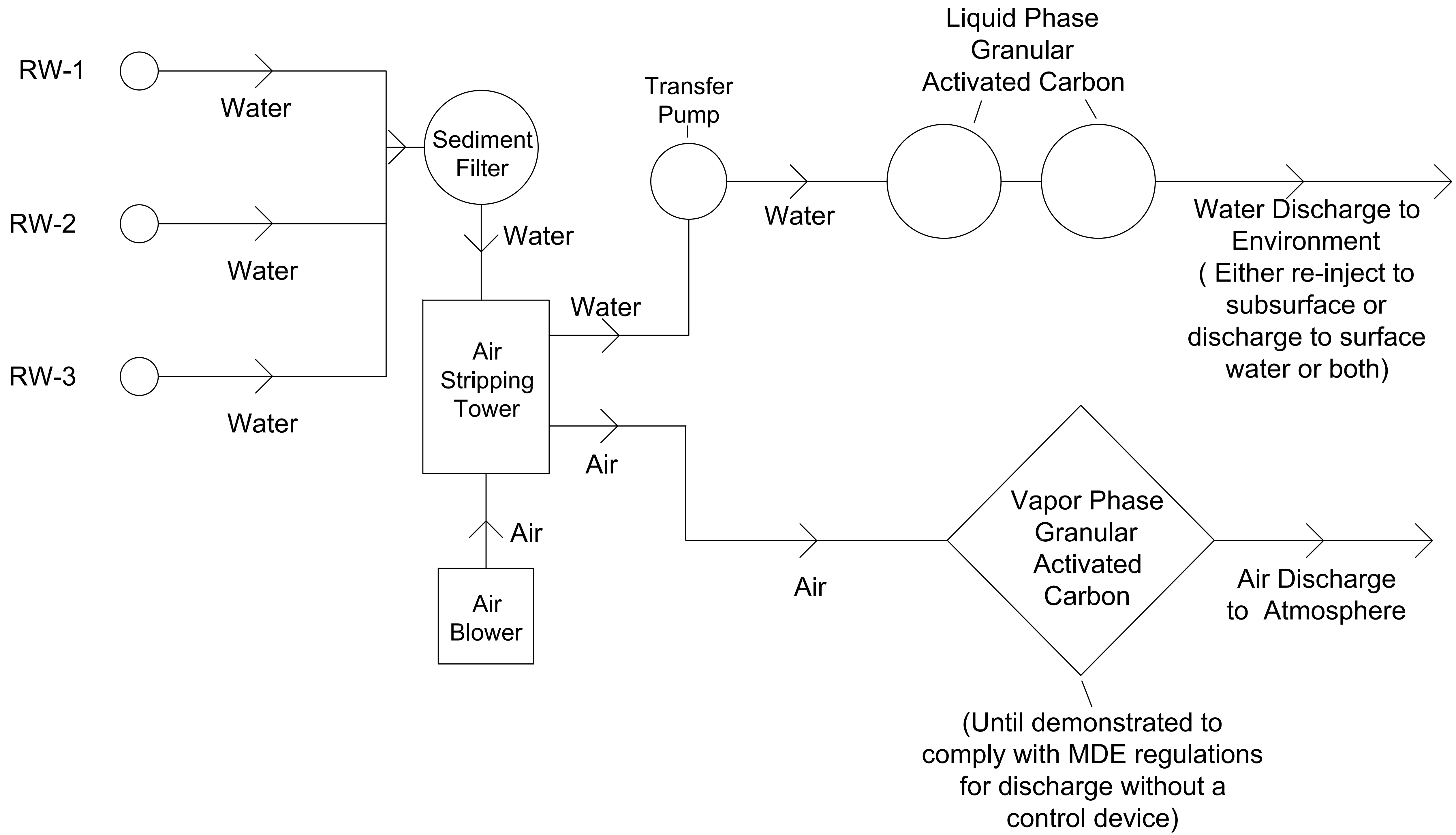
Environmental Alliance, Inc.
660 Yorklyn Road, Hockessin, DE 19707
Phone: (302) 234-4400 - Fax: (302)234-1535

Wally's Citgo Station
19200 Middletown Road
Parkton, MD

GROUNDWATER MODEL RECOVERY WELL LOCATIONS

DESIGNED BY: VB	DRAWN BY: AGG	UPDATED BY: -- --	FIGURE NO.:
APPROVED BY:	PROJECT NO.: 1962	DATE: 08/18/2009	4-3

Thursday, August 20, 2009 10:51:30 AM • G:\EAI Projects\PCG Projects\Carroll Fuel\1962-Parkton\1962-Maps\2009-08\1962_Scenario1_Contours.mxd



Environmental Alliance, Inc.
660 Yorklyn Road - Hockessin, DE 19707
Phone: (302) 234-4400 -Fax: (302) 234-1535

Wally's Citgo Station
19200 Middletown Road
Parkton, Maryland

Pump and Treat System
Line Diagram Schematic

DESIGNED BY:	DRAWN BY:	UPDATED BY:	FIGURE NO:
PCM	SKJ	AGG	4-4
APPROVED BY: -	PROJECT NO. 1962	DATE: 8/19/2009	

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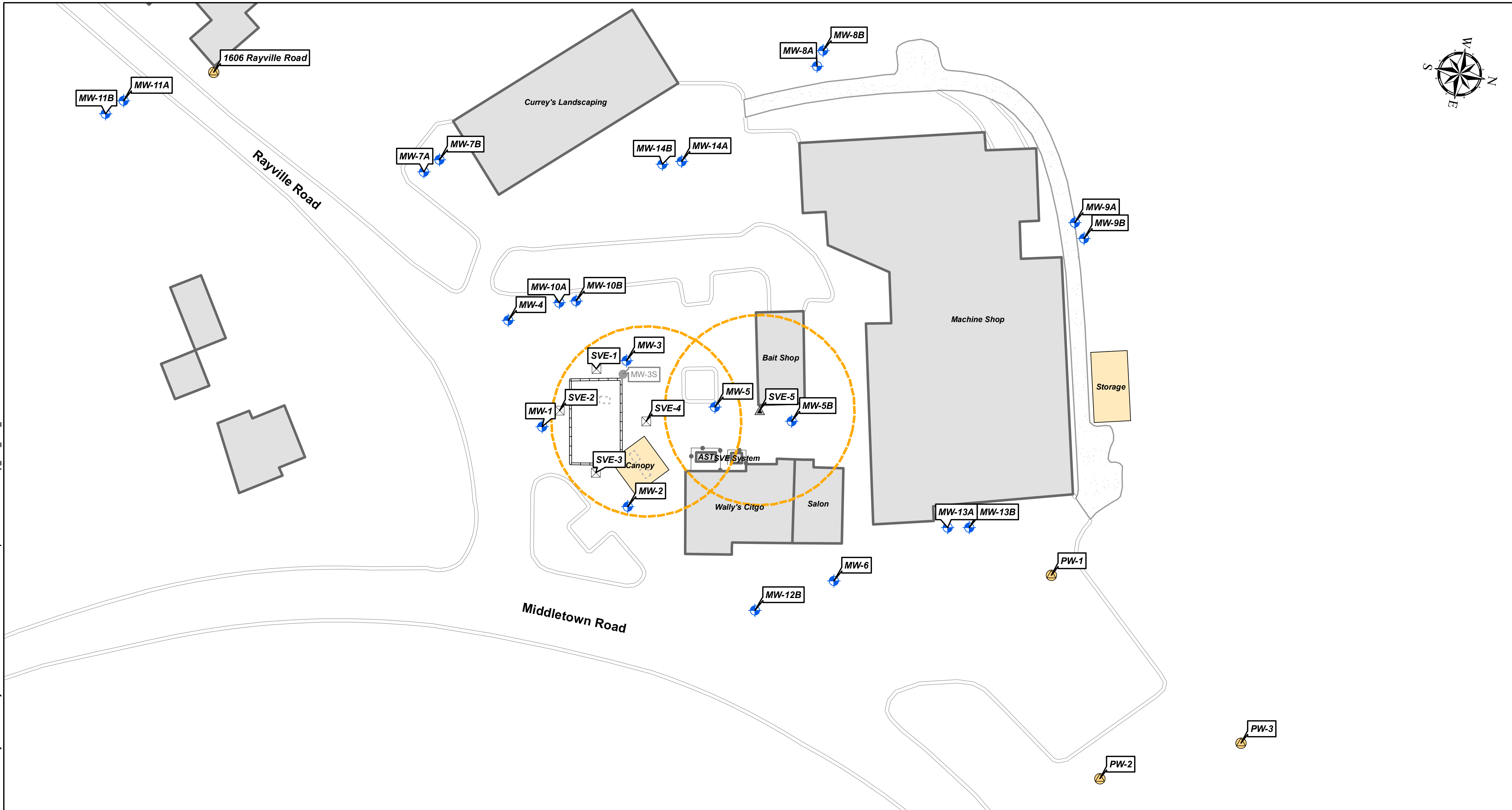

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Legend

- Predicted Radius of Influence (0.1" H2O) (only SVE-4 and SVE-5 are proposed for operation)
- Proposed Soil Vapor Extraction Point
- Soil Vapor Extraction Point
- Monitoring Well
- Potable Well
- Abandoned Well
- Edge of Pavement
- Fence
- Tank Field
- Building
- Canopy
- Dispenser
- Gravel

0 60 120 Feet

Source: Site features based on Baltimore County GIS data

Environmental Alliance, Inc.
660 Yorklyn Road, Hockessin, DE 19707
Phone: (302) 234-4400 - Fax: (302)234-1535

Wally's Citco Station
19200 Middletown Road
Parkton, Maryland

Proposed SVE Locations and Predicted SVE Radius of Influence

DESIGNED BY: PCM	DRAWN BY: AGG	UPDATED BY: SKJ	FIGURE NO.:
APPROVED BY:	PROJECT NO.: 1962	DATE: 08/19/2009	4-5

5.0 CORRECTIVE ACTION PLAN SCHEDULE

As described in the previous section, there are certain tasks that must be completed in order to finalize certain design aspects of this CAP Addendum. Given the current situation, Alliance proposes the following general schedule of actions to facilitate finalizing the design, installation and start up of the remediation system.

1) Upon MDE approval of the CAP Addendum, Alliance will immediately initiate the following:

   - Obtain the necessary approvals from Baltimore County to discharge treated water from the pump and treat system to the storm sewer previously described.
   - Apply for an NPDES permit from MDE to discharge the treated groundwater to the storm sewer. The final discharge quality requirements for the treated water discharge will be provided by MDE.
   - Initiate the installation of the three proposed recovery wells on the station property (RW-1, RW-2 and RW-3). Once permits are received, the wells will be installed as described. Following installation, the wells will be developed and sampled to determine the yield and water quality in each well. This information will be used to finalize the design of the treatment system.
   - SVE-5 will be installed at the same time as the three recovery wells.
   - When access has been received for the proposed off site well locations, these off site wells will be installed. Note that access requests have already been initiated.

2) The design of the pump and treat system will be finalized based upon confirmation of the discharge location and the discharge quality requirements in the NPDES permit from MDE. If desired, Alliance will provide MDE with the final engineering specifications of the process equipment prior to purchase and installation.

3) After the design is complete, with any final input from MDE, the SVE system and pump and treat system equipment will be ordered and installed. Start up procedures, a long term operations and maintenance schedule and reporting schedule will be finalized with MDE before operations begin.

Appendix I

MDE Communications

MDE

MARYLAND DEPARTMENT OF THE ENVIRONMENT

Oil Control Program, Suite 620, 1800 Washington Blvd., Baltimore MD 21230-1719

410-537-3442 • 410-537-3092 (fax) 1-800-633-6101

May 28, 2009

Mr. John Phelps
Carroll Independent Fuel Company
2700 Loch Raven Boulevard
Baltimore, Maryland 21208

RE: DIRECTIVE: REQUEST FOR CAP ADDENDUM AND POTABLE WELL INVESTIGATION WORK PLAN
Case No. 2006-0319-BA2
Notice of Violation NV-2007-067
Wally's Citgo
19200 Middletown Road, Parkton
Baltimore County, Maryland
Facility I.D. No. 4593

Dear Mr. Phelps:

The Maryland Department of the Environment, Oil Control Program (MDE-OCP) has received and reviewed the *Corrective Action Plan (CAP) - February 26, 2009* for the above referenced site, as required by the Department's directive letter dated January 9, 2009. The *CAP* proposed remediation of the site via soil vapor extraction (SVE) combined with a groundwater pump-and-treat system. The Department issued letters to members of the Parkton community for a comment period to the *CAP*, per Code of Maryland Regulations (COMAR) 26.10.09.08.08 (Community Letter dated April 15, 2009). A letter from counsel representing select members of the community was received by the Department on April 30, 2009. On May 5, 2009, representatives of the MDE-OCP, Carroll Independent Fuel Company (CIFCO), your environmental consultants, and legal council met to discuss the case and the *CAP*. A copy of the response from legal council representing select members of the community was presented to CIFCO at that time.

Based on the Department's review of the case and *CAP*, the following comments and requirements are outlined below:

1. The Department approves the SVE pilot test as proposed in the *CAP*. The pilot test must be completed **no later than July 24, 2009**. The pilot test report with recommendations for full scale implementation of the proposed SVE system must be received by the Department **no later than September 4, 2009**. The Department must be notified prior to any work related to this activity, including installation of the approved SVE wells and conducting the pilot test, at least five (5) days prior to field work.

2. In order for the MDE-OCP to evaluate the pump-and-treat remedial action as proposed in the *CAP* (i.e. suitability of the proposed well locations, the recovery well capture area, and monitoring), the Department requires an investigation of the impacted off-site drinking water wells. This investigation is necessary to understand the hydrogeology and contaminate migration pathways that contributed to the impacts of these drinking water wells.

   The MDE-OCP requires borehole geophysics testing that, at a minimum, must include the following: caliper; acoustic televiewer; optical televiewer; and resistivity tests. These tests will be performed at the drinking water wells located at 1606, 1608, and 1612 Rayville Road. The data collected for the Department's review must include, but may not be limited to the following: casing depth and casing integrity; depth of all fractures, joints, foliations (with orientations), degree of water production, and aperture size; total depth of the well; depth to water; pump depth; and well yield. The Department must receive a Work Plan detailing the down well investigation **no later than June 12, 2009**.

   Please note, the data collected will be used not only to understand how these wells were impacted, but also to evaluate potential remedial strategies such as drilling replacement drinking water wells and using the existing drinking water wells as groundwater recovery wells.

3. Per the January 9, 2009 directive letter, the Department still requires the installation of a monitoring well network to delineate the total extent of contamination (i.e. horizontal and vertical extent of dissolved levels) both on-site and off-site. At this time, the Department does not consider this task to be completed. The MDE-OCP requires a Work Plan to be submitted with a site map and well construction details for the placement of monitoring wells at properties down gradient and to the west of monitoring wells MW-7 and MW-7B. Drinking water wells in this area have been impacted and the groundwater must be investigated. As such, monitoring/test wells must be installed to monitor and delineate the extent of contamination (properties included but not limited for investigation are 1606, 1608 and 1612 Rayville Road). CIFCO must obtain access agreements with these impacted residents. Domestic well sampling and carbon change-outs must continue at each residence, as previously required.

4. With regard to the groundwater pump-and-treat proposal, the MDE-OCP does not approve discharge of treated water into the tank field or septic field, as proposed. Alternative discharge methods and locations (e.g. on-site storm water inlet, construction of an infiltration gallery) must be thoroughly evaluated for MDE-OCP approval.

5. Pending off-site investigations and an evaluation of the *CAP Addendum*, additional wells may be needed for recovery, both on-site and off-site, to obtain hydraulic control of the dissolved plume. Potential monitoring locations may be identified between MW-7A/MW-7B and MW-10A/MW-10B and near MW-7.

6. The Department understands that a computer model was used for the *CAP* design. All data must be included with the *CAP Addendum* including model parameters, input values, and the results.

7. The Department must receive a revised site map depicting additional groundwater monitoring well and recovery well locations.

Requirements 3 through 7 must be completed and submitted as a *CAP Addendum* to the Department <u>no later that July 10, 2009</u>. The geophysical data collected from the three off-site drinking water wells (i.e. Requirement 2) must also be included in the *CAP Addendum*.

Failure to complete the advised actions may result in enforcement proceedings that could include the issuance of civil penalties and other legal sanctions. All information, data, reports or plans generated for this site must be submitted to the Oil Control Program for review by the dates specified or agreed upon by the Department.

If you have any questions, please contact the case manager, Ms. Jenny Martin, at 410-537-3413 (email: jmartin@mde.state.md.us) or Central Region Section Head, Ms. Ellen Jackson, at 410-537-3482 (email; ejackson@mde.state.md.us).

Sincerely,

for:

Christopher H. Ralston, Chief
Remediation and State-Lead Division
Oil Control Program

JM/nln

cc: Mr. Andrew Applebaum (Environmental Alliance, Inc.)
Mr. Dwight Stone (Whiteford, Taylor and Preston Law)
Mr. Peter Angelos (Law Offices of Peter G. Angelos, PC)
Mr. Howard Phelps (CIFCO)
Mr. Kevin Koepenick (Baltimore County DEPRM)
Ms. Barbara Brown (MDE)
Ms. Pricilla Carroll, Esq. (MDE)
Mr. Herbert M. Meade (MDE)
Mr. Horacio Tablada (MDE)

MARYLAND DEPARTMENT OF THE ENVIRONMENT
Oil Control Program, Suite 620, 1800 Washington Blvd., Baltimore MD 21230-1719
410-537-3442 • 410-537-3092 (fax) 1-800-633-6101

July 23, 2009

Mr. John Phelps
Carroll Independent Fuel Company
2700 Loch Raven Boulevard
Baltimore MD 21208

RE: CAP ADDENDUM EXTENSION APPROVAL
Case No. 2006-0319-BA2
Notice of Violation NV-2007-067
Wally's Citgo
19200 Middletown Road, Parkton
Baltimore County, Maryland
Facility I.D. No. 4593

Dear Mr. Phelps:

The Oil Control Program recently completed a review of the case file, including the *Status of Activities Required by May 28, 2009 MDE Directive Letter and Corrective Action Plan Addendum Extension Request - July 9, 2009* and the *Quarterly Update Report - July 6, 2009* for the above-referenced property. Based on this review and the completion of activities required in the Department's May 2009 directive letter to date, the Department grants an extension for the submittal of the *CAP Addendum*. The required *CAP Addendum* must now be submitted to the Department **no later than August 21, 2009**. All other requirements must be completed by the dates previously specified by the Department.

The Department has reviewed the data submitted in the *Quarterly Update Report - July 6, 2009*; and given the increase in dissolved MTBE and benzene levels detected in the pre-filtration samples from 1608 and 1612 Rayville Road, the Department requires all domestic well sampling data be submitted on a **monthly basis** as *Domestic Well Sampling Reports*. These reports must include the dates of carbon filter replacement, totalizer readings, the number and total poundage of carbon filters at each residence, and any other data collected regarding domestic well sampling. Groundwater monitoring well sampling data must continue to be submitted on a **quarterly basis** under separate cover.

If you have any questions, please contact the case manager, Ms. Jenny Martin, at 410-537-3413 (email: jmartin@mde.state.md.us) or Central Region Section Head, Ms. Ellen Jackson, at 410-537-3482 (email: ejackson@mde.state.md.us).

Sincerely,

Christopher H. Ralston, Chief
Remediation and State-Lead Division
Oil Control Program

JM/nln

cc: Mr. Richard Martin (1606 Rayville Road)
Mr. Charles Belt (1608 Rayville Road)
Ms. Gail Fissel (1612 Rayville Road)
Mr. Andrew Applebaum (Environmental Alliance, Inc.)
Mr. Dwight Stone (Whiteford, Taylor and Preston Law)
Mr. Peter Angelos (Law Offices of Peter G. Angelos, PC)
Mr. Howard Phelps (CIFCO)
Mr. Kevin Koepenick (Baltimore County DEPRM)
Ms. Barbara Brown (MDE)
Pricilla Carroll, Esquire
Mr. Herbert M. Meade
Mr. Horacio Tablada

Appendix II

Disposal Documentation

SAO 6/23/09

CleanVenture/CycleChem

CVCC 128847

NON-HAZARDOUS SOLID WASTE

The Environmental Services Source

BILL OF LADING

Page 1 of 1 — 24 Hour Emergency Number (410) 268-9170

Generator's Name and Mailing Address: Wally's BP Station
13200 Middletown Road
Parkton, MD 21120
Generator's Phone (410) 723-9000

BOL

SOME.

Transporter 1 Company Name: CLEAN VENTURE INC.

State Trans. ID-NJDEPE
Decal No.-
Transporter's Phone (

Transporter 2 Company Name:

State Trans. ID-NJDEPE
Decal No.-
Transporter's Phone ( )

Designated Facility Name and Site Address: CYCLE CHEM, INC.
550 INDUSTRIAL DRIVE
LEWISBERRY, PA 17339

10. US EPA ID Number

Facility's Phone (717) 938 4700

	US DOT Description (Including Proper Shipping Name, Hazard Class or Division, ID Number and Packing Group)	Containers No.	Containers Type	Total Quantity	Unit Wt/Vol	Waste No.
a.	NON HAZ, NON RCRA SOLIDS (soil cuttings)	19	DM	11,400	P	NONE
b.						
c.						
d.						

GENERATOR

J. Additional Descriptions for Materials Listed Above

a.

b.

c.

d.

CCI Generator # and Product Codes: [illegible] (DLD-9 Non haz soil)

JOB# 90807-04.09

GENERATOR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations and are non-hazardous by USEPA & applicable state regulations.

PLACARDS REQUIRED: NO

PLACARDS SUPPLIED: ☐ YES ☒ NO- FURNISHED BY CARRIER

Printed/Typed Name: Lisa Lemire — Signature: [signature] — Month Day Year: 06 29 09

TRANSPORTER

Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name: ANDREW FEEZER — Signature: [signature] — Month Day Year: 06 29 09

Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name: — Signature: — Month Day Year:

FACILITY

Facility Owner or Operator: Certification of receipt of hazardous materials covered by this manifest.

Printed/Typed Name: John Dixon — Signature: [signature] — Month Day Year: 06 30 09

SIGNATURE AND INFORMATION *MUST* BE LEGIBLE ON ALL COPIES

COPY 1 - WHITE - GENERATOR   COPY 2 - PINK - TRANSPORTER   COPY 3 - BLUE - CycleChem   COPY 4 - CANARY - FACILITY

NON-HAZARDOUS WASTE MANIFEST	1. Generator ID Number: NA	2. Page 1 of: 1	3. Emergency Response Phone: 443-257-8507	4. Waste Tracking Number: NA0701043B

5. Generator's Name and Mailing Address: Wally's BP, Middletown Rd, Freeland, MD

Generator's Site Address (if different than mailing address): c/o Environmental [illegible]

Generator's Phone:

6. Transporter 1 Company Name: Water Dept Inc — U.S. EPA ID Number: NA

7. Transporter 2 Company Name: — U.S. EPA ID Number:

8. Designated Facility Name and Site Address: Water Dept Inc 7301 Avondale Rd, New Windsor, MD 21776 — U.S. EPA ID Number: NA

Facility's Phone:

	9. Waste Shipping Name and Description	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.
1.	Non-Hazardous Non-Regulated Liq	01	VT	1975	G
2.					
3.					
4.					

13. Special Handling Instructions and Additional Information

14. GENERATOR'S CERTIFICATION: I certify the materials described above on this manifest are not subject to federal regulations for reporting proper disposal of Hazardous Waste.

Generator's/Offeror's Printed/Typed Name	Signature	Month	Day	Year
[illegible] as agent of Wally's	[signature]	07	01	09

15. International Shipments ☐ Import to U.S. ☒ Export from U.S. Port of entry/exit: [illegible]

Transporter Signature (for exports only): Date leaving U.S.:

16. Transporter Acknowledgment of Receipt of Materials

Transporter	Printed/Typed Name	Signature	Month	Day	Year
Transporter 1	Aaron Shank	[signature]	07	01	09
Transporter 2					

17. Discrepancy

17a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection

Manifest Reference Number:

17b. Alternate Facility (or Generator) — U.S. EPA ID Number

Facility's Phone:

17c. Signature of Alternate Facility (or Generator) — Month Day Year

18. Designated Facility Owner or Operator: Certification of receipt of materials covered by the manifest except as noted in Item 17a

Printed/Typed Name — Signature — Month Day Year

GENERATOR — INT'L — TRANSPORTER — DESIGNATED FACILITY

169-BLS-C 5 11979 (Rev. 8/06)

GENERATOR'S/SHIPPER'S INITIAL COPY

Appendix III

ARM Geophysical Report and Supplemental Evaluation

ENVIRONMENTAL ALLIANCE

August 3, 2009

Mr. Andrew Applebaum
Environmental Alliance, Inc.
121 Union Avenue, Suite 1
Middlesex, NJ 08846

Subject: Results of Geophysical Well Logging
Wally's Citgo Site, Parkton, Maryland
ARM Project: 09234

Dear Mr. Applebaum,

This letter report summarizes the methods, results, and conclusions of a borehole geophysical investigation performed at the above referenced location on June 30, 2009. Logging was performed in three domestic wells located at 1606, 1608, and 1612 Rayville Road. The objective of this investigation was to identify and determine the orientation of planar features such as fractures and foliation planes and to locate and characterize water-bearing zones. To achieve these objectives, standard well logs and borehole images were acquired from each well.

ARM performed well logging to achieve the same objectives in September 18, 19, and October 13, 2006. Wells MW-7A, MW-7B, MW-8A, MW-8B, MW-9A and MW-9B were logged during this previous investigation. The orientation data collected from these wells are included in this report so that a more statistically significant and representative stereographic analysis could be performed.

LOGGING METHODS

The logs that were run for this investigation include:

- Natural Gamma
- Fluid Temperature
- Fluid Resistivity
- 3-Arm Caliper
- Short & Long Normal Resistivity
- Single Point Resistance
- Optical Televiewer (OTV)
- Acoustic Televiewer (ATV)

An overview of the logging methods used during this investigation is presented in Attachment A. The OTV logs were acquired using a Robertson Geologging Micrologger 2 and digital optical televiewer probe. The remaining logs were acquired using a MGX II and Matrix digital logging system manufactured by Mount Sopris Instrument Company.

INTERPRETATION

BASIC LOG DESCRIPTIONS

The geophysical well logs acquired during this investigation are presented in Attachment B. All log depths are referenced to top of casing as indicated in the header of each log. The majority of the acquired data are presented as standard curves that represent the change in measured parameter with depth. The format of the televiewer logs deserve further explanation and are discussed below.

The televiewer logs contain borehole images and structural information obtained from the OTV and ATV tool. The Optical View track is an "unwrapped" image of the borehole wall (Figure 1). The cylindrical borehole surface is unzipped along the north azimuth and unrolled to a flat strip. The compass orientation (with respect to true north) is presented at the top of the log. The unwrapped format is distorted like any projection of a curved surface on a flat one. Horizontal and vertical planes will be undistorted. However, dipping planes will be represented as a sine wave: the greater the dip, the greater the wave amplitude.

The Acoustic Amplitude and Travel Time tracks are presented in a similar fashion. The Acoustic Amplitude log is a 360° image of the strength or amplitude of the reflected pulse. Lighter colors indicate harder or more competent rock, while darker colors represent fractures and less competent rock. The Travel Time data is similar to sonar and represent the travel time of the acoustic pulse as is travels from the tool to the borehole wall and back. This information serves a high resolution and 360° caliper that can indicate the relative lateral depth or openness of fractures.

The Plane Projection track presents the fracture signatures digitized from the unwrapped Optical View and Acoustic Amplitude tracks. For this investigation, the digitized planes are categorized as either filled or open fractures. The Dip & Dip Direction log is a presentation in which the vertical axis is depth and the horizontal is dip from 0° to 90°. As shown in Figure 2, the azimuth of the dip direction is indicated by the orientation of the tadpole tail, measured in a clockwise direction from north.

INTERPRETATION OF STRUCTURAL DIAGRAMS

The structural data are presented on polar and rose diagrams for statistical analysis and pattern visualization. Polar diagrams are used in this report to plot the dip and dip direction of planar features. Zero degree dip is represented at the center of the diagram and 90° at the circumference. The dip direction is indicated by the compass azimuth, measured clockwise from north (0°), as shown in Figure 3.

The rose diagram graphically illustrates the strike distribution of a set of planes. Radiating rays are drawn with lengths proportional to number of strike measurements within each 10° sector. It is important to recognize that in this report, the polar diagram represents dip and dip direction, whereas the rose diagram represents strike. Using the right-hand-rule convention, strike equals the dip direction minus 90°.

RESULTS AND DISCUSSION

ORIENTATION ANALYSIS OF PLANAR FEATURES

Optical and acoustic televiewer images were used to identify fracture and foliation planes. Planar features are picked from the image logs by fitting the signature to a line. As discussed above, only horizontal or vertical planes appear as straight lines on the unwrapped image. Dipping features appear as a sinusoidal curve. The orientation of planar features can only be accurately calculated if signature is symmetrical. Unsymmetrical traces occur if the feature is warped or if the borehole cross section is irregular. In this case, the signature is not picked and the orientations are not included in the stereographic analysis. However, these features are identified on the televiewer logs as "Non-Planar Void or Joint".

The orientations of all digitized planes are tabulated in Attachment B. Stereographic analysis was performed on these data and results are presented in the polar and rose diagrams shown in Figures 4 through 9. Predominant groups or "sets" are indicated by the clustering of data points in the polar diagrams. The orientation data collected during the logging performed by ARM in 2006 are included in this report so that a more statistically significant and representative stereographic analysis could be performed.

Figure 4 presents a symbolic polar diagram that shows the orientation of planes categorized by well. This presentation is useful for identifying lateral changes in plane orientation. In this case, the scatter of orientations shows some deviation between wells, which suggest some lateral changes in orientation exists at this site. Figure 5 is a polar diagram of all planes grouped by plane type. The mean orientations of foliation and fracture plane sets were calculated using Fisher statistics and are shown in Table 1. These mean vectors are associated with statistical results such as confidence and variability cones and Fisher dispersion constants, which are also shown on the figures. An explanation of these terms and methods is presented in Attachment C. The mean orientation of foliation planes is illustrated by the statistical contouring in Figure 6 and is shown at the right of the diagram. The rose diagram shown in Figure 7 shows the dominant strike of foliation planes is to the NNE/SSW. The mean orientations of the open fracture plane set is illustrated by the statistical contouring in Figure 8 and is shown along with the statistical results at the right of the diagram. The similarity in orientation between foliation planes and fracture planes suggests the latter are open partings along foliation planes. The rose diagram shown in Figure 9 shows the strike distribution of open fracture planes. The predominant strike direction is to the NNE/SSW.

Table 1: Mean Orientation of Planar Features

Type	Dip (deg)	Dip Direction (deg)	Strike/Dip
Foliation Planes	27	281	N11E/27NW
Open Fracture Planes	34	284	N14E/34NW

INTERPRETATION OF WATER BEARING ZONES

The interpretation of well logs and images suggests the occurrence and migration of ground water are primarily influenced by open fractures. Water bearing zones identified from the logs are listed below in Table 2 and shown as symbols at the corresponding depth on the HydroLogs. Some difficulties in identifying water bearing zones were met in this investigation since borehole fluid column was disturbed during logging. The water column was disturbed by the removal of the well pumps immediately prior to logging. This limits the effectiveness of the fluid temperature and fluid resistivity logs. These limitations notwithstanding, the primary indicators of water bearing zones were the presence of open fractures observed in televiewer images and caliper data, as well as decreases in formation resistivity. The majority of open fractures occur within the upper 70 ft of rock. A listing of interpreted water bearing zones is provided in Table 2.

Table 2: Interpreted water bearing zones

Well	Depth (ft)
1606 Rayville	43
	59
	62
	74
1608 Rayville	45
	60
	66
1612 Rayville	63
	70
	83

CLOSING

The results of this investigation successfully achieved the project objects by identifying and determining the orientations of fractures and foliation planes and by locating and characterizing water-bearing zones. The data collection and interpretation methodologies used in this investigation are consistent with standard practices applied to similar geophysical investigations. The correlation of geophysical responses with probable subsurface features is based on the past results of similar surveys although it is possible that some variation could exist at this site.

Please contact us if you have any questions regarding this survey. We appreciate your business and look forward to working with you again.

Kind regards,
ARM Geophysics

M. Scott McQuown, P.G.
Senior Geologist & Geophysicist

FIGURES

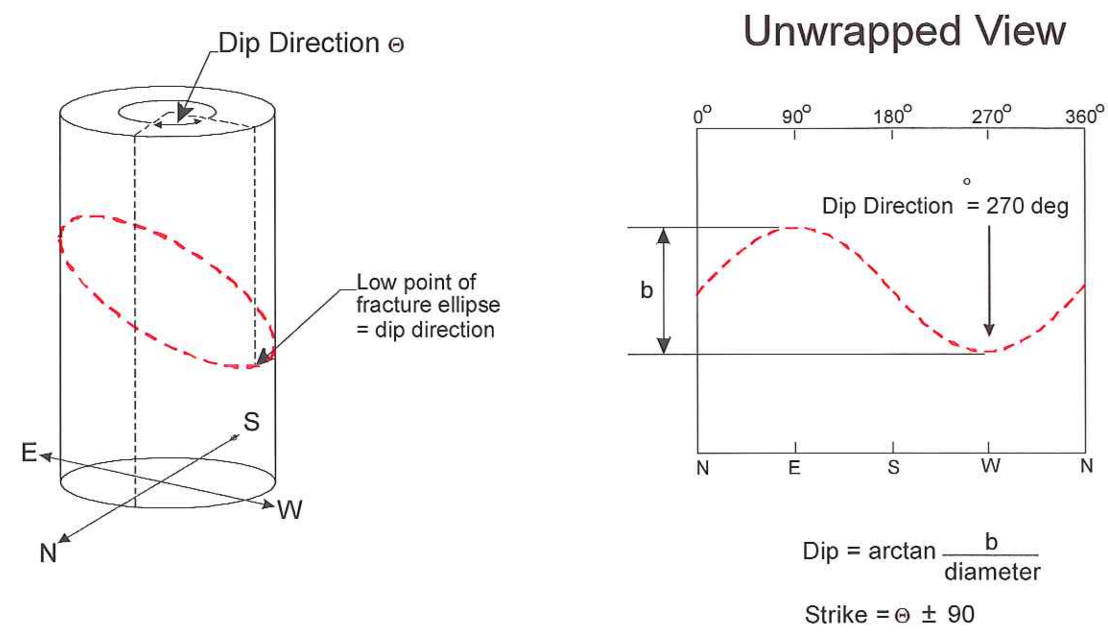


Figure 1: Diagram illustrating unwrapped view of fracture signature.

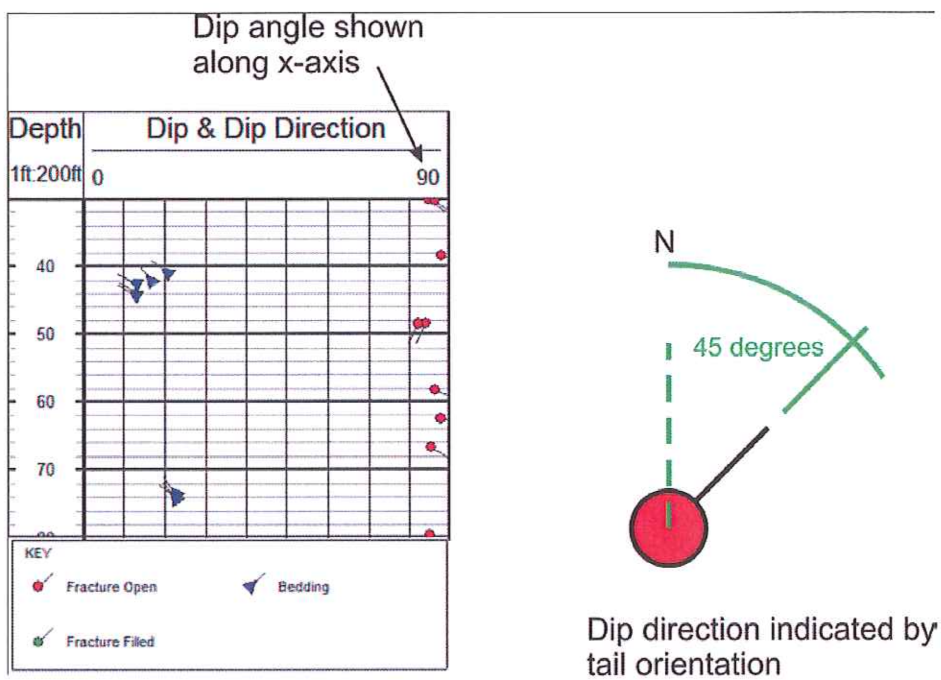


Figure 2: Dip & dip direction determination from the tadpole plot.

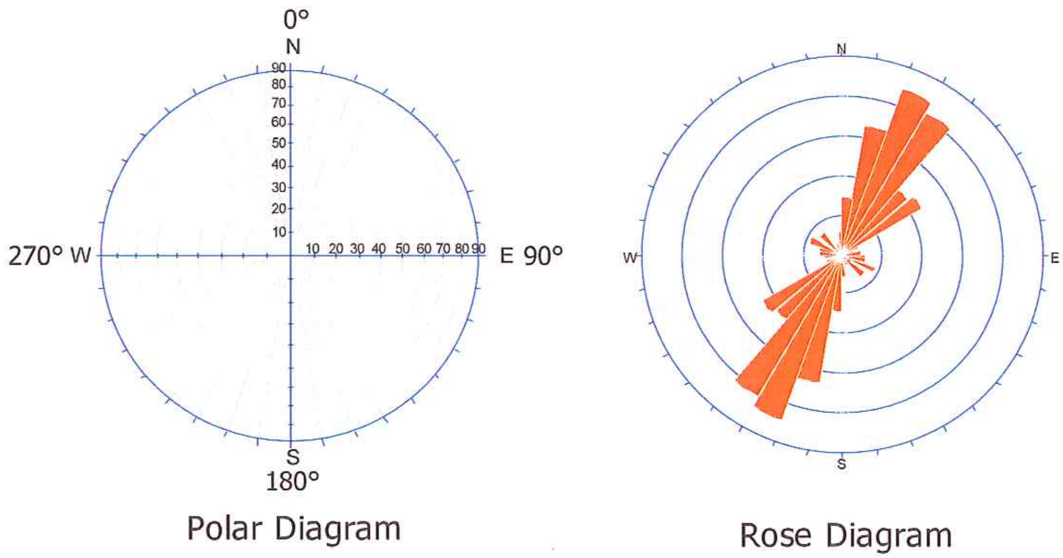


Figure 3: Example polar and rose diagrams. Polar diagram is used in this report for plotting dip and dip direction. Rose diagrams are used for plotting the frequency or number of strike measurements per sector.

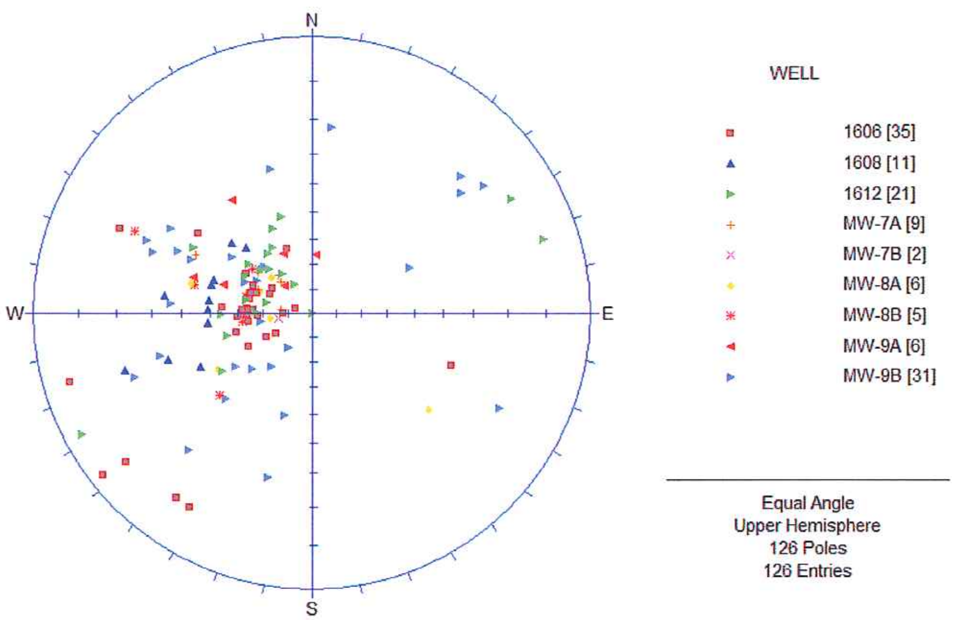


Figure 4: Polar diagram showing dip and dip direction of all planes categorized by well.

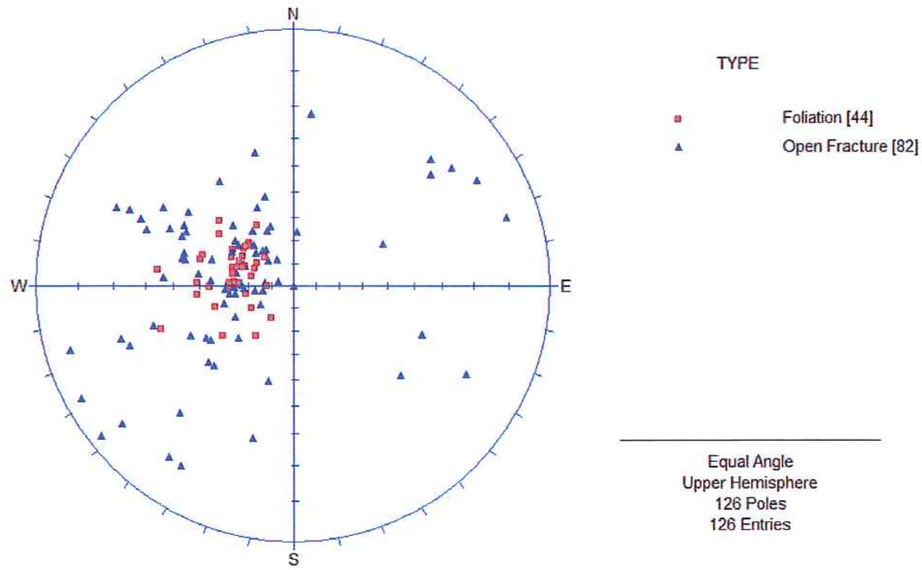


Figure 5: Polar diagram showing dip and dip direction of all planes categorized by plane type.

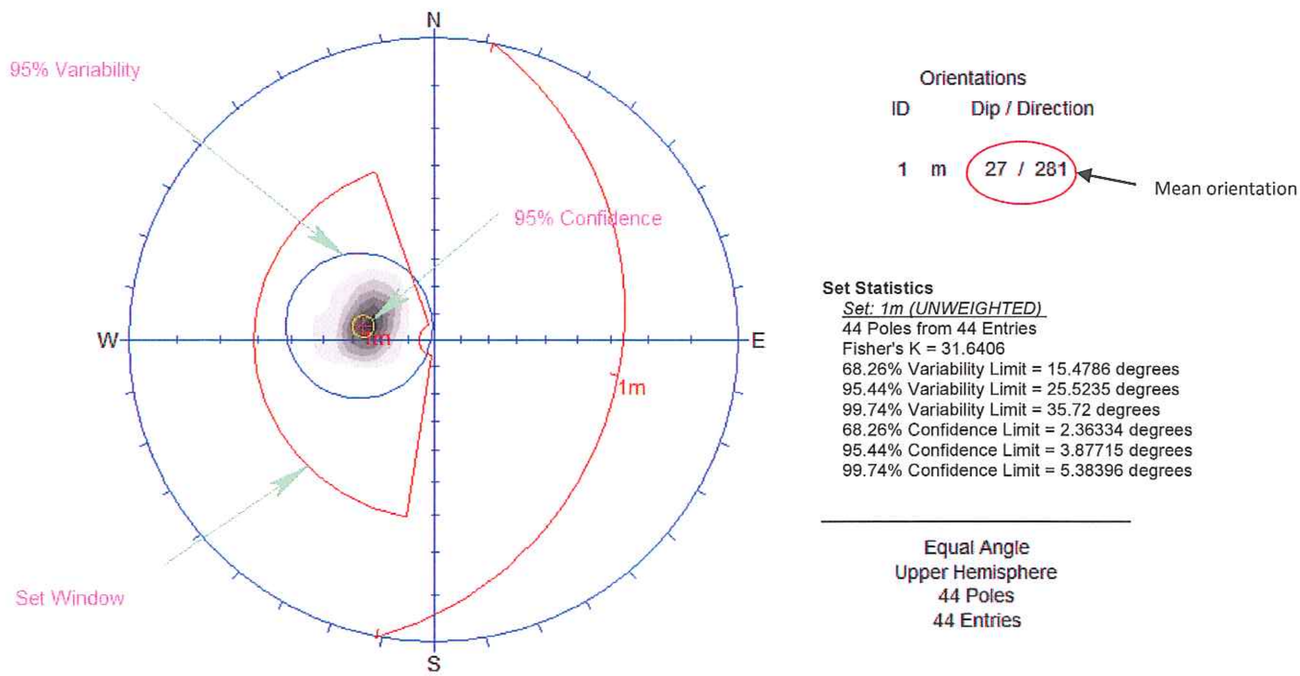


Figure 6: Statistical contouring illustrating the mean dip and dip direction of foliation planes. The calculated mean of the set is shown to the right of the diagram.

