



September 9, 2014

Ms. Diane Douglas  
Government of the District of Columbia  
District Department of the Environment  
Planning and Enforcement Branch  
Water Quality Division  
1200 First St., NE, 5<sup>th</sup> Floor  
Washington, DC 20002

ECS Project No. 23253

Reference: Environmental Site Characterization, Roosevelt High School Proposed  
Geothermal Well Field, 4301 13<sup>th</sup> Street NW, Washington, DC 20011.

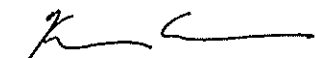
Dear Ms. Douglas:

ECS Mid-Atlantic, LLC (ECS) is pleased to provide the District Department of the Environment (DDOE) with the Environmental Site Assessment (ESA) for the proposed geothermal well field for the above referenced property. The ESA has been completed in general accordance with the proposed procedures of the Work Plan and the recommendations presented during the geothermal well permitting process and the environmental well permitting process.


If there are questions regarding this report, or a need for further information, please contact us at 703-471-8400.

Respectfully submitted,

**ECS MID-ATLANTIC, LLC**

  
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**ENVIRONMENTAL SITE CHARACTERIZATION  
ROOSEVELT HIGH SCHOOL  
GEOTHERMAL WELL FIELD  
4301 13<sup>TH</sup> STREET, NW  
WASHINGTON, DC 20011**

**ECS PROJECT NO. 23253**

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**ENVIRONMENTAL SITE ASSESSMENT  
ROOSEVELT HIGH SCHOOL  
4301 13<sup>TH</sup> STREET, NW  
WASHINGTON, DC 20011**

**ECS PROJECT NO. 23253**

**1.0 INTRODUCTION**

**1.1 Property Location and Background**

The subject property is located at 4301 13<sup>th</sup> Street, NW Washington DC 20011 and is further identified as District of Columbia Square 2915, Lot 0802. The property is owned and operated by the Washington, DC Department of General Services (DGS). The study area is located within the current Roosevelt High School campus. A renovation and modernization of Roosevelt High School is currently being performed.

A geothermal well field will be installed as part of the planned renovation and modernization of the current Roosevelt High School. Two previously removed underground storage tanks (USTs) were located to the east of the existing school building depicted on Figure 1. On July 2, 2014, representatives for DGS, Smoot/Gilbane (general contractor), and DDOE met to discuss the environmental requirements for the geothermal well installation. During this meeting DDOE determined that at least six monitoring wells would be required to characterize subsurface conditions. Subsurface characterization data was needed to determine if contaminants present in the subsurface could adversely affect the geothermal well field installation.

**1.2 Future Use**

Renovation of the Roosevelt High School is currently underway and will include the installation of a geothermal well field within the existing athletic field located on the north side of the property. Once construction of the geothermal wells is complete, the athletic field will be restored to its original condition. A figure depicting the location of the proposed geothermal field is included as Figure 2.

**1.3 Surrounding Land Use**

The adjacent properties to the north and east contain residential apartment buildings and single family homes. The adjacent property to the south-east, near the intersection of Kansas Ave, NW and Upshur St, NW, contains an active gasoline service station. The

property to the west contains a K-12 school facility and park. Based on a site reconnaissance, some of the neighboring residential buildings contain basements.

#### **1.4 Site Utilities**

The Site is served by municipal water, sewer, natural gas, telephone and electric utilities. Each of the utilities are located underground and generally run to 13<sup>th</sup> St. NW, with the exception of the onsite natural gas line, which runs to the onsite boiler house located at the center of the property. Groundwater is not used at the property.

#### **1.5 Work Plan Submittal**

In order to determine if compounds of concern were present in the soil and groundwater in the vicinity of the proposed geothermal well field, DDOE requested the completion of environmental site characterization activities. On July 24, 2014, ECS submitted a Work Plan to DDOE describing the proposed procedures for completing the environmental site characterization of the proposed geothermal field. The site characterization activities included:

- The installation of six two-inch diameter groundwater monitoring wells (MW-1 through MW-6) for the collection of groundwater samples;
- Field screening and collection of soil samples during monitoring well installation for total petroleum hydrocarbons as diesel range organics (TPH DRO), total petroleum hydrocarbons as gasoline range organics (TPH GRO), volatile organic compounds (VOCs), Resource Conservation and Recovery Act (RCRA) metals, and polychlorinated biphenyls (PCBs) analysis;
- Low-flow sampling targeting the bottom of the water column in deep wells MW-1 and MW-3; and
- Low-flow sampling targeting the top of the water column in shallow wells MW-2, MW-4, MW-5 and MW-6.