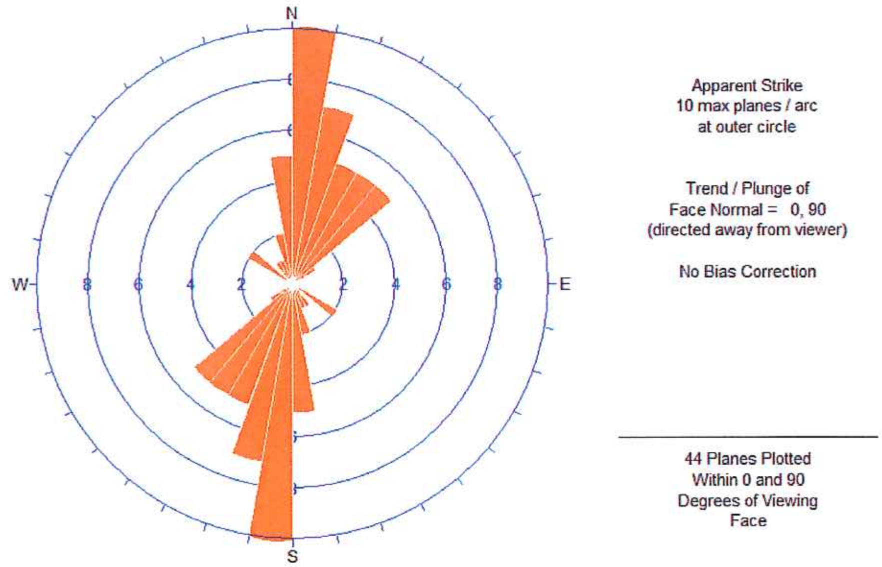


Figure 7: Rose diagram illustrating the strike distribution of foliation planes. The predominant strike direction is to the NNE/SSW.

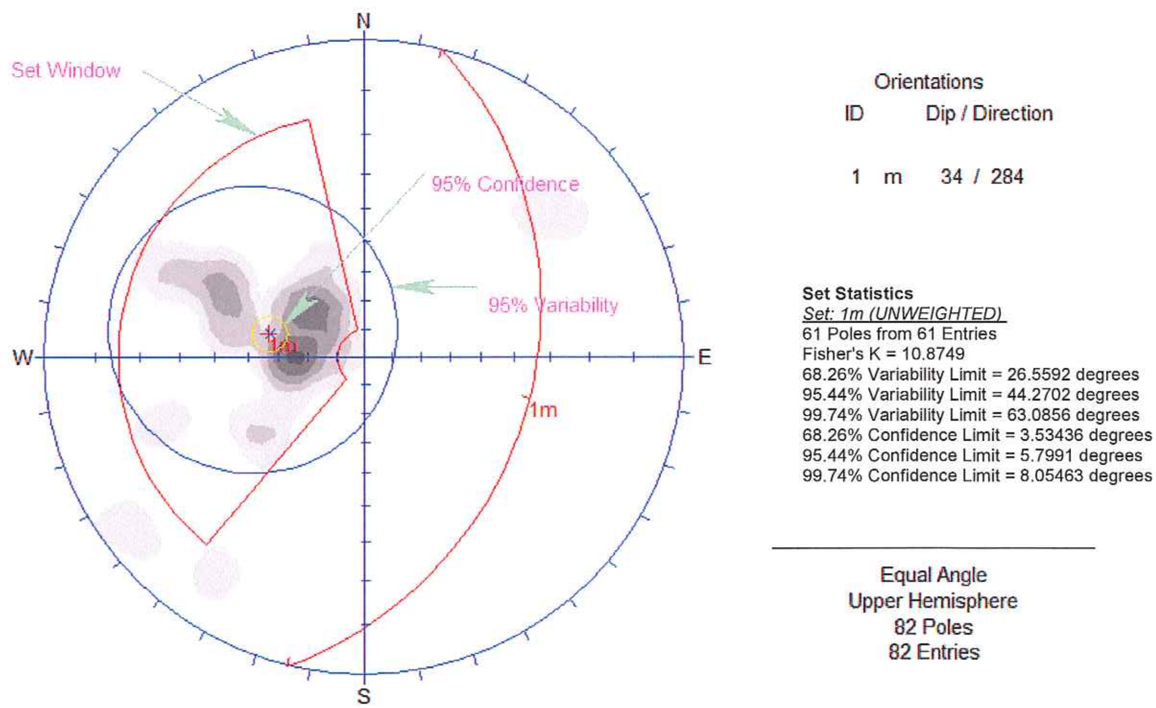


Figure 8: Statistical contouring illustrating the mean dip and dip direction of fracture planes. The calculated mean of each set is shown to the right of the diagram.

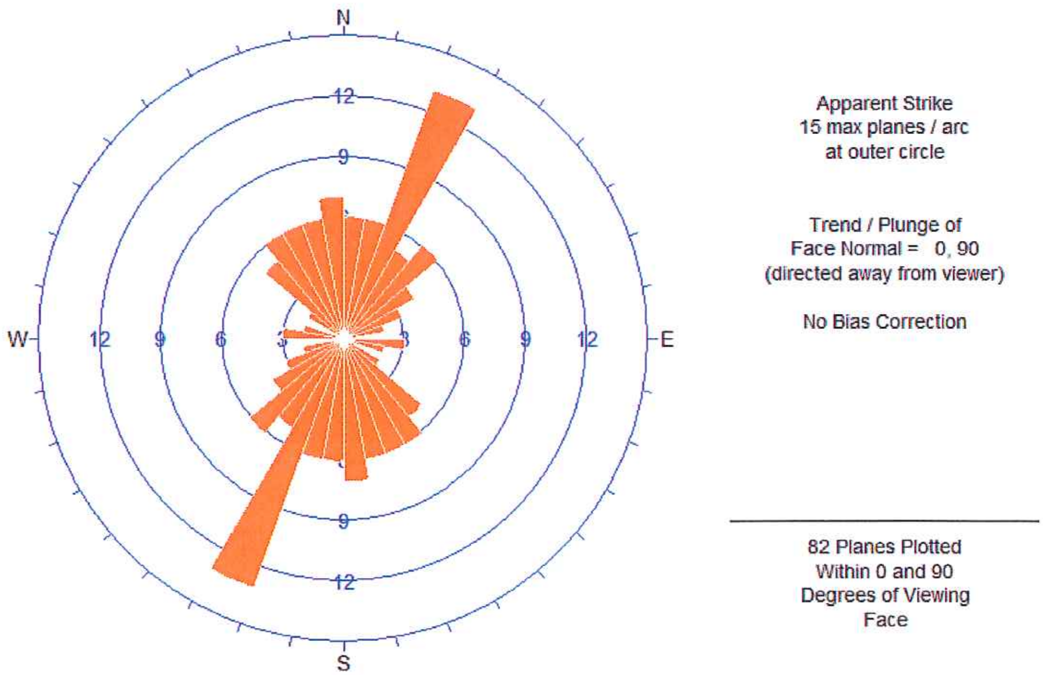


Figure 9: Rose diagram illustrating the strike distribution of fracture planes. The predominant strike direction is NNE/SSW.

ATTACHMENT A
LOGGING METHODS

1129 West Governor Road, PO Box 797
Hershey, PA 17033-0797
Voice: (717) 533 - 8600
Fax: (717) 533 - 8605

ATTACHMENT A: OVERVIEW OF LOGGING METHODS

CALIPER LOGS

The caliper log measures variations in borehole size as a function of depth in a well. Some example responses of in a caliper log is shown in Figure A- 1 (Rider, 2002[1.]) The log data enables (a) the detection of competent or fractured geologic units, (b) the location of washouts or tight zones, (c) the optimal placement of well screen, sand, and bentonite, and (d) the establishment of appropriate borehole correction factors to be applied to other well log curves. Further, when run in combination with other logs, the caliper log may be an indicator of lithologic makeup and degree of consolidation. The typical caliper response in a fractured, weathered, or karstic unit is a relatively abrupt increase in borehole size.

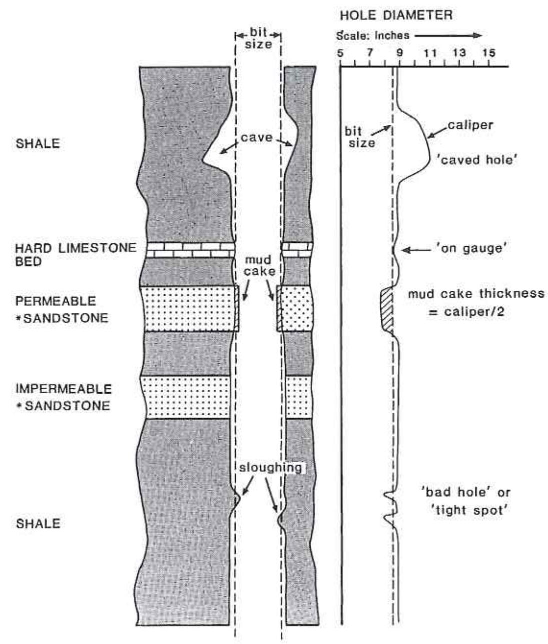


Figure A- 1: The caliper log showing some typical responses. (From Rider, 2002).

SPONTANEOUS POTENTIAL (SP) LOGS

The SP log measures the natural voltages that are created within the borehole due to the presence of borehole fluids, formation fluids, and formation matrix materials. It is recorded by measuring the difference in electrical potential in millivolts between an electrode in the borehole and a grounded electrode at the surface. The SP log is commonly used to 1) detect permeable beds, 2) detect boundaries of permeable beds, 3) determine formation water resistivity, and 4) determine the volume of shale in permeable beds. The constant SP readings observed in thicker shale units define the shale base line, a reference line from which further formation matrix and formation fluid property calculations may be completed. Although this log is consistently used in oil and gas applications, its effectiveness in water wells is limited since the method requires a contrast in salinity between borehole and formation fluids (Figure A- 2). This condition is often not met in ground water wells.

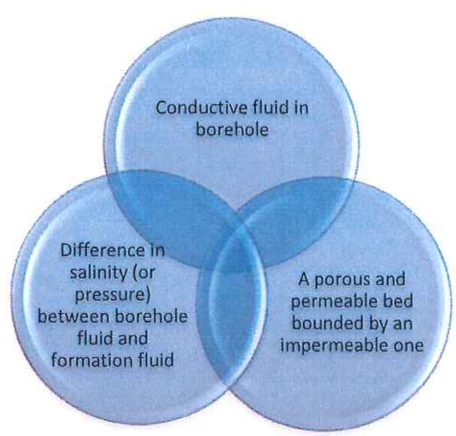


Figure A- 2: Conditions required to produce an SP response.

1 Rider, M. (2006) The Geological Interpretation of Well Logs, *Rider-French Consulting, Ltd.*, 280pp.

The SP log can be qualitatively used for permeability recognition. SP deflections from the shale base line commonly indicate the presence of a permeable bed. The magnitude and direction of the deflection is dependent upon the relative resistivity (or salinity) values of the borehole fluid and the formation fluid. If the formation fluid resistivity is less than the borehole fluid resistivity, then the relative SP values will decrease in a porous, coarse-grained unit. Alternately, if the formation fluid resistivity is greater than the borehole fluid resistivity, the relative SP values will increase in the same body, and the curve shape is referred to as a "reversed SP". If both fluid resistivities are equal, no SP deflection will occur.

GAMMA RAY LOGS

The gamma ray log is a passive instrument that measures the amount of naturally occurring radioactivity from geologic units within the borehole. Commonly occurring radioelements include potassium, thorium, and uranium; the two former elements are predominant within a common fine-grained rock sequence. The gamma ray log is also an excellent lithologic indicator because fine-grained clays and shales contain a higher radioelement concentration than limestones or sands. Gamma ray values are often used to assess the percentage of clay materials (indurated or non-indurated) that are present within a formation by utilizing empirically derived equations and sand-shale base line information.

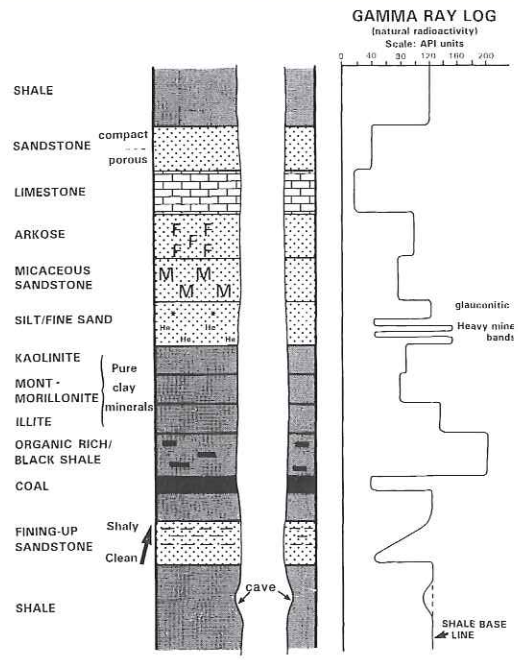


Figure A- 3: Characteristic gamma ray responses. (From Rider, 2002).

NORMAL RESISTIVITY LOGS

Resistivity is a measure of how well an electric current passes through a material. Formation resistivity is an intrinsic property of rocks and depends on the porosity and resistivity of the interstitial fluid and rock matrix.

In sedimentary rocks, the resistivity values of shales (5 - 30 ohm-m) is generally lower than the resistivity of sandstone (30 – 100 ohm-m), which is lower than the resistivity limestone (75 – 300 ohm-m). The resistivity log often shows a picture of the overall depositional sequence in sedimentary environment. Resistivity of igneous and metamorphic rocks is extremely high when compared to resistivity in sedimentary rocks, with values that are commonly thousands of ohm-meters. Example resistivity log responses are shown in Figure A- 4.

FLUID RESISTIVITY LOGS

of fluid resistivity, which is the reciprocal of fluid conductivity, provides data related to the concentration of dissolved solids in the fluid column. Although the quality of the fluid column may not reflect the quality of adjacent interstitial fluids, information can be quite useful when combined with other logs. For example, change in fluid resistivity associated with a water-producing zone that is corroborated by other logs may indicate the inflow of ground water.

SINGLE-POINT RESISTANCE LOGS

Single point resistance measurements are made by passing a constant current between two electrodes and recording the voltage fluctuations as the probe is moved up the borehole. The resistance variations measured in the borehole is primarily due to variations in the immediate vicinity of the downhole electrode.

The resistance log is strongly affected by the resistance of the drilling fluid and variations in borehole diameter. It is extremely useful for detecting fractures in boreholes with relatively constant diameter. In sedimentary environments, the resistance log generally follows the variations in resistivity of the formation. Shales in clay generally exhibit low values, sandstones have intermediate values, while coal and limestone beds have high resistance values.

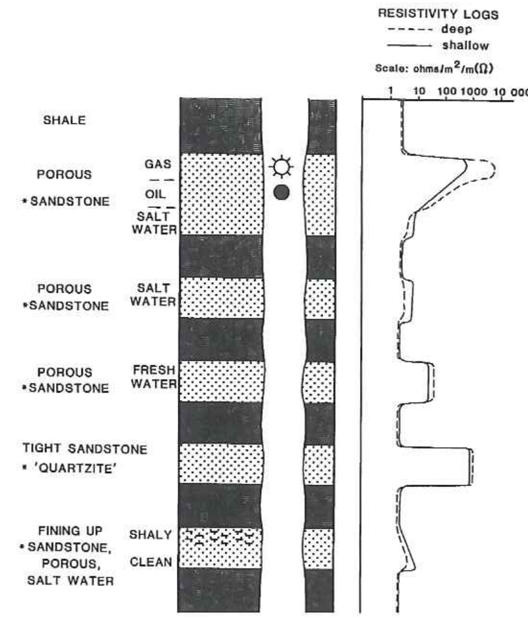


Figure A- 4: Characteristic resistivity responses. (From Rider, 2002)

TEMPERATURE LOGS

Temperature logs measure the change in fluid temperature within the borehole as a function of depth. This log can indicate the location of water- producing strata or fracture zones within the well. The inherent assumption of this technique is that the fluids entering the borehole from water producing zones are either cooler or warmer than the fluid in the borehole. In this case, it is possible to relate a temperature anomaly to a depth range in which waters of different temperature are emanating from a water-producing/receiving or fractured lithologic unit.

OPTICAL TELEVIEWER (OTV) LOGS

The optical televiewer probe combines the axial view of a downward looking digital imaging system with a precision ground hyperbolic mirror to obtain an undistorted 360° view of the borehole wall. The probe records one 360° line of pixels at 0.003-ft depth intervals. The sample circle can be divided into 720 or 360 radial samples to give 0.5° or 1° radial resolution. For this investigation, the highest radial resolution (0.5°) was used. The line of pixels is aligned with respect to True North and digitally stacked to construct a complete, undistorted, and oriented image of the borehole walls. The data are 24 -bit true color and may be used for lithologic determination as part of the interpretation. Since the acquired image is digitized and properly oriented with respect to borehole deviation and tool rotation, it allows data processing to provide accurate strike and dip information of structural features. The borehole image is often shown as an "unwrapped" 360° image in which the cylindrical borehole image is sliced down the northern axis and flattened out as shown in Figure A- 6.

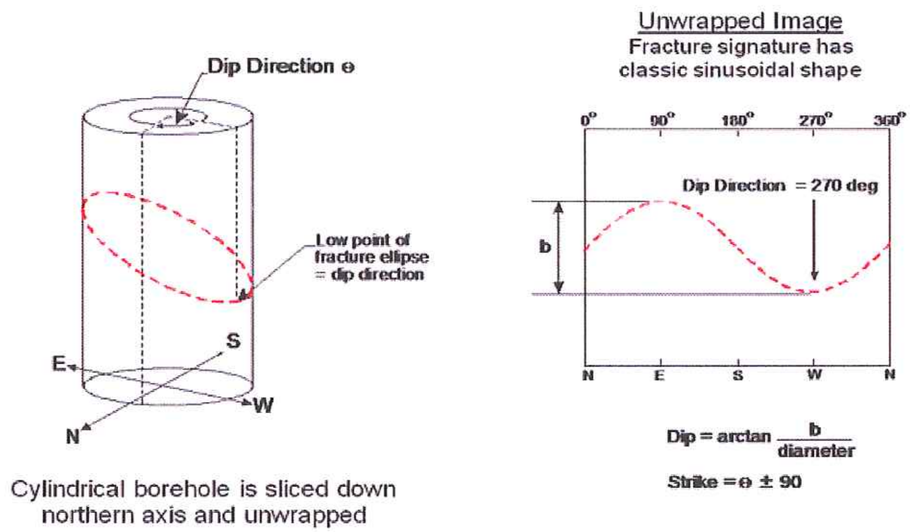


Figure A- 5: Schematic showing the sinusoidal fracture signature in the unwrapped borehole view.

ACOUSTIC TELEVIEWER (ATV) LOGS

Acoustic televiewer provides a 360° acoustic image of the borehole walls that can be used to identify and determine the orientation of planar features such as bedding and fractures. The data can also indicate the relative degree of hardness of formation materials. As shown in Figure A-7, Ultrasonic pulses are transmitted from a rotating transducer inside the tool. The transmitted pulses reflect off the borehole wall and return to the tool where the travel time and amplitude of the acoustic signal are measured. In order for the acoustic waves to travel to and from the borehole wall, the well must be fluid filled. Greater travel time can indicate openings in the rock. Strong amplitude suggests smooth, competent rock. Weaker amplitudes suggest rough or less competent rock.

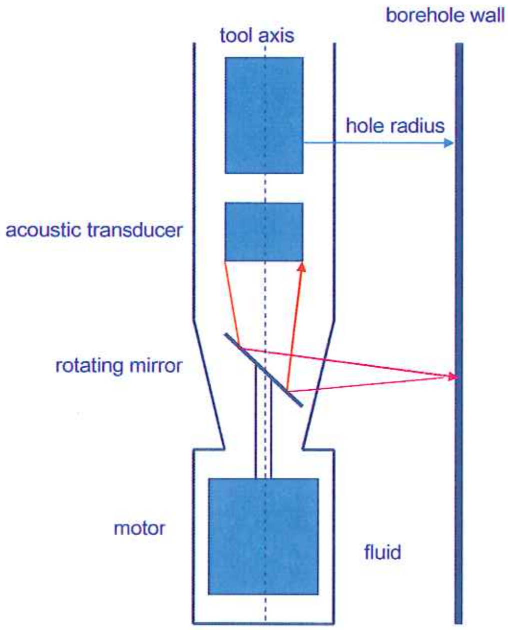


Figure A- 6: Schematic of the acoustic televiewer tool.

ATTACHMENT B
WELL LOGS

ARM GEOPHYSICS Surface & Borehole Services

HydroLog

Well Name: 1612 Rayville
API Well Number: N/A
Company: Environmental Alliance, Inc.
Municipality: Parkton
Farm: N/A
7.5' Quad Name: New Freedom
County: Baltimore
State: Maryland
Date: 6/30/2009
Recorded by: M. Scott McQuown, P.G.
Witness:

Elevations:
Kelly bushings: N/A
Drilling floor: N/A
Ground level:
Permanent datum is:
Permanent datum elevation: Unknown
Log is measured from: Top of casing, 1.35' above grd
Height above log datum: N/A
Drilling measured from: N/A
Height above drilling datum: N/A

TD - Driller:
TD - logger: 114'
Drive Pipe Depth: N/A
Deepest Casing - Driller:
Deepest Casing - Logger: 23'
Fluid Level:

Notes:

WELL LOGGING OPERATIONS

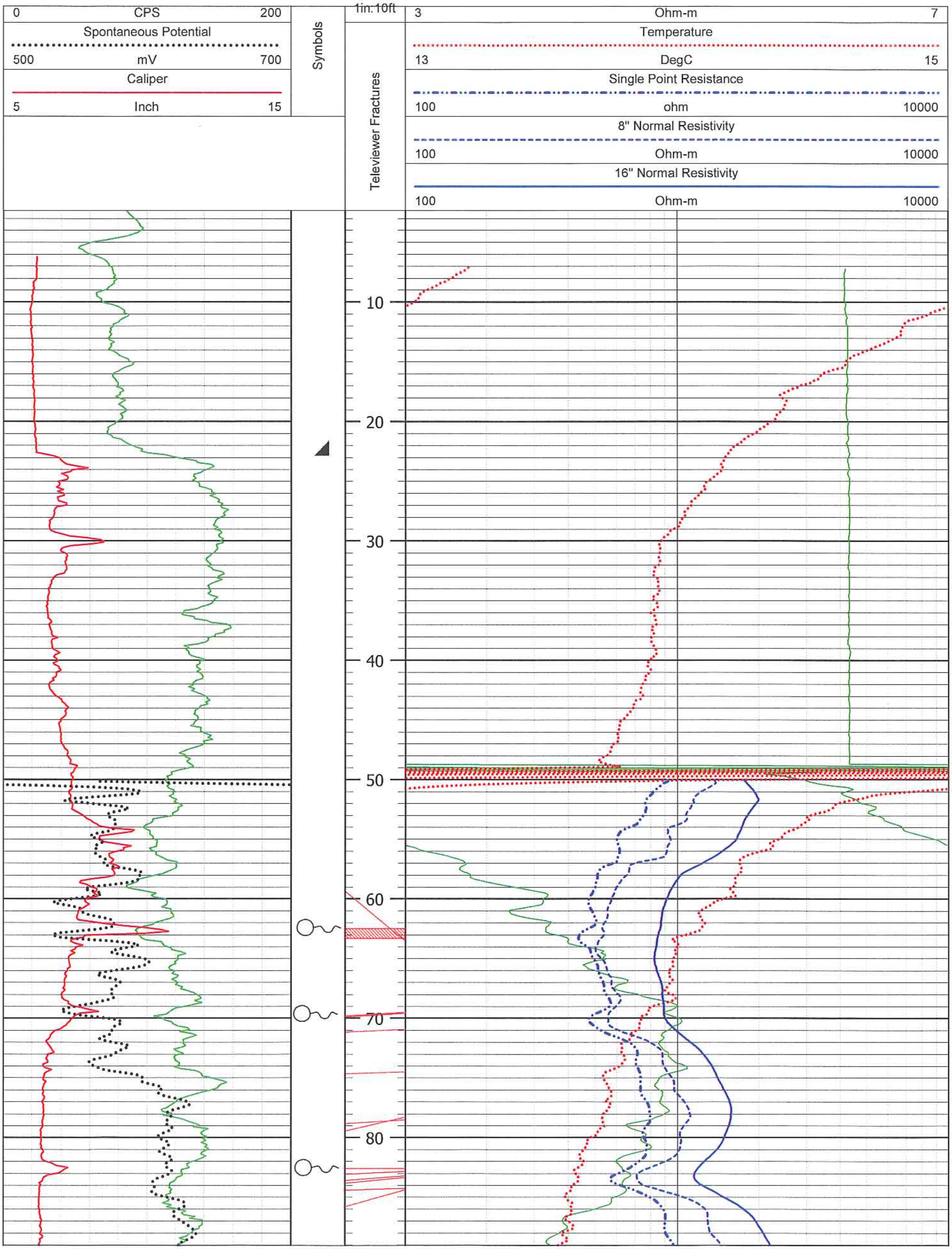
Run	1	2			
Log	POLY	CAL			
Date	6/30/2009	6/30/2009			

Symbols

Casing Bottom

Water-bearing zone (undifferentiated)

Gamma Ray		Depth 1in:10ft	Fluid Resistivity


0 CPS 200
Spontaneous Potential
500 mV 700
Caliper
5 Inch 15
Symbols
1in:10ft
Televiewer Fractures
3 Ohm-m 7
Temperature
13 DegC 15
Single Point Resistance
100 ohm 10000
8" Normal Resistivity
100 Ohm-m 10000
16" Normal Resistivity
100 Ohm-m 10000
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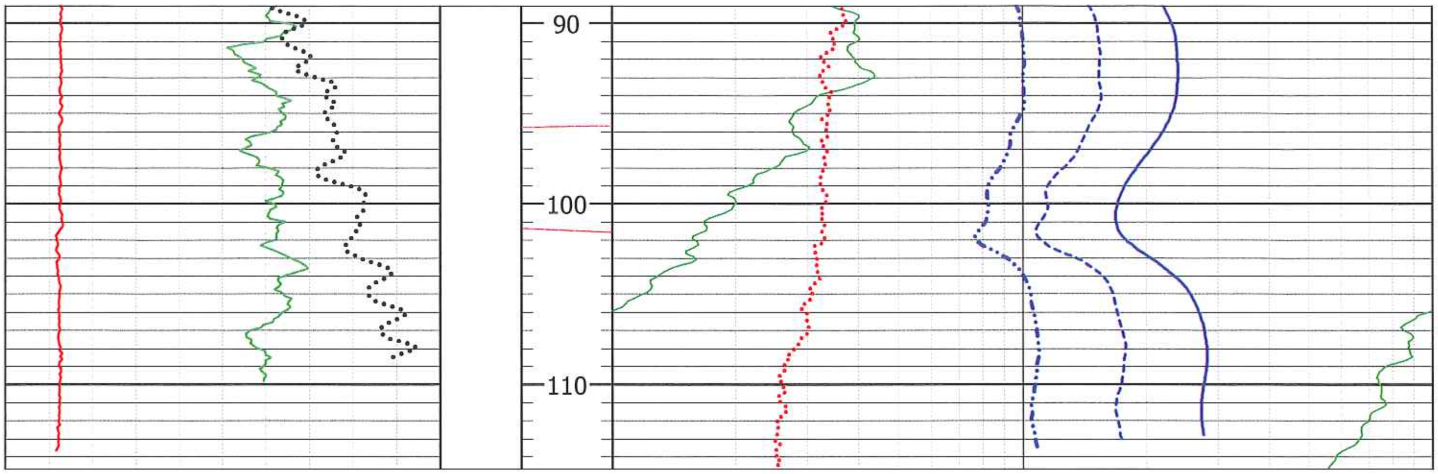
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100
110

ARM GEOPHYSICS
Surface & Borehole Services

Optical Televiewer
Acoustic Televiewer

Well Name: 1612 Rayville
API Well Number: N/A
Company: Environmental Alliance, Inc.
Municipality: Parkton
Farm: N/A
7.5' Quad Name: New Freedom
County: Baltimore
State: Maryland
Date: 6/30/2009
Recorded by: M. Scott McQuown, P.G.
Witness:

Elevations:
Kelly bushings: N/A
Drilling floor: N/A
Ground level:
Permanent datum is:
Permanent datum elevation: Unknown
Log is measured from: Top of casing, 1.35' above grd
Height above log datum: N/A
Drilling measured from: N/A
Height above drilling datum: N/A

TD - Driller:
TD - logger: 114'
Drive Pipe Depth: N/A
Deepest Casing - Driller:
Deepest Casing - Logger: 23'
Fluid Level:

Notes:

Magnetic declination applied: 11.1 deg West

WELL LOGGING OPERATIONS

Run	1	2			
Log	OTV	ATV			
Date	6/30/09	6/30/09			

Plane Type

Open Fracture   Bedding / Foliation   Non-planar void or joint

Optical View	Depth	Acoustic Amplitude	Acoustic Travel Time	Plane Projection	Dip & Dip Direction

0° 90° 180° 270° 0°	1in:1ft	0° 90° 180° 270° 0°	0° 90° 180° 270° 0°	0° 90° 180° 270° 0°	0 90

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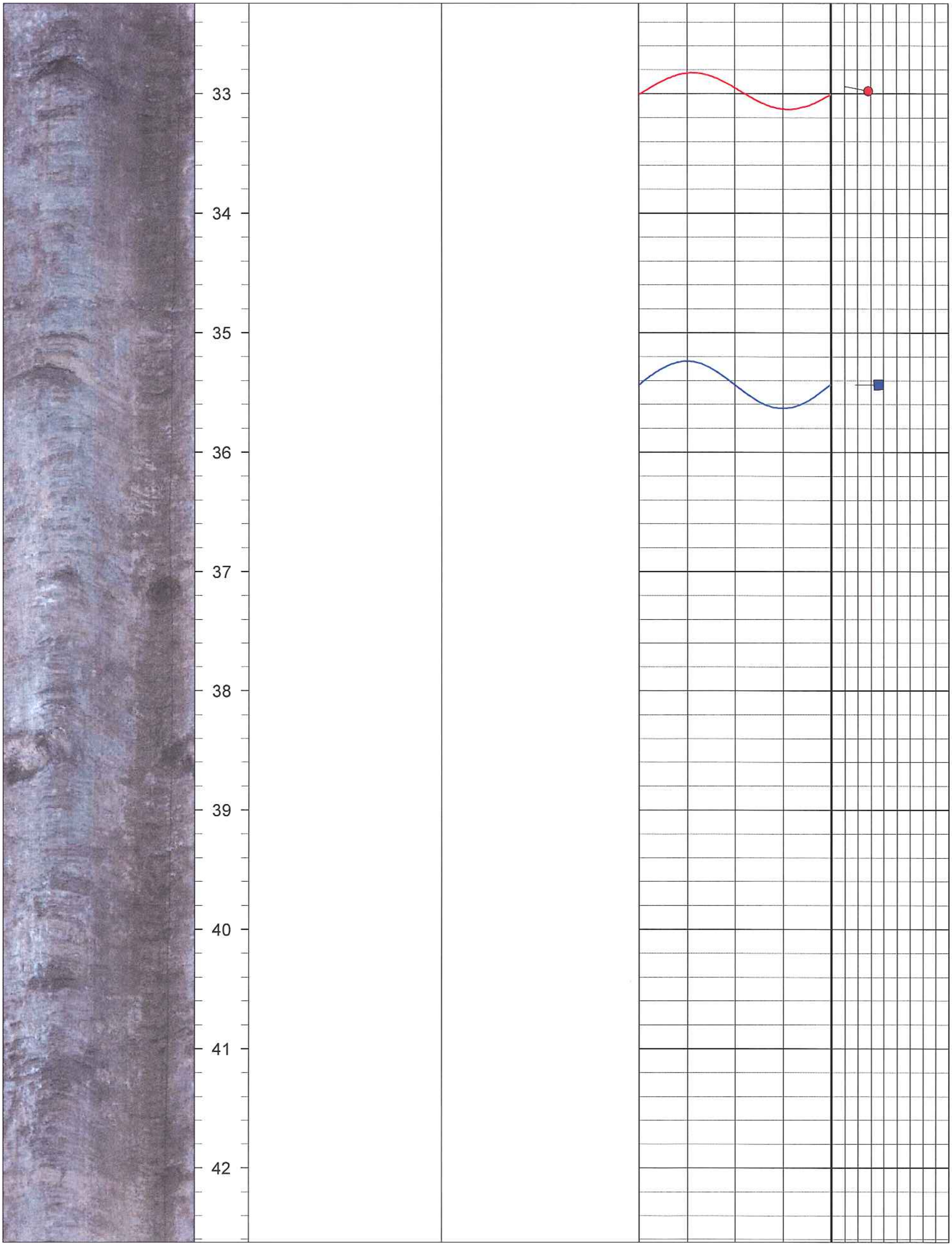
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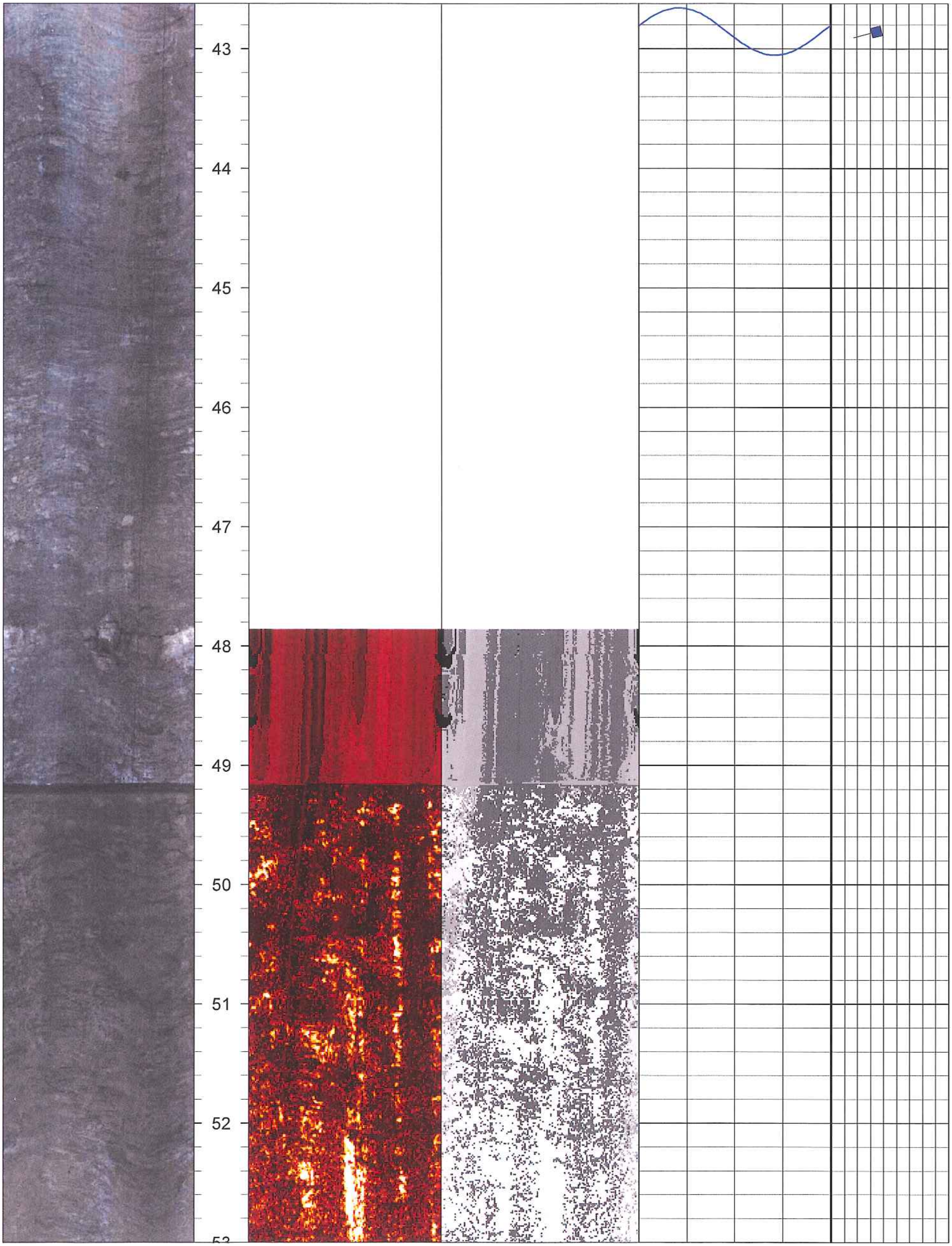
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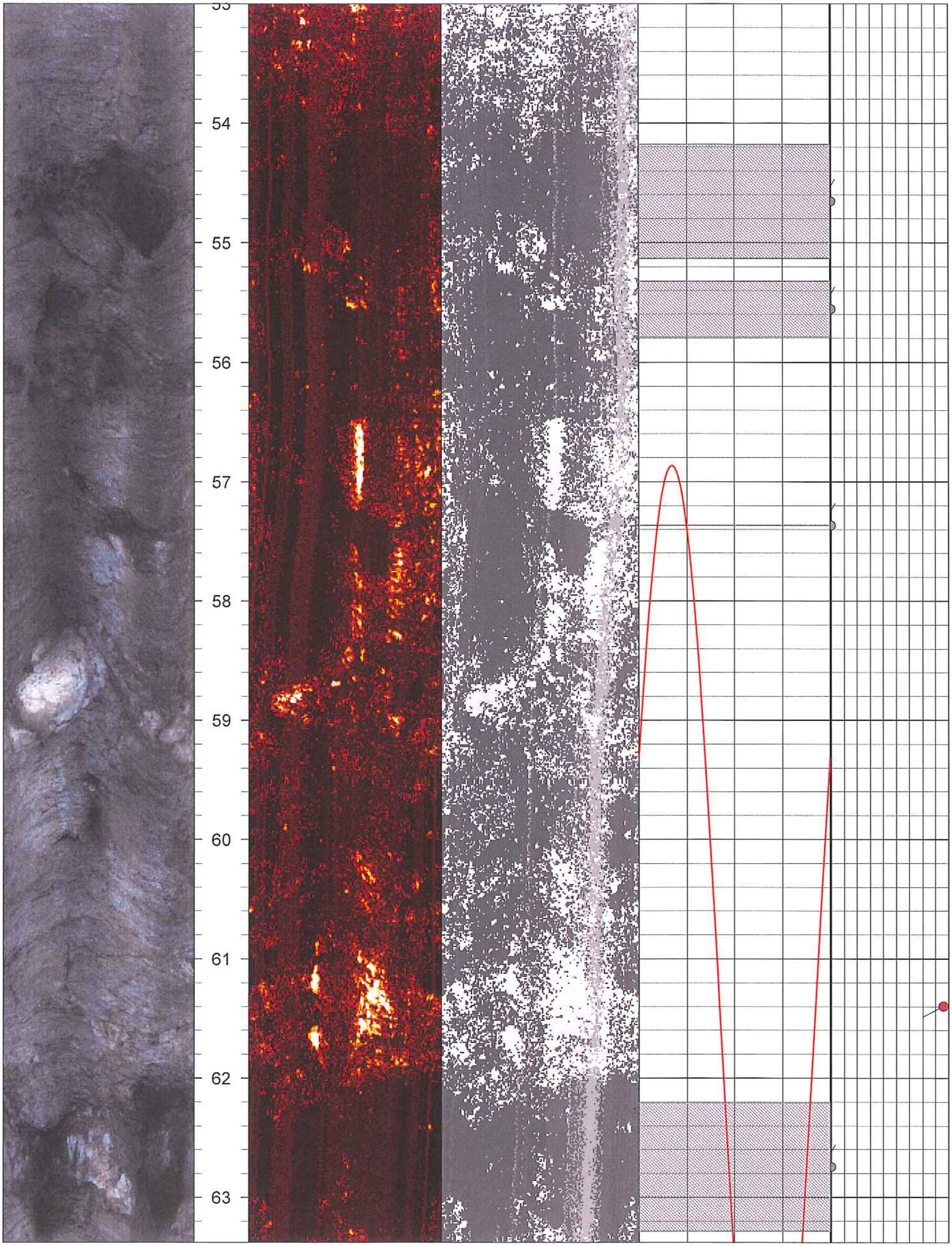
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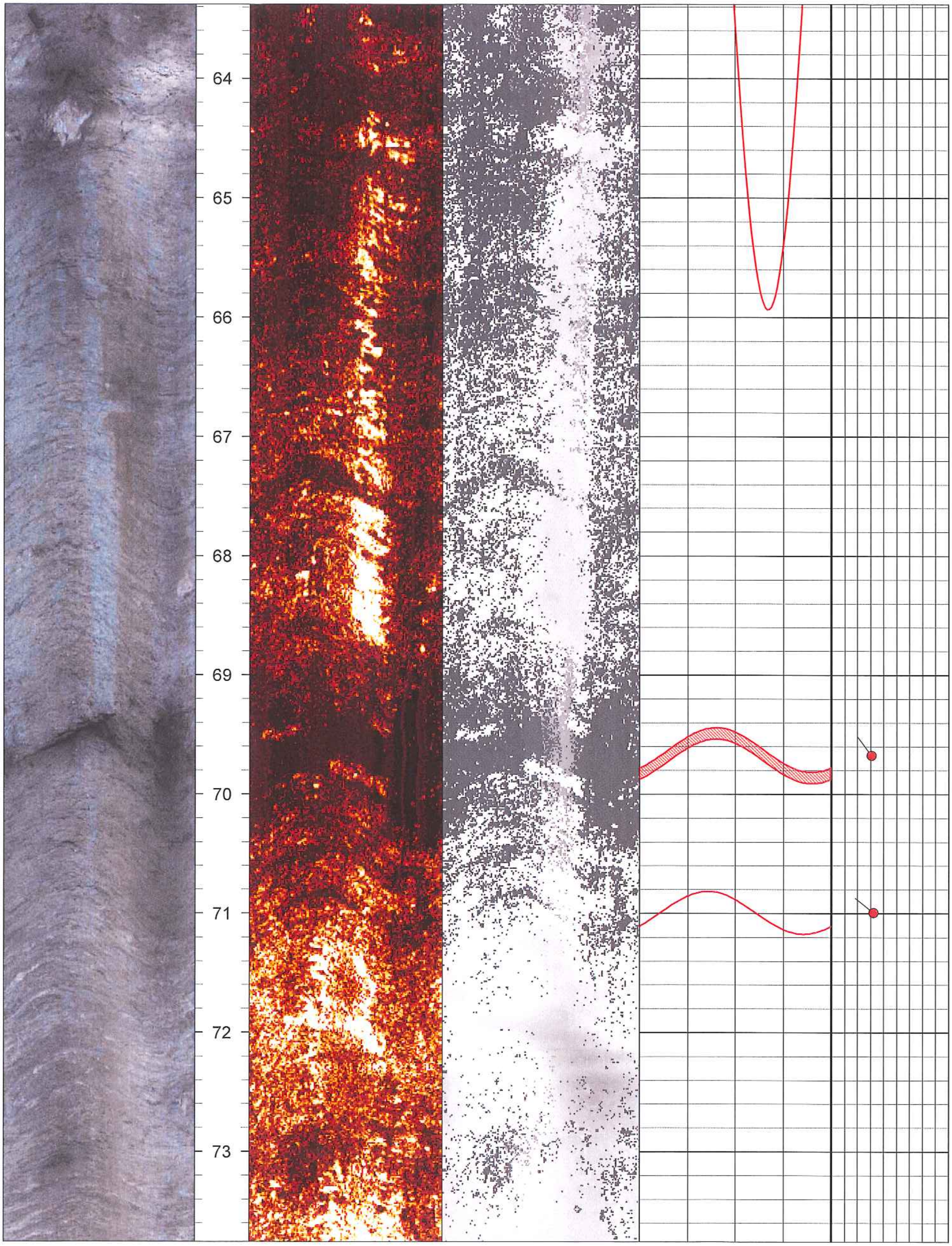
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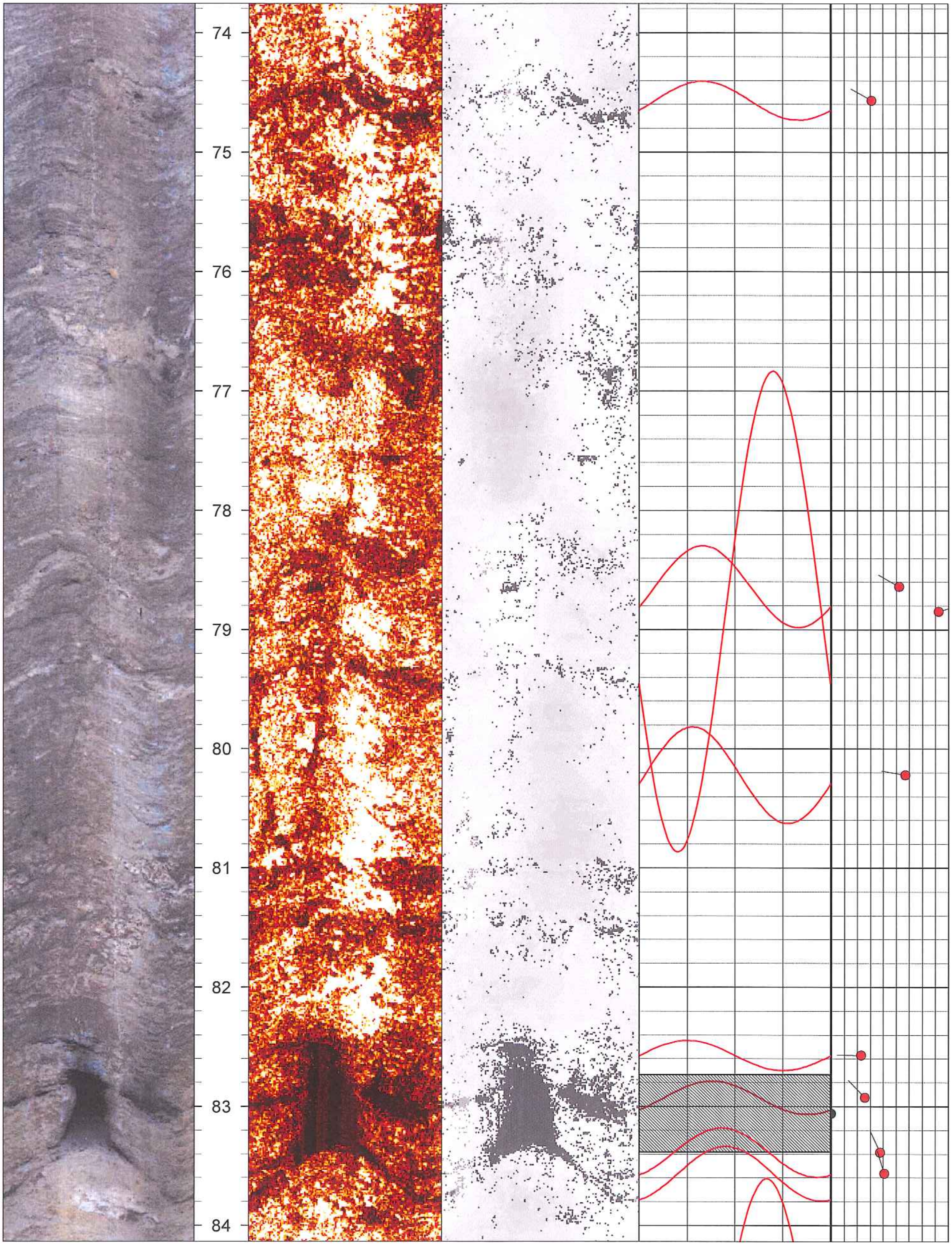
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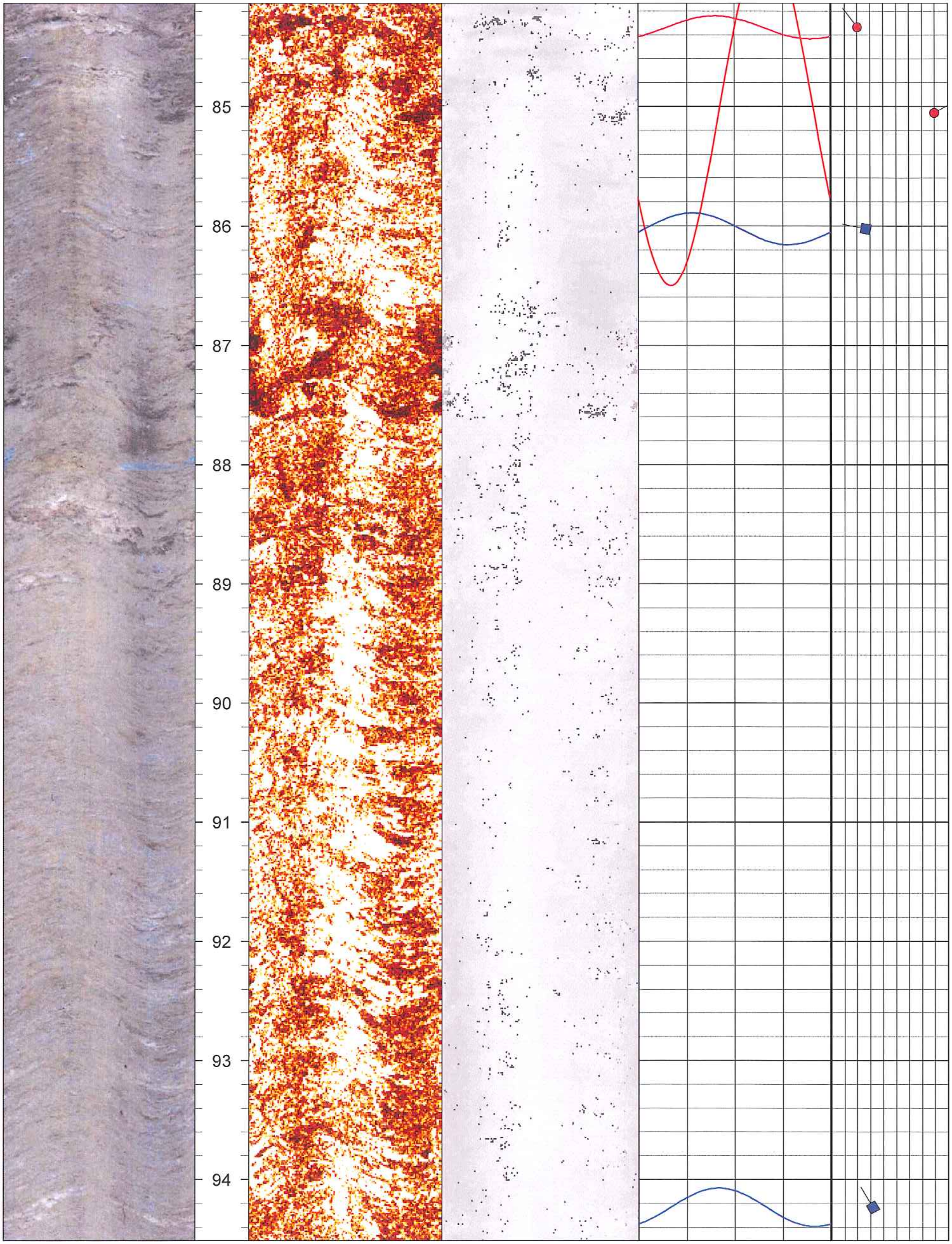