On August 5, 2014, DDOE Water Quality approved the Work Plan and a private space Soil Boring permit was obtained from the DCRA. A copy of the approved Work Plan and Soil Boring Permit are included as Appendix I.

## **2.0 AREA GEOLOGY, HYDROGEOLOGY, AND STRATIGRAPHY**

### **2.1 Area Geology and Hydrogeology**

The subject site is located within the Coastal Plain Physiographic Province. The soils encountered in this area are the residual product of in-place chemical weathering of rocks presently underlying the site and/or Cretaceous age Potomac Group deposits consisting of interbedded sands, silts and clays. In general, shallow unconfined groundwater movement within the overlying soils is controlled largely by the topographic gradients. However as the groundwater percolates downward, it becomes controlled by the subsurface geologic conditions. Thus, the direction of groundwater movement in the deeper aquifer may not be consistent with the surficial topography.

Surface waters primarily recharge shallow aquifers by infiltration along higher elevations. Once in the shallow aquifer, the groundwater typically discharges into streams or other surface water bodies at lower elevations. The depth of the shallow water table is transient and can vary greatly with seasonal fluctuations in precipitation. Groundwater movement in the shallow aquifer is generally from high to low elevations. As such, shallow groundwater is expected to flow generally to the west. Based on the presumed groundwater flow direction, properties located to the east appear to be up-gradient relative to the site and properties to the north and south are positioned cross-gradient from the subject site.

### **2.2 Topography**

As determined from the USGS Topographic Map, Quadrangle (Figure 2) Washington West, the subject site is situated approximately 180 feet above mean sea level with topography sloping to the west. No water bodies are designated on the site. Based on a review of the topographic map and site topography, surface runoff would be expected to flow towards the site from the east.

### **2.3 Site Stratigraphy**

Geotechnical and environmental investigations have been performed at the property. The subsurface conditions encountered within the soil borings are consistent with the regional geology. Topsoil thicknesses ranging from approximately 3 to 6 inches were recorded. Fill material was encountered from approximately 1 to 10 feet and natural soils were encountered directly beneath the existing fill and predominately consisted of silty sand (SM) and clayey sand (SC) interlayered with clay (CL) containing various amounts of sand, silt, and gravel. Weathered rock was encountered at depths ranging from 25 to 35 feet.

### **3.0 INVESTIGATION METHODS**

#### **3.1 Soil Boring and Monitoring Well Installation**

ECS installed four monitoring wells in the vicinity of the proposed geothermal well field and two monitoring wells in the vicinity of the former UST location. Monitoring well locations are depicted on Figure 1. The monitoring wells were installed using a truck-mounted auger drill rig, which utilized continuous flight, hollow stem augers (HSA) to advance each bore hole.

The wells were completed as two-inch diameter PVC wells to final depths ranging between 17 to 40 feet below ground surface (bgs) with 0.020-inch machine slot screen and PVC casing. Each well was constructed with machine slot screen installed in the bottom 10 feet of each monitoring well. Filter sand was placed in the annulus around the screened PVC to two feet above the screened PVC. Hydrated bentonite was placed from the top of the filter sand to two feet above the filter sand as a low permeability seal. The monitoring wells were constructed in accordance with DDOE Well Construction Application Process and Well Construction Requirements for a permanent well. The well annulus extended at least 1.5 inches from the well casing to the borehole wall. Well casing consisted of new, undamaged pipe material meeting appropriate ASTM standards for the intended well use. Casing lengths were threaded together, not glued. Bentonite cement grout (60:40) was used to fill the annular space between the well casing and the borehole wall to the top of a low permeability seal. The bentonite cement grout consisted of bentonite powder and portland cement slurry with a 60:40 solids mix ratio consisting of 150 lbs of bentonite powder, 94 lbs of portland cement hydrated with 82 gallons of water which was placed using a tremie pipe from the top of the bentonite to the surface. The bentonite was hydrated with potable water as it was poured into the annulus around the wells, thereby ensuring that all bentonite was properly hydrated. The low permeability seal extended down to the top of the well filter pack and was comprised of at least two feet of fully hydrated medium-sized bentonite chips. Only clean, organic-free sand was used for the filter pack. The filter pack extended two feet above the well screen.

The wells were completed using a 5-inch diameter cover with a galvanized steel sleeve. Cement was placed around and at the base of the cover to prevent surface water infiltration.

Following well installation the wells were developed utilizing the well development methods detailed in the April 1992, Ground Water Forum, Monitoring Well Development Guidelines for Superfund Project Managers previously provided by DDOE.