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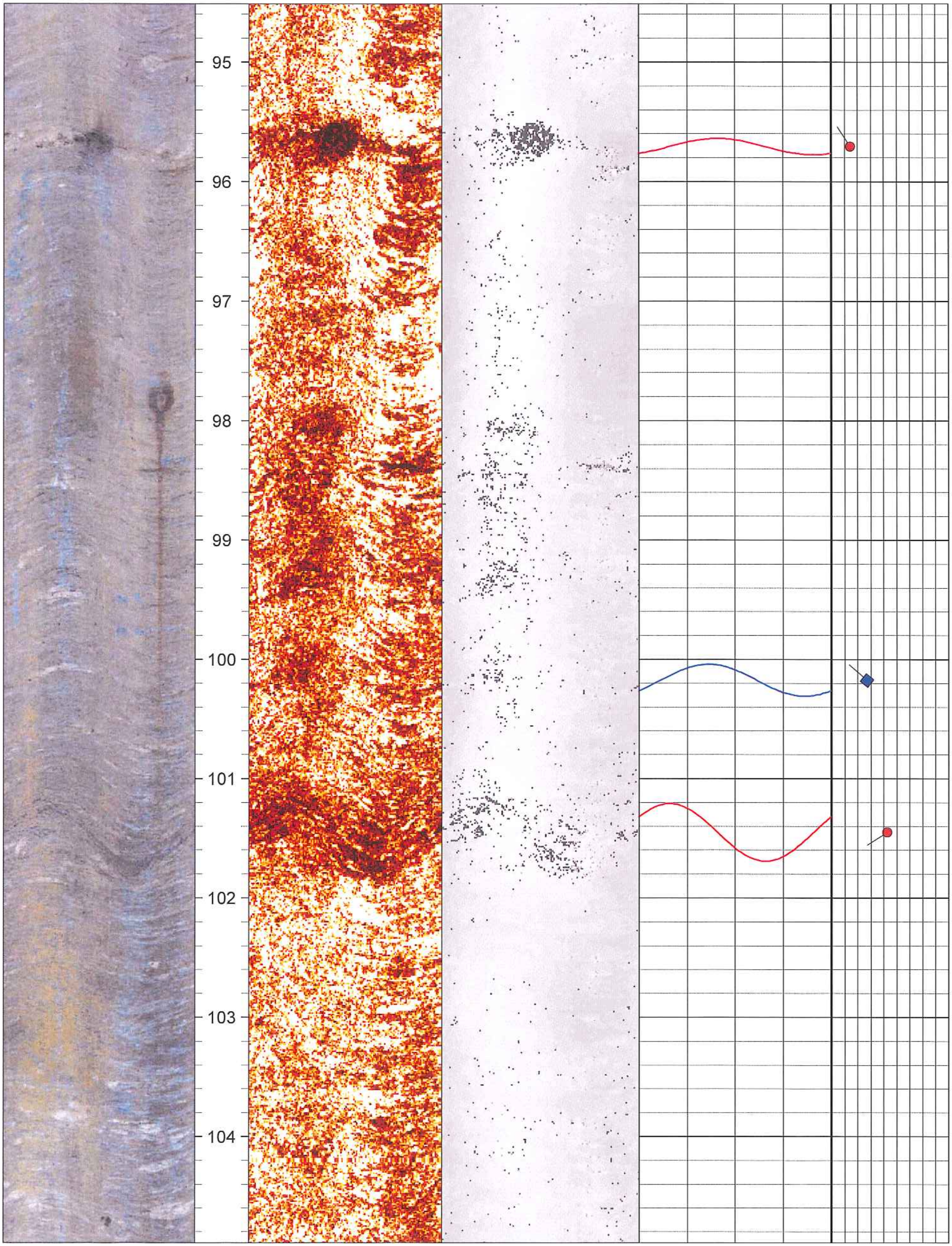
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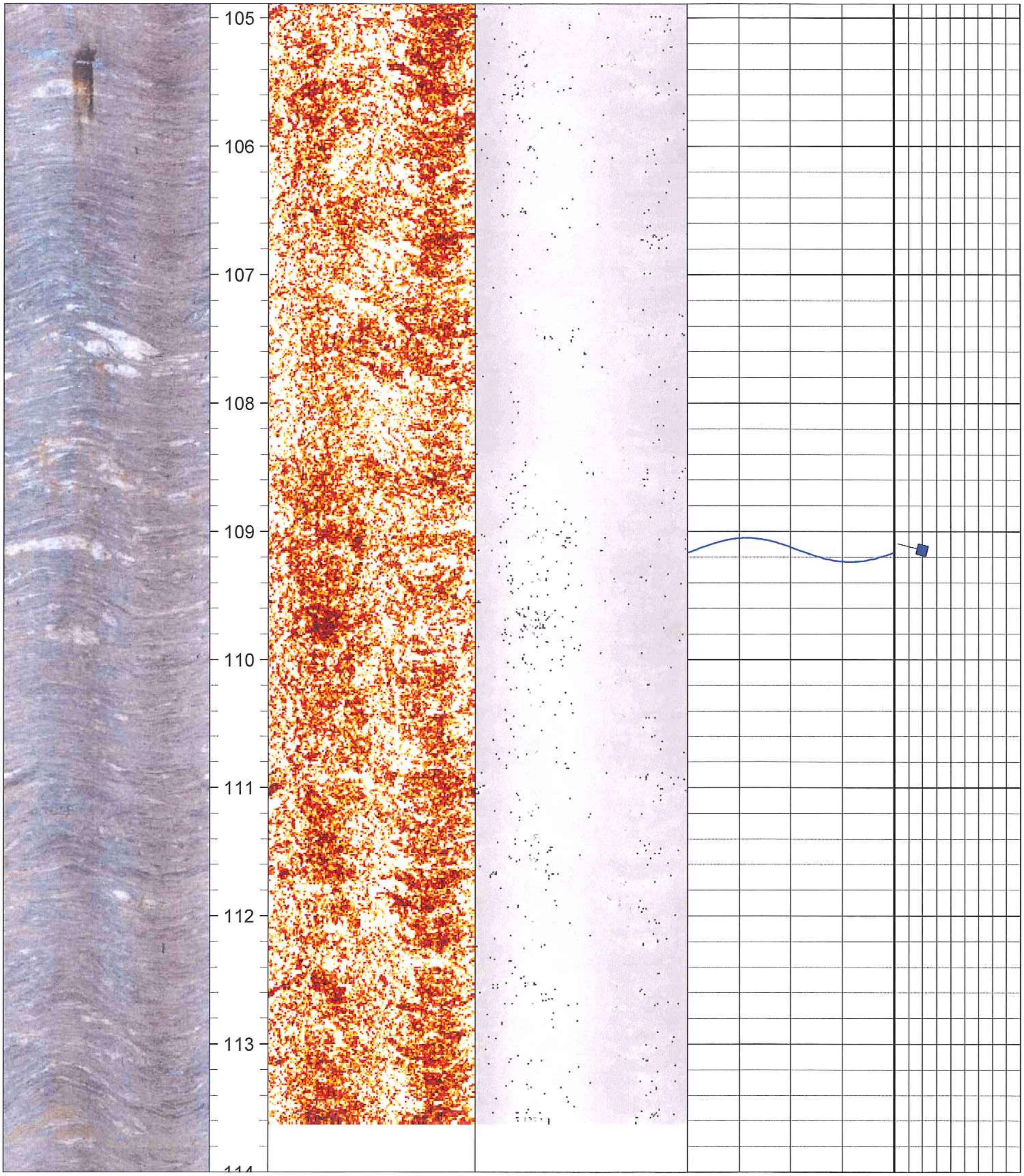
105
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113

ARM GEOPHYSICS
Surface & Borehole Services

HydroLog

Well Name:	1608 Rayville
API Well Number:	N/A
Company:	Environmental Alliance, Inc.
Municipality:	Parkton
Farm:	N/A
7.5' Quad Name:	New Freedom
County:	Baltimore
State:	Maryland
Date:	6/30/2009
Recorded by:	M. Scott McQuown, P.G.
Witness:	

Elevations:

Kelly bushings:	N/A
Drilling floor:	N/A
Ground level:	
Permanent datum is:	
Permanent datum elevation:	Unknown
Log is measured from:	Top of casing, 3.75' below grd
Height above log datum:	N/A
Drilling measured from:	N/A
Height above drilling datum:	N/A

TD - Driller:	
TD - logger:	84.7'
Drive Pipe Depth:	N/A
Deepest Casing - Driller:	
Deepest Casing - Logger:	44'
Fluid Level:	

Notes:

WELL LOGGING OPERATIONS

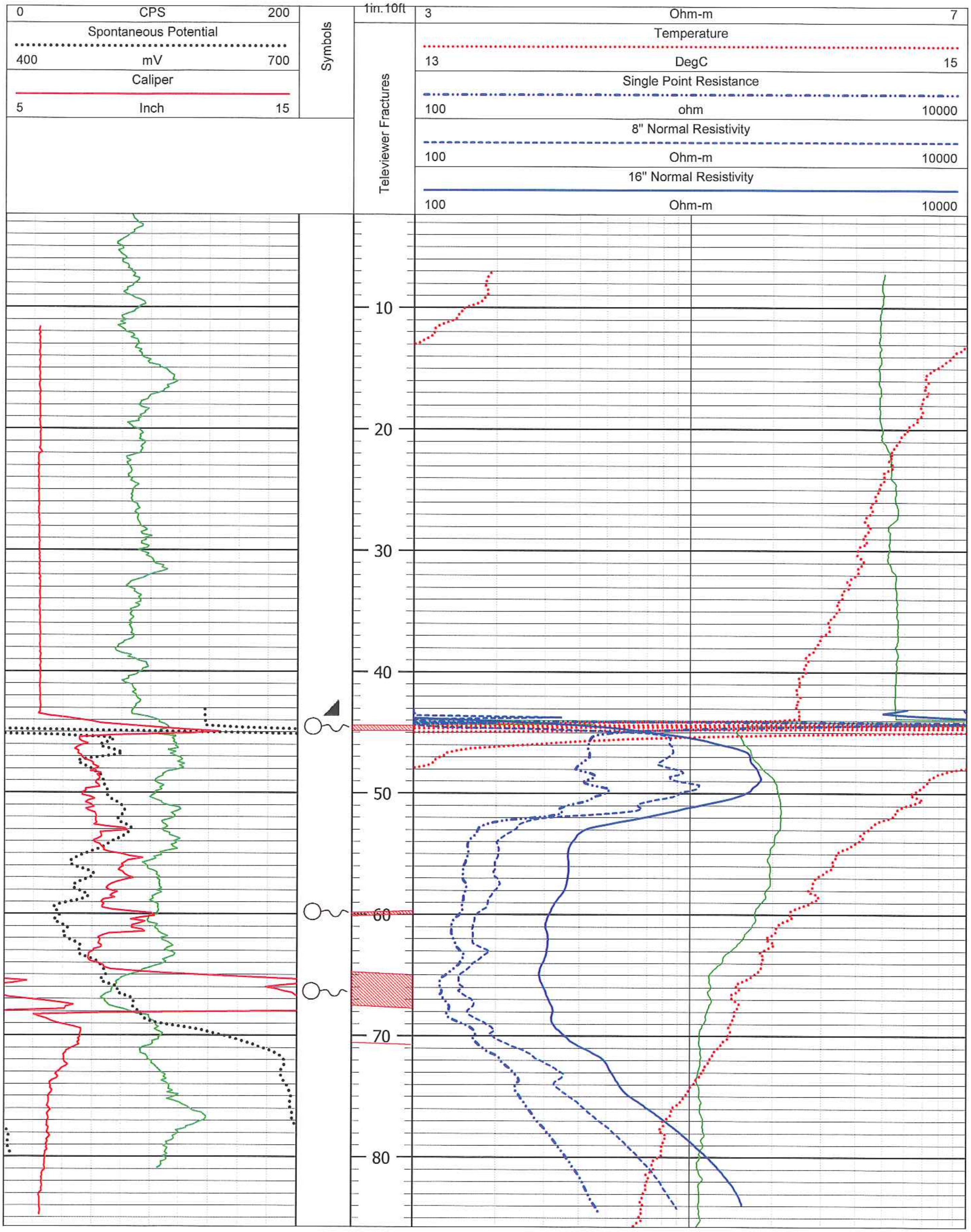
Run	1	2			
Log	POLY	CAL			
Date	6/30/2009	6/30/2009			

Symbols

◢ Casing Bottom

○∼ Water-bearing zone (undifferentiated)

Gamma Ray		Depth 1in:10ft	Fluid Resistivity


0 CPS 200
Spontaneous Potential
400 mV 700
Caliper
5 Inch 15
Symbols
1in:10ft
Televiewer Fractures
3 Ohm-m 7
Temperature
13 DegC 15
Single Point Resistance
100 ohm 10000
8" Normal Resistivity
100 Ohm-m 10000
16" Normal Resistivity
100 Ohm-m 10000
10
20
30
40
50
60
70
80

ARM GEOPHYSICS *Surface & Borehole Services*

Optical Televiewer
Acoustic Televiewer

Well Name: 1608 Rayville
API Well Number: N/A
Company: Environmental Alliance, Inc.
Municipality: Parkton
Farm: N/A
7.5' Quad Name: New Freedom
County: Baltimore
State: Maryland
Date: 6/30/2009
Recorded by: M. Scott McQuown, P.G.
Witness:

Elevations:
Kelly bushings: N/A
Drilling floor: N/A
Ground level:
Permanent datum is:
Permanent datum elevation: Unknown
Log is measured from: Top of casing, 3.75' below grd
Height above log datum: N/A
Drilling measured from: N/A
Height above drilling datum: N/A

TD - Driller:
TD - logger: 84.7'
Drive Pipe Depth: N/A
Deepest Casing - Driller:
Deepest Casing - Logger: 44'
Fluid Level:

Notes:

Magnetic declination applied: 11.1 deg West

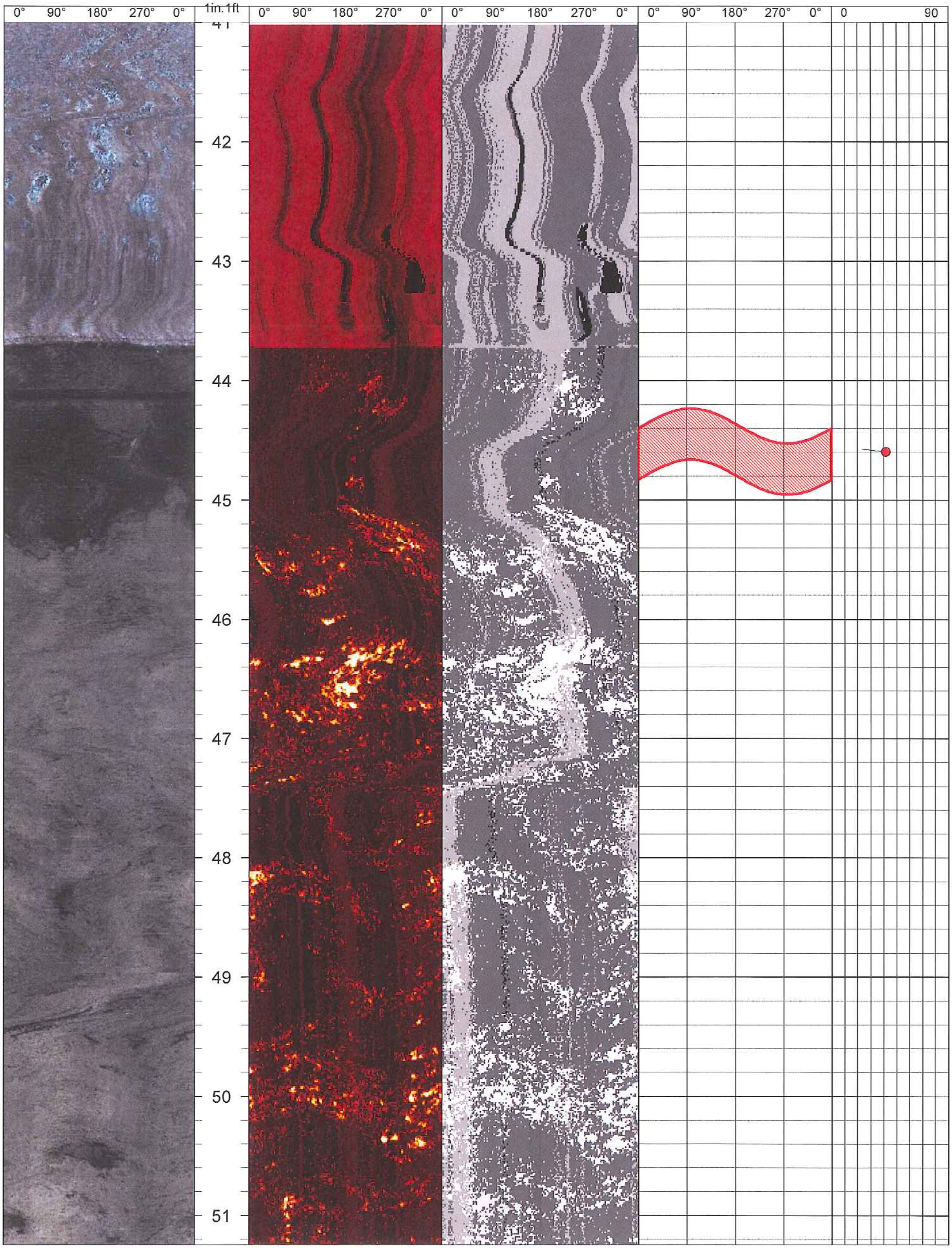
WELL LOGGING OPERATIONS

Run	1	2			
Log	OTV	ATV			
Date	6/30/2009	6/30/2009			

Plane Type

Open Fracture   Bedding / Foliation

Optical View	Depth	Acoustic Amplitude	Acoustic Travel Time	Plane Projection	Dip & Dip Direction


0° 90° 180° 270° 0°
1in:1ft
0° 90° 180° 270° 0°
0° 90° 180° 270° 0°
0° 90° 180° 270° 0°
0 90
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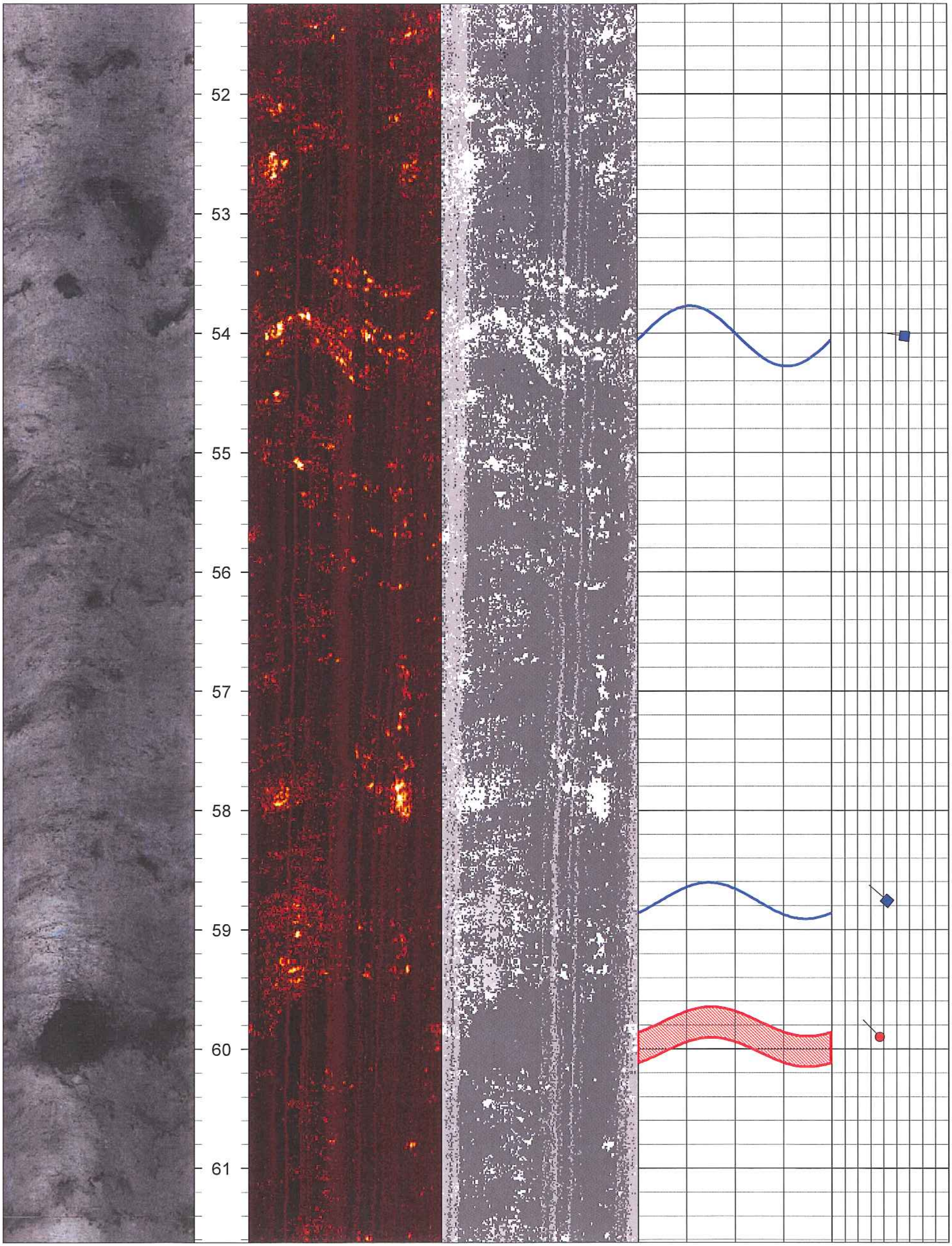
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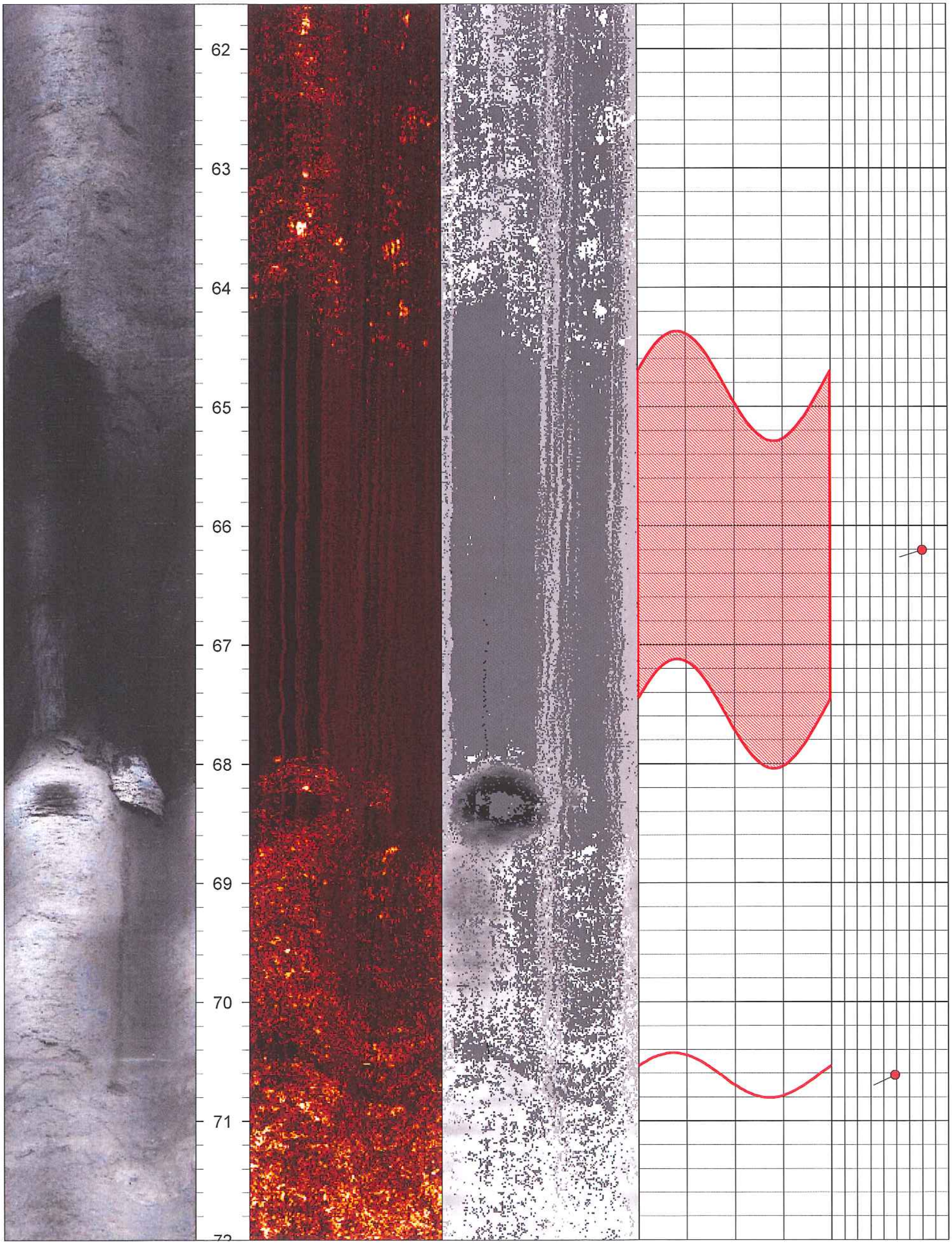
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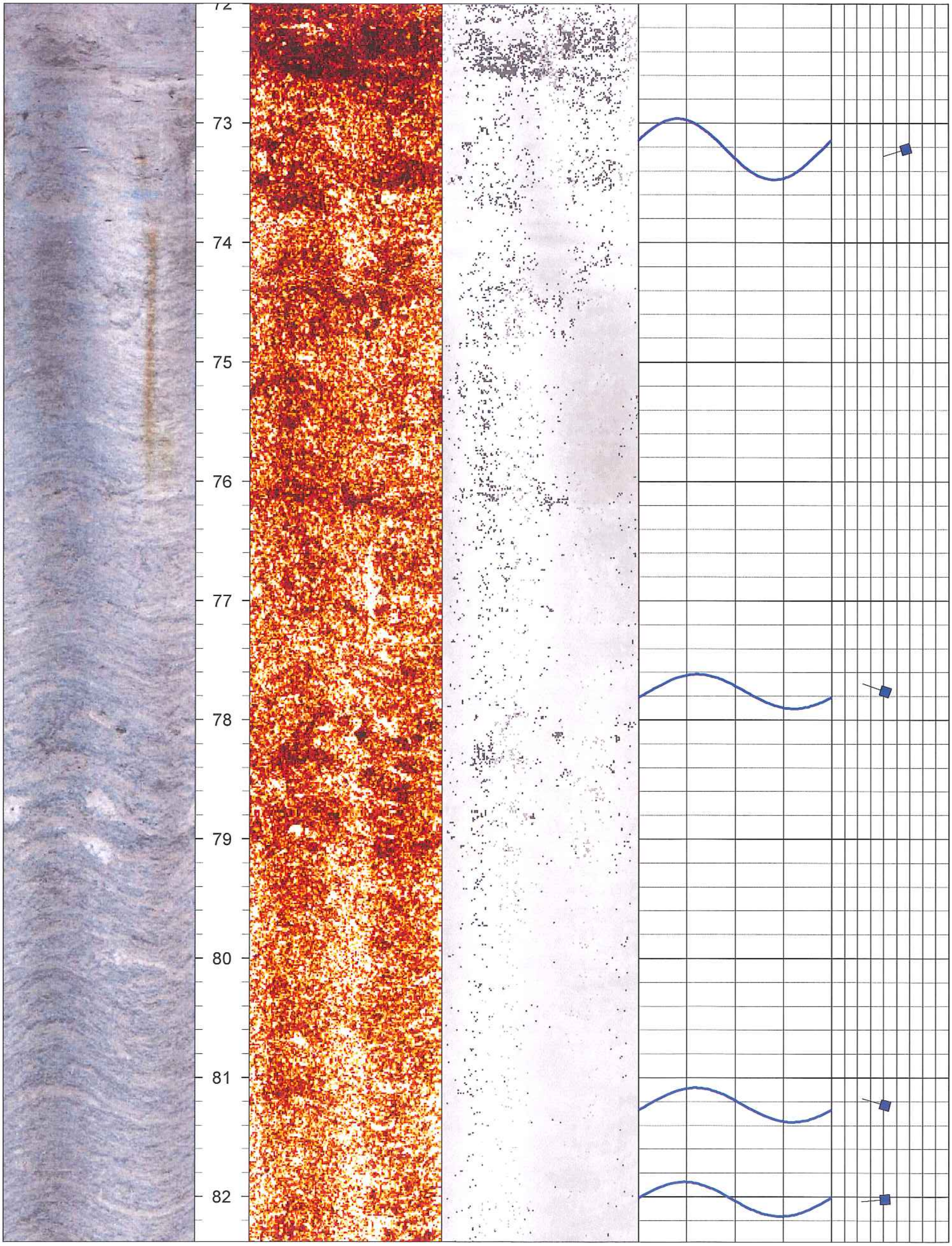
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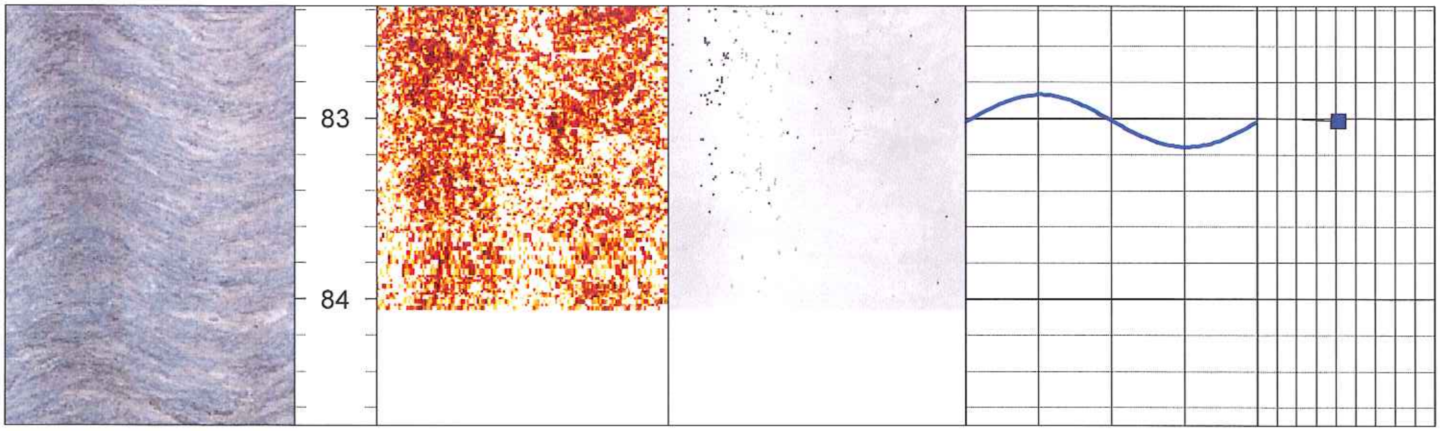
82


83
84

ARM GEOPHYSICS
Surface & Borehole Services

HydroLog

Well Name:	1606 Rayville
API Well Number:	N/A
Company:	Environmental Alliance, Inc.
Municipality:	Parkton
Farm:	N/A
7.5' Quad Name:	New Freedom
County:	Baltimore
State:	Maryland
Date:	6/30/2009
Recorded by:	M. Scott McQuown, P.G.
Witness:	

Elevations:

Kelly bushings:	N/A
Drilling floor:	N/A
Ground level:	
Permanent datum is:	
Permanent datum elevation:	Unknown
Log is measured from:	Top of casing, 3.4' below grd
Height above log datum:	N/A
Drilling measured from:	N/A
Height above drilling datum:	N/A

TD - Driller:	
TD - logger:	135.7'
Drive Pipe Depth:	N/A
Deepest Casing - Driller:	
Deepest Casing - Logger:	27'
Fluid Level:	

Notes:

WELL LOGGING OPERATIONS

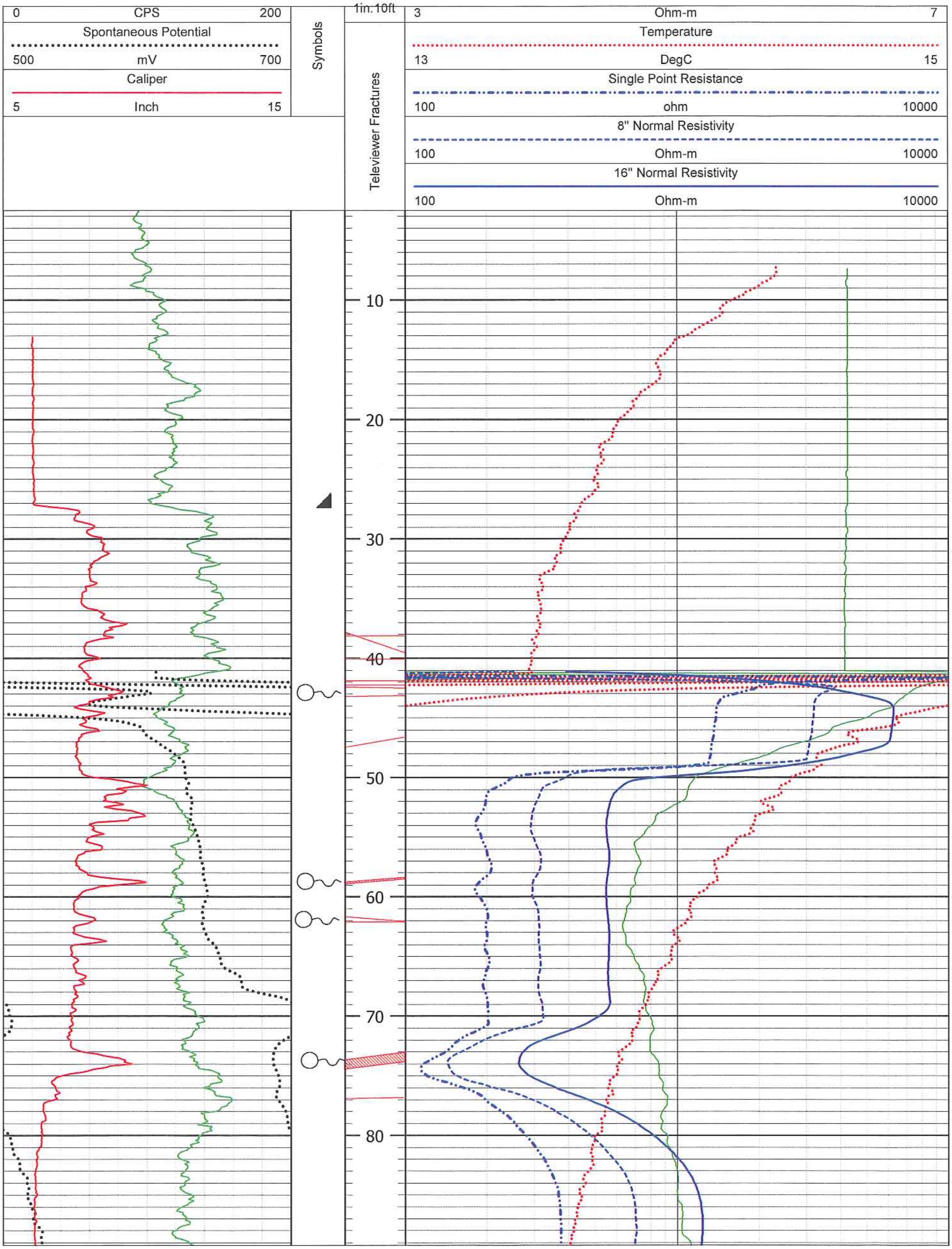
Run	1	2			
Log	POLY	CAL			
Date	6/30/2009	6/30/2009			

Symbols

Casing Bottom

Water-bearing zone (undifferentiated)

Gamma Ray		Depth 1in:10ft	Fluid Resistivity


0 CPS 200
Spontaneous Potential
500 mV 700
Caliper
5 Inch 15
Symbols
1in:10ft
Televiewer Fractures
3 Ohm-m 7
Temperature
13 DegC 15
Single Point Resistance
100 ohm 10000
8" Normal Resistivity
100 Ohm-m 10000
16" Normal Resistivity
100 Ohm-m 10000
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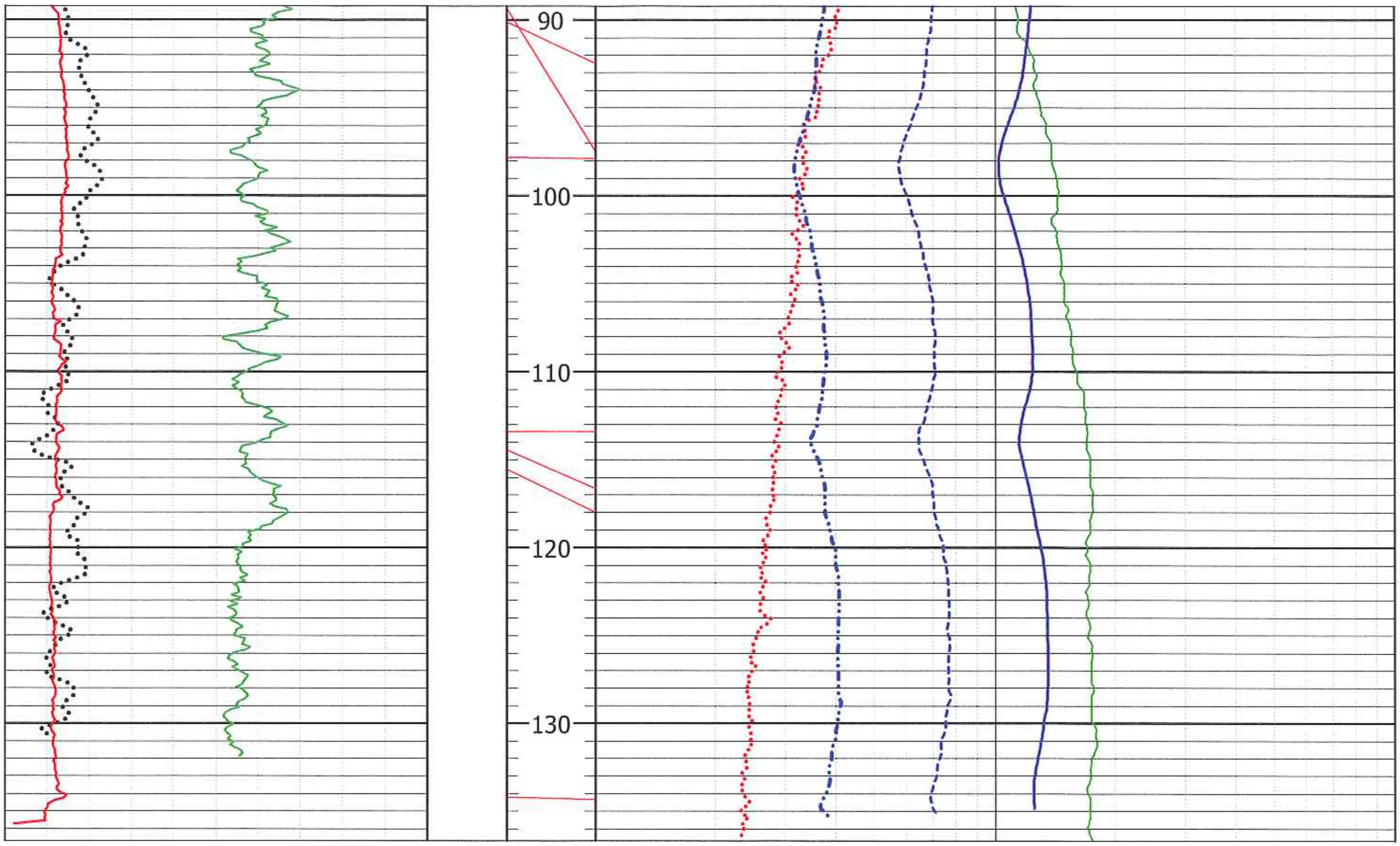
90
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130