The following method was used to develop the wells and establish proper hydraulic connection with the surrounding formation:

- The static water level and depth to sediment in the well was recorded prior to the start of well development;

- Each well was overpumped at a higher pumping rate than the pumping rate which was used during sampling;
- The pump was placed towards the bottom of the monitoring well to facilitate the removal of a large volume of water and sediment;
- Tubing was connected to the pump and connected to a flow through cell followed by a 55-gallon steel drum to containerize the development water during development;
- The flow-through cell and water quality meter monitored groundwater conditions including turbidity, specific conductance, pH, dissolved oxygen, and temperature;
- Three well volumes of groundwater were removed from each well and then the pump was removed and a surge block inserted to surge the well to better grade and wash the sediment in and around the filter pack; and
- Once the well had been surged once, the pump was inserted again and pumping continued until completion.

This pattern of well development continued until the turbidity readings were 5 NTU or below. Well development was complete once the remaining groundwater parameters were stabilized to within 10% of the previous readings, the well was clear of sediment at the bottom of the well, and the groundwater flow was clear. Field recordings of the groundwater parameters, sediment levels, water levels, and development times were maintained throughout the development of each well. The well development information for each well was recorded on the DDOE Well Development Log.

In order to allow time for the monitoring well to equilibrate with the surrounding formation and aquifer following installation, groundwater samples were collected approximately five days following well development.

The monitoring well construction information is included on the boring logs which are included in Appendix II. The field notes from the monitoring well installation and subsequent groundwater sampling event are included as Appendix III and photographs of the monitoring well installation are included in Appendix IV.

### **3.2 Soil Sampling**

During drilling operations, soil samples were collected every five feet using a two-inch outside diameter, split-barrel sampler. Each sample was screened for the presence of VOCs using a photoionization detector (PID) equipped with a 10.6 electron volt lamp. Two soil samples from each boring were collected for laboratory analysis. Generally soil samples were collected from the capillary zone and the vadose zone where elevated PID readings or visual or olfactory evidence of hydrocarbon impact was observed. If elevated PID readings were not observed and no visual or olfactory evidence of hydrocarbon impact was observed, a soil sample was collected from the fill material.



The soil samples selected for laboratory analysis were preserved in the field using methanol and sodium bisulfate, labeled with individual custody seals, placed immediately on ice, and submitted to an independent laboratory under chain of custody documentation for analysis of VOCs by EPA Method 8260B, TPH GRO and TPH DRO by EPA Method 8015B. Additionally one soil sample from each boring was submitted for RCRA metals and PCBs.

### **3.3 Groundwater Sampling**

In order to allow time for each monitoring well to equilibrate with the surrounding formation and aquifer following well installation, groundwater samples were collected from the monitoring wells approximately five days following well completion.

Prior to collecting groundwater samples, the static water level from each well was measured with an electronic interface probe (EIP) with a 100 foot tape. Both the top and bottom of the water column was gauged with the EIP to determine if LNAPL or DNAPL were present. Neither LNAPL nor DNAPL was identified in the monitoring wells.

The groundwater samples were collected using low-flow sampling procedures by using a calibrated Horiba U-52 meter capable of monitoring 11 groundwater parameters in combination with a QED bladder pump. During purging of the wells, groundwater conditions in each well were monitored. Well stabilization parameters included pH, temperature, specific conductance, oxidation-reduction potential, dissolved oxygen, and turbidity. Once the groundwater quality parameters equilibrated to within 10% of the previous three parameter readings, the well was sampled. A groundwater sample was collected from near the top of the water column within wells MW-2, MW-4, MW-5, and MW-6. A groundwater sample was collected from the bottom of the water column in monitoring wells MW-1 and MW-3.

Once well stabilization was achieved, the groundwater samples were collected in laboratory-grade glass jars with individual custody seals, placed immediately on ice, packaged in coolers with individual custody seals, and submitted to an independent laboratory under chain-of-custody documentation for analysis of VOCs by EPA Method 8260B, TPH GRO and TPH DRO by EPA Method 8015B, polycyclic aromatic hydrocarbons (PAHs) by EPA Method 8270, ethylene dibromide (EDB) by EPA Method 8011, and total dissolved metals by EPA Method 6020A. The low-flow sampling tables are included in Appendix IV.

### **3.4 Well Elevation Survey**

On August 27, 2014, ECS surveyed the top-of-casing (TOC) elevations of the monitoring wells using standard survey techniques. The elevation of the top of the PVC casing of each monitoring well was determined to within 0.01 feet. The wells were surveyed against

the known elevation of two survey benchmarks established for construction purposes. The elevations of the survey benchmarks were 181.85 and 191.33 feet above mean sea level. Using the survey data in conjunction with the computer software Surfer, ECS determined the groundwater flow direction and hydraulic gradient. The elevation data are presented in Table 1. A potentiometric surface map depicting the groundwater flow direction is included as Figure 3.

### **3.5 Quality Assurance/Quality Control Methods**

During the environmental site characterization, quality assurance/quality control (QA/QC) protocol included the following:

- All equipment used at multiple locations was decontaminated between uses using a mixture of potable water and Alconox;
- Sampling equipment such as split spoons or submersible pumps was allowed to air dry between sample collection;
- All laboratory bottleware and coolers were labeled with individual custody seals;
- One trip blank was included with the project specific bottleware ordered from the laboratory and was analyzed along with the samples;
- Following sample receipt, the laboratory provided a sample custody receipt sheet along with the chain of custody documentation to ensure the bottleware arrived at the laboratory intact and not tampered with during transit; and
- The laboratory also provided a copy of their NELAC certification.

### **3.6 Decontamination Procedures**

During the monitoring well installation and groundwater sampling event, any equipment used in multiple monitoring wells was decontaminated with a mixture of potable water and the cleaning detergent Alconox. The equipment was thoroughly rinsed and scrubbed with the Alconox solution. The equipment was then allowed to air dry prior to reuse. All equipment was decontaminated including split spoons, augers, pumps, and electronic interface probes.

### **3.7 Soil and Purge Water Disposal**

All soil cuttings, purge water, and decontamination water were collected into labeled 55-gallon open head steel drums awaiting disposal. Once analytical results were received, ECS arranged to have the drums removed from the site and taken to an appropriate facility for disposal. Copies of the disposal manifests are included in Appendix V.

## **4.0 INVESTIGATION RESULTS**

### **4.1 Site Geology**

Soils identified during the additional monitoring well installation typically consisted of silty sand (SP), and silt (ML). Weathered rock was also encountered at a depth of 35-40 feet bgs. Shallow borings were terminated five feet beneath the first encountered groundwater and the deeper borings were terminated once the bedrock was encountered. The environmental boring logs with well construction information are included in Appendix II.

### **4.2 Site Hydrogeology**

During the monitoring well installation, groundwater in the vicinity of the geothermal well field was encountered at depths ranging from 7.83 feet bgs in MW-4 to 10.32 feet bgs in MW-6, with saturated soil conditions at approximately 8.5 feet bgs. On August 27, 2014, the monitoring wells were gauged again and the static water levels were recorded at depths ranging from 11.88 feet bgs in MW-4 to 18.55 feet bgs in MW-1. Gauging data recorded on August 27, 2014 was used to prepare a potentiometric surface map (Figure 3). The gauging data indicated that groundwater flow direction is toward the west.

### **4.3 Soil Sampling Results**

Soil samples collected during the monitoring well installation were screened with a PID. Field screening results for soil samples ranged from 0.0 ppm at multiple sample locations to 13.0 ppm in boring MW-1 at a depth of 5 feet bgs. Field screening results are summarized on the Boring Logs in Appendix II. Two soil samples were submitted for laboratory analysis from each boring. In total, 12 soil samples were submitted for laboratory analysis from the general vicinity of the former USTs and from the proposed geothermal field.

VOC and petroleum concentrations in the vicinity of the former USTs and in the proposed geothermal field were screened using DDOE's Risk-Based Corrective Action (RBCA) Tier 0 Soil Screening Levels or Tier 1 Technical Guidance concentrations. Environmental Protection Agency, Region 3, Regional Screening Levels (RSLs) were used if a Tier 0 or Tier 1 value was not available. The concentration of 142 mg/kg of TPH DRO reported in the soil sample collected from MW-1 at 5 feet exceeded the Tier 0 concentration. Additionally, the laboratory reported that the soil sample collected from MW-4 at a depth of 5 feet bgs contained a concentration of benzene of 46.8 ug/kg, exceeding the Tier 0 standard. With the exception of TPH DRO in MW-1 and benzene in MW-4, none of the remaining concentrations exceeded their respective screening criteria.

### Vicinity of Former Underground Storage Tanks

Of the 4 soil samples collected in the vicinity of the former tanks (MW-1 and MW-2), three of the soil samples contained detectable concentrations of petroleum hydrocarbons or VOCs above the laboratory reporting limits at the following concentrations:

- TPH DRO – not detected (nd) to 142 micrograms per kilogram (mg/kg);
- Acetone – nd to 95.6 milligrams per kilogram (ug/kg);
- Carbon Disulfide– nd to 7.7 ug/kg;
- Naphthalene – nd to 4.4 ug/kg; and
- Tetrachloroethene – nd to 43.8 ug/kg.