ARM GEOPHYSICS
Surface & Borehole Services

Optical Televiewer
Acoustic Televiewer

Well Name: 1606 Rayville
API Well Number: N/A
Company: Environmental Alliance, Inc.
Municipality: Parkton
Farm: N/A
7.5' Quad Name: New Freedom
County: Baltimore
State: Maryland
Date: 6/30/2009
Recorded by: M. Scott McQuown, P.G.
Witness:

Elevations:
Kelly bushings: N/A
Drilling floor: N/A
Ground level:
Permanent datum is:
Permanent datum elevation: Unknown
Log is measured from: Top of casing, 3.4' below grd
Height above log datum: N/A
Drilling measured from: N/A
Height above drilling datum: N/A

TD - Driller:
TD - logger: 135.7'
Drive Pipe Depth: N/A
Deepest Casing - Driller:
Deepest Casing - Logger: 27'
Fluid Level:

Notes:

Magnetic declination applied: 11.1 deg West

WELL LOGGING OPERATIONS

Run	1	2			
Log	OTV	ATV			
Date	6/30/2009	6/30/2009			
Return depth error	.09	0.02			

Plane Type

Open Fracture
Bedding / Foliation
Non-planar void or joint

Optical View	Depth	Acoustic Amplitude	Acoustic Travel Time	Plane Projection	Dip & Dip Direction

0° 90° 180° 270° 0°	1in:1ft	0° 90° 180° 270° 0°	0° 90° 180° 270° 0°	0° 90° 180° 270° 0°	0 90

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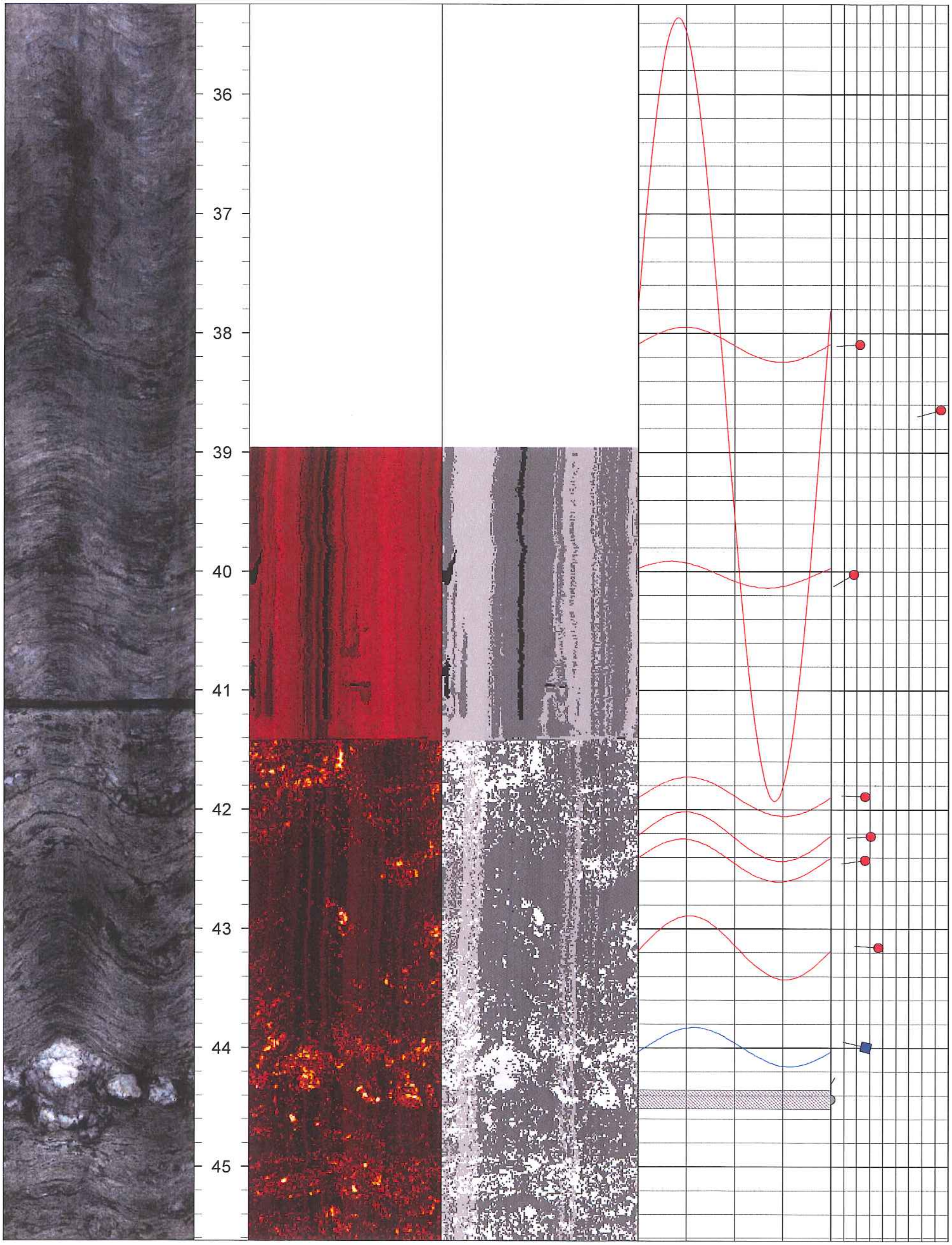
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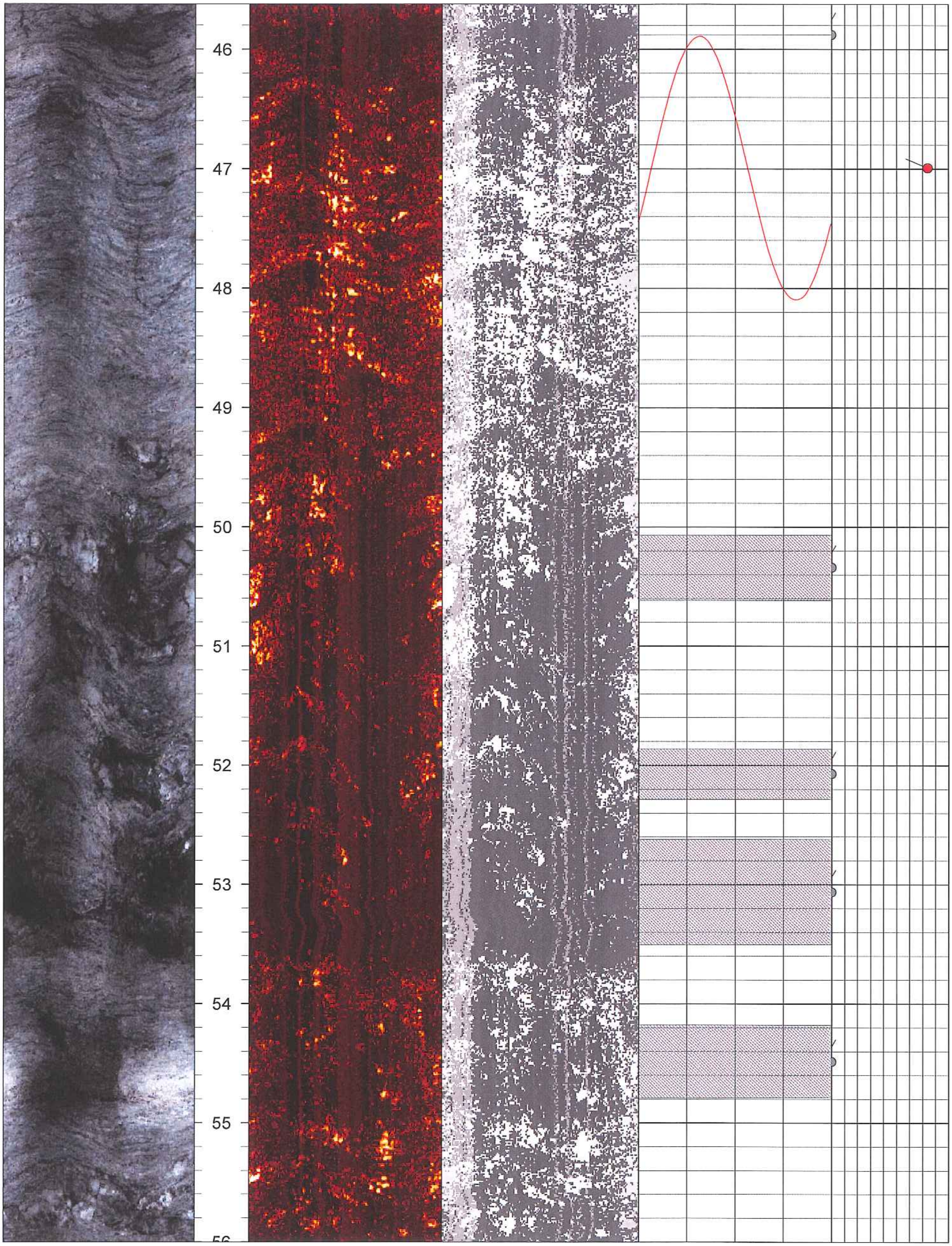
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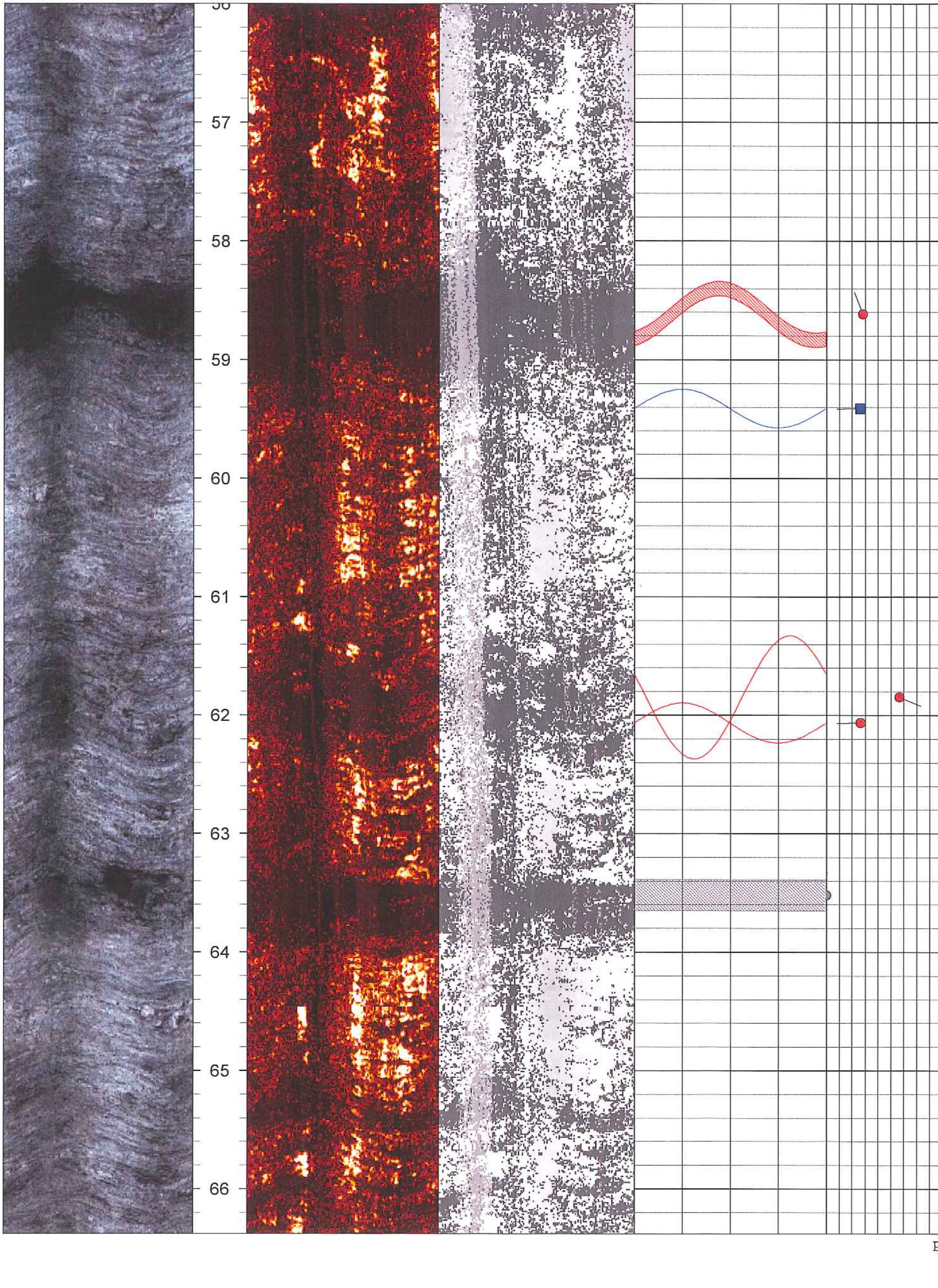
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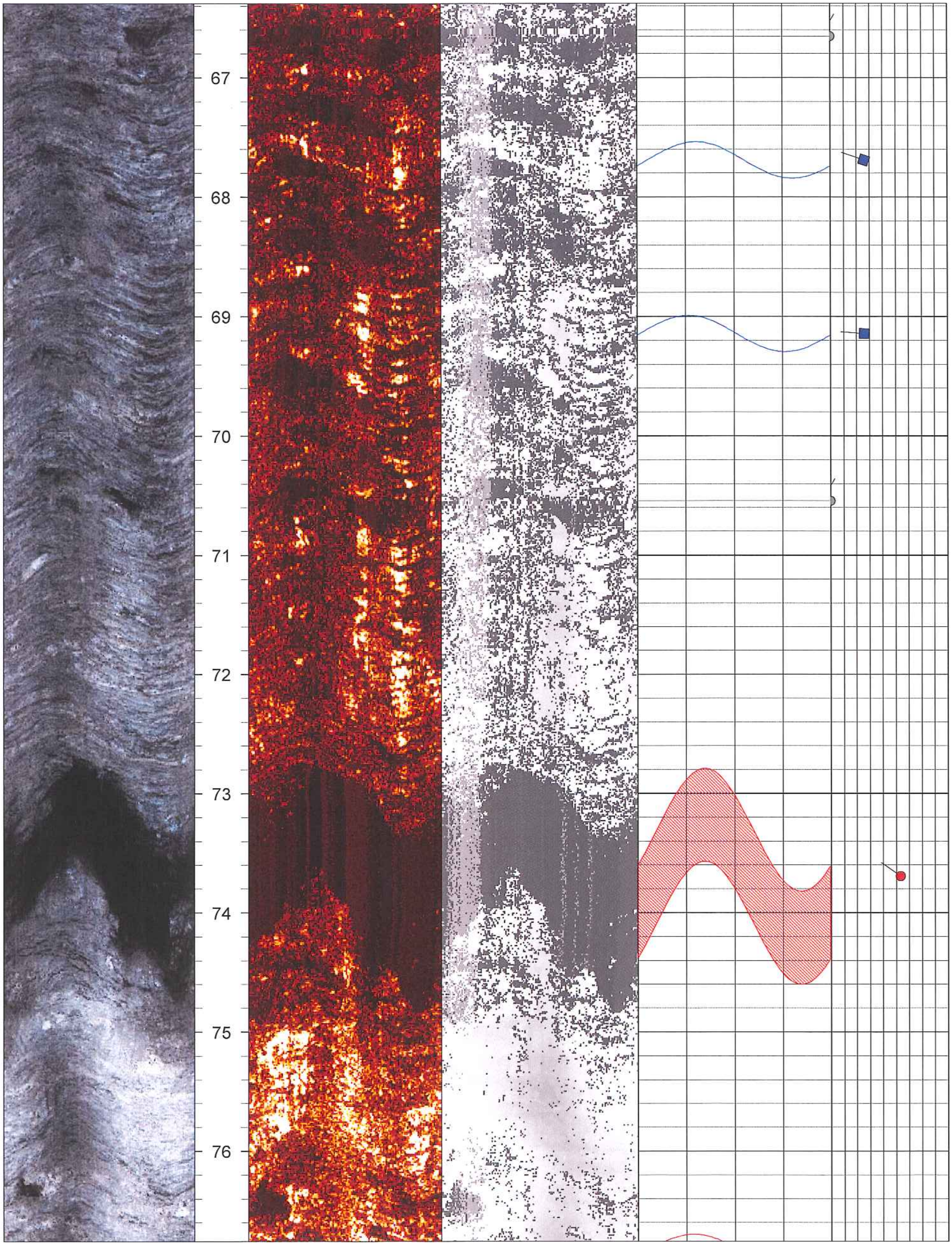
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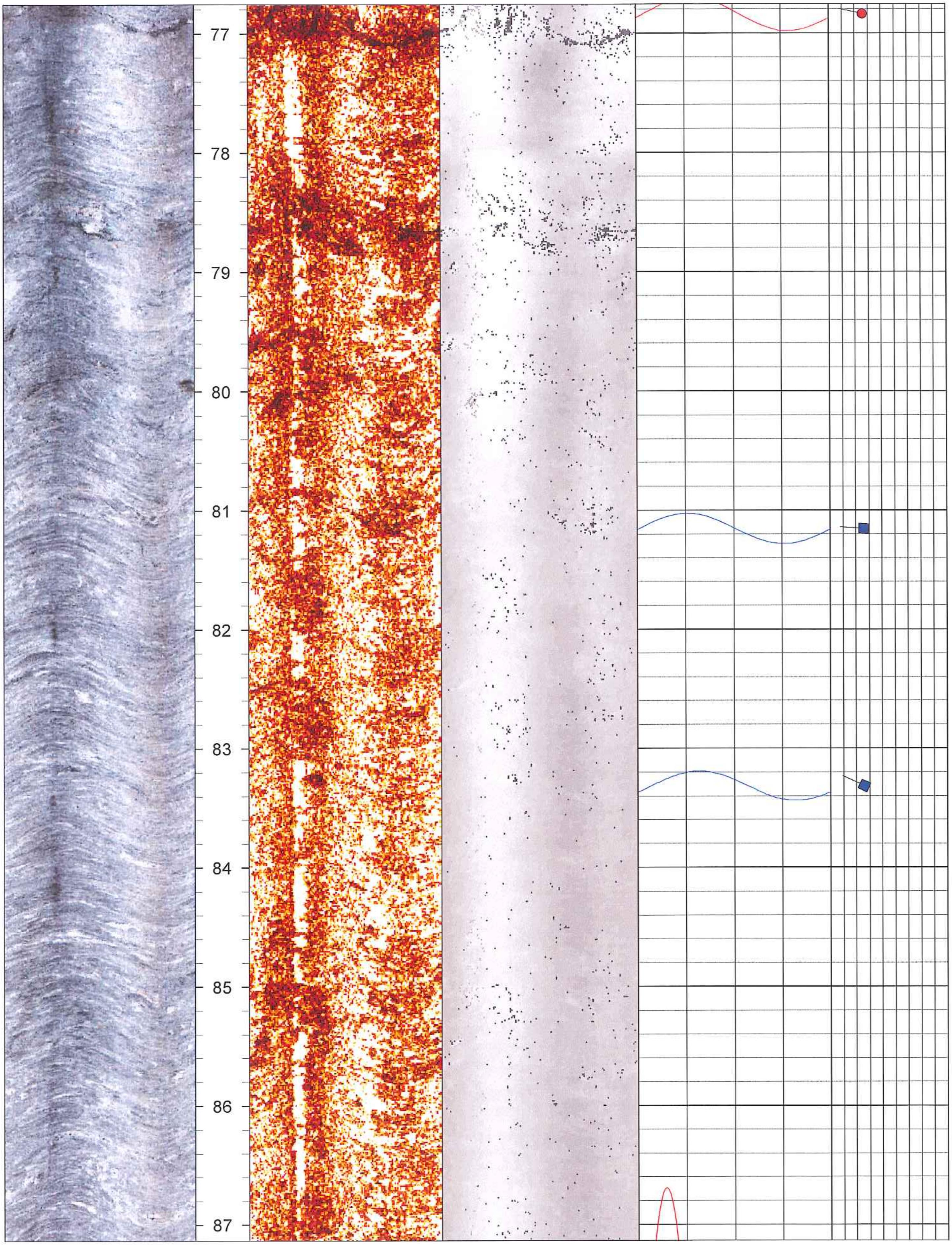
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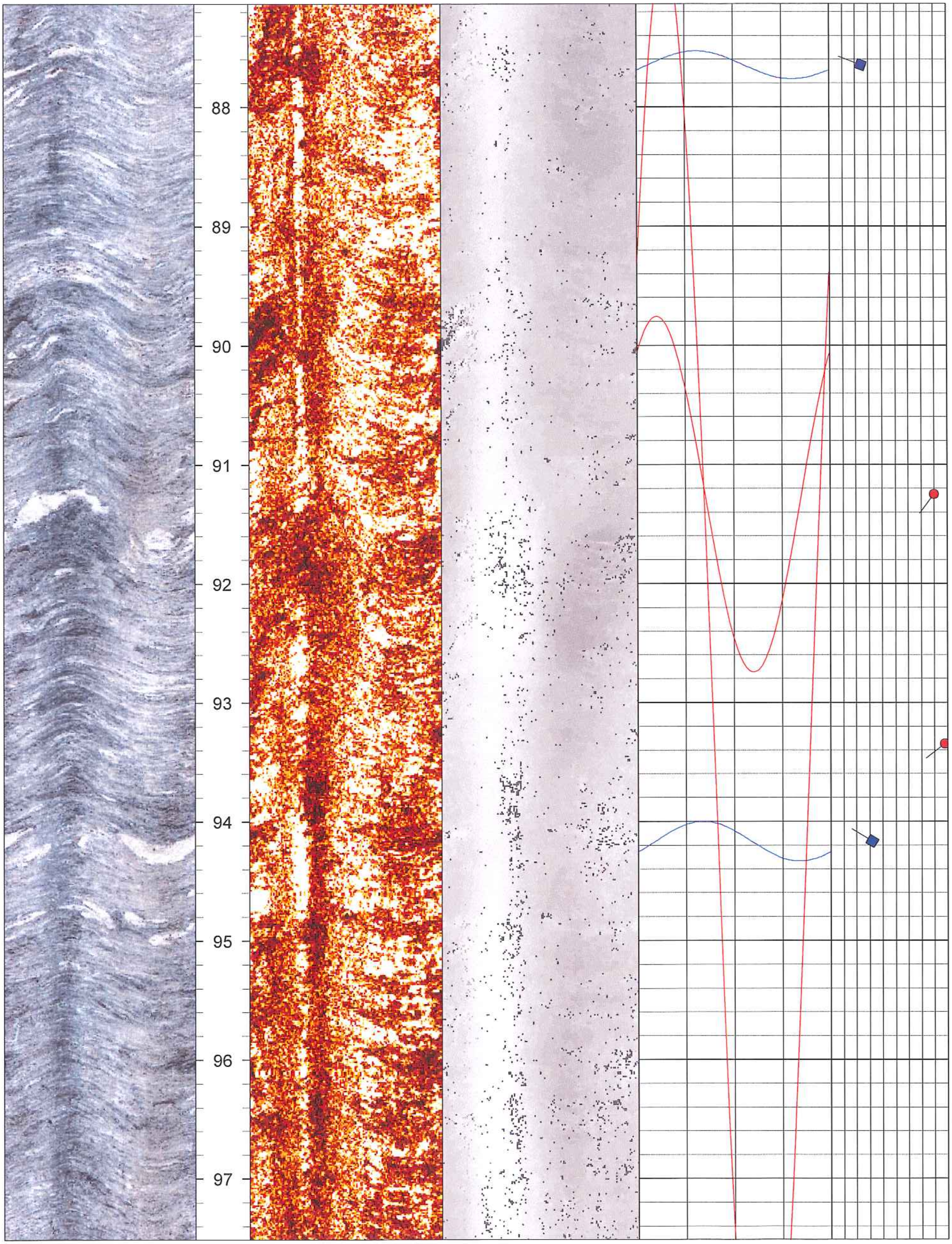
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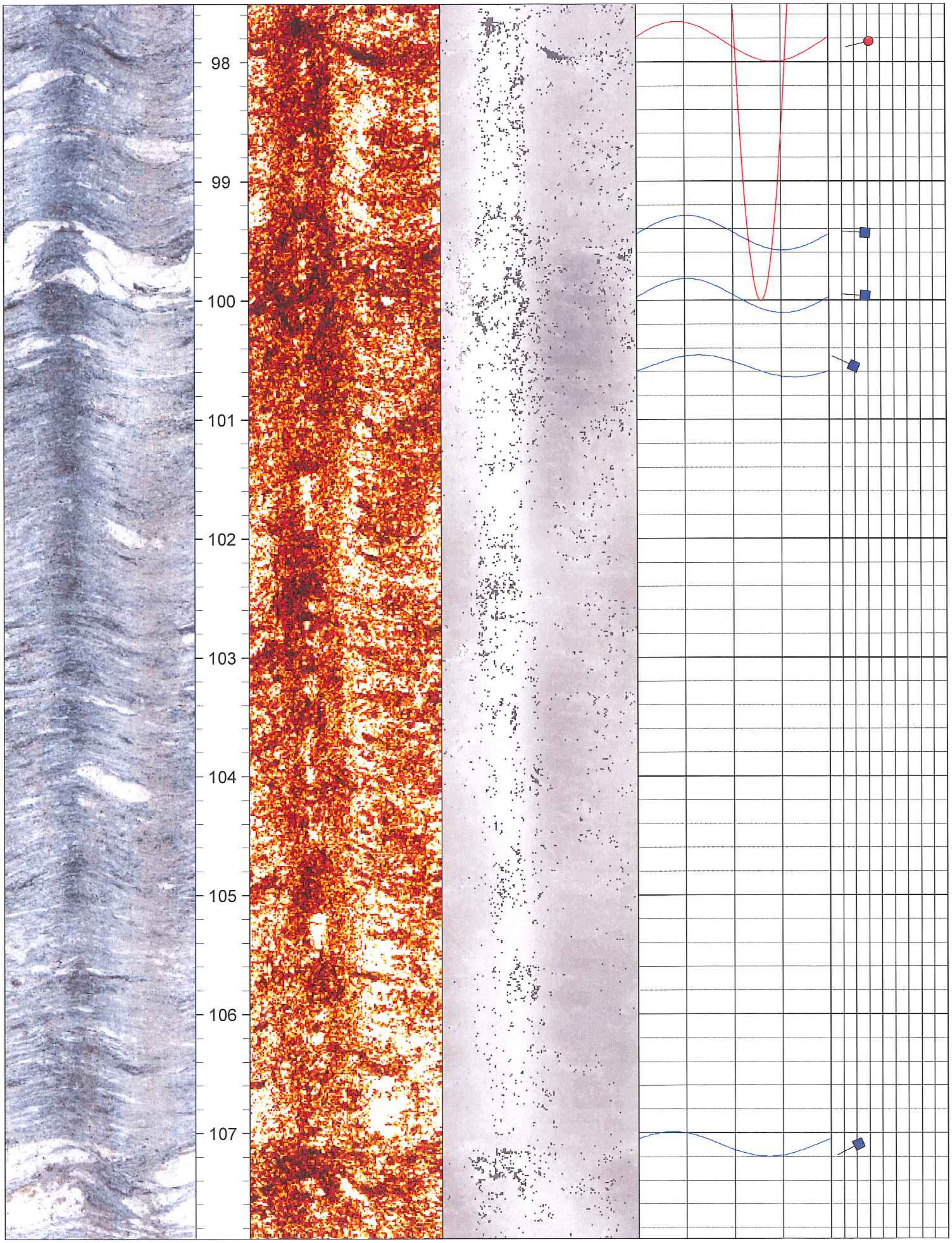
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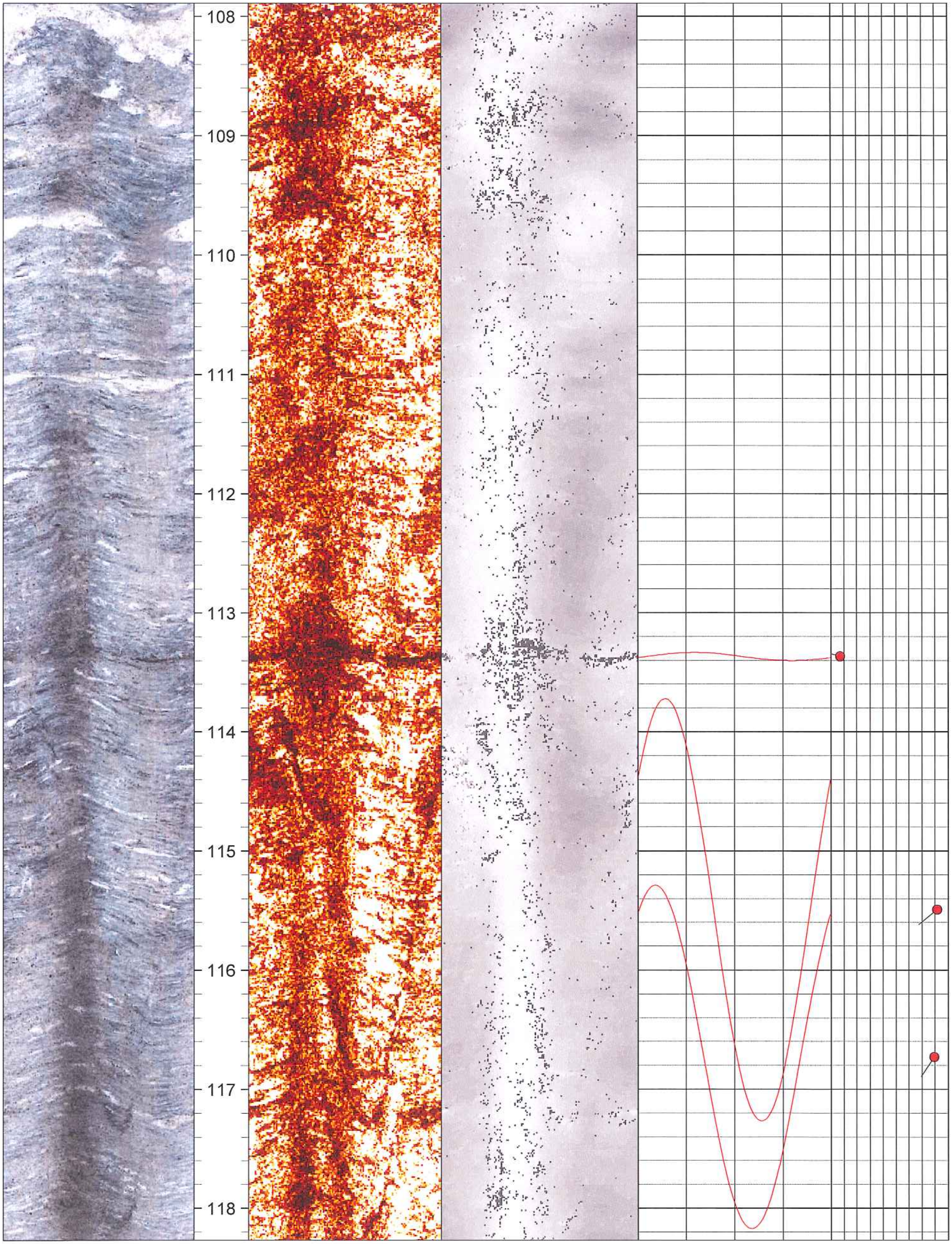
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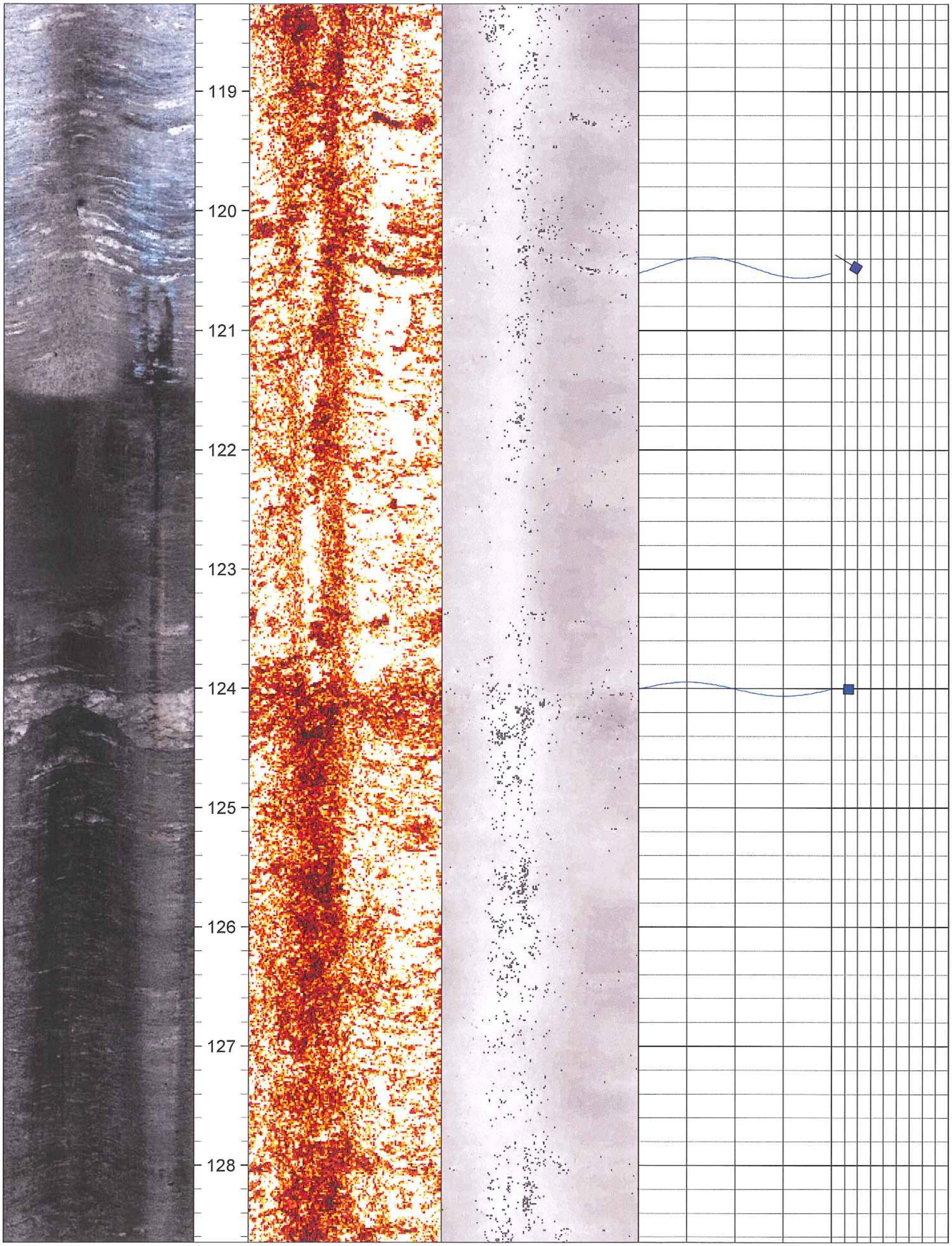
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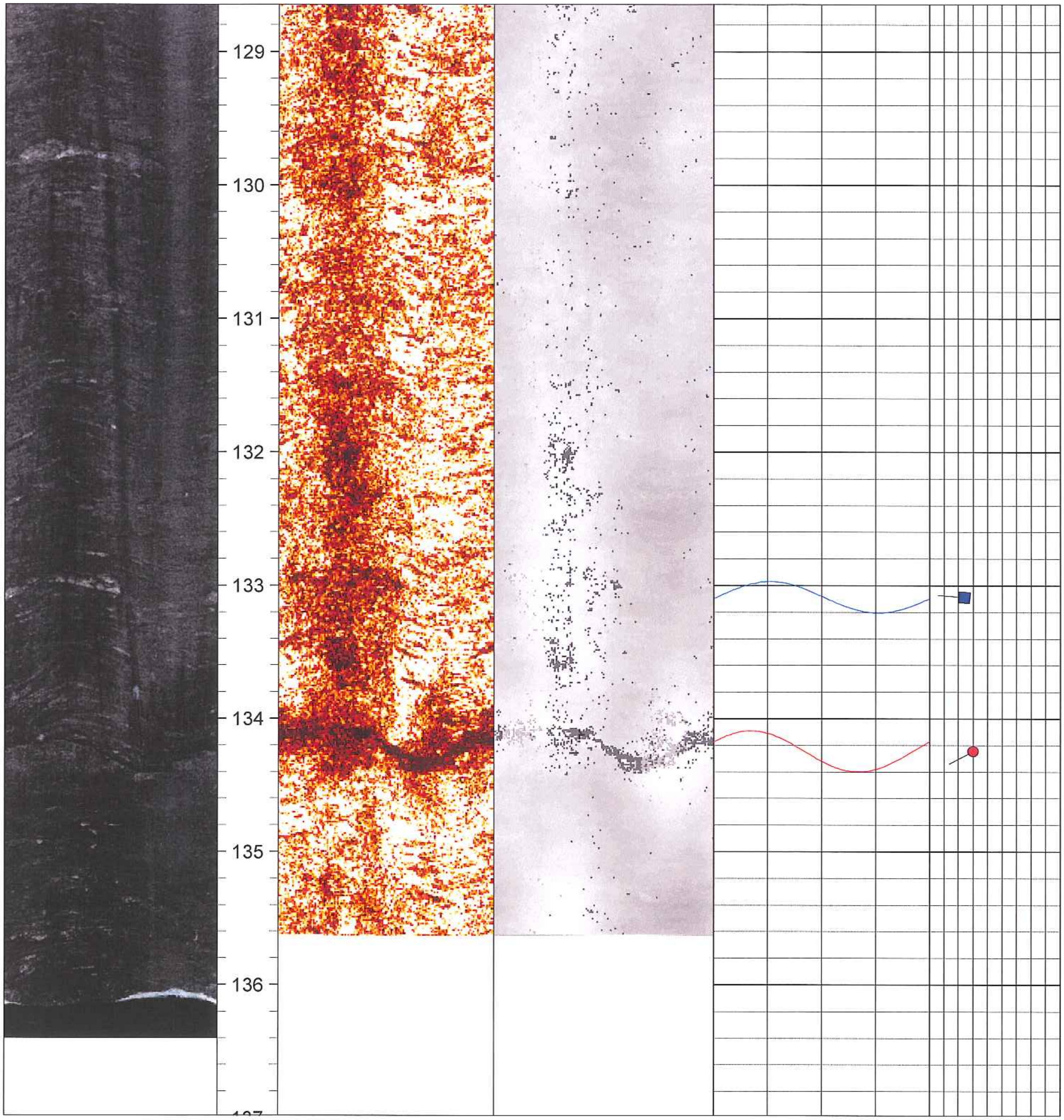
129
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136

ATTACHMENT C
STATISTICAL METHODS

DEFINITION OF TERMS:

Confidence Limit - This angular value reflects confidence in the MEAN within a specified degree of certainty. For example, a 95% confidence cone indicates that the true MEAN lies within the cone angle of the calculated mean, with a 95% confidence. This feature gives an indication of the reliability of the sample, or if the sample is big enough.

Variability Limit - This value reflects the natural variability of the data, assuming that the mean is correct. A 95% variability indicates that any pole, selected from the population represented by the mapped sample, has a 95% probability of falling within the variability cone.

Fisher Dispersion Coefficient - A Fisher Dispersion Coefficient "K" is automatically calculated for each Set. A larger "K" indicates a tighter cluster.

FORMULAS

The formulae for the confidence and variability limits used in this report are as follows:

Variability limit angle: cos(alpha) = 1.0 + log(1-P)/(K)
Confidence limit angle: cos(alpha) = 1.0 + log(1-P)/(RK)

where **P** is one of 2 probabilities:

For variability, it is the probability that a vector selected at random makes a solid angle of theta with the calculated mean.
For confidence, it is the probability that the calculated mean is within theta of the true population mean.

P in the above formulae ranges from 0 to 1 (i.e. 0 % to 100%)

K and **R** are defined as follows: **K** is Fisher's constant **= (N - 1) / (N - R)**; where **N** is the total length of pole vectors in a set, and **R** is the length of the resultant vector (upon vector addition of all poles in the set)

The values of N and R are derived from the mean vector calculation for a set. Since we consider a sphere of unit radius, each pole vector is of unit length, and therefore the value of N is numerically equal to the number of poles in the set. The value of R is the length of the resultant vector, upon vector addition of all poles in a set (therefore the value of R is always less than or equal to the value of N). The orientation of vector R, is the mean orientation for the set.

Reference :

Priest, S.D. (1985) Hemispherical projection methods in rock mechanics. London: George Allen & Unwin. 124p. The formulae are calculated as described in Section 5.4 pages 44 to 50 (Variability: Equations 5.17 and 5.18, Confidence: Equations 5.19 and 5.20)

ATTACHMENT C
TABULATED LISTING OF PLANE ORIENTATIONS

Orientations of Fracture and Foliation Planes
Wally's Citgo Site

Well ID	Depth (feet)	Dip Dir. (deg)	Dip (deg)	Type	Strike/Dip (Quadrant)	Strike Azimuth (Right-hand-rule)
MW-9B	87.02	295	55	Open Fracture	N25E/55NW	205.0
MW-9B	87.65	294	65	Open Fracture	N24E/65NW	204.0
MW-9B	88.49	344	56	Open Fracture	N74E/56NW	254.0
MW-9B	94.23	300	25	Foliation	N30E/25NW	210.0
MW-9B	95.06	294	50	Open Fracture	N24E/50NW	204.0
MW-9B	96.72	301	60	Open Fracture	N31E/60NW	211.0
MW-9B	99.12	291	62	Open Fracture	N21E/62NW	201.0
MW-9B	109.18	269	26	Foliation	N1W/26SW	179.0
MW-9B	117.58	305	38	Foliation	N35E/38NW	215.0
MW-9B	135.83	314	26	Foliation	N44E/26NW	224.0
MW-9B	141.8	117	73	Open Fracture	N27E/73SE	27.0
MW-9B	149.07	295	29	Foliation	N25E/29NW	205.0
MW-9B	165.73	217	26	Foliation	N53W/26SW	127.0
MW-9B	173.06	261	20	Foliation	N9W/20SW	171.0
MW-9B	185.98	195	62	Open Fracture	N75W/62SW	105.0
MW-9B	186.78	250	67	Open Fracture	N20W/67SW	160.0
MW-9B	189.38	222	66	Open Fracture	N48W/66SW	132.0
MW-9B	195.21	312	26	Foliation	N42E/26NW	222.0
MW-9B	196.32	225	46	Open Fracture	N45W/46SW	135.0
MW-9B	200.74	195	41	Open Fracture	N75W/41SW	105.0
MW-9B	205.02	235	36	Foliation	N35W/36SW	145.0
MW-9B	208.09	215	16	Foliation	N55W/16SW	125.0
MW-9B	216.2	227	32	Open Fracture	N43W/32SW	137.0
MW-9B	217.29	65	41	Open Fracture	N25W/41NE	335.0
MW-9B	218.82	47	71	Open Fracture	N43W/71NE	317.0
MW-9B	219.04	51	68	Open Fracture	N39W/68NE	321.0
MW-9B	219.7	53	74	Open Fracture	N37W/74NE	323.0
MW-9B	221.86	274	53	Open Fracture	N4E/53NW	184.0
MW-9B	224.31	270	25	Foliation	N0W/25W	180.0
MW-9B	229.7	254	58	Open Fracture	N16W/58SW	164.0
MW-9B	232.73	6	67	Open Fracture	N84W/67NE	276.0
MW-9A	46.17	314	15	Open Fracture	N44E/15NW	224.0
MW-9A	51.09	288	36	Open Fracture	N18E/36NW	198.0
MW-9A	55.49	287	47	Open Fracture	N17E/47NW	197.0
MW-9A	57.15	4	23	Open Fracture	N86W/23NE	274.0
MW-9A	57.9	334	26	Open Fracture	N64E/26NW	244.0
MW-9A	58.19	325	52	Open Fracture	N55E/52NW	235.0
MW-8B	84.46	263	27	Open Fracture	N7W/27SW	173.0
MW-8B	86.19	228	47	Open Fracture	N42W/47SW	138.0
MW-8B	90.49	307	29	Open Fracture	N37E/29NW	217.0
MW-8B	93.28	295	69	Open Fracture	N25E/69NW	205.0
MW-8B	93.49	284	46	Open Fracture	N14E/46NW	194.0
MW-7A	45.68	294	23	Open Fracture	N24E/23NW	204.0
MW-7A	49.2	287	27	Foliation	N17E/27NW	197.0
MW-7A	50.51	270	27	Foliation	N0W/27W	180.0
MW-7A	51.03	297	49	Open Fracture	N27E/49NW	207.0
MW-7A	52.74	307	26	Foliation	N37E/26NW	217.0
MW-7A	58.05	293	22	Foliation	N23E/22NW	203.0
MW-7A	59	319	20	Open Fracture	N49E/20NW	229.0
MW-7A	60.1	314	17	Foliation	N44E/17NW	224.0
MW-7A	60.93	277	12	Open Fracture	N7E/12NW	187.0
MW-7B	100.98	261	13	Open Fracture	N9W/13SW	171.0

Orientations of Fracture and Foliation Planes
Wally's Citgo Site

Well ID	Depth (feet)	Dip Dir. (deg)	Dip (deg)	Type	Strike/Dip (Quadrant)	Strike Azimuth (Right-hand-rule)
MW-7B	215.92	307	29	Open Fracture	N37E/29NW	217.0
MW-8A	47.78	284	47	Open Fracture	N14E/47NW	194.0
MW-8A	48.15	264	16	Open Fracture	N6W/16SW	174.0
MW-8A	48.81	130	56	Open Fracture	N40E/56SE	40.0
MW-8A	48.89	292	22	Open Fracture	N22E/22NW	202.0
MW-8A	53.32	239	42	Open Fracture	N31W/42SW	149.0
MW-8A	61.87	312	21	Open Fracture	N42E/21NW	222.0
1606	38.1	267	22	Open Fracture	N3W/22SW	177.0
1606	38.64	254	84	Open Fracture	N16W/84SW	164.0
1606	40.02	240	17	Open Fracture	N30W/17SW	150.0
1606	41.89	272	26	Open Fracture	N2E/26NW	182.0
1606	42.22	267	30	Open Fracture	N3W/30SW	177.0
1606	42.42	262	26	Open Fracture	N8W/26SW	172.0
1606	43.16	274	36	Open Fracture	N4E/36NW	184.0
1606	43.99	283	27	Foliation	N13E/27NW	193.0
1606	46.99	294	74	Open Fracture	N24E/74NW	204.0
1606	58.62	339	28	Open Fracture	N69E/28NW	249.0
1606	59.41	268	26	Foliation	N2W/26SW	178.0
1606	61.85	111	56	Open Fracture	N21E/56SE	21.0
1606	62.06	269	26	Open Fracture	N1W/26SW	179.0
1606	67.69	289	26	Foliation	N19E/26NW	199.0
1606	69.14	274	26	Foliation	N4E/26NW	184.0
1606	73.69	305	53	Open Fracture	N35E/53NW	215.0
1606	76.84	283	26	Open Fracture	N13E/26NW	193.0
1606	81.15	273	26	Foliation	N3E/26NW	183.0
1606	83.31	295	26	Foliation	N25E/26NW	205.0
1606	87.65	290	24	Foliation	N20E/24NW	200.0
1606	91.25	216	79	Open Fracture	N54W/79SW	126.0
1606	93.35	232	87	Open Fracture	N38W/87SW	142.0
1606	94.17	301	31	Foliation	N31E/31NW	211.0
1606	97.83	256	31	Open Fracture	N14W/31SW	166.0
1606	99.43	273	28	Foliation	N3E/28NW	183.0
1606	99.96	273	28	Foliation	N3E/28NW	183.0
1606	100.55	295	19	Foliation	N25E/19NW	205.0
1606	107.1	243	21	Foliation	N27W/21SW	153.0
1606	113.37	285	7	Open Fracture	N15E/7NW	195.0
1606	115.49	231	81	Open Fracture	N39W/81SW	141.0
1606	116.73	212	79	Open Fracture	N58W/79SW	122.0
1606	120.47	302	19	Foliation	N32E/19NW	212.0
1606	124.01	270	12	Foliation	N0W/12W	180.0
1606	133.08	274	24	Foliation	N4E/24NW	184.0
1606	134.24	242	29	Open Fracture	N28W/29SW	152.0
1608	44.59	277	41	Open Fracture	N7E/41NW	187.0
1608	54.03	277	56	Foliation	N7E/56NW	187.0
1608	58.76	311	42	Foliation	N41E/42NW	221.0
1608	59.9	315	37	Open Fracture	N45E/37NW	225.0
1608	66.2	253	70	Open Fracture	N17W/70SW	163.0
1608	70.61	244	48	Open Fracture	N26W/48SW	154.0
1608	73.22	252	57	Foliation	N18W/57SW	162.0
1608	77.76	289	41	Foliation	N19E/41NW	199.0
1608	81.23	286	41	Foliation	N16E/41NW	196.0
1608	82.02	265	41	Foliation	N5W/41SW	175.0

Orientations of Fracture and Foliation Planes
Wally's Citgo Site

Well ID	Depth (feet)	Dip Dir. (deg)	Dip (deg)	Type	Strike/Dip (Quadrant)	Strike Azimuth (Right-hand-rule)
1608	83.01	272	41	Foliation	N2E/41NW	182.0
1612	35.43	269	36	Foliation	N1W/36SW	179.0
1612	42.86	255	35	Foliation	N15W/35SW	165.0
1612	61.4	242	86	Open Fracture	N28W/86SW	152.0
1612	62.88	0	0	Open Fracture	N90E/0N	270.0
1612	69.67	324	30	Open Fracture	N54E/30NW	234.0
1612	70.99	308	32	Open Fracture	N38E/32NW	218.0
1612	74.57	299	31	Open Fracture	N29E/31NW	209.0
1612	78.64	299	52	Open Fracture	N29E/52NW	209.0
1612	78.85	72	82	Open Fracture	N18W/82NE	342.0
1612	82.57	271	23	Open Fracture	N1E/23NW	181.0
1612	82.92	316	25	Open Fracture	N46E/25NW	226.0
1612	83.38	335	37	Open Fracture	N65E/37NW	245.0
1612	83.56	342	40	Open Fracture	N72E/40NW	252.0
1612	84.34	323	20	Open Fracture	N53E/20NW	233.0
1612	85.05	60	79	Open Fracture	N30W/79NE	330.0
1612	86.02	281	27	Foliation	N11E/27NW	191.0
1612	94.23	329	31	Foliation	N59E/31NW	239.0
1612	95.7	328	14	Open Fracture	N58E/14NW	238.0
1612	100.17	310	27	Foliation	N40E/27NW	220.0
1612	101.45	237	42	Open Fracture	N33W/42SW	147.0
1612	109.14	283	19	Foliation	N13E/19NW	193.0

ARM Supplemental Evaluation

ENVIRONMENTAL ALLIANCE

Andrew Applebaum

From: Scott McQuown [smcquown@armgeophysics.net]
Sent: Wednesday, August 12, 2009 8:18 AM
To: aapplebaum@envalliance.com
Subject: Structure Plots for '09 data
Attachments: structure plots of 09 wells.doc

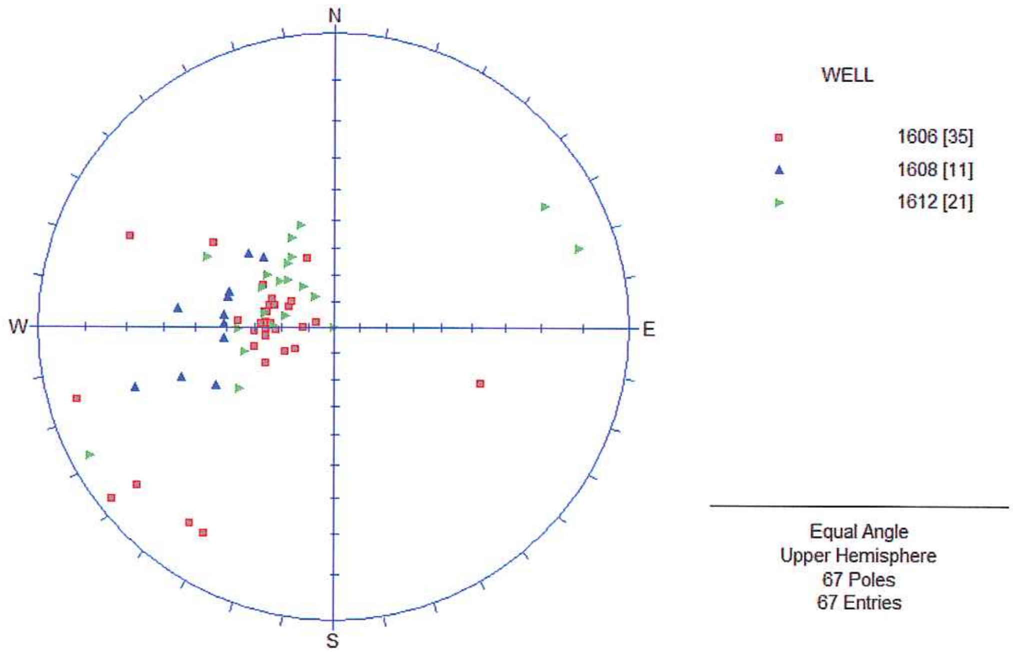
Hi Drew,

Here are the structure plots for the '09 data as you requested.

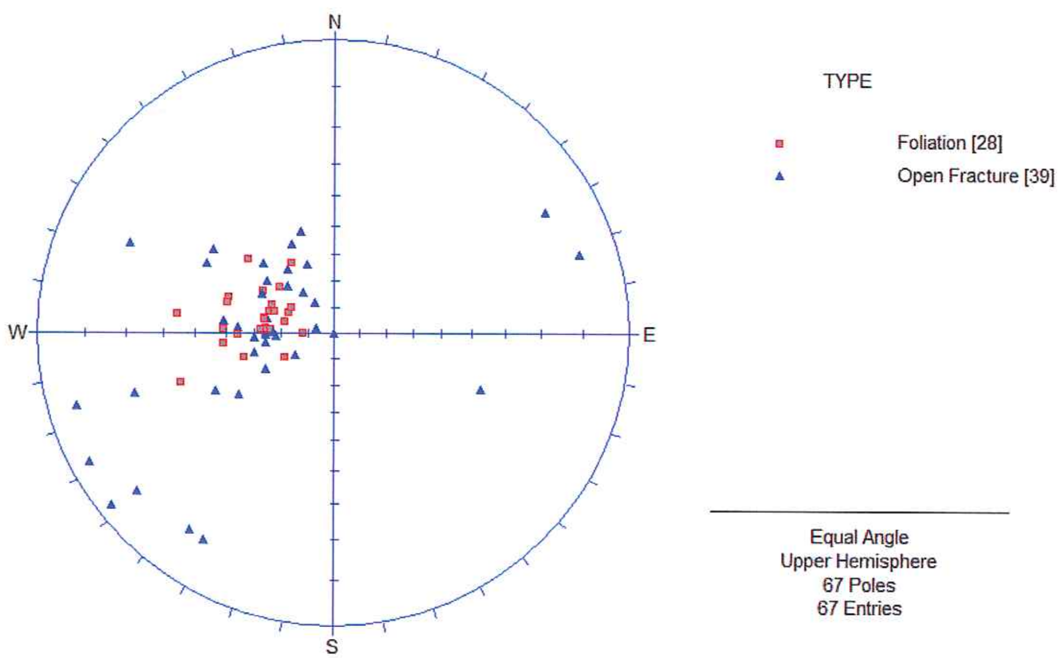
Kind regards,
Scott

M. Scott McQuown, P.G.
Senior Geologist/Geophysicist
Borehole Operations Manager

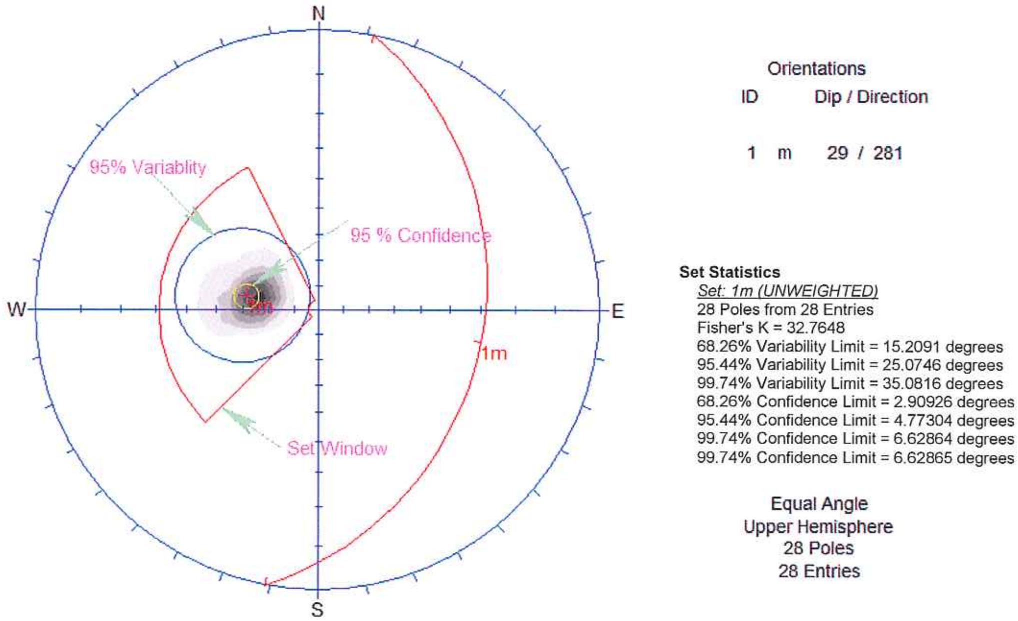
ARM Geophysics
1129 West Governor Road
P.O. Box 797, Hershey, PA 17033-0797
Toll Free: 888-WELL-LOG
Mobile: 610-380-4778
Fax: 866-601-1994
smcquown@armgeophysics.net
www.armgeophysics.net



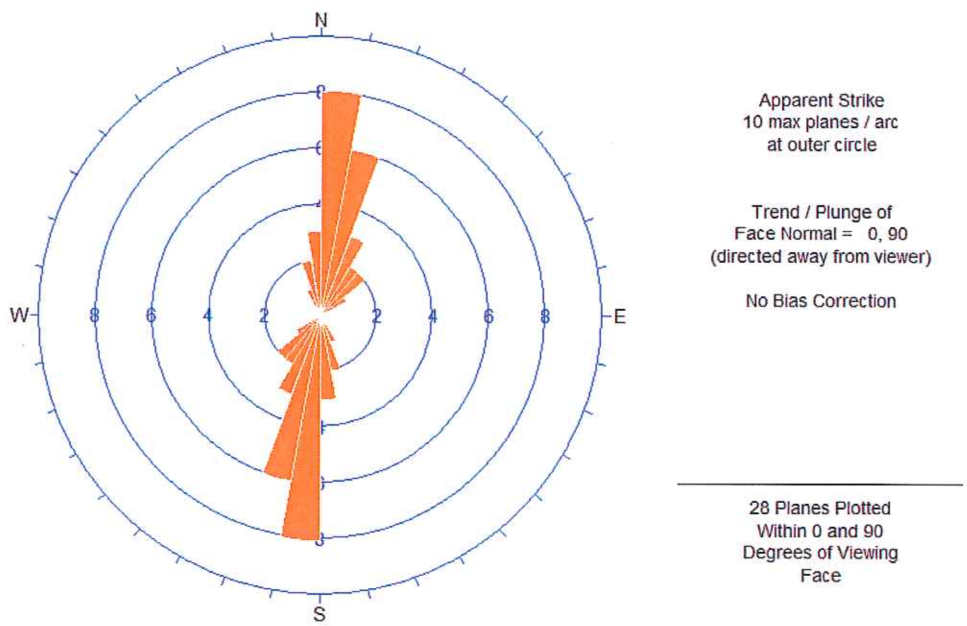
Polar diagram of all planes categorized by well.



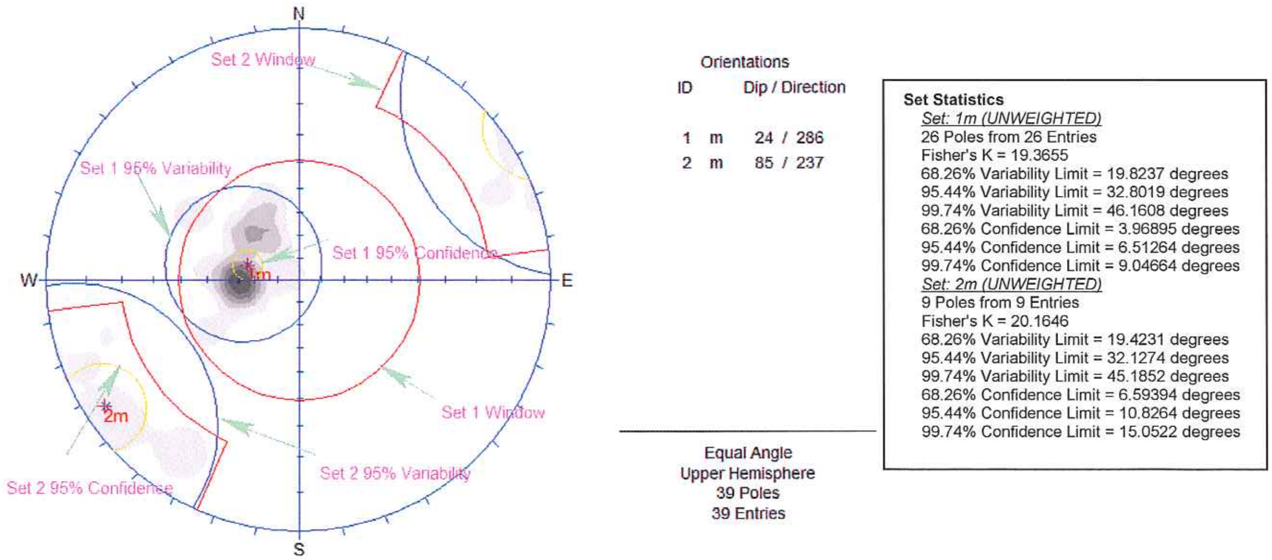
Polar diagram of all planes categorized by type.



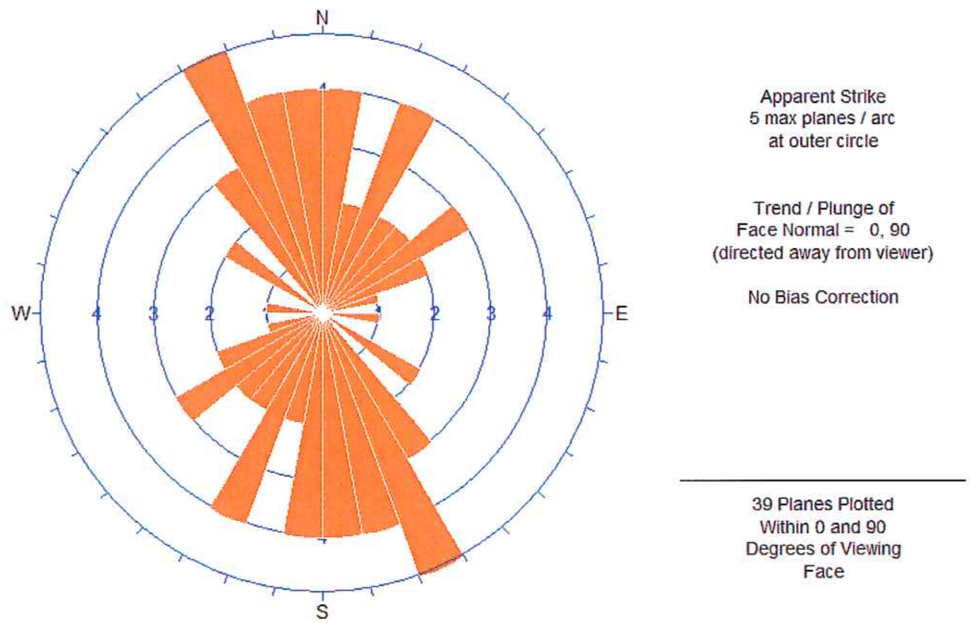
Polar plot of foliation planes showing mean dip and dip directions and statistical results



Rose diagram of foliation planes showing a predominant NNE/SSW strike direction



Polar diagram of fracture planes showing mean dip & dip direction and set statistics.



Rose diagram showing strike distribution of fracture planes.

Dip Dir. (deg)	Dip (deg)	Type	Strike/Dip (Quadrant)	Strike Azimuth (Right-hand-rule)
281	29	Foliation	N11E/29NW	191.0
286	24	Frac Set 1	N16E/24NW	196.0
237	85	Frac Set 2	N33W/85SW	147.0

Appendix IV

Soil Boring/Well Logs

Log of Boring: SVE-01

Date Started:	06/15/09	**Project Code:**	1962
Date Completed:	06/15/09	**Project Name:**	Carroll Fuel - Parkton
Total Depth (ft):	37.00	**Drilled By:**	Eichelbergers
Boring Diameter (in):	8 3/4"	**Logged By:**	Jason Yaple
Bedrock Depth (ft):	29	**Drill Rig:**	T4
Elevation (ft-msl):	N/A	**Drill Method:**	Air Rotary
Remark:	N/A	**Sampling Method:**	Direct observation

Depth	Sample Number	Sample Interval	Recovery (inches)	PID/ FID	Lithological Description	Interpreted Lithology	Well Construction	Comments
0	1				FILL: Asphalt and gravel sub-base			Set 4" diameter 20 slot screen 22-37', casing 0-22', #2 sand 20-37', hydrated bentonite hole plug 1-20', concrete 0-1'.
	2				ML: Red brown silty fire sand with large gravel rock fragments throughout, moist			
-5								
				0.0				
-10								
	3				ML: Same as above, more regular drill chatter lighter/ tan color			
	4				ML: Same as above, maroon			
-15				0.0				
	5				SAPROLITE: Brown/ green saprolite, regular chatter, easy drilling, similar texture to above			Terminate borehole @ 37' BGS
-20				0.0				
-25								
				0.0				
	6			0.5	SCHIST: Gray sandy cuttings with gravel bedrock fragments micaceous schist, graphitic texture			
-30								
				0.0				
-35				0.0				
				0.0				

Log of Boring: SVE-02

Date Started: 06/15/09
Date Completed: 06/15/09
Total Depth (ft): 37.00
Boring Diameter (in): 8 3/4"
Bedrock Depth (ft): 26
Elevation (ft-msl): N/A
Remark: N/A

Project Code: 1962
Project Name: Carroll Fuel - Parkton
Drilled By: Eichelbergers
Logged By: Jason Yaple
Drill Rig: T4
Drill Method: Air Rotary
Sampling Method: Direct observation

Depth	Sample Number	Sample Interval	Recovery (inches)	PID/ FID	Lithological Description	Interpreted Lithology	Well Construction	Comments
0	1				FILL: Asphalt and gravel sub base			Set 4" diameter 20 slot screen 22-37', casing 0-22', #2 sand 21-37', hydrated bentonite hole plug 1-21', concrete 0-1'.
	2				ML: Brown and maroon silt and sand with many rock fragments			
-5								
				0.0				
-10								
				0.0				
-15								
	3			0.0	SAPROLITE: Gray green and brown weatherd schist (saprolite) sandy silt cuttings more drill chatter			
-20								
	4			0.0	SAPROLITE: Tan color same as above			
	5				SAPROLITE: Dark brown			
-25				0.0				
	6				SCHIST: Gray micaceous schist steady drill chatter, graphitic texture			Terminate borehole @ 37'
				0.0				
-30								
				0.0				
-35								

Log of Boring: SVE-03

Date Started:	06/15/09	**Project Code:**	1962
Date Completed:	06/15/09	**Project Name:**	Carroll Fuel - Parkton
Total Depth (ft):	37.00	**Drilled By:**	Eichelbergers
Boring Diameter (in):	8 3/4"	**Logged By:**	Jason Yaple
Bedrock Depth (ft):	33	**Drill Rig:**	T4
Elevation (ft-msl):	N/A	**Drill Method:**	Air Rotary
Remark:	N/A	**Sampling Method:**	Direct observation

Depth	Sample Number	Sample Interval	Recovery (inches)	PID/ FID	Lithological Description	Interpreted Lithology	Well Construction	Comments
0	1				FILL: Asphalt and gravel fill			Set 4" diameter 20 slot screen 22-37', casing 0-22', #2 sand 21-37', hydrated bentonite hole plug 1-21', concrete 0-1'.
-2	2			0.0	ML: Light brown/maroon silt with sand and gravel fragments			
-12	3			0.0	ML: Same as above, tan and red			
-15	4			0.0	SAPROLITE: Saprolite bedrock schist weathered high mica content gray green			
-20				0.0				
-23				0.0				
-32				0.0				
-33	5				SCHIST: Gray and brown steady drilling chatter, schist bedrock			Terminate borehole @ 37'

Environmental Alliance, Inc.

Log of Boring: SVE-04

Date Started: 06/15/09
Date Completed: 06/15/09
Total Depth (ft): 37.00
Boring Diameter (in): 8 3/4"
Bedrock Depth (ft): 31
Elevation (ft-msl): N/A
Remark: N/A

Project Code: 1962
Project Name: Carroll Fuel - Parkton
Drilled By: Eichelbergers
Logged By: Jason Yaple
Drill Rig: T4
Drill Method: Air Rotary
Sampling Method: Direct observation

Sample Number	PID/ FID	Lithological Description
1		ASPHALT: Asphalt and gravel
2	0.0	ML: Light brown and maroon silt with sand and gravel fragments, high micaceous, soft, non-plastic
3	0.0	ML: Same as above, tan and red zones
4	0.0	SAPROLITE: Gray green highly micaceous weathered schist bedrock saprolite graphitic texture cuttings
5		SAPROLITE: Tan same as above
6		SAPROLITE: Gray same as above
7	0.0	SCHIST: Gray schist bedrock, harder drill chatter, highly micaceous

Depth: 0, -5, -10, -15, -20, -25, -30, -35

Columns: Depth | Sample Number | Sample Interval | Recovery (inches) | PID/ FID | Lithological Description | Interpreted Lithology | Well Construction | Comments

Comments:

Set 4" diameter 20 slot screen 22-37', casing 0-22', #2 sand 21-37', hydrated bentonite hole plug 1-21', concrete 0-1'.

Terminate borehole @ 37' BGS

Appendix V

Laboratory Analytical Reports

Pace Analytical Services, Inc.
1700 Elm Street - Suite 200
Minneapolis, MN 55414
(612)607-1700

July 07, 2009

Cari Finch
Environmental Alliance
1035 Berfield Blvd.
Suite I
Millersville, MD 21108

RE: Project: 1962C T:09 Wally's BP
Pace Project No.: 1098058

Dear Cari Finch:

Enclosed are the analytical results for sample(s) received by the laboratory on June 26, 2009. The results relate only to the samples included in this report. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Colin Schuft

colin.schuft@pacelabs.com
Project Manager

Enclosures

Pace Analytical Services, Inc.
1700 Elm Street - Suite 200
Minneapolis, MN 55414
(612)607-1700

CERTIFICATIONS

Project: 1962C T:09 Wally's BP
Pace Project No.: 1098058

Minnesota Certification IDs

Wisconsin Certification #: 999407970
Washington Certification #: C754
Alaska Certification #: UST-078
Arizona Certification #: AZ-0014
Tennessee Certification #: 02818
Pennsylvania Certification #: 68-00563
Oregon Certification #: MN200001
North Dakota Certification #: R-036
North Carolina Certification #: 530
New York Certification #: 11647
New Jersey Certification #: MN-002
Montana Certification #: MT CERT0092
Minnesota Certification #: 027-053-137
Maine Certification #: 2007029
Louisiana Certification #: LA080009
Louisiana Certification #: 03086
Kansas Certification #: E-10167
Iowa Certification #: 368
Illinois Certification #: 200011
Florida/NELAP Certification #: E87605
California Certification #: 01155CA

Montana Certification IDs

Montana Certification #: MT CERT0040
Idaho Certification #: MT00012
EPA Region 8 Certification #: 8TMS-Q

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SAMPLE SUMMARY

Project: 1962C T:09 Wally's BP
Pace Project No.: 1098058

Lab ID	Sample ID	Matrix	Date Collected	Date Received
1098058001	**SVE10625091125**	Air	06/25/09 11:25	06/26/09 09:13
1098058002	**SVE20625091315**	Air	06/25/09 13:15	06/26/09 09:13
1098058003	**SVE30625091435**	Air	06/25/09 14:35	06/26/09 09:13
1098058004	**SVE40625091540**	Air	06/25/09 15:40	06/26/09 09:13
1098058005	**MW50625091645**	Air	06/25/09 16:45	06/26/09 09:13

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SAMPLE ANALYTE COUNT

Project: 1962C T:09 Wally's BP
Pace Project No.: 1098058

Lab ID	Sample ID	Method	Analysts	Analytes Reported
1098058001	**SVE10625091125**	TO-3 Air	DB1	8
1098058002	**SVE20625091315**	TO-3 Air	DB1	8
1098058003	**SVE30625091435**	TO-3 Air	DB1	8
1098058004	**SVE40625091540**	TO-3 Air	DB1	8
1098058005	**MW50625091645**	TO-3 Air	DB1	8

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ANALYTICAL RESULTS

Project: 1962C T:09 Wally's BP

Pace Project No.: 1098058

Sample: SVE10625091125 **Lab ID: 1098058001** Collected: 06/25/09 11:25 Received: 06/26/09 09:13 Matrix: Air

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
TO3 GCV AIR BTEX BAG	Analytical Method: TO-3 Air							
Benzene	ND	ppmv	0.20	2		07/06/09 12:12	71-43-2	
Ethylbenzene	ND	ppmv	0.20	2		07/06/09 12:12	100-41-4	
Methyl-tert-butyl ether	ND	ppmv	0.20	2		07/06/09 12:12	1634-04-4	
THC as Gas	**10**	ppmv	2.0	2		07/06/09 12:12		A4
Toluene	**1.1**	ppmv	0.20	2		07/06/09 12:12	108-88-3	
m&p-Xylene	ND	ppmv	0.40	2		07/06/09 12:12	1330-20-7	
o-Xylene	ND	ppmv	0.20	2		07/06/09 12:12	95-47-6	
TO3 GCV AIR Meth,Ethane,Ethene	Analytical Method: TO-3 Air							
THC as C1-C4	**4.0**	ppmv	3.0	2		07/01/09 10:43		A4

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ANALYTICAL RESULTS

Project: 1962C T:09 Wally's BP
Pace Project No.: 1098058

Sample: SVE20625091315 **Lab ID: 1098058002** Collected: 06/25/09 13:15 Received: 06/26/09 09:13 Matrix: Air

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
TO3 GCV AIR BTEX BAG	Analytical Method: TO-3 Air							
Benzene	ND	ppmv	0.20	2		07/06/09 13:42	71-43-2	
Ethylbenzene	ND	ppmv	0.20	2		07/06/09 13:42	100-41-4	
Methyl-tert-butyl ether	ND	ppmv	0.20	2		07/06/09 13:42	1634-04-4	
THC as Gas	**4.7**	ppmv	2.0	2		07/06/09 13:42		A4
Toluene	ND	ppmv	0.20	2		07/06/09 13:42	108-88-3	
m&p-Xylene	ND	ppmv	0.40	2		07/06/09 13:42	1330-20-7	
o-Xylene	ND	ppmv	0.20	2		07/06/09 13:42	95-47-6	
TO3 GCV AIR Meth,Ethane,Ethene	Analytical Method: TO-3 Air							
THC as C1-C4	**6.7**	ppmv	3.0	2		07/01/09 10:48		A4

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ANALYTICAL RESULTS

Project: 1962C T:09 Wally's BP

Pace Project No.: 1098058

Sample: SVE30625091435 **Lab ID: 1098058003** Collected: 06/25/09 14:35 Received: 06/26/09 09:13 Matrix: Air

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
TO3 GCV AIR BTEX BAG	Analytical Method: TO-3 Air							
Benzene	ND	ppmv	0.44	4.35		07/06/09 14:00	71-43-2	
Ethylbenzene	ND	ppmv	0.44	4.35		07/06/09 14:00	100-41-4	
Methyl-tert-butyl ether	ND	ppmv	0.44	4.35		07/06/09 14:00	1634-04-4	
THC as Gas	**7.8**	ppmv	4.4	4.35		07/06/09 14:00		A4
Toluene	ND	ppmv	0.44	4.35		07/06/09 14:00	108-88-3	
m&p-Xylene	ND	ppmv	0.87	4.35		07/06/09 14:00	1330-20-7	
o-Xylene	ND	ppmv	0.44	4.35		07/06/09 14:00	95-47-6	
TO3 GCV AIR Meth,Ethane,Ethene	Analytical Method: TO-3 Air							
THC as C1-C4	**4.9**	ppmv	3.9	2.59		07/01/09 11:00		A4

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 1962C T:09 Wally's BP
Pace Project No.: 1098058

Sample: SVE40625091540 **Lab ID: 1098058004** Collected: 06/25/09 15:40 Received: 06/26/09 09:13 Matrix: Air

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
TO3 GCV AIR BTEX BAG	Analytical Method: TO-3 Air							
Benzene	ND	ppmv	0.19	1.93		07/06/09 14:13	71-43-2	
Ethylbenzene	**1.1**	ppmv	0.19	1.93		07/06/09 14:13	100-41-4	
Methyl-tert-butyl ether	ND	ppmv	0.19	1.93		07/06/09 14:13	1634-04-4	
THC as Gas	**115**	ppmv	1.9	1.93		07/06/09 14:13		A4
Toluene	**12.2**	ppmv	0.19	1.93		07/06/09 14:13	108-88-3	
m&p-Xylene	**7.9**	ppmv	0.39	1.93		07/06/09 14:13	1330-20-7	
o-Xylene	**3.0**	ppmv	0.19	1.93		07/06/09 14:13	95-47-6	
TO3 GCV AIR Meth,Ethane,Ethene	Analytical Method: TO-3 Air							
THC as C1-C4	**5.0**	ppmv	2.9	1.93		07/01/09 11:05		A4

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ANALYTICAL RESULTS

Project: 1962C T:09 Wally's BP
Pace Project No.: 1098058

Sample: MW50625091645 **Lab ID: 1098058005** Collected: 06/25/09 16:45 Received: 06/26/09 09:13 Matrix: Air

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
TO3 GCV AIR BTEX BAG	Analytical Method: TO-3 Air							
Benzene	ND	ppmv	0.20	2		07/06/09 14:27	71-43-2	
Ethylbenzene	**2.0**	ppmv	0.20	2		07/06/09 14:27	100-41-4	
Methyl-tert-butyl ether	ND	ppmv	0.20	2		07/06/09 14:27	1634-04-4	
THC as Gas	**160**	ppmv	2.0	2		07/06/09 14:27		A4
Toluene	**21.8**	ppmv	0.20	2		07/06/09 14:27	108-88-3	E
m&p-Xylene	**17.4**	ppmv	0.40	2		07/06/09 14:27	1330-20-7	
o-Xylene	**6.1**	ppmv	0.20	2		07/06/09 14:27	95-47-6	
TO3 GCV AIR Meth,Ethane,Ethene	Analytical Method: TO-3 Air							
THC as C1-C4	ND	ppmv	3.0	2		07/01/09 11:11		A4

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QUALITY CONTROL DATA

Project: 1962C T:09 Wally's BP
Pace Project No.: 1098058

QC Batch: AIR/8780 Analysis Method: TO-3 Air
QC Batch Method: TO-3 Air Analysis Description: TO3 GCV AIR METH,ETHANE,ETHENE
Associated Lab Samples: 1098058001, 1098058002, 1098058003, 1098058004, 1098058005

METHOD BLANK: 644002 Matrix: Air
Associated Lab Samples: 1098058001, 1098058002, 1098058003, 1098058004, 1098058005

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
THC as C1-C4	ppmv	ND	1.5	07/01/09 10:11	

LABORATORY CONTROL SAMPLE & LCSD: 644003 644004

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% Rec Limits	RPD	Max RPD	Qualifiers
THC as C1-C4	ppmv	30	35.4	33.5	118	112	70-130	5	30	

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QUALITY CONTROL DATA

Project: 1962C T:09 Wally's BP
Pace Project No.: 1098058

QC Batch: AIR/8793 | Analysis Method: TO-3 Air
QC Batch Method: TO-3 Air | Analysis Description: TO3 GCV AIR BTEX BAG
Associated Lab Samples: 1098058001, 1098058002, 1098058003, 1098058004, 1098058005

METHOD BLANK: 645947 | Matrix: Air
Associated Lab Samples: 1098058001, 1098058002, 1098058003, 1098058004, 1098058005

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Benzene	ppmv	ND	0.10	07/06/09 10:20	
Ethylbenzene	ppmv	ND	0.10	07/06/09 10:20	
m&p-Xylene	ppmv	ND	0.20	07/06/09 10:20	
Methyl-tert-butyl ether	ppmv	ND	0.10	07/06/09 10:20	
o-Xylene	ppmv	ND	0.10	07/06/09 10:20	
THC as Gas	ppmv	ND	1.0	07/06/09 10:20	
Toluene	ppmv	ND	0.10	07/06/09 10:20	

LABORATORY CONTROL SAMPLE & LCSD: 645948 645949

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% Rec Limits	RPD	Max RPD	Qualifiers
Benzene	ppmv	1	1.0	1.0	103	103	70-130	0	30	
Ethylbenzene	ppmv	1	1.0	1.0	104	104	70-130	0	30	
m&p-Xylene	ppmv	2	2.1	2.1	106	104	70-130	2	30	
Methyl-tert-butyl ether	ppmv	1	1.1	1.1	107	108	70-130	1	30	
o-Xylene	ppmv	1	1.1	1.1	111	108	70-130	2	30	
THC as Gas	ppmv	10	8.9	8.7	89	87	70-130	2	30	
Toluene	ppmv	1	1.0	1.0	103	105	70-130	2	30	

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Minneapolis, MN 55414
(612)607-1700

QUALIFIERS

Project: 1962C T:09 Wally's BP
Pace Project No.: 1098058

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to changes in sample preparation, dilution of the sample aliquot, or moisture content.

ND - Not Detected at or above adjusted reporting limit.

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

S - Surrogate

1,2-Diphenylhydrazine (8270 listed analyte) decomposes to Azobenzene.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

Pace Analytical is NELAP accredited. Contact your Pace PM for the current list of accredited analytes.

U - Indicates the compound was analyzed for, but not detected.

ANALYTE QUALIFIERS

A4	Sample was transferred from a Tedlar bag into a Summa Canister within 48 hours of collection.
E	Analyte concentration exceeded the calibration range. The reported result is estimated.

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QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: 1962C T:09 Wally's BP
Pace Project No.: 1098058

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
1098058001	**SVE10625091125**	TO-3 Air	AIR/8780		
1098058002	**SVE20625091315**	TO-3 Air	AIR/8780		
1098058003	**SVE30625091435**	TO-3 Air	AIR/8780		
1098058004	**SVE40625091540**	TO-3 Air	AIR/8780		
1098058005	**MW50625091645**	TO-3 Air	AIR/8780		
1098058001	**SVE10625091125**	TO-3 Air	AIR/8793		
1098058002	**SVE20625091315**	TO-3 Air	AIR/8793		
1098058003	**SVE30625091435**	TO-3 Air	AIR/8793		
1098058004	**SVE40625091540**	TO-3 Air	AIR/8793		
1098058005	**MW50625091645**	TO-3 Air	AIR/8793		

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ANALYTICAL RESULTS

Client: Environmental Alliance
Phone: (410)729-9000

Lab Project Number: 1098058
Project Name: 1962C T:09 Wally's BP

Lab Sample No: 1098058001 ProjSampleNum: 1098058001 Date Collected: 06/25/09 11:25
Client Sample ID: SVE10625091125 Matrix: Air Date Received: 06/26/09 9:13

Parameters	Report Limit ppmv	Results ppmv	Report Limit mg/m3	Results mg/m3	DF	Analyzed		CAS No.
Air								
TO-3 Air								
Benzene	0.2	ND	0.65	ND	2	07/06/09 12:12	DB1	71-43-2
Ethylbenzene	0.2	ND	0.88	ND	2	07/06/09 12:12	DB1	100-41-4
m&p-Xylene	0.4	ND	1.8	ND	2	07/06/09 12:12	DB1	1330-20-7
Methyl-tert-butyl ether	0.2	ND	0.73	ND	2	07/06/09 12:12	DB1	1634-04-4
o-Xylene	0.2	ND	0.88	ND	2	07/06/09 12:12	DB1	95-47-6
THC as C1-C4	3	4.0	3.1	4.11	2	07/01/09 10:43	DB1	
THC as Gas	2	10	8.7	43.4	2	07/06/09 12:12	DB1	
Toluene	0.2	1.1	0.77	4.21	2	07/06/09 12:12	DB1	108-88-3

Lab Sample No: 1098058002 ProjSampleNum: 1098058002 Date Collected: 06/25/09 13:15
Client Sample ID: SVE20625091315 Matrix: Air Date Received: 06/26/09 9:13

Parameters	Report Limit ppmv	Results ppmv	Report Limit mg/m3	Results mg/m3	DF	Analyzed		CAS No.
Air								
TO-3 Air								
Benzene	0.2	ND	0.65	ND	2	07/06/09 13:42	DB1	71-43-2
Ethylbenzene	0.2	ND	0.88	ND	2	07/06/09 13:42	DB1	100-41-4
m&p-Xylene	0.4	ND	1.8	ND	2	07/06/09 13:42	DB1	1330-20-7
Methyl-tert-butyl ether	0.2	ND	0.73	ND	2	07/06/09 13:42	DB1	1634-04-4
o-Xylene	0.2	ND	0.88	ND	2	07/06/09 13:42	DB1	95-47-6
THC as C1-C4	3	6.7	3.1	6.89	2	07/01/09 10:48	DB1	
THC as Gas	2	4.7	8.7	20.4	2	07/06/09 13:42	DB1	
Toluene	0.2	ND	0.77	ND	2	07/06/09 13:42	DB1	108-88-3

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ANALYTICAL RESULTS

Client: Environmental Alliance
Phone: (410)729-9000

Lab Project Number: 1098058
Project Name: 1962C T:09 Wally's BP

Lab Sample No: 1098058003 ProjSampleNum: 1098058003 Date Collected: 06/25/09 14:35
Client Sample ID: SVE30625091435 Matrix: Air Date Received: 06/26/09 9:13

Parameters	Report Limit ppmv	Results ppmv	Report Limit mg/m3	Results mg/m3	DF	Analyzed		CAS No.
Air								
TO-3 Air								
Benzene	0.44	ND	1.4	ND	4.35	07/06/09 14:00	DB1	71-43-2
Ethylbenzene	0.44	ND	1.9	ND	4.35	07/06/09 14:00	DB1	100-41-4
m&p-Xylene	0.87	ND	3.8	ND	4.35	07/06/09 14:00	DB1	1330-20-7
Methyl-tert-butyl ether	0.44	ND	1.6	ND	4.35	07/06/09 14:00	DB1	1634-04-4
o-Xylene	0.44	ND	1.9	ND	4.35	07/06/09 14:00	DB1	95-47-6
THC as C1-C4	3.9	4.9	4	5.04	2.59	07/01/09 11:00	DB1	
THC as Gas	4.4	7.8	19	33.9	4.35	07/06/09 14:00	DB1	
Toluene	0.44	ND	1.7	ND	4.35	07/06/09 14:00	DB1	108-88-3

Lab Sample No: 1098058004 ProjSampleNum: 1098058004 Date Collected: 06/25/09 15:40
Client Sample ID: SVE40625091540 Matrix: Air Date Received: 06/26/09 9:13

Parameters	Report Limit ppmv	Results ppmv	Report Limit mg/m3	Results mg/m3	DF	Analyzed		CAS No.
Air								
TO-3 Air								
Benzene	0.19	ND	0.62	ND	1.93	07/06/09 14:13	DB1	71-43-2
Ethylbenzene	0.19	1.1	0.84	4.86	1.93	07/06/09 14:13	DB1	100-41-4
m&p-Xylene	0.39	7.9	1.7	34.9	1.93	07/06/09 14:13	DB1	1330-20-7
Methyl-tert-butyl ether	0.19	ND	0.7	ND	1.93	07/06/09 14:13	DB1	1634-04-4
o-Xylene	0.19	3.0	0.84	13.2	1.93	07/06/09 14:13	DB1	95-47-6
THC as C1-C4	2.9	5.0	3	5.14	1.93	07/01/09 11:05	DB1	
THC as Gas	1.9	115	8.2	499	1.93	07/06/09 14:13	DB1	
Toluene	0.19	12.2	0.73	46.7	1.93	07/06/09 14:13	DB1	108-88-3

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ANALYTICAL RESULTS

Client: Environmental Alliance
Phone: (410)729-9000

Lab Project Number: 1098058
Project Name: 1962C T:09 Wally's BP

Lab Sample No: 1098058005
ProjSampleNum: 1098058005
Date Collected: 06/25/09 16:45
Client Sample ID: MW50625091645
Matrix: Air
Date Received: 06/26/09 9:13

Parameters	Report Limit ppmv	Results ppmv	Report Limit mg/m3	Results mg/m3	DF	Analyzed		CAS No.
Air								
TO-3 Air								
Benzene	0.2	ND	0.65	ND	2	07/06/09 14:27	DB1	71-43-2
Ethylbenzene	0.2	2.0	0.88	8.83	2	07/06/09 14:27	DB1	100-41-4
m&p-Xylene	0.4	17.4	1.8	76.8	2	07/06/09 14:27	DB1	1330-20-7
Methyl-tert-butyl ether	0.2	ND	0.73	ND	2	07/06/09 14:27	DB1	1634-04-4
o-Xylene	0.2	6.1	0.88	26.9	2	07/06/09 14:27	DB1	95-47-6
THC as C1-C4	3	ND	3.1	ND	2	07/01/09 11:11	DB1	
THC as Gas	2	160	8.7	694	2	07/06/09 14:27	DB1	
Toluene	0.2	21.8	0.77	83.5	2	07/06/09 14:27	DB1	108-88-3

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CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

1098058

Page: 1 of 1

1298530

Section A Required Client Information:

- Company: Environmental Alliance
- Address: 1035 Benfield Blvd, Suite I, Millersville, MD 21108
- Email To: cfinch@envalliance.com
- Phone: 410-729-9000 Fax: 410-729-9001
- Requested Due Date/TAT: Normal

Section B Required Project Information:

- Report To: Bobbi Ann Barnes
- Copy To: Cori finch
- Purchase Order No.: 1962C T:09
- Project Name: Wally's BP
- Project Number: 1962C T:09

Section C Invoice Information:

- Attention:
- Company Name:
- Address:
- Pace Quote Reference:
- Pace Project Manager:
- Pace Profile #:

REGULATORY AGENCY

- ☐ NPDES ☐ GROUND WATER ☐ DRINKING WATER
- ☐ UST ☐ RCRA ☒ OTHER Air

Site Location STATE: MD

Section D Required Client Information

SAMPLE ID (A-Z, 0-9 / ,-) Sample IDs MUST BE UNIQUE

Matrix Codes MATRIX / CODE: Drinking Water DW, Water WT, Waste Water WW, Product P, Soil/Solid SL, Oil OL, Wipe WP, Air AR, Tissue TS, Other OT

Requested Analysis Filtered (Y/N)

Preservatives columns: Unpreserved, H_2SO_4, HNO_3, HCl, NaOH, $Na_2S_2O_3$, Methanol, Other (no entries)

ITEM #	SAMPLE ID	MATRIX CODE	SAMPLE TYPE (G=GRAB C=COMP)	Composite Start DATE	Composite Start TIME	Composite End/Grab DATE	Composite End/Grab TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	BTEX+MtBE (8260)	TPHEC5-C8 (TO3)	TPHEC8-C10 (TO3)	Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
1	SVE10625091125	AR	G	6/25/09	11:25				2	X	X	X		1098058001
2	SVE20625091315	↓	↓	↓	13:15				2	X	X	X		002
3	SVE30625091435	↓	↓	↓	14:35				2	X	X	X		003
4	SVE40625091540	↓	↓	↓	15:40				2	X	X	X		004
5	MW50625091645	↓	↓	↓	16:45				2	X	X	X		005
6														
7														
8														
9														
10														
11														
12														

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)
	Mark Harris / EAI	6/25/09	17:00	[signature] Pace	6/26/09	08:13	thus	N	N	Y

ORIGINAL

SAMPLER NAME AND SIGNATURE

- PRINT Name of SAMPLER: Mark Harris
- SIGNATURE of SAMPLER: [signature]
- DATE Signed (MM/DD/YY): 06/25/09

*Important Note: By signing this form you are accepting Pace's NET 30 day payment terms and agreeing to late charges of 1.5% per month for any invoices not paid within 30 days.

F-ALL-Q-020rev.07, 15-May-2007

AIR Sample Condition Upon Receipt

Pace Analytical

Client Name: ENV. ALLIANCE Project # 1098058

Courier: [X] Fed Ex [ ] UPS [ ] USPS [ ] Client [ ] Commercial [ ] Pace Other________

Optional
Proj. Due Date:
Proj. Name:

Custody Seal on Cooler/Box Present: [ ] yes [X] no Seals intact: [ ] yes [ ] no

Packing Material: [ ] Bubble Wrap [ ] Bubble Bags [X] None [ ] Other________

Tracking #: 7967 2691 5756

Date and Initials of person examining contents: 6-26-09 K

		Comments:
Chain of Custody Present:	[X] Yes [ ] No [ ] N/A	1.
Chain of Custody Filled Out:	[X] Yes [ ] No [ ] N/A	2.
Chain of Custody Relinquished:	[X] Yes [ ] No [ ] N/A	3.
Sampler Name & Signature on COC:	[X] Yes [ ] No [ ] N/A	4.
Samples Arrived within Hold Time:	[X] Yes [ ] No [ ] N/A	5.
Short Hold Time Analysis (<72hr):	[X] Yes [ ] No [ ] N/A	6. TO3
Rush Turn Around Time Requested:	[ ] Yes [X] No [ ] N/A	7.
Sufficient Volume:	[X] Yes [ ] No [ ] N/A	8.
Correct Containers Used:	[X] Yes [ ] No [ ] N/A	9.
-Pace Containers Used:	[X] Yes [ ] No [ ] N/A	
Containers Intact:	[X] Yes [ ] No [ ] N/A	10.
Media: AIR (BAG)		11.
Sample Labels match COC:	[X] Yes [ ] No [ ] N/A	12.
Samples Received: 10 BAGS		

Canisters		Flow Controllers		Stand Alone G		Tedlar Bags	
Sample Number	Can ID	Sample Number	Can ID	Sample Number	Can ID	Sample Number	Can ID

Client Notification/ Resolution:

Field Data Required? Y / N

Person Contacted: ____________________ Date/Time: ____________

Comments/ Resolution: ____________________

Project Manager Review: [signature] Date: 6/26/09

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office (i.e out of hold, incorrect preservative, out of temp, incorrect containers) REVIEWED 6/26/09 R

A106 Rev.01 (22May2009)

Appendix VI

Groundwater Model Report

GROUNDWATER MODEL REPORT
WALLY'S CITGO STATION
19200 MIDDLETOWN ROAD
PARKTON, MARYLAND

April 15, 2009

Prepared By:

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Hockessin, DE 19707
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326 Conestoga Road
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STATE OF DELAWARE
VAL F. BRITTON
Reg. No. 664
REGISTERED PROFESSIONAL GEOLOGIST

Andrew J. Applebaum, P.G.
(DE #S4-0000995)
Geological Services Manager

Val F. Britton, P.G.
(DE #S4-0000664)
Technical Consultant

J:\EAI_files\2610_Wallys_Citgo_Litigation\FINAL Wally's Citgo Report Text 4-13-09.doc

ENVIRONMENTAL ALLIANCE

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TABLES

FIGURES

FIGURES (CONTINUED)

1.0 INTRODUCTION

The Wally's Citgo facility is an active commercial gasoline service station located at 19200 Middletown Road in Parkton, Baltimore County, Maryland (site). The site is situated near the southwest corner of the intersection of Middletown Road and Rayville Road. Figure 1 presents the location of the site.

The initial investigation activities associated with the site were implemented in the summer of 2005 to comply with the Maryland Department of the Environment – Oil Control Program (MDE) emergency regulations concerning underground storage tank system (USTs) within high risk groundwater use areas in Maryland. The detected presence of benzene and methyl-tertiary butyl ether (MTBE) concentrations above MDE groundwater standards at site monitoring wells installed at that time has led to continuing investigation and interim remedial actions conducted to date.

Numerous monitoring wells (23 installed with one abandoned in January 2008) and soil borings (23 installed) were advanced to evaluate conditions associated with the Wally's Citgo property to comply with the MDE investigation requirements since 2005. Table 1 presents an inventory of the existing monitoring wells installed. In addition, potable water supply wells in the area have been sampled on a regular basis by Alliance with other area potable wells sampled from time to time since 2005 to confirm groundwater quality and to supplement potable well data collected by MDE and the Baltimore County Health Department. The results of the initial groundwater evaluation indicated that a source of MTBE was present in the groundwater near the underground storage tank (UST) system on the Wally's Citgo property. The presence of other petroleum constituents (i.e. benzene, toluene, etc.) were also identified in groundwater at much lesser concentrations than MTBE.

Since initiation of investigation activities in 2005, Alliance (under MDE oversight) has also conducted groundwater investigation activities to characterize the physical nature of the groundwater system in addition to monitoring well installation and monitoring/potable well monitoring. The investigation work conducted includes, but is not limited to the following activities.

- Down-hole geophysical testing and geochemical testing (refer to Hydrogeologic Investigation Update Report and Work Plan by Alliance dated February 6, 2007).
- Packer testing (refer to Hydrogeologic Investigation Update Report, Groundwater Delineation Work Plan, and Soil Alternative Corrective Action Plan (Update Report, Delineation Work Plan, and Soil CAP) by Alliance dated June 15, 2007).
- Pump testing (refer to Update Report, Delineation Work Plan, and Soil CAP referenced above and Pump Testing Report by Alliance dated July 31, 2007).

In January 2008 as part of interim remedial actions conducted at the site (that has included operation of a soil vapor extraction system and excavation of soil identified above MDE standards), the existing UST system was removed for upgrade to a new UST system. Soil proximate to the then existing UST system was excavated to remove potential residual impact that could act as a continuing source for groundwater impact. During system removal/upgrade activities, no significant soil contamination was identified. Given this observation, the actual source of a release to create a groundwater impact at the site is unclear. Refer to UST Closure, UST System Installation, And Soil Remediation Sampling Results Letter Report by Alliance dated March 6, 2008 for details.

Based on site physical and chemical characterization data and information collected from other sources, a site conceptual model has been developed and refined to guide investigation and evaluation of potential corrective action activities. The anticipated pathway of petroleum contaminants through the subsurface environment would be similar to that of infiltrated water through the subsurface to form a groundwater system. Precipitation infiltrating through the regolith (unconsolidated sediments and saprolite) would mobilize petroleum constituents along a path downward to the bedrock groundwater system. The reduction in permeability from unconsolidated sediments to saprolite would likely cause increased lateral dispersion of the petroleum constituents, although infiltration water and petroleum constituents would continue to follow a downward path to the underlying schist bedrock as no groundwater is shown to collect in the unconsolidated sediments to saprolite.

The reduced permeability of bedrock would cause the infiltration water and petroleum constituents to collect and/or disperse along the bedrock surface while also penetrating downward through bedrock preferential pathways. In the schist bedrock, the major preferential pathways are the secondary porosity features (fractures and bedding plane or foliation partings). A negligible pathway through the schist bedrock would be through the rock matrix (primary porosity). Upon encountering groundwater stored in the bedrock secondary porosity, the infiltration water and petroleum constituents would continue to disperse through the bedrock groundwater system with the flow of groundwater.

The orientation of the bedrock secondary porosity features in conjunction with the natural vertical and horizontal hydraulic gradients would control the flow of contaminants with groundwater. Operation of the potable wells in the area will draw groundwater along the secondary porosity features, diverting the flow of groundwater from the natural direction (gravity controlled by the general topographic gradient of the area). Consistent demand of bedrock groundwater from the limited storage available to the potable wells would restrict the lateral dispersion of the petroleum constituents outside of the site area. The potable wells along the identified preferred groundwater flow orientation of fracture strike, would generally act as sumps to collect groundwater. Potable wells outside of the secondary porosity orientation and not in the immediate area of the site would tend to draw groundwater from areas other than the area impacted by groundwater. The vertical distribution of impact in the groundwater system would also tend to be limited as minimal to no groundwater bearing zones have been identified with increased depth in bedrock.

The purpose of the groundwater model discussed in this report is to provide a numeric representation of the hydrogeologic conditions existing at the site and the surrounding area based on the existing site conceptual model. The model allows the evaluation of groundwater flow and MTBE transport at the site and in the surrounding areas through numeric simulations based on existing data. It is not the intent of this groundwater model document to describe the methods used to collect the data used, however, in some cases a brief explanation of the quality of the data is discussed where interpretation is warranted.

Groundwater Modeling Systems (GMS) software, Version 6.5, developed by the United States Department of Defense and distributed by Aqueveo, Inc. was utilized in the development of the groundwater model for the site. This modeling software consists of numerous modules that are interfaced to allow more accurate representation of hydrogeologic conditions and greater flexibility in simulating and evaluating flow conditions on the site and surrounding area.

The "site" generally encompasses the entire region of the groundwater model that incorporates numerous properties within the general drainage basin of the site.

It is not the intent of the groundwater model to solely define the hydrogeologic characteristics that exist at the site, but rather the model is intended to be used as an additional evaluation tool in conjunction with the more conventional evaluation methods that have been applied to the site.

Figures that have been included as part of this report are provided in an 11 x 17 inch paper size format and are in color allowing the data to be graphically presented. Black and white copies and/or smaller paper size copies of the figures may not present the data in the clarity originally intended.

2.0 MODEL CONSTRUCTION

2.1 General

Within acceptable geologic practice, the collection and/or evaluation of all data desired for a particular investigative purpose may not be possible due to economics and/or logistic limitations. For this reason, some necessary simplifying assumptions relative to the site's geologic or hydrogeologic characteristics have been made during the development of this groundwater model. However, all of the assumptions and speculations have been based on sound and accepted geologic and hydrogeologic theory and are identified when utilized.

The model was constructed in three stages. The first stage consisted of developing a three dimensional solid conceptual model representing the physical characteristics of the site. The second stage consisted of converting the three-dimensional solid conceptual model into a numeric model for calibration and subsequent flow simulation. MODFLOW 2000, a widely used and accepted finite difference model developed by the United States Geologic Survey, was utilized for the numeric model. The model was constructed as a steady-state model, which allows the input data to be interpolated through numerous iterations to solve the finite difference equation. The third step consisted of incorporating a MODPATH code to evaluate the movement of particles in the groundwater system. The modeled simulations presented in this report are under steady state conditions.

2.2 Numeric Flow Model Construction

Boundary Conditions

The boundary conditions of the model are presented on Figure 1. The general model area (model domain) is bordered to the north and southwest by groundwater divides that were designated as MODFLOW "no flow" boundaries. It was apparent that any groundwater movement on the eastern side of the model domain would not impact the results of the model; therefore, this boundary was also assigned as a MODFLOW "no flow" boundary.

A small western section of the model boundary associated with Frog Hollow Cove and a section in the southeastern portion of the model associated with Owl Branch Creek were assigned as MODFLOW drains. Based on the evaluation of the hydrogeologic characteristics of these areas, it was assumed that these surface water bodies did not exhibit tidal influences and received groundwater as base flow discharge.

The elevations of the surface water streams (drain nodes) were based on the United States Geologic Survey (USGS) topographic quadrangle map of the area. The elevations were estimated from the USGS maps and then 2.0 feet were subtracted from the estimated surface water elevation at each node location to estimate the bottom of the creek bed elevation. The bottom of the creek bed elevation was used in the model as the node elevation. These elevations are presented on Figure 1.

Surface Water

Several small surface water bodies exist within the model domain. It is assumed that these surface water bodies receive groundwater as base flow from the surrounding groundwater aquifer. These surface water bodies were assigned as MODFLOW drains in the model. The elevations were estimated from the USGS maps and then 2.0 feet were subtracted from the estimated surface water elevation at each node location to estimate the bottom of the surface water body bed elevation. The bottom of the stream bed elevation was used in the model as the node elevation. These elevations are presented on Figure 1. The conductance values for the surface water body bed materials were varied from 200 to 500 ft^2/day/ft. It should be noted that the drain conductance values had very little effect on the model solution (i.e., the model was insensitive to changes in the drain conductance values), especially at the model boundaries.

Potable Supply Wells

There is no public water supply in the area of the site and as a result, each home or business obtains potable water from a private water supply well on the individual property. The well locations were assigned as MODFLOW "wells" in the model domain. The locations of these wells are presented on Figure 2 and an inventory of these wells along with potable well information (available well data from MDE and Baltimore County Health Department data bases and assumed values for wells with no data based on available well information in the area) is provided on Table 2. The open intervals of the wells were assigned to specific model layers.

The majority of the pumping rates used in the model were estimated. However, several of the wells on and near the site had flow meters and actual pumping rates could be determined. Table 2 presents the pumping rates that were used in the model.

Model Grid

It has been assumed that anisotropy (preferential flow direction) exists on the site based on a pumping test that was performed on the site in May and June of 2007. Based on the pumping test, it was determined that preferential flow existed along the strike direction (approximately N47ºE).

The model grid was oriented parallel to the strike direction to simulate the preferential flow in this direction. A general grid spacing of approximately 130 by 130 feet was assigned to the outer domain of the model. The grid was refined in area of the site facility to allow details of the model to be appropriately discretionized. The grid in this portion of the model was approximately 30 by 30 feet. The general model grid is presented on Figure 3.

Recharge

The groundwater recharge values used in the model are presented on Figure 4. Groundwater recharge is based on the average annual precipitation in a region. As a general "rule of thumb", recharge is approximately 1/3 of the actual precipitation that occurs in relatively flat and porous terrain. Average precipitation in the area of the site is approximately 45 inches per year.[1] Under ideal conditions, approximately 15 inches would recharge per year. However, it is expected that recharge would be lower in the area of the site due to the low permeability of the soil material.

[1] National Oceanic and Atmospheric Administration (NOAA), Baltimore County, Maryland

Based on data provided by the USGS, recharge in the region ranges from 9.3 to 13.4 inches per year.[2] According to the MDE in a 1998 publication entitled Maryland Ground Water Balance Database Publication Information, groundwater recharge in the general model domain was calculated to be approximately 8.4 inches per year (0.002 ft/day).

Based on the site characteristics, two additional recharge values were assigned to the model domain in the area of the site. The second recharge value was assigned to the paved portion of the site. The specific site area is paved; however, the pavement is in poor condition and numerous landscape areas are present within the paved area. This area was assigned a relatively lower recharge value of 0.0015 ft/day.

The third recharge area is in the location where the underground storage tanks and associated soil was removed and backfilled with gravel material. Based on historic groundwater elevation measurements collected at the site, a consistent groundwater mound is present below this excavation area. It has been assumed that water collects in the excavation area and recharges the underlying area at a higher rate than the surrounding area. A relatively higher recharge rate of 0.14 ft/day was used in this area to reproduce the mounding that was observed from the site monitoring wells.

A sensitivity analysis of recharge was conducted to better understand the impact that this parameter has on the groundwater model results. Higher and lower values of recharge were evaluated. It was determined that the model was very sensitive to recharge: the higher values caused flooding in the model in areas where none has been observed, and the lower recharge values resulted in “dry cells” in the model where groundwater was known to exist. Additionally, the sensitivity analysis was compared to the residual error between the observed groundwater elevations and the simulated groundwater elevations. Table 6 presents the results of the sensitivity analyses for recharge.

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[2] Estimates of Mean-Monthly & Annual Groundwater Recharge: Brandywine Creek (01480800) Marsh Creek (01480675), Red Clay Creek (01479820), United States Geological Survey (USGS), Water Science Center.

Model Layers

Figure 5 presents a graphical representation of the model layers and the hydraulic parameters utilized in the construction of the groundwater model.

The site and general model area is underlain by the Pretty Boy Schist (renamed locally from the Wissahickon Schist). The geology consists of approximately 40 feet of unconsolidated sediment grading into weathered bedrock (saprolite) that in turn grades into fractured crystalline bedrock. According to site specific data and publication data, the more permeable portion of the bedrock material exists above 100 feet. A transition of lower hydraulic conductivities begins at approximately 100 feet to approximately 300 feet at which depth very low hydraulic conductivities exist.

Based on the evaluation of the hydrogeologic conditions that exist on the site, it is evident that a water table condition exists in the general area of the site. The water table exists in the bedrock portion of the geologic material.

For the purpose of model construction, the model was assigned eight MODFLOW layers to represent the hydrogeologic units that exist at the site. Generally, the upper five layers were designated to represent the more permeable upper bedrock. These layers are each 20 feet thick. It should be noted that the unconsolidated sediment and saprolite were not represented since groundwater flow did not exist in these units. The sixth and seventh layers represent the transitional zones (20 feet thick and 200 feet thick, respectively) and the eighth layer represents the vertical no-flow boundary of the model base.

Hydraulic Conductivity Assignment

Based on existing data (May and June 2007 pumping test and April and May 2007 slug tests conducted at the site), the average horizontal hydraulic conductivity of the upper bedrock ranged from 0.35 ft/day to 0.93 ft/day. Based on the calibration of the model (discussed below), a mean horizontal hydraulic conductivity was assigned over the entire domain of the model of 0.41 ft/day. A sensitivity analysis of the hydraulic conductivity was conducted and is presented on Table 7.

In conjunction with the horizontal hydraulic conductivity, horizontal and vertical anisotropy ratios were assigned to the model layers. The horizontal hydraulic conductivity was based on the May-June 2007 pumping test zone of influence. Based on the pumping test, a 2:1 ratio existed along strike with the preferential flow direction along strike. As a result, an anisotropy ratio of 0.5 was assigned to the model.

A vertical anisotropy ratio of 1.2 was assigned to the layers of the model. This was based on the model calibration only. Sensitivity analyses of the horizontal and vertical anisotropy ratios are presented on Table 8.

2.3 Numeric Flow Model Calibration[3]

General

Calibration refers to the demonstration that the model is capable of producing field measured heads and flows. Calibration can be evaluated both qualitatively and quantitatively; however, even in a quantitative evaluation, the judgment of when the fit between model and reality is good enough is a subjective one.

The groundwater model was calibrated to mean groundwater elevations collected in the site monitoring wells and flow measurements collected in surface water streams. In addition, a comparison was made to two additional sets of groundwater elevation data. The two additional sets of groundwater elevation data included a composite set (numerous dates) of apparent static water level measurements available from the MDE provided on drilling permits for existing residential wells, and a set of water levels collected by the MDE in March of 1964.

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[3] Anderson, M.P., Woessner, W. W., 1992, Applied Groundwater Modeling – Simulation of Flow and Advective Transport, Academic Press, Inc., pp. 223-246.

Monitoring Well Calibration (Mean Water Levels)

Mean groundwater elevation data was calculated from the existing site monitoring well data. These values were used as the calibration target for the model.

Initially, the associated average hydraulic conductivities were assigned to the eight layers close to the values presented on Figure 5 to achieve the best calibration to the target values. Recharge values were chosen close to those values presented on Figure 4, again to achieve the best calibration to the target values. Trial and error was used to achieve the calibration. Concurrent with the hydraulic conductivity and recharge parameter adjustments, simulated surface water flow volumes were evaluated as discussed below.

During the calibration process, sensitivity analyses of the recharge values and the hydraulic conductivity values (horizontal hydraulic conductivity, horizontal anisotropy, and vertical anisotropy) were conducted to identify the optimum values to best match the calibration targets. Tables 6, 7, and 8 present the results of the sensitivity analyses. A further discussion of the sensitivity analyses is provided below.

The result of the calibration is presented in tabular format on Table 3 and is graphically presented on Figure 7.

Surface Water Calibration

During the calibration process for the site monitoring wells, two surface water stream calibration points were evaluated for flow volume. The location of the calibration points were based on locations where stream flows were measured in the field on September 24, 2008. The location of the monitoring points and the observed flows are presented on Figure 6.

During the calibration process, simulated flows were compared to observed flows. The final results of the calibration for the flows are presented on Figure 6.

Comparison of MDE Groundwater Elevation Data – Composite Dates

A comparison of composite groundwater elevation data provided by the MDE from well installations in the area of the site to the simulated head elevations is presented on Figure 7. The MDE groundwater elevation measurements used in this comparison were evidently obtained from drilling permits as the "static level" at the time the well was installed. These measurements extend over numerous years and do not represent a single synoptic "snap shot" in time; however, they do provide a reasonable groundwater elevation estimate at those well locations. Table 4 presents a tabular format of the comparison of the MDE data to the calibrated groundwater elevation data. Figure 8 provides a graphical representation of the comparison.

Results of the comparison (see Figure 7) show that the MDE data plots along the "perfect fit" line, with data points being well distributed on both sides of the line suggesting a reasonable match.

MDE Groundwater Elevation Data – March 1964

A second set of MDE groundwater elevation data was used for comparison to the calibrated site monitoring well groundwater elevation data. The second set of MDE data was collected by MDE over two days in March 1964, providing a reasonable synoptic "snap shot" of groundwater elevations across the model domain.

Table 5 presents a tabular comparison of this data to the calibrated mean groundwater elevation data from the site monitoring well data. Figure 9 presents a graphical comparison of the data.

Results of both comparisons (see Figures 7 and 8) show that the MDE data plots along the "perfect fit" line, with data points being well distributed on both sides of the line suggesting a reasonable match.

Sensitivity Analyses

As discussed above, several sensitivity evaluations were conducted on the hydraulic parameters input into the model. The sensitivity analyses allow key parameters of the model to be adjusted independently of the other parameters to evaluate the sensitivity of each of the parameters within the model. Generally, the purpose of the sensitivity analyses confirms the uniqueness of the set of hydrogeologic parameters used in the model. This prevents the use of model boundary conditions that allow broad ranges of parameter values that are non-unique to a specific site.

During the initial calibration, the recharge values were changed while the average hydraulic conductivity values for each of the eight layers (provided on Figure 5) was held constant. The recharge parameter was sensitive and was found to provide the best calibration to the mean groundwater elevations in the site monitoring wells at a value of 0.002 ft/day. Table 6 presents the results of the recharge sensitivity evaluation. It should be noted that recharge values above 0.002 ft/day also resulted in flooding of the lower portions of the model where none has been observed. Values lower than 0.002 ft/day resulted in a significant drop in simulated stream flows.

As discussed above, the hydraulic conductivity parameters used for the calibration to the mean site groundwater elevation data worked best with the average values presented on Figure 5. These values were derived through a trial and error process. Once the best quantitative calibration was obtained, a sensitivity analysis of the parameters was conducted. Table 7 presents the sensitivity analyses for the horizontal hydraulic conductivity. Horizontal hydraulic conductivity was a sensitive parameter and there was a very limited range in values that allowed the model to converge.

Vertical and horizontal anisotropy was also evaluated for sensitivity in the model. Results of these evaluations are presented on Table 8. Vertical anisotropy did not appear to be a sensitive parameter. Horizontal anisotropy was an extremely sensitive parameter and allowed the model to converge only with a ratio of 0.5.

Flow Budget

The flow budget of the MODFLOW model was evaluated to determine if reasonable inflows and outflows of the model had been achieved. Based on the understanding of the site's hydrologic cycle, the aquifer on the site is primarily recharged from precipitation. Groundwater is discharged from the aquifer through drainage into surface water streams and extraction from potable wells. Results of the flow budget are presented on Table 9.

Based on the results of the flow budget, it is evident that the inflow of water into the model domain closely matches the outflow of water from the model domain suggesting a reasonable water budget balance.

3.0 SIMULATED GROUNDWATER FLOW

3.1 General

The simulated groundwater flow across the model domain is presented on Figure 10 through 13. Figure 10 presents the groundwater flow in the general area of the site and Figure 11 presents the groundwater flow over the entire region of the model. Figures 12 and 13 provide cross sections through the model domain (see Figure 11 for the location of the cross sectional lines).

Based on the groundwater model simulation, groundwater elevations generally follow the topographic contours. There is a distinct groundwater divide that roughly parallels Rayville Road to the east. Groundwater in the vicinity of the site generally flows to the southwest.

3.2 Particle Tracking Analyses

As part of the groundwater flow simulations, a particle tracking analysis was conducted using MODPATH. MODPATH is a widely used and accepted software code, developed by the USGS that interfaces with MODFLOW and allows particle tracking in the flow model. This type of analysis allowed particles to be released in the potable pumping wells and a reverse track of their pathways was simulated to evaluate the potential migration pathways of dissolved state contaminants in the groundwater originating from the site.

Four particles were released from each of the plaintiff well locations (with detectable concentrations of MTBE) along the open interval of the well and were allowed to track backwards without any time limit constraints. Marker arrows were placed along the path lines every one year to allow an approximate time frame to be evaluated. Due to the size of the model domain and the distribution of plaintiff wells with MTBE detections, the presentation of the path line results were divided into four quadrants centered on the site location. The quadrants are identified as northwest (Figure 14), northeast (Figure 15), southwest (Figure 16), and southeast (Figure 17). In addition, particle tracking was applied to the three on-site pumping wells PW-1, PW-2, and PW-3. The results of the particle tracking from these wells are presented on Figure 18.

The reverse particle tracking is based on groundwater advection only and does not suggest that dissolved groundwater constituents would migrate the entire length of the particle track line. It simply suggests that if a particle were free to move, this is where it would eventually end up assuming that there were no other factors diminishing the migration such as sorption, decay, dilution, etc.

Northwest Quadrant (Figure 14)

Based on the model simulation, none of the plaintiff wells in the northwest quadrant would be reached by constituents released in the vicinity of the site.

Northeast Quadrant (Figure 15)

Based on the model simulation, none of the plaintiff wells in the northeast quadrant would be reached by constituents released in the vicinity of the site.

Southwest Quadrant (Figure 16)

It is evident that all of the plaintiff wells (1606, 1608, 1612, 1616, 1620, and 1624 Rayville Road) in the southwest quadrant along Rayville Road could be reached by constituents released at the site location. The estimated times of constituents reaching the plaintiff wells range from approximately 14 years at 1606 Rayville Road to approximately 28 years at 1624 Rayville Road.

Southeast Quadrant (Figure 17)

The closest plaintiff well to the site, 19105 Middletown Road, does not appear to draw groundwater directly from the site as the particle tracking ends at a point where the particles released from the potable well terminate at the groundwater surface. The particle tracking shows an approximate travel time from potable well to the groundwater surface of 15 years. The four other plaintiff wells southeast from the site (18940, 18941, 18833, and 18829 Middletown Road) are far enough that they would not be reached due to the limited zone of influence from these wells.

4.0 SUMMARY AND CONCLUSIONS

Based on the results of the groundwater model simulation discussed in this document, the following conclusions have been reached:

- ♦ A well defined groundwater divide exists along the topographic ridge on which the site is situated. The configuration of the groundwater divide results in groundwater flow in a southwest direction from the site location.
- ♦ Six plaintiff wells (1606, 1608, 1612, 1616, 1620, and 1624 Rayville Road) have the potential to be reached by constituents released from the site.

In summary six plaintiff wells (1606, 1608, 1612, 1616, 1620, and 1624 Rayville Road) have the potential to be reached by constituents released at the site location. None of the other plaintiff wells are at locations that would allow them to be impacted based on the hydrogeologic characteristics that exist in the area.

5.0 LIMITATIONS

The modeling in this report was performed using a commercially available software package (Groundwater Modeling System-GMS, Version 6.5 developed by the United States Department of Defense) designed to simulate groundwater flow and the migration of contaminants. Where available, actual data from the site was utilized to calibrate the models and develop the graphical representations presented in this document. In other instances, assumptions were necessary to complete the model and limitations associated with the site data result in a level of uncertainty in the model predictions. Therefore, the results of the model predictions should be independently evaluated using actual site monitoring data.

The results of the model may differ from actual site conditions because of unknown subsurface conditions. The results of the models presented in this document shall not be construed to create any warranty or representation with regard to the site. The conclusions presented in this report were based on the services described, and not on scientific tasks or procedures beyond the described scope of services.

TABLES

TABLE 1
Well Inventory/Specifications
Wally's Citgo Station
Parkton, Maryland

Well ID	Top of Casing Elevation (ft/msl)	Well Depth[1] (ft)	Depth to Top of Screen/Open Borehole (ft)	Screen/Open Borehole Length (ft)	Top of Screen/Open Borehole Elevation (ft/msl)	Bottom of Screen/Open Borehole Elevation (ft/msl)	Model Layer(s)
MW-1	802.09	62	37	25	765.09	740.09	2-3
MW-2	801.83	60	40	20	761.83	741.83	2-3
MW-3	801.45	62	42	20	759.45	739.45	2-3
MW-4	801.35	60	40	20	761.35	741.35	2-4
MW-5	802.18	50.5	30.5	20	771.68	751.68	2-3
MW-5B[2]	802.64	100	70	30	732.64	702.64	4-5
MW-6	801.08	60.5	40.5	20	760.58	740.58	2-4
MW-7A[2]	796.66	65	40	25	756.66	731.66	3-4
MW-7B[2]	796.64	120	70	50	726.64	676.64	4-7
MW-8A[2]	793.1	65	40	25	753.1	728.1	3-4
MW-8B[2]	792.69	100	73.5	26.5	719.19	692.69	4-5
MW-9A[2]	798.18	65	40	25	758.18	733.18	3-4
MW-9B[2]	798.04	120	72	48	726.04	678.04	4-7
MW-10A[2]	800.69	62	40	22	760.69	738.69	3-4
MW-10B[2]	800.75	100	70	30	730.75	700.75	4-5
MW-11A[2]	795.52	60	40	20	755.52	735.52	3-4
MW-11B[2]	795.22	100	70	30	725.22	695.22	4-5
MW-12B[2]	800.28	100	70	30	730.28	700.28	4-5
MW-13A[2]	801.74	60	40	20	761.74	741.74	3
MW-13B[2]	801.78	100	70	30	731.78	701.78	4-5
MW-14A[2]	797.53	60	40	20	757.53	737.53	3
MW-14B[2]	797.33	100	70	30	727.33	697.33	4-5

[1] = Value identifies actual well depth and not actual boring depth
[2] = Open borehole well
ft= feet
ft/msl= feet mean sea level

TABLE 2

Active Pumping Wells and Rates Used in Steady State Model
Wally's Citgo Station
Parkton, Maryland

Well ID	Pumping Rate (ft^3/d)	Pumping Rate (gpd)	Pumping Rate (gpm)	Well Depth (ft)	Casing Depth (ft)	Model Layer(s)
3ELL	10	75	0.1	245	40	3-7
4ELL	20	150	0.1	300	80	5-7
5ELL	15	112	0.1	200	40	3-7
6ELL	20	150	0.1	225	60	4-7
7ELL	15	112	0.1	285	48	3-7
8ELL	20	150	0.1	225	78	5-7
9ELL	20	150	0.1	185	60	4-7
3HED	20	150	0.1	200	40	3-7
5HED	25	187	0.1	200	40	3-7
1801LAU	20	150	0.1	100	40	3-5
18829MID	15	112	0.1	200	40	3-7
18833MID	25	187	0.1	200	40	3-7
18940MID	15	112	0.1	200	40	3-7
18941MID	20	150	0.1	200	40	3-7
19022MID	20	150	0.1	305	40	3-7
19101MID	20	150	0.1	300	20	2-7
19105MID	15	112	0.1	200	40	3-7
19115MID	20	150	0.1	345	42	3-7
19119MID	20	150	0.1	345	42	3-7
19201MID	20	150	0.1	350	56	3-7
19205MID	25	187	0.1	250	46	3-7
19205MID	20	150	0.1	250	46	3-7
19222MID	20	150	0.1	400	40	3-7
19223MID	20	150	0.1	400	40	3-7
19229MID	20	150	0.1	202	40	3-7
19235MID	10	75	0.1	400	40	3-7
19239MID	10	75	0.1	400	40	3-7
19303MID	10	75	0.1	180	44	3-7
19305MID	Can't Locate					
19535MID	Outside of model domain					

TABLE 2

Active Pumping Wells and Rates Used in Steady State Model

Wally's Citgo Station

Parkton, Maryland

Well ID	Pumping Rate (ft^3/d)	Pumping Rate (gpd)	Pumping Rate (gpm)	Well Depth (ft)	Casing Depth (ft)	Model Layer(s)
3PAR	20	150	0.1	300	40	3-7
1614PAR	20	150	0.1	200	40	3-7
1704PAR	20	150	0.1	224	40	3-7
1620PHIL	20	150	0.1	200	40	3-7
1302RAY	25	187	0.1	200	40	3-7
1414RAY	20	150	0.1	400	40	3-7
1416RAY	30	224	0.2	100	40	3-5
1500RAY	20	150	0.1	125	63	3-6
1501RAY	15	112	0.1	180	28	2-7
1506RAY	15	112	0.1	142	46	3-6
1510RAY	15	112	0.1	200	40	3-7
1521RAY	20	150	0.1	125	47	3-6
1523RAY	20	150	0.1	200	32	2-7
1525RAY	20	150	0.1	175	41	3-7
1525RAY	15	112	0.1	175	41	3-7
1527RAY	10	75	0.1	200	40	3-7
1529RAY	15	112	0.1	200	40	3-7
1606RAY	4.24	32	0.0	200	40	3-7
1608RAY	3.82	29	0.0	200	40	3-7
1612RAY	10.45	78	0.1	200	40	3-7
1614RAY	20	150	0.1	125	40	3-6
1616RAY	15	112	0.1	200	40	3-7
1620RAY	20	150	0.1	200	40	3-7
1624RAY	15	112	0.1	200	55	3-7
19300RIC	20	150	0.1	460	29	2-7
19305RIC	20	150	0.1	300	46	3-7
19328RIC	20	150	0.1	300	46	3-7
19200SHA	20	150	0.1	400	22	2-7
19201SHA	20	150	0.1	350	56	3-7
19202SHA	20	150	0.1	460	38	3-7
19203SHA	20	150	0.1	200	98	6-7
19205SHA	20	150	0.1	460	45	3-7
19206SHA	20	150	0.1	360	39	3-7

TABLE 2

Active Pumping Wells and Rates Used in Steady State Model

Wally's Citgo Station

Parkton, Maryland

Well ID	Pumping Rate (ft^3/d)	Pumping Rate (gpd)	Pumping Rate (gpm)	Well Depth (ft)	Casing Depth (ft)	Model Layer(s)
19207SHA	20	150	0.1	400	42	3-7
19208SHA	20	150	0.1	240	31	2-7
19209SHA	20	150	0.1	300	31	2-7
19210SHA	20	150	0.1	220	22	2-7
19211SHA	20	150	0.1	460	51	3-7
19212SHA	20	150	0.1	360	39	3-7
19213SHA	20	150	0.1	580	20	2-7
19214SHA	20	150	0.1	360	41	3-7
19215SHA	20	150	0.1	460	49	3-7
MW-10A	0	0	0.0	62	40	3-4
PW-1	50.13	375	0.3	242	79	5-7
PW-2	49.89	373	0.3	305	47	3-7
PW-3	22.08	165	0.1	400	40	3-7
UKNOWND	20	150	0.1	225	50	3-7
UNKNOWN3	20	150	0.1	225	50	3-7

Note: Green shade indicates that no data was available and values were estimated

ft= feet

ft^3/d= cubic feet per day

gpd= gallons per day

gpm= gallons per minute

TABLE 3
Residual Calibration Error - Mean Head Elevations - Site Monitoring Wells
Groundwater Flow Simulation
Wally's Citgo
Parkton, Maryland

Well ID	Observed Head Elevation (ft/msl)*	Computed Head Elevation (ft/msl)	Residual Head Error	Comments
MW-1	761.27	759.78	1.49	
MW-2	761.48	759.80	1.68	
MW-3	761.32	759.53	1.79	
MW-4	761.29	758.79	2.50	
MW-5	761.91	758.74	3.17	
MW-6	758.05	757.62	0.43	
MW-7A	753.03	756.96	-3.93	
MW-7B	751.46	756.75	-5.29	
MW-8A	751.97	754.05	-2.08	
MW-9A	758.01	754.42	3.59	
MW-9B	758.25	754.42	3.83	
MW-10A	761.47	758.31	3.16	
MW-11A	749.13	755.48	-6.35	
MW-13A	759.89	755.85	4.04	
MW-14A	754.57	756.03	-1.46	

Sum of Residual Error	6.57	Feet
Mean of Residual Error	-0.44	Feet
Mean Absolute Error	2.99	Feet
Root Mean Square Error	3.35	Feet

* Based on mean groundwater elevation measurements (entire data set). Deep wells with similar screen intervals or groundwater elevations were not used in calibration.
ft/msl= feet mean sea level

TABLE 4

Comparison of Composite MDE Groundwater Elevation Data to Simulated Groundwater Elevation Data

Wally's Citgo

Parkton, Maryland

Well ID	Observed Head Elevation (ft/msl)*	Computed Head Elevation (ft/msl)	Residual Head Error	Comments
35	723			Dry Cell in Layer 5
59	749	751.00	-2.00	Calibrated to Layer 5 Head
58	740	732.00	8.00	Calibrated to Layer 5 Head
57	740	736.00	4.00	Calibrated to Layer 5 Head
55	729	744.00	-15.00	Calibrated to Layer 5 Head
56	739	746.00	-7.00	Calibrated to Layer 5 Head
12	735	751.00	-16.00	Calibrated to Layer 5 Head
53	735	755.00	-20.00	Calibrated to Layer 5 Head
52	769	757.00	12.00	Calibrated to Layer 5 Head
71	736	750.00	-14.00	Calibrated to Layer 5 Head
48	759	791.00	-32.00	Calibrated to Layer 5 Head
47	734	725.00	9.00	Calibrated to Layer 5 Head
50	680	669.00	11.00	Calibrated to Layer 5 Head
18	450	502.00	-52.00	Calibrated to Layer 5 Head
89	660	688.00	-28.00	Calibrated to Layer 5 Head
70	701	673.00	28.00	Calibrated to Layer 5 Head
61	660	647.00	13.00	Calibrated to Layer 5 Head
60	627	614.00	13.00	Calibrated to Layer 5 Head
68	580	582.00	-2.00	Calibrated to Layer 5 Head

Sum of Residual Error	-90.00	Feet
Mean of Residual Error	5.00	Feet
Mean Absolute Error	15.93	Feet
Root Mean Square Error	19.99	Feet

* Based on MDE groundwater elevation data from drilling records (permits) at time wells were installed. Measurements span a broad range in time.
ft/msl= feet mean sea level

TABLE 5

Comparison of MDE Groundwater Elevation Data Collected in March 1964 To Simulated Groundwater Elevation Data
Wally's Citgo
Parkton, Maryland

Well ID	Observed Head Elevation (ft/msl)*	Computed Head Elevation (ft/msl)	Residual Head Error	Comments
59	749	752.00	-3.00	Calibrated to Layer 5 Head
57	740	740.00	0.00	Calibrated to Layer 5 Head
56	739	750.00	-11.00	Calibrated to Layer 5 Head
48	759	792.00	-33.00	Calibrated to Layer 5 Head
47	734	731.00	3.00	Calibrated to Layer 5 Head
61	660	646.00	14.00	Calibrated to Layer 5 Head
60	627	615.00	12.00	Calibrated to Layer 5 Head
68	580	585.00	-5.00	Calibrated to Layer 5 Head

Sum of Residual Error	-23.00	Feet
Mean of Residual Error	2.08	Feet
Mean Absolute Error	10.28	Feet
Root Mean Square Error	14.29	Feet

* Based on MDE groundwater elevation data collected in March 1964
ft/msl= feet mean sea level

TABLE 6

Sensitivity Analyses for Recharge
Wally's Citgo
Parkton, Maryland

Recharge Rate (ft/day)										
Main Area of Model	0.0018	0.0019	0.0019	0.0019	0.002	0.0021	0.002	0.002	0.002	0.002
Paved Site Area	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015	0.0015
Excavation Area	0.0015	0.0015	0.03	0.06	0.0015	0.0015	0.13	0.14	0.15	0.06
Mean Error	-6.15	-3.63	-3.02	-2.38	-1.3	NC	-0.65	0.44	0.48	0.5
Mean Abs. Error	6.36	4.42	4.01	3.57	3.12	NC	3.21	2.99	3.35	3.61
Root Mean Sq. Error	7.02	4.97	4.45	3.94	3.45	NC	3.46	3.35	3.47	3.46

NC - Model did not converge
Hydraulic conductivity was held constant based on values presented on Table 7
Highlited values represent parameters used and error summaries of final model simulation

TABLE 7

Sensitivity Analyses for Hydraulic Conductivity
Wally's Citgo
Parkton Maryland

Hydraulic Conductivity (ft/day)									
Layer 1	0.38	0.39	0.4	0.41	0.42	0.43	0.43	0.43	0.43
Layer 2	0.38	0.39	0.4	0.41	0.42	0.43	0.43	0.43	0.43
Layer 3	0.38	0.39	0.4	0.41	0.42	0.43	0.43	0.43	0.43
Layer 4	0.38	0.39	0.4	0.41	0.42	0.43	0.43	0.43	0.43
Layer 5	0.38	0.39	0.4	0.41	0.42	0.43	0.43	0.43	0.43
Layer 6	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Layer 7	0.005	0.005	0.005	0.005	0.005	0.1	0.001	0.004	0.006
Layer 8	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
Mean Error	NC	0.502	0.492	-0.44	-0.623	NC	NC	0.342	0.348
Mean Abs. Error		3.45	3.39	2.99	3.23			3.43	3.35
Root Mean Sq. Error		3.74	3.64	3.35	3.45			3.45	3.207

NC - Model did not converge
Recharge was held constant at unique values presented on Table 6.
Highlited values represent parameters used and error summaries of final model simulation

TABLE 8

Sensitivity Analyses for Anisotropy Ratios
Wally's Citgo
Parkton, Maryland

Vertical Anisotropy	0.6	0.8	1	1.2	1.4	1.6
Mean Error	0.44	0.45	0.44	0.44	0.44	0.45
Mean Abs. Error	2.99	2.99	2.99	2.99	2.99	2.99
Root Mean Sq. Error	3.35	3.35	3.35	3.35	3.35	3.35

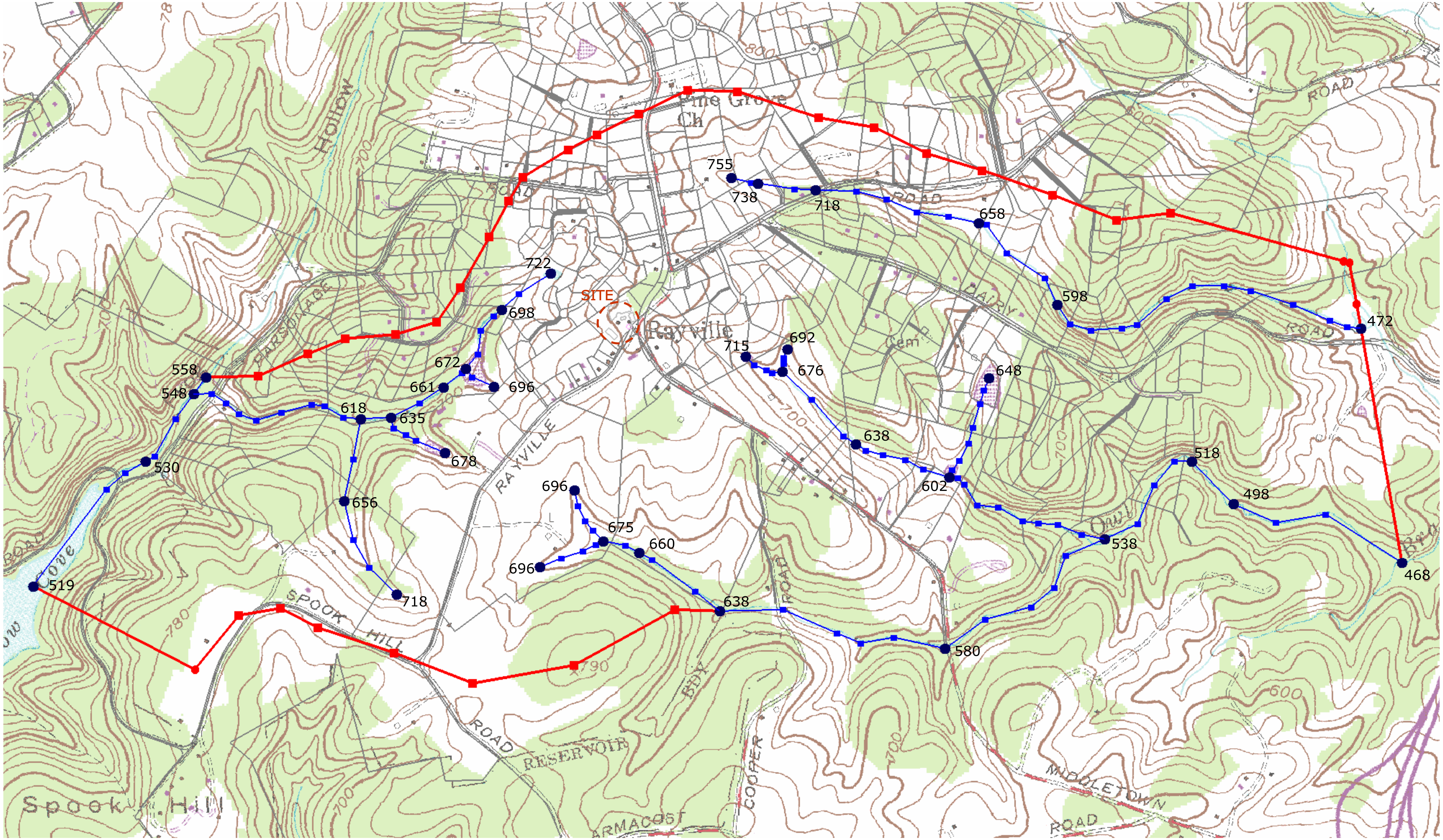
Horizontal Anisotropy	0.3	0.4	0.5	0.6
Mean Error	NC	NC	0.44	NC
Mean Abs. Error			2.99	
Root Mean Sq. Error			3.35	

NC - Model did not converge
Conductivity and recharge were held constant based on values presented on Tables 6 and 7.
Highlited values represent parameters used and error summaries of final model simulation

TABLE 9
Flow Budget
Wally's Citgo Station
Parkton, Maryland

	Flow In	Flow Out
Source/Sinks		
Drains (Creeks)	0	-108167.1001
Wells	0	-6462.7900
Recharge	114703.2655	0
Total	114703.2655	-114629.8901
% Difference		0.0640

FIGURES



NOTES

BASE MAP FROM USGS TOPOGRAPHIC QUADRANGLE MAP

EXPLANATION

BOUNDARY CONDITIONS

DRAIN (NODAL ELEVATIONS FT/MSL)

NO FLOW

APPROXIMATE SCALE (FEET)

0 1000 2000 4000

ENVIRONMENTAL ALLIANCE

CAD FILE NAME: NA

PLOT DATE: 04/13/09

DRAWING SCALE: AS SHOWN

INCEP DATE: 10/15/08

PROJECT No.:

DESIGNED BY: VFB

DRAWN BY: VFB

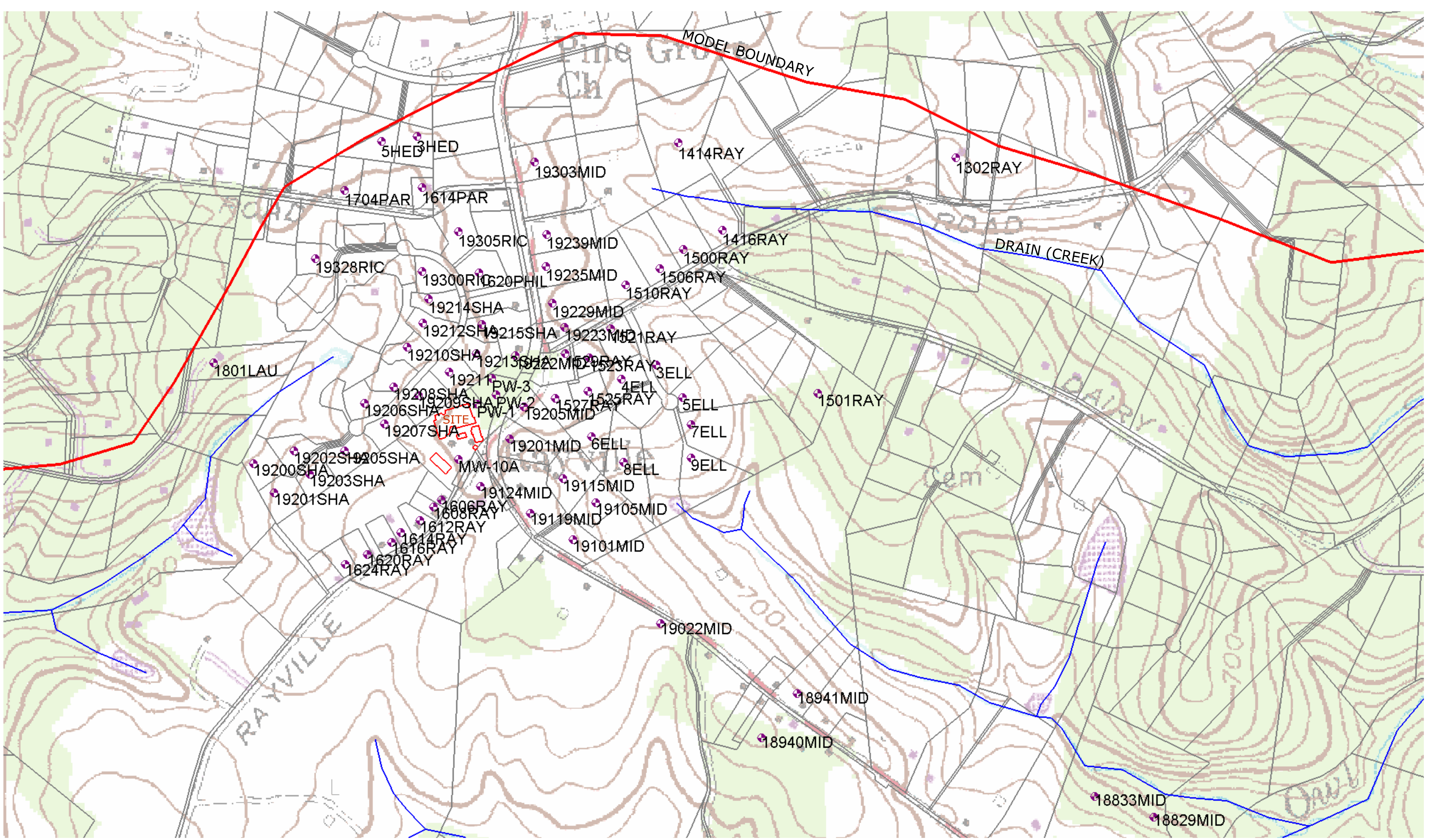
CHECKED BY: VFB

GENERAL MODEL CONSTRUCTION
BOUNDARY CONDITIONS

WALLY'S CITGO STATION - 19200 MIDDLETOWN ROAD
PARKTON, MARYLAND

FIGURE

1



NOTES

BASE MAP FROM USGS TOPOGRAPHIC QUADRANGLE MAP

EXPLANATION

RESIDENTIAL WELL LOCATION

APPROXIMATE SCALE (FEET)

0 500 1000 2000

ENVIRONMENTAL ALLIANCE

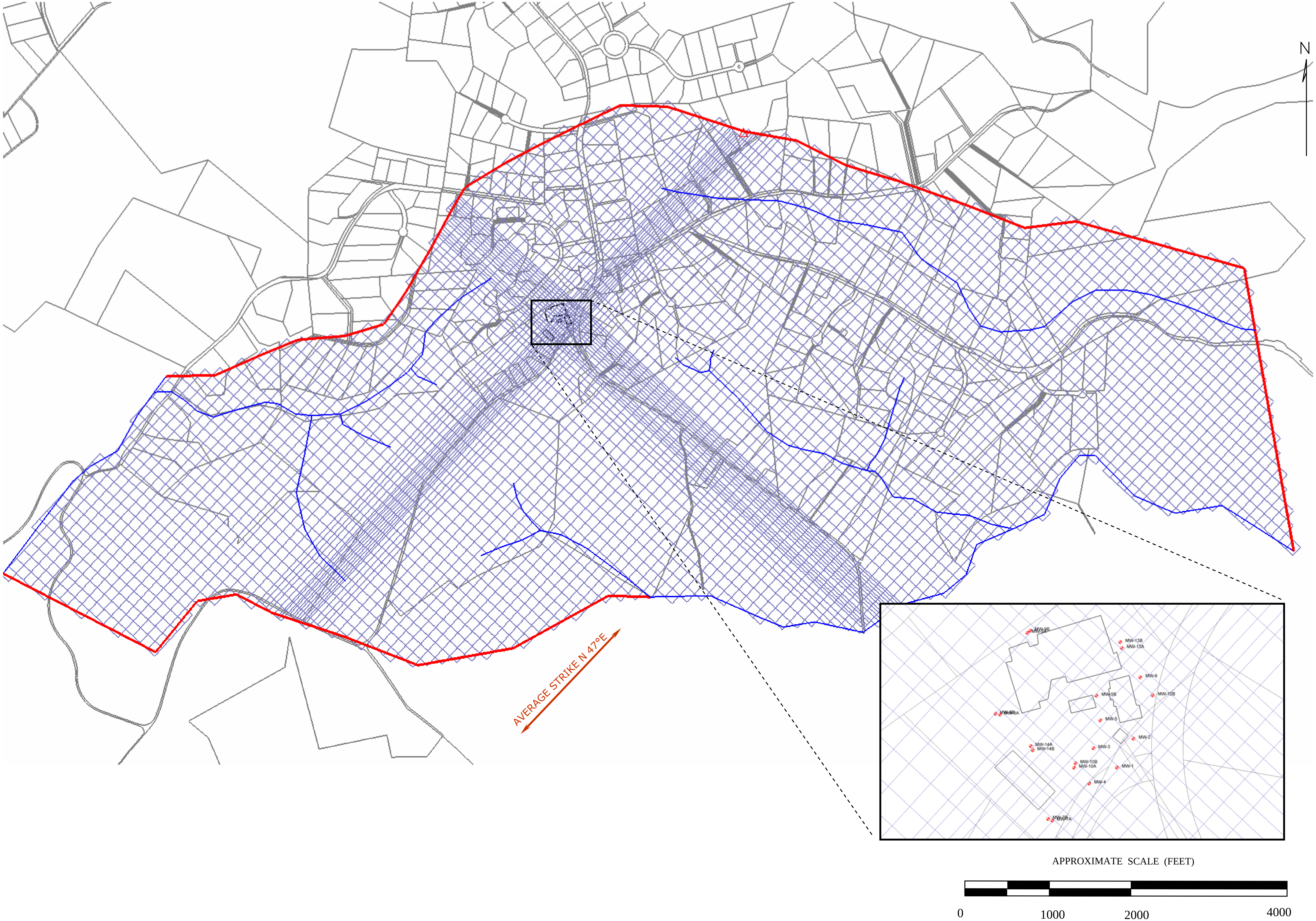
CAD FILE NAME:: NA
PLOT DATE:: 04/13/09
DRAWING SCALE:: AS SHOWN
INCEP DATE:: 10/15/08
PROJECT No.:
DESIGNED BY: VFB
DRAWN BY: VFB
CHECKED BY: VFB

RESIDENTIAL WELL LOCATIONS

WALLY'S CITGO STATION - 19200 MIDDLETOWN ROAD
PARKTON, MARYLAND

FIGURE

2



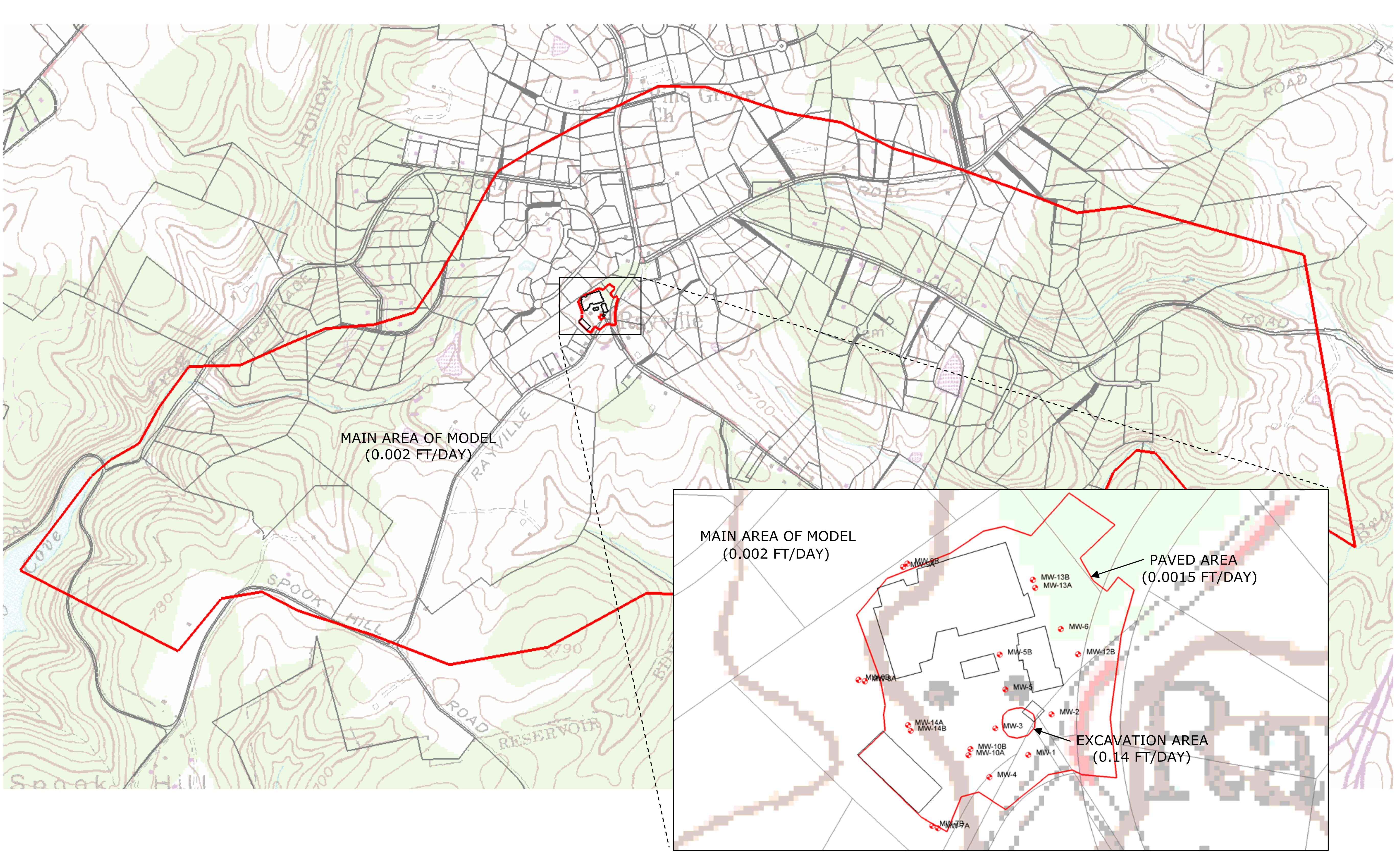
ENVIRONMENTAL ALLIANCE

CAD FILE NAME:	NA
PLOT DATE:	04/13/09
DRAWING SCALE:	AS SHOWN
INCEP DATE:	10/15/08
PROJECT No.:	
DESIGNED BY:	VFB
DRAWN BY:	VFB
CHECKED BY:	VFB

MODEL GRID

WALLY'S CITGO STATION - 19200 MIDDLETOWN ROAD
PARKTON, MARYLAND

FIGURE
3



APPROXIMATE SCALE (FEET)

0 1000 2000 4000

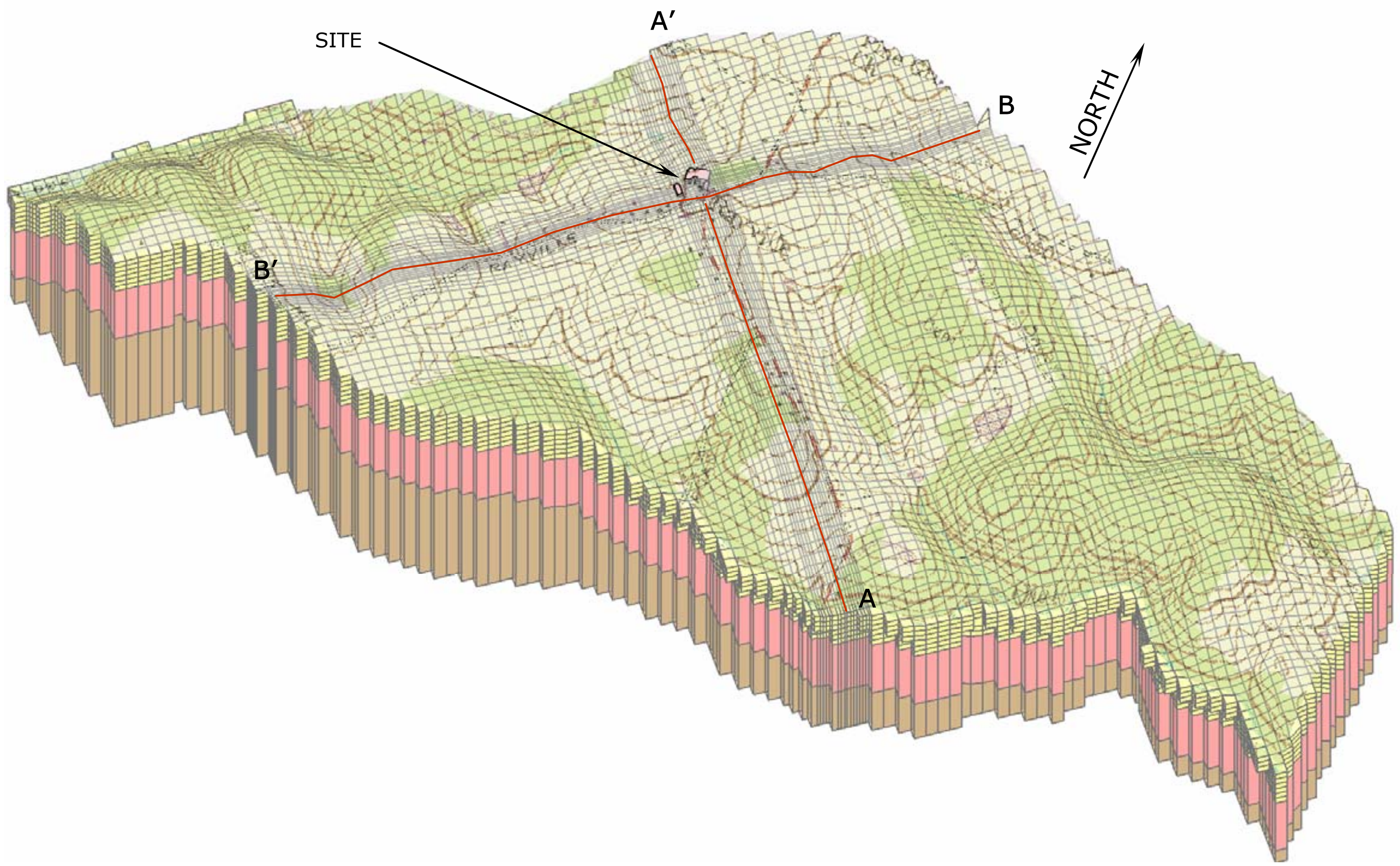
ENVIRONMENTAL ALLIANCE

CAD FILE NAME: NA	PLOT DATE: 04/13/09	DRAWING SCALE: AS SHOWN	INCEP DATE: 10/15/08
PROJECT No.:	DESIGNED BY: VFB	DRAWN BY: VFB	CHECKED BY: VFB

RECHARGE AREAS AND VALUE DESIGNATIONS

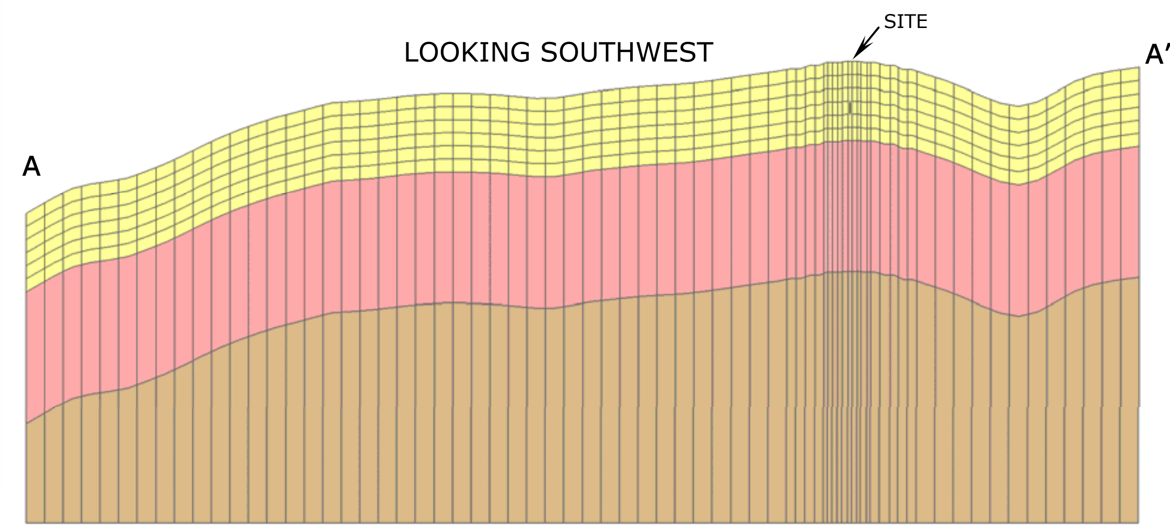
WALLY'S CITGO STATION - 19200 MIDDLETOWN ROAD
PARKTON, MARYLAND

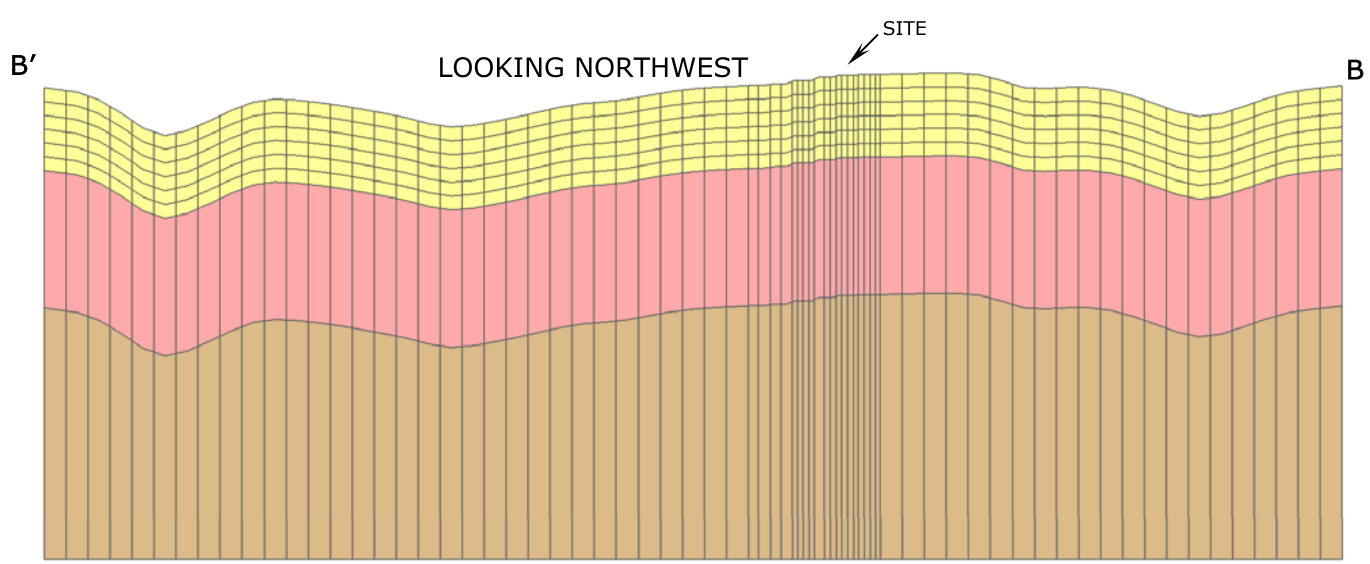
FIGURE 4



NOTES

1. VERTICAL EXAGGERATION IS 4X
2. LAYERS 1 THROUGH 6 ARE EACH 20 FEET THICK. LAYER 7 IS 200 FEET THICK AND LAYER 8 IS APPROXIMATELY 300 FEET THICK IN THE AREA OF THE SITE.





HYDRAULIC PARAMETERS

	Horizontal K (ft/day)	Horizontal Anisotropy	Vertical Anisotropy	Porosity
Layer 1	0.41	0.5	1.2	0.3
Layer 2	0.41	0.5	1.2	0.3
Layer 3	0.41	0.5	1.2	0.3
Layer 4	0.41	0.5	1.2	0.3
Layer 5	0.41	0.5	1.2	0.3
Layer 6	0.1	0.5	1	0.2
Layer 7	0.005	0.9	1	0.1
Layer 8	0.00001	0.9	1	0.05

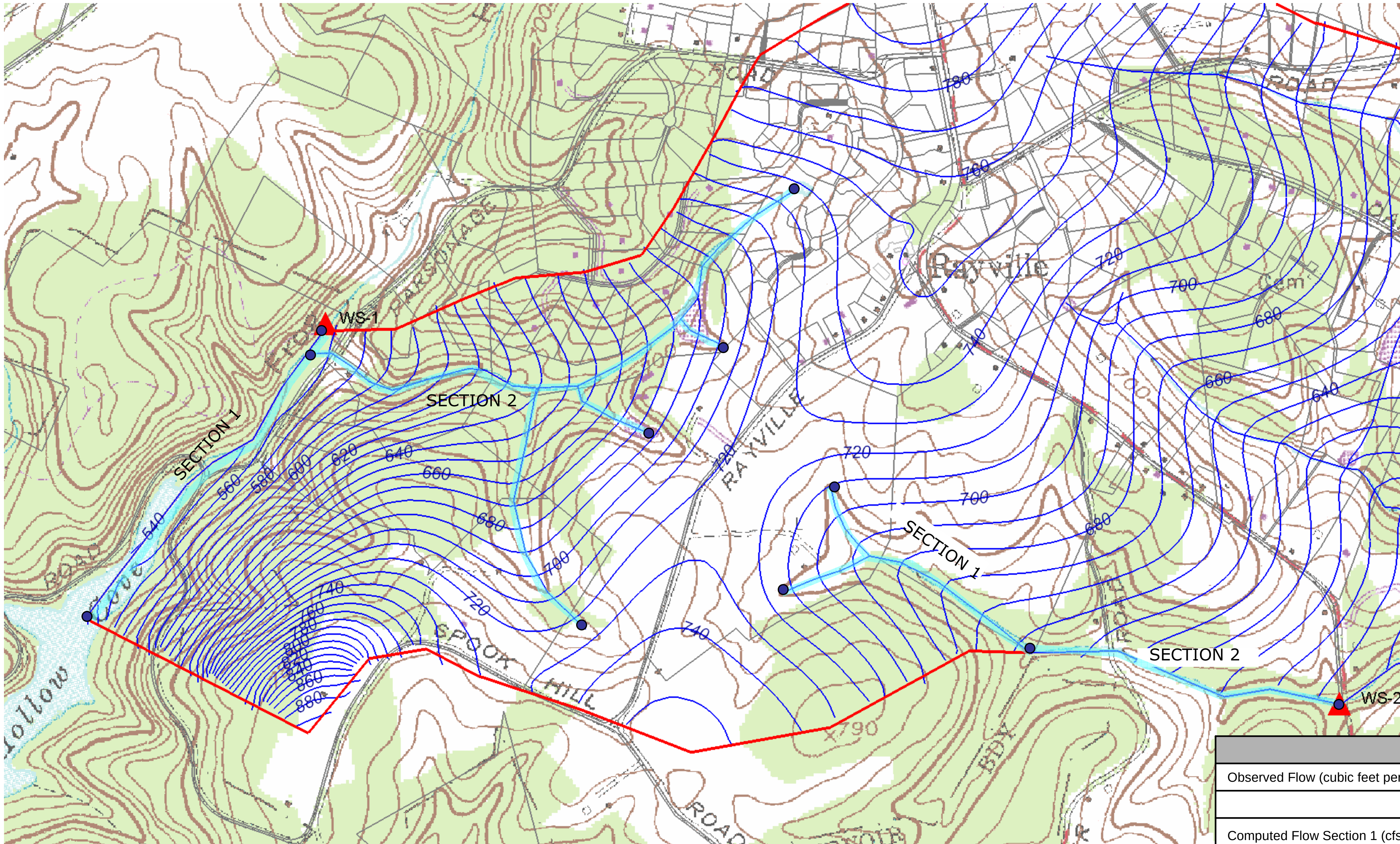
ENVIRONMENTAL ALLIANCE

CAD FILE NAME:: NA
PLOT DATE:: 04/13//09
DRAWING SCALE:: AS SHOWN
INCEP DATE:: 10/15/08
PROJECT No.:
DESIGNED BY: VFB
DRAWN BY: VFB
CHECKED BY: VFB

GENERAL MODEL CONSTRUCTION
LAYER DISTRIBUTION AND PARAMETERS

WALLY'S CITGO STATION - 19200 MIDDLETOWN ROAD
PARKTON, MARYLAND

FIGURE
5



NOTES

1. BASE MAP FROM USGS TOPOGRAPHIC QUADRANGLE MAP
2. COMPUTED FLOW VALUES FOR STREAM SEGMENTS ON THE MODEL BOUNDARIES WERE DOUBLED TO ACCOUNT FOR BASE FLOW FROM THE OUTSIDE OF THE MODEL DOMAIN.

EXPLANATION

- STREAM SECTION USED IN FLOW CALCULATION
- STREAM FLOW MEASUREMENT LOCATION (OBSERVED 9/24/08)
- GROUNDWATER ELEVATION CONTOUR (FT/MSL)

	WS-1	WS-2
Observed Flow (cubic feet per second - cfs)	**0.2896**	**0.3498**
Computed Flow Section 1 (cfs)	0.1894	0.1560
Computed Flow section 2 (cfs)	0.2852	0.1270
Total Computed Flow (cfs)	**0.4746**	**0.2830**
Residual (cfs)	0.1850	0.0668

APPROXIMATE SCALE (FEET)

0 500 1000 2000

ENVIRONMENTAL ALLIANCE

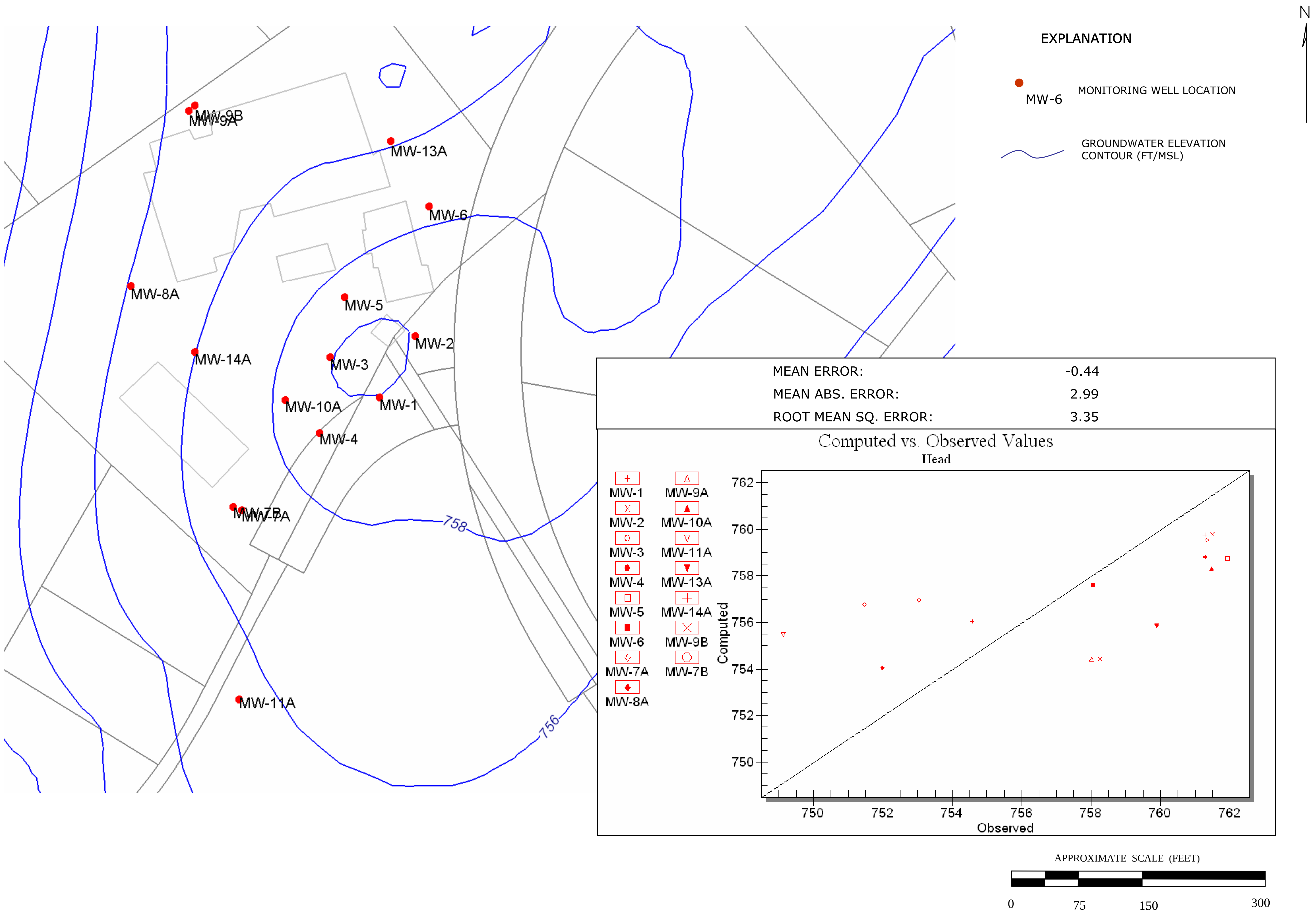
CAD FILE NAME:: NA
PLOT DATE:: 04/13/09
DRAWING SCALE:: AS SHOWN
INCEP DATE:: 10/15/08
PROJECT No.:
DESIGNED BY: VFB
DRAWN BY: VFB
CHECKED BY: VFB

CALIBRATION SURFACE WATER

WALLY'S CITGO STATION - 19200 MIDDLETOWN ROAD
PARKTON, MARYLAND

FIGURE

6



ENVIRONMENTAL ALLIANCE

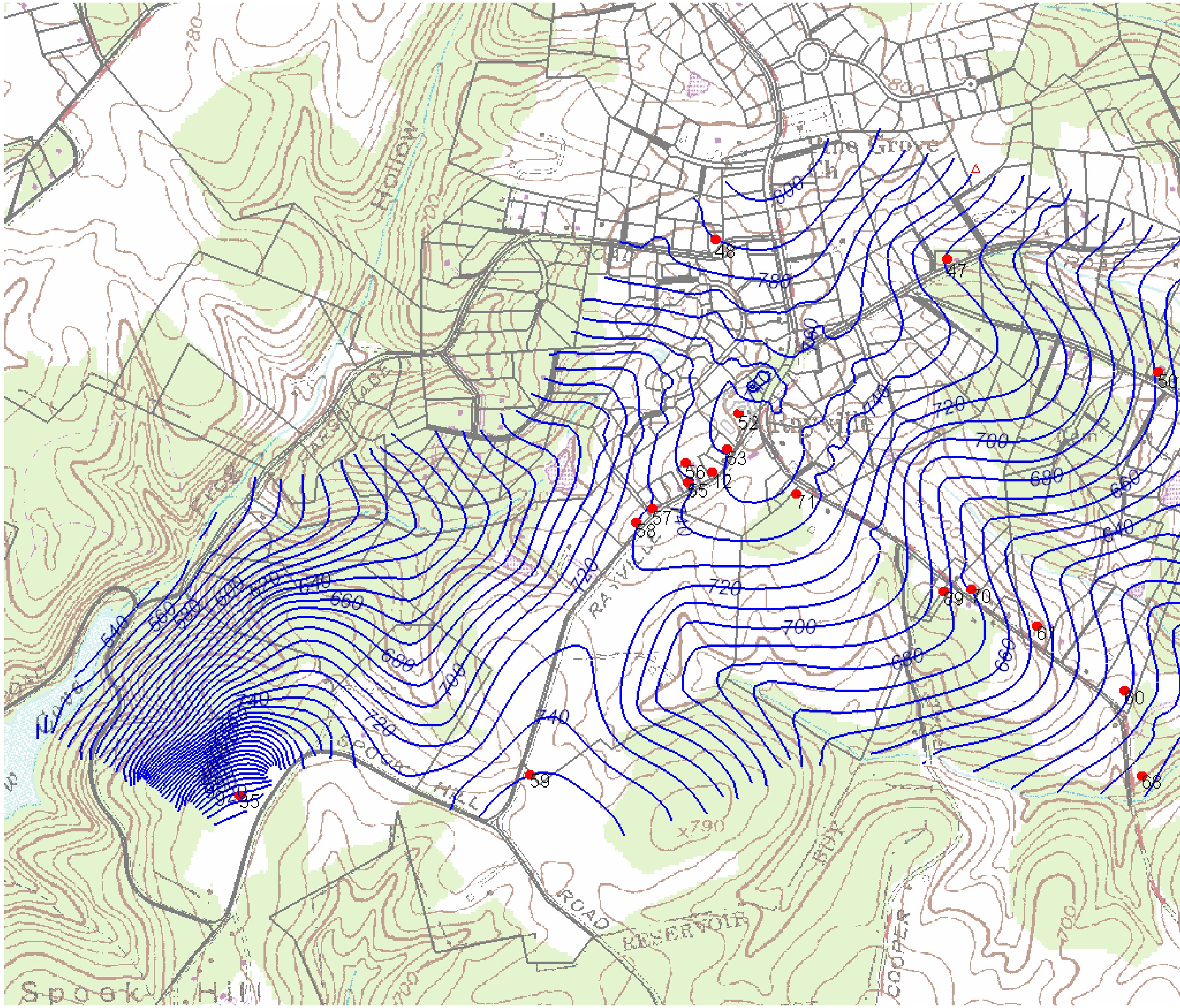
CAD FILE NAME: NA
PLOT DATE: 04/13/09
DRAWING SCALE: AS SHOWN
INCEP DATE: 10/15/08

PROJECT No.:
DESIGNED BY: VFB
DRAWN BY: VFB
CHECKED BY: VFB

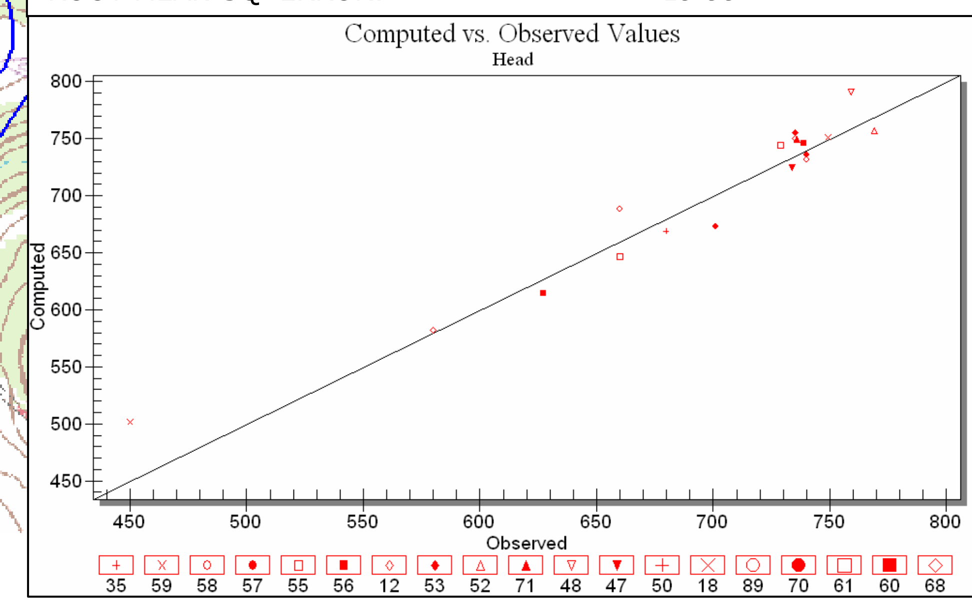
CALIBRATION – SITE MONITORING WELLS
DISTRIBUTION OF ERROR

WALLY'S CITGO STATION - 19200 MIDDLETOWN ROAD
PARKTON, MARYLAND

FIGURE
7



MEAN ERROR:	5.00
MEAN ABS. ERROR:	15.93
ROOT MEAN SQ. ERROR:	19.99



EXPLANATION

GROUNDWATER ELEVATION CONTOUR (FT/MSL)

59 MDE WELL LOCATION

APPROXIMATE SCALE (FEET)

0 1000 2000 4000

ENVIRONMENTAL ALLIANCE

CAD FILE NAME: NA

PLOT DATE: 04/13/09

DRAWING SCALE: AS SHOWN

INCEP DATE: 10/15/08

PROJECT No.:

DESIGNED BY: VFB

DRAWN BY: VFB

CHECKED BY: VFB

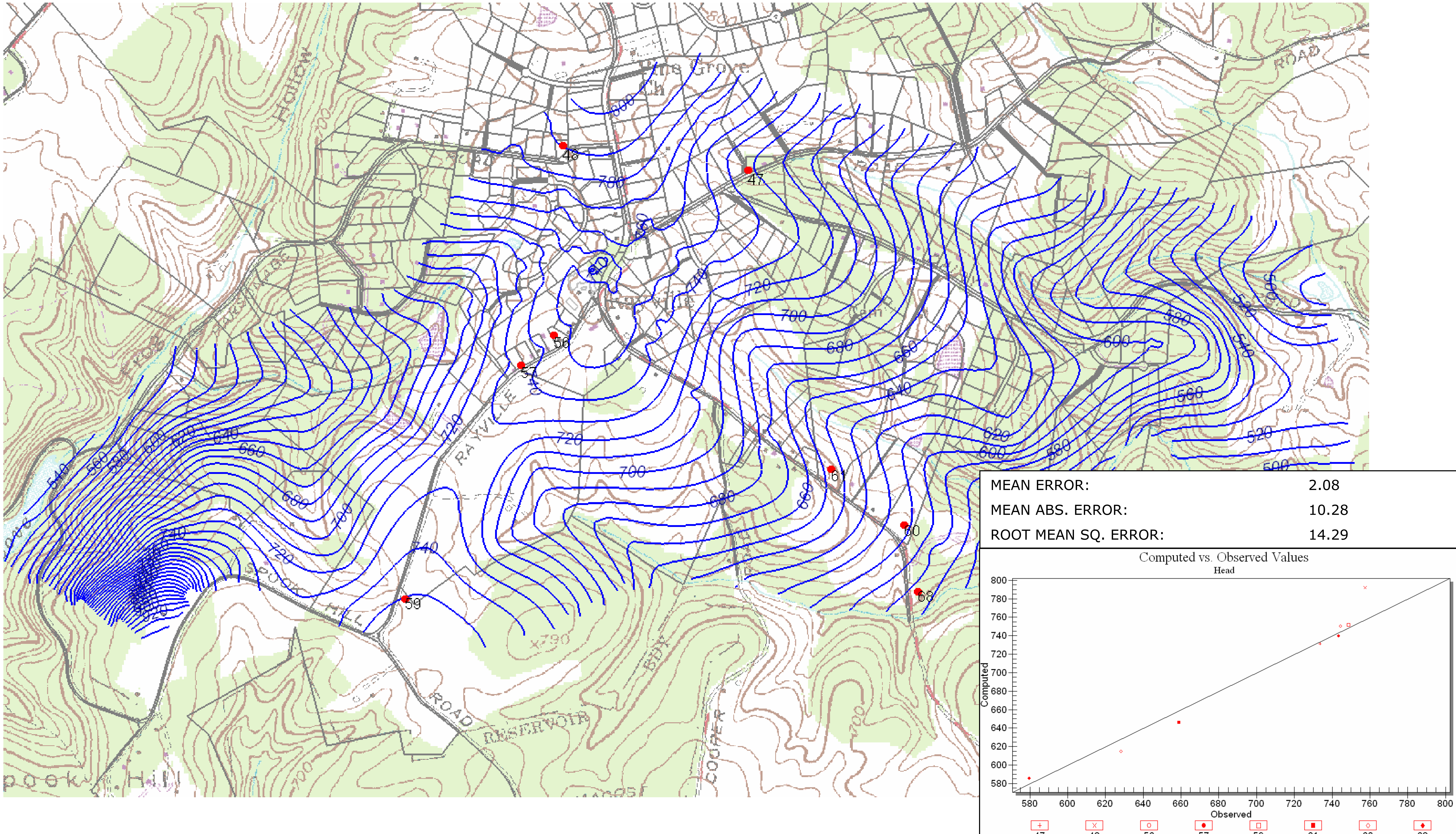
MDE COMPOSITE GROUNDWATER ELEVATION DATA
OBSERVED VS. COMPUTED

WALLY'S CITGO STATION - 19200 MIDDLETOWN ROAD
PARKTON, MARYLAND

FIGURE

8

N



MEAN ERROR:	2.08
MEAN ABS. ERROR:	10.28
ROOT MEAN SQ. ERROR:	14.29

EXPLANATION

GROUNDWATER ELEVATION CONTOUR (FT/MSL)

59 MDE WELL LOCATION

APPROXIMATE SCALE (FEET)

0 1000 2000 4000

ENVIRONMENTAL ALLIANCE

CAD FILE NAME: NA

PLOT DATE: 04/13/09

DRAWING SCALE: AS SHOWN

INCEP DATE: 10/15/08

PROJECT No.:

DESIGNED BY: VFB

DRAWN BY: VFB

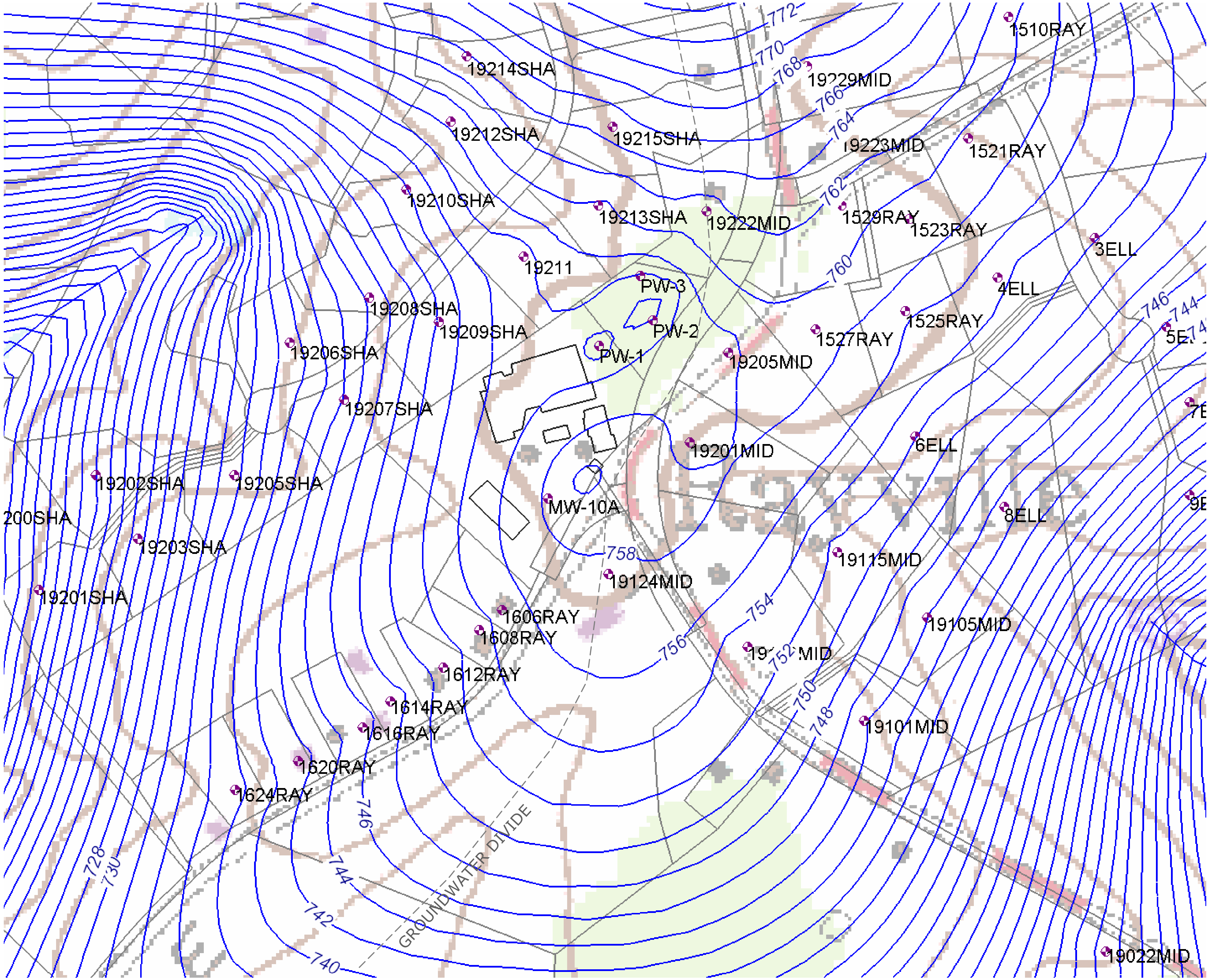
CHECKED BY: VFB

MDE MARCH 1964 GROUNDWATER ELEVATION DATA OBSERVED VS. COMPUTED

WALLY'S CITGO STATION - 19200 MIDDLETOWN ROAD PARKTON, MARYLAND

FIGURE

9



N

NOTES

1. BASE MAP FROM USGS TOPOGRAPHIC QUADRANGLE MAP
2. HEAD ELEVATION PRESENTED IS FROM MODEL LAYER 6.

EXPLANATION

GROUNDWATER ELEVATION CONTOUR (FT/MSL)

RESIDENTIAL WELL LOCATION

APPROXIMATE SCALE (FEET)

0 250 500 1000

ENVIRONMENTAL ALLIANCE

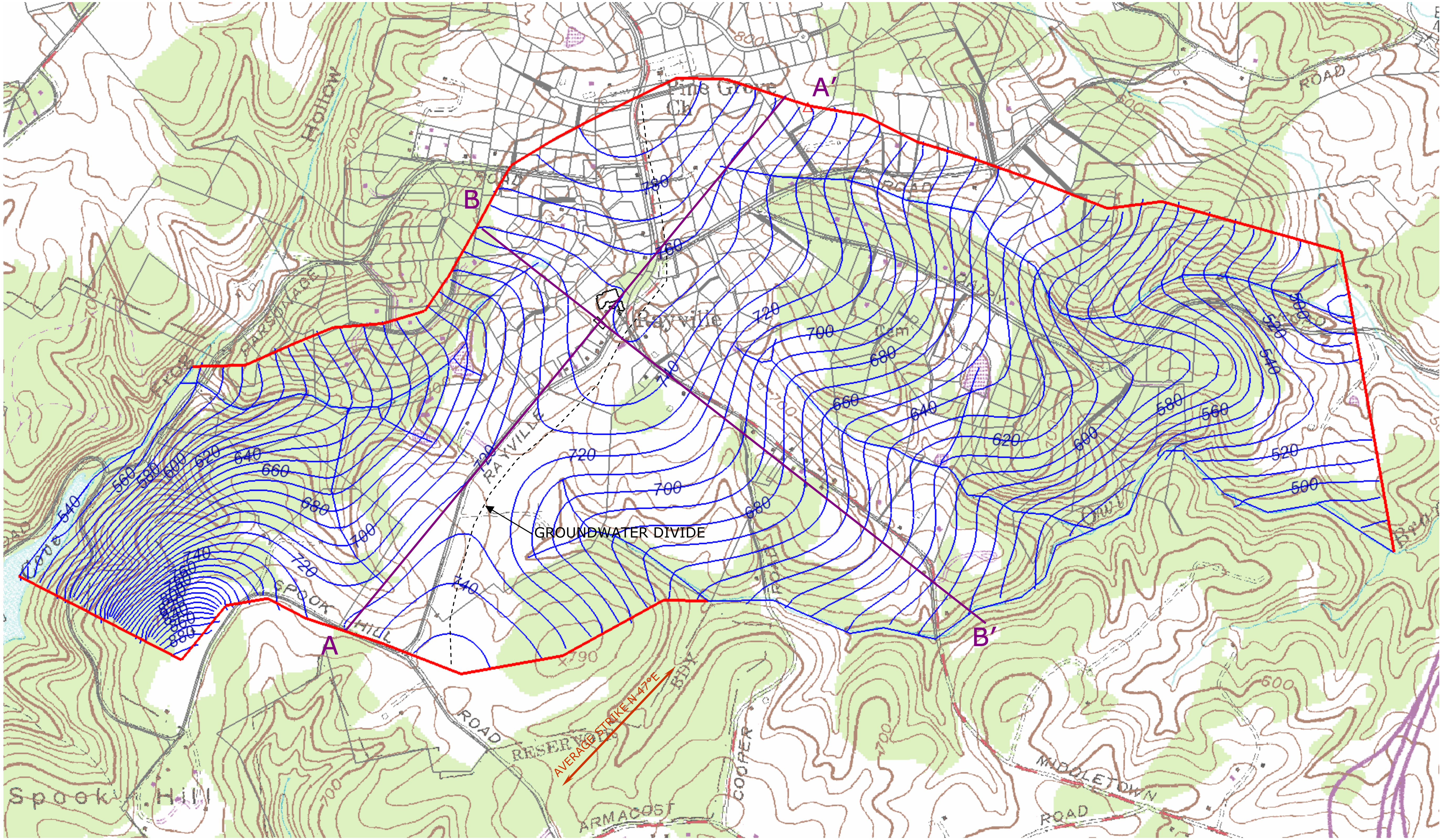
CAD FILE NAME: NA	PROJECT No.:
PLOT DATE: 04/13/09	DESIGNED BY: VFB
DRAWING SCALE: AS SHOWN	DRAWN BY: VFB
INCEP DATE: 10/15/08	CHECKED BY: VFB

SIMULATED GROUNDWATER FLOW ELEVATION CONTOURS – LOCAL TO SITE

WALLY'S CITGO STATION - 19200 MIDDLETOWN ROAD PARKTON, MARYLAND

FIGURE

10



EXPLANATION

GROUNDWATER ELEVATION CONTOUR (FT/MSL)

NOTES

1. BASE MAP FROM USGS TOPOGRAPHIC QUADRANGLE MAP
2. HEAD ELEVATION PRESENTED IS FROM MODEL LAYER 6.

APPROXIMATE SCALE (FEET)

0 1000 2000 4000

ENVIRONMENTAL ALLIANCE

CAD FILE NAME::	NA
PLOT DATE::	04/13/09
DRAWING SCALE::	AS SHOWN
INCEP DATE::	10/15/08
PROJECT No.:	
DESIGNED BY:	VFB
DRAWN BY:	VFB
CHECKED BY:	VFB

SIMULATED REGIONAL GROUNDWATER FLOW CROSS SECTIONAL LINES

WALLY'S CITGO STATION - 19200 MIDDLETOWN ROAD
PARKTON, MARYLAND

FIGURE

11

NOTES

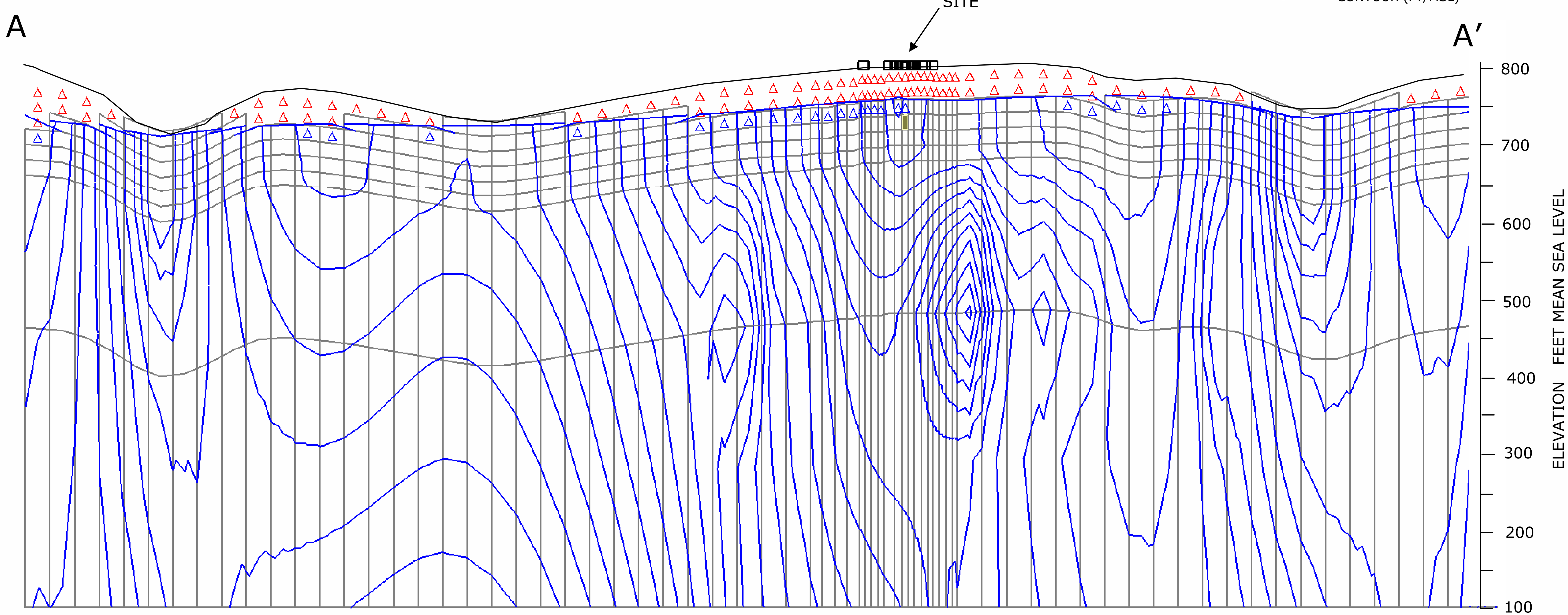
VERTICAL EXAGGERATION IS 4X

EXPLANATION

△ DRY CELL

△ FLOODED CELL

GROUNDWATER ELEVATION CONTOUR (FT/MSL)



LOOKING NORTHWEST

APPROXIMATE SCALE (FEET)

0 300 600 1200

ENVIRONMENTAL ALLIANCE

CAD FILE NAME:	NA
PLOT DATE:	04/13/09
DRAWING SCALE:	AS SHOWN
INCEP DATE:	10/15/08
PROJECT No.:	
DESIGNED BY:	VFB
DRAWN BY:	VFB
CHECKED BY:	VFB

HYDROLOGIC CROSS SECTION A – A′

WALLY'S CITGO STATION - 19200 MIDDLETOWN ROAD
PARKTON, MARYLAND

FIGURE

12

NOTES

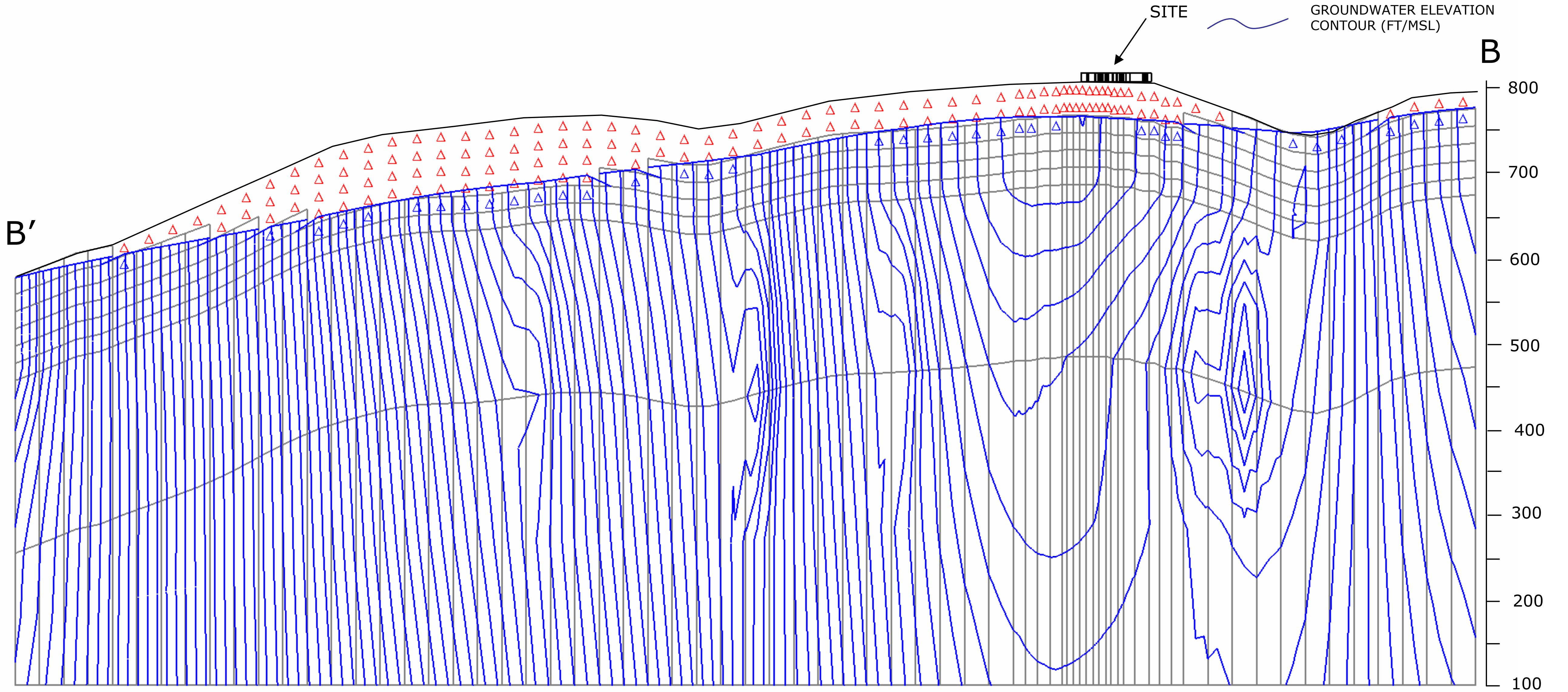
VERTICAL EXAGGERATION IS 4X

EXPLANATION

△ DRY CELL

△ FLOODED CELL

GROUNDWATER ELEVATION CONTOUR (FT/MSL)



LOOKING SOUTHWEST

APPROXIMATE SCALE (FEET)

0 300 600 1200

ENVIRONMENTAL ALLIANCE

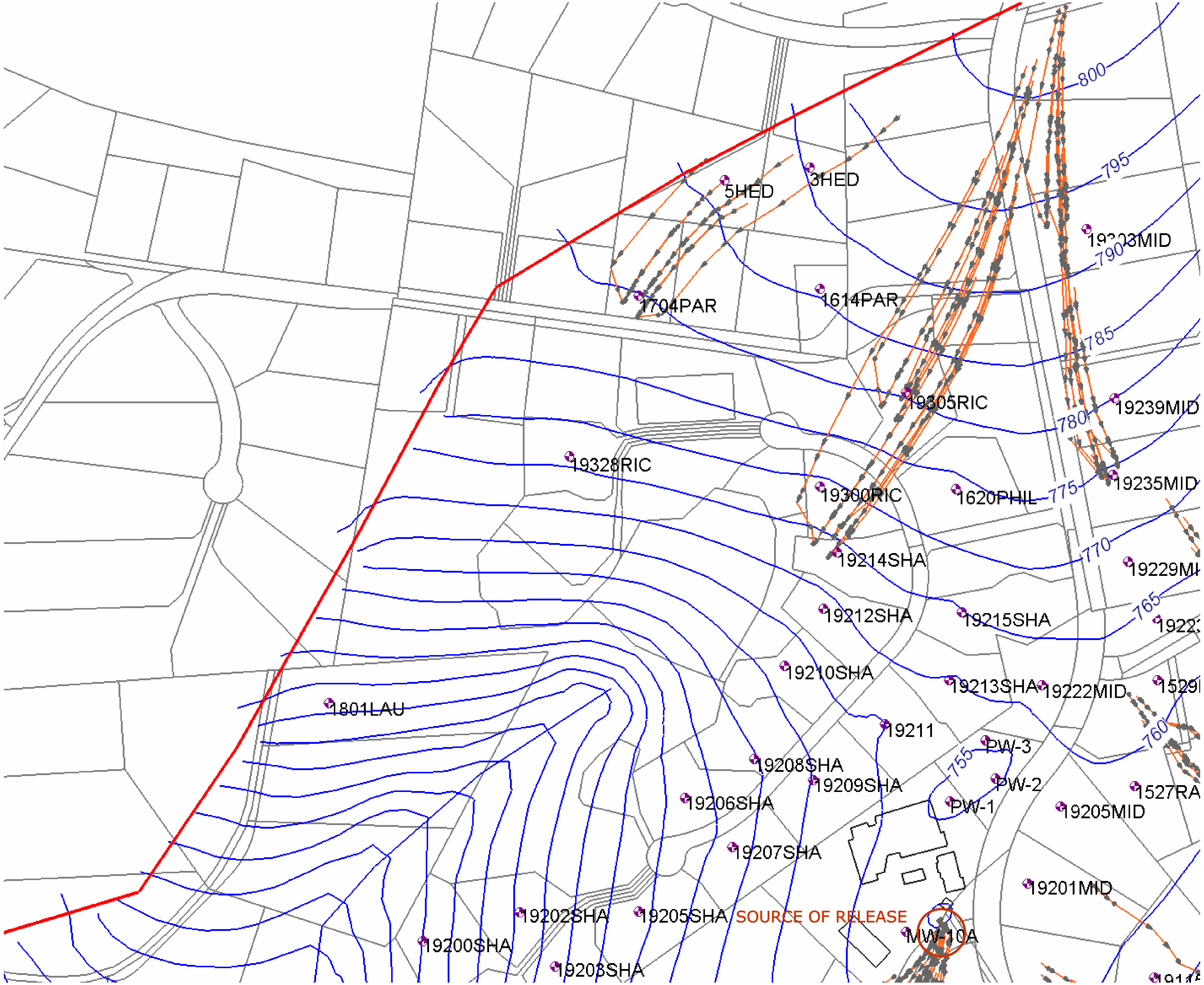
CAD FILE NAME:	NA
PLOT DATE:	04/13/09
DRAWING SCALE:	AS SHOWN
INCEP DATE:	10/15/08
PROJECT No.:	
DESIGNED BY:	VFB
DRAWN BY:	VFB
CHECKED BY:	VFB

HYDROLOGIC CROSS SECTION B – B′

WALLY'S CITGO STATION - 19200 MIDDLETOWN ROAD
PARKTON, MARYLAND

FIGURE

13



NOTES

1. THIS FIGURE REPRESENTS A REVERSE PARTICLE TRACKING WHERE PARTICLES WERE RELEASED FROM THE RESIDENTIAL WELLS AND TRACK BACKWARDS ALONG THE ZONE OF CAPTURE THAT THE WELL INFLUENCES. THIS SIMULATION IS BASED ON ADVECTION ONLY AND DOES NOT NECESSARILY INDICATE THAT A WELL WILL IMPACT THE ENTIRE LENGTH OF THE PARTICLE TRACK.
2. HEAD ELEVATION PRESENTED IS FROM MODEL LAYER 6. PARTICLE TRACK PRESENTED IS FROM ALL LAYERS.

EXPLANATION

GROUNDWATER ELEVATION CONTOUR (FT/MSL)

PARTICLE PATHLINE

DISTANCE BETWEEN ARROWS IS ONE YEAR

WELL LOCATION

APPROXIMATE SCALE (FEET)

0 250 500 1000

ENVIRONMENTAL ALLIANCE

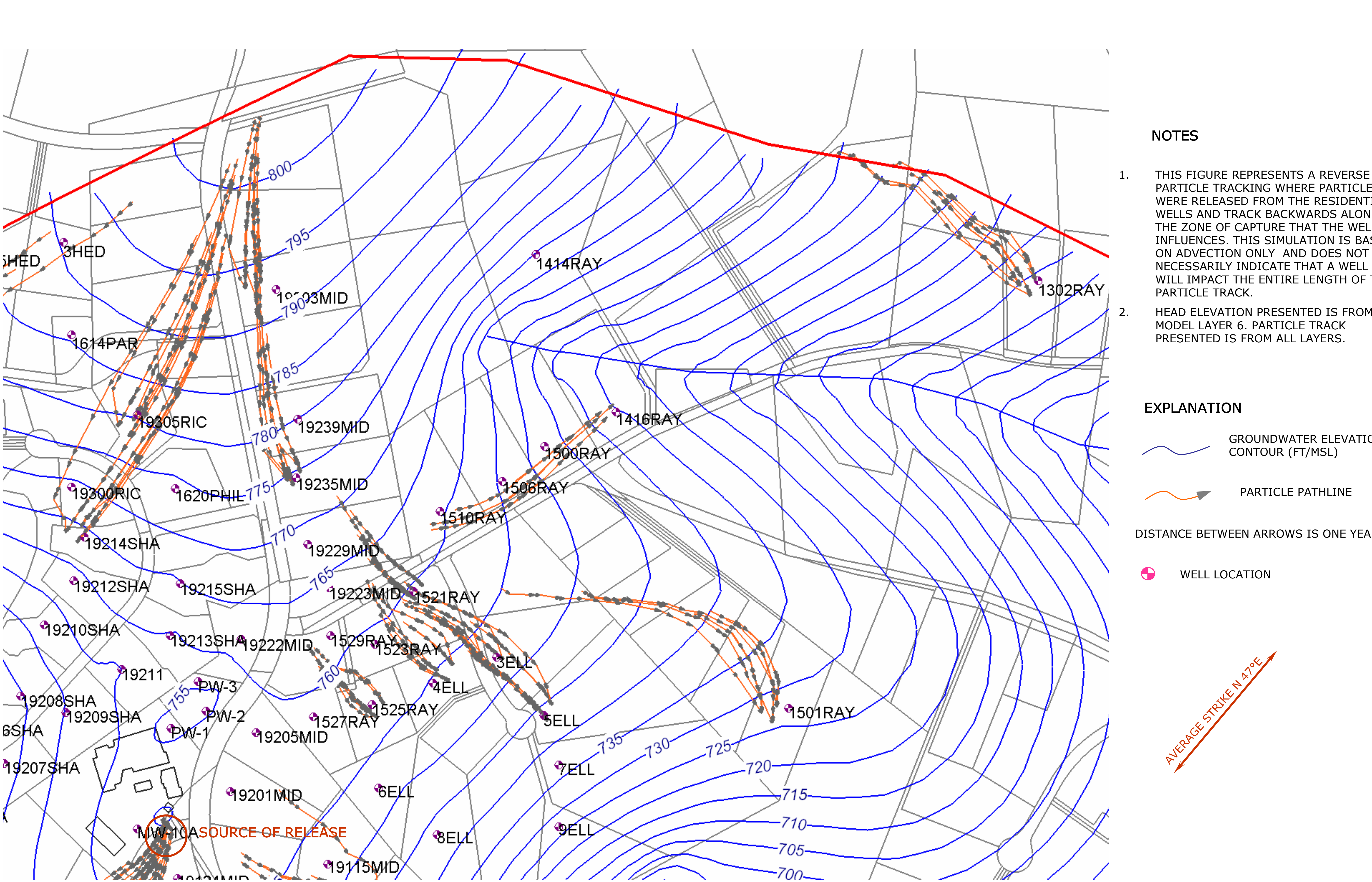
CAD FILE NAME: NA	PLOT DATE: 04/13/09	DRAWING SCALE: AS SHOWN	INCEP DATE: 10/15/08
PROJECT No.:	DESIGNED BY: VFB	DRAWN BY: VFB	CHECKED BY: VFB

PARTICLE TRACKING – NORTHWEST QUADRANT ZONE OF CAPTURE FROM PLAINTIFF WELLS

WALLY'S CITGO STATION - 19200 MIDDLETOWN ROAD PARKTON, MARYLAND

FIGURE

14



NOTES

1. THIS FIGURE REPRESENTS A REVERSE PARTICLE TRACKING WHERE PARTICLES WERE RELEASED FROM THE RESIDENTIAL WELLS AND TRACK BACKWARDS ALONG THE ZONE OF CAPTURE THAT THE WELL INFLUENCES. THIS SIMULATION IS BASED ON ADVECTION ONLY AND DOES NOT NECESSARILY INDICATE THAT A WELL WILL IMPACT THE ENTIRE LENGTH OF THE PARTICLE TRACK.
2. HEAD ELEVATION PRESENTED IS FROM MODEL LAYER 6. PARTICLE TRACK PRESENTED IS FROM ALL LAYERS.

EXPLANATION

GROUNDWATER ELEVATION CONTOUR (FT/MSL)

PARTICLE PATHLINE

DISTANCE BETWEEN ARROWS IS ONE YEAR

WELL LOCATION

APPROXIMATE SCALE (FEET)

0 300 600 1200

ENVIRONMENTAL ALLIANCE

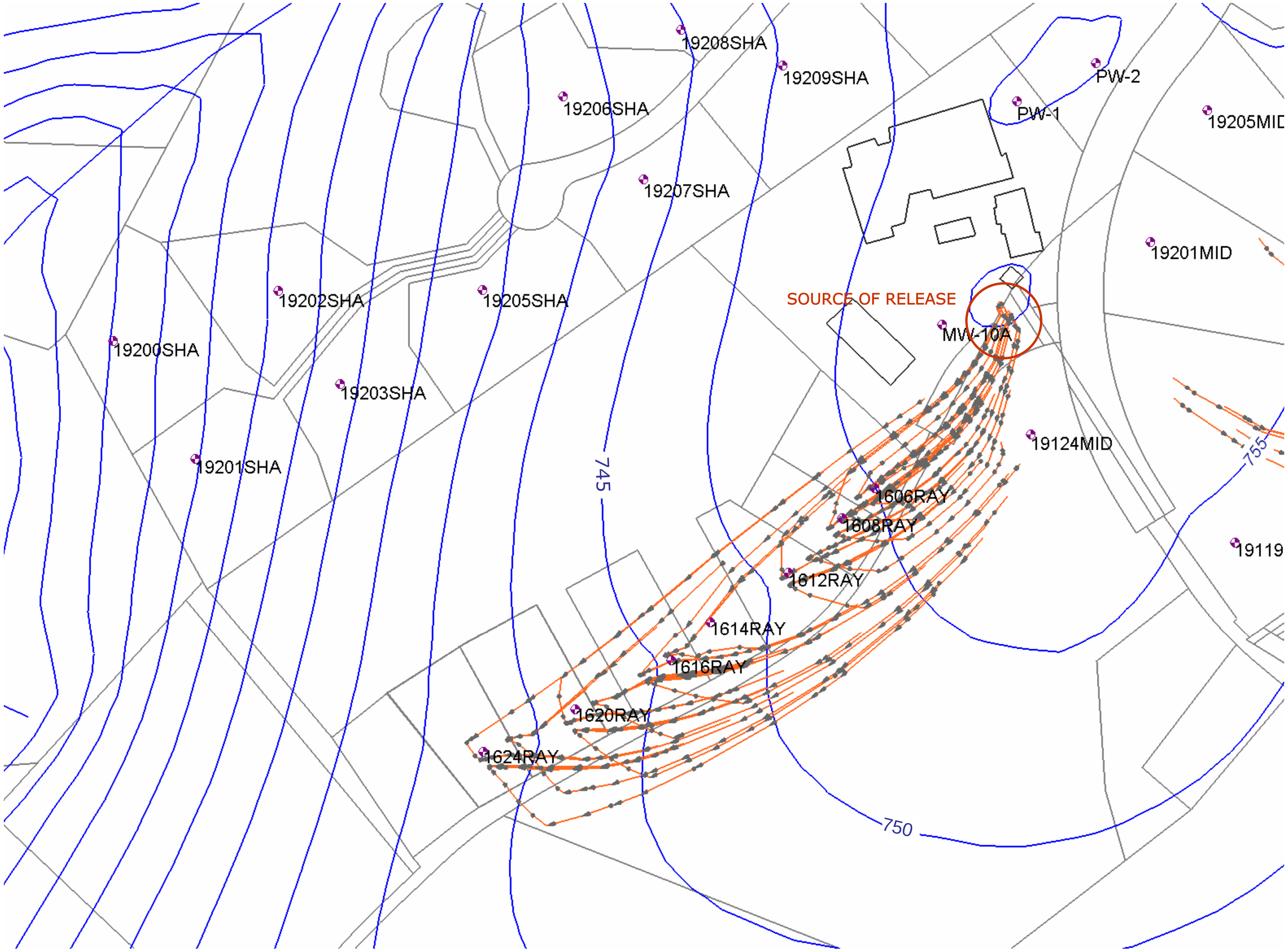
CAD FILE NAME:	NA
PLOT DATE:	04/13/09
DRAWING SCALE:	AS SHOWN
INCEP DATE:	10/15/08
PROJECT No.:	
DESIGNED BY:	VFB
DRAWN BY:	VFB
CHECKED BY:	VFB

PARTICLE TRACKING – NORTHEAST QUADRANT ZONE OF CAPTURE FROM PLAINTIFF WELLS

WALLY'S CITGO STATION - 19200 MIDDLETOWN ROAD PARKTON, MARYLAND

FIGURE

15



N

NOTES

1. THIS FIGURE REPRESENTS A REVERSE PARTICLE TRACKING WHERE PARTICLES WERE RELEASED FROM THE RESIDENTIAL WELLS AND TRACK BACKWARDS ALONG THE ZONE OF CAPTURE THAT THE WELL INFLUENCES. THIS SIMULATION IS BASED ON ADVECTION ONLY AND DOES NOT NECESSARILY INDICATE THAT A WELL WILL IMPACT THE ENTIRE LENGTH OF THE PARTICLE TRACK.
2. HEAD ELEVATION PRESENTED IS FROM MODEL LAYER 6. PARTICLE TRACK PRESENTED IS FROM ALL LAYERS.

EXPLANATION

GROUNDWATER ELEVATION CONTOUR (FT/MSL)

PARTICLE PATHLINE

DISTANCE BETWEEN ARROWS IS ONE YEAR

WELL LOCATION

AVERAGE STRIKE N 47°E

APPROXIMATE SCALE (FEET)

0 300 600

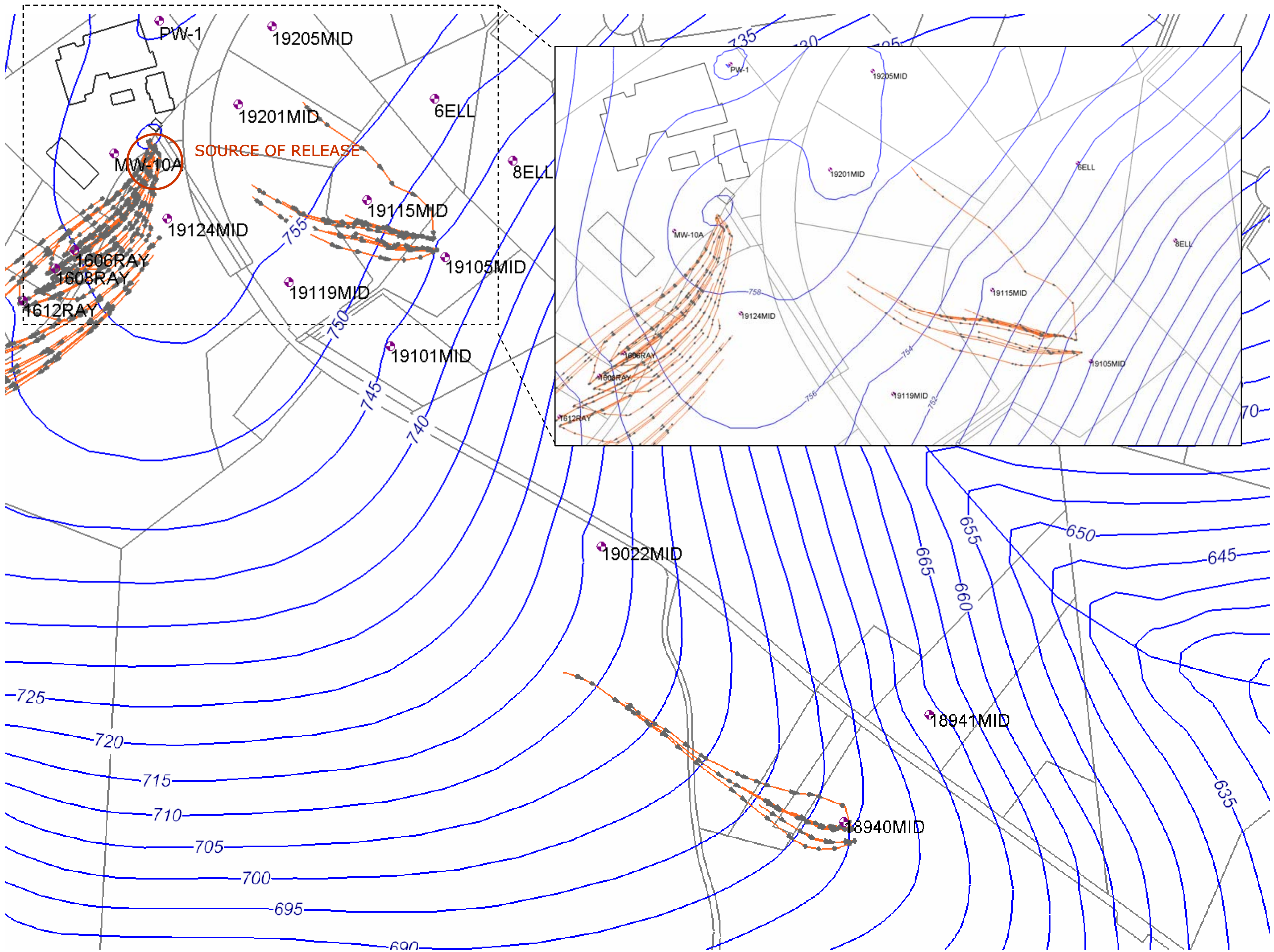
ENVIRONMENTAL ALLIANCE

CAD FILE NAME: NA	PLOT DATE: 04/13/09
DRAWING SCALE: AS SHOWN	INCEP DATE: 10/15/08
PROJECT No.:	DESIGNED BY: VFB
DRAWN BY: VFB	CHECKED BY: VFB

PARTICLE TRACKING – SOUTHWEST QUADRANT
ZONE OF CAPTURE FROM PLAINTIFF WELLS

WALLY'S CITGO STATION - 19200 MIDDLETOWN ROAD
PARKTON, MARYLAND

FIGURE
16



NOTES

1. THIS FIGURE REPRESENTS A REVERSE PARTICLE TRACKING WHERE PARTICLES WERE RELEASED FROM THE RESIDENTIAL WELLS AND TRACK BACKWARDS ALONG THE ZONE OF CAPTURE THAT THE WELL INFLUENCES. THIS SIMULATION IS BASED ON ADVECTION ONLY AND DOES NOT NECESSARILY INDICATE THAT A WELL WILL IMPACT THE ENTIRE LENGTH OF THE PARTICLE TRACK.
2. HEAD ELEVATION PRESENTED IS FROM MODEL LAYER 6. PARTICLE TRACK PRESENTED IS FROM ALL LAYERS.

EXPLANATION

GROUNDWATER ELEVATION CONTOUR (FT/MSL)

PARTICLE PATHLINE

DISTANCE BETWEEN ARROWS IS ONE YEAR

WELL LOCATION

APPROXIMATE SCALE (FEET)

0 300 600 1200

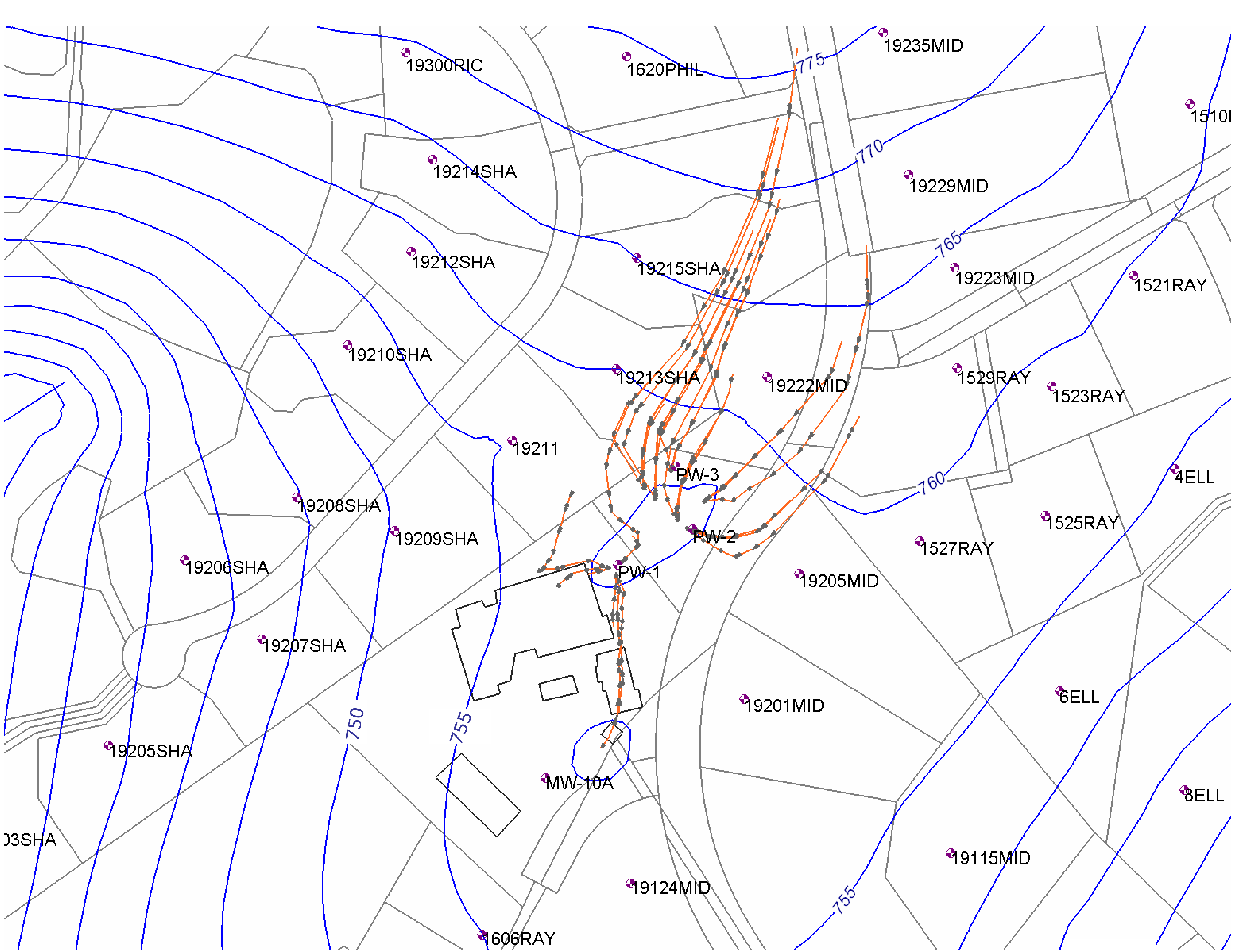
ENVIRONMENTAL ALLIANCE

CAD FILE NAME: NA
PLOT DATE: 04/13/09
DRAWING SCALE: AS SHOWN
INCEP DATE: 10/15/08
PROJECT No.:
DESIGNED BY: VFB
DRAWN BY: VFB
CHECKED BY: VFB

PARTICLE TRACKING – SOUTHEAST QUADRANT ZONE OF CAPTURE FROM PLAINTIFF WELLS

WALLY'S CITGO STATION - 19200 MIDDLETOWN ROAD PARKTON, MARYLAND

FIGURE 17



N

NOTES

1. THIS FIGURE REPRESENTS A REVERSE PARTICLE TRACKING WHERE PARTICLES WERE RELEASED FROM THE RESIDENTIAL WELLS AND TRACK BACKWARDS ALONG THE ZONE OF CAPTURE THAT THE WELL INFLUENCES. THIS SIMULATION IS BASED ON ADVECTION ONLY AND DOES NOT NECESSARILY INDICATE THAT A WELL WILL IMPACT THE ENTIRE LENGTH OF THE PARTICLE TRACK.
2. HEAD ELEVATION PRESENTED IS FROM MODEL LAYER 6. PARTICLE TRACK PRESENTED IS FROM ALL LAYERS.

EXPLANATION

GROUNDWATER ELEVATION CONTOUR (FT/MSL)

PARTICLE PATHLINE

DISTANCE BETWEEN ARROWS IS ONE YEAR

WELL LOCATION

AVERAGE STRIKE N 47°E

APPROXIMATE SCALE (FEET)

0 150 300 600

ENVIRONMENTAL ALLIANCE

CAD FILE NAME: NA
PLOT DATE: 04/13/09
DRAWING SCALE: AS SHOWN
INCEP DATE: 10/15/08
PROJECT No.:
DESIGNED BY: VFB
DRAWN BY: VFB
CHECKED BY: VFB

PARTICLE TRACKING – PW-1 THROUGH PW-3
ZONE OF CAPTURE

WALLY'S CITGO STATION - 19200 MIDDLETOWN ROAD
PARKTON, MARYLAND

FIGURE

18