### Proposed Geothermal Field

Of the 8 soil samples collected in the are of the proposed geothermal field (MW-3 to MW-6), seven of the soil samples contained detectable concentrations of petroleum hydrocarbons or VOCs above the laboratory reporting limits at the following concentrations:

- TPH DRO – nd to 84.8 mg/kg;
- Acetone – nd to 92.2 ug/kg;
- Benzene – nd to 46.8 ug/kd;
- Carbon Disulfide– nd to 2.2 ug/kg;
- Toluene – nd to 5.6 ug/kg; and
- M- & p-xylenes – in one soil sample at a concentration of 1.2 ug/kg.

### PCBs

The laboratory reported that one soil sample collected from the MW-1 location at a depth of 5 feet bgs contained a concentration of the PCB Aroclor-1254 of 150 ug/kg. The concentration was below the EPA RSL of 240 ug/kg and the source of the PCB is unknown. The concentration of PCB in the soil is beneath the EPA RSL and appears to be isolated to the vicinity of the former USTs. As such, the presence of the PCB Aroclor-1254 is not considered to be a risk to human health or the environment. PCBs were not identified in the proposed geothermal field.

### RCRA Metals

Six of the twelve soil samples were analyzed for RCRA metals. The laboratory reported that the soil samples contained concentrations of arsenic, barium, cadmium, chromium, lead, mercury, and selenium. The concentrations of metals in the soil do not exceed the EPA RSLs for metals in subsurface soil with the exception of arsenic and one

concentration of lead. The concentrations of arsenic are consistent with background concentrations of arsenic in the greater Washington, DC area and are therefore not a significant risk to human health or the environment.

The laboratory reported a concentration of lead in the soil sample collected from MW-3 at 5 feet bgs of 1,680 mg/kg, exceeding the EPA Region 3 residential screening level of 400 mg/kg. Following identification of the elevated lead, ECS requested that the laboratory analyze the soil sample by Toxicity Characteristic Leaching Procedure (TCLP) for lead to determine if the concentration of lead would result in the soil being classified as a characteristic hazardous waste. The laboratory reported that the soil contained 0.602 milligrams per liter (mg/L) of lead which would not result in the soil being classified as a characteristic hazardous waste. The source of the elevated lead is unknown, but may be related to an older metal pipe located in close proximity. Regardless of the source, the elevated lead appears to be isolated to one area of the property as lead concentrations in the other soil samples were below the EPA screening level. Based on the current redevelopment plans, the only disturbance to the soil that will occur will occur during the installation of the geothermal wells and will be limited. Therefore, the soil containing elevated lead concentrations will likely remain in place. Following geothermal well installation the area will be returned to the current grade which will likely require the import of topsoil, reducing the potential exposure for future users of the site to the area impacted with lead.

Soil laboratory results are summarized in Tables 2 and 3 and the laboratory reports are included in Appendix VI.

#### **4.4 Groundwater Sampling Results**

On August 19, 2014, approximately five days following the completion of the monitoring well installation, groundwater samples were collected from each well. Prior to sample collection, the static water level from each well was measured. The groundwater samples were collected from the top and bottom of the water column using low-flow sampling procedures using a calibrated Horiba U-52 meter capable of monitoring 11 groundwater parameters in combination with a QED bladder pump.

Six groundwater samples were analyzed for VOCs, TPH GRO and TPH DRO, PAHs, EDB, and total dissolved metals. The results are summarized below.

##### **TPH DRO & TPH GRO**

TPH GRO was not detected in groundwater samples collected from the six monitoring wells at or above the laboratory reporting limits during the sampling event. TPH DRO was detected in monitoring well MW-5 below the DC RBCA screening level in one groundwater sample at a concentration of 0.21 mg/L.

### VOCs

The laboratory reported at least one or more of the VOCs chloroform, methyl tert butyl ether (MTBE), tetrachloroethene (PCE), or trichloroethene (TCE) in four of the groundwater samples collected. The following VOCs were identified in the groundwater samples:

- Chloroform – nd to 4.6 micrograms per liter (ug/L);
- MTBE – nd to 2.1 J ug/L;
- PCE – nd to 70.8 ug/L; and
- TCE – nd to 2.6 J ug/L.

Chloroform does not have a DC RBCA screening value; therefore the results were compared to the EPA Region 3 Tap Water RSL value. Chloroform concentrations exceeded the EPA RSLs of 0.22 ug/L in two of the groundwater samples collected but were all below the maximum contaminant level (MCL) of 70 ug/L for drinking water. Chloroform is used frequently in laboratories and is also a by-product of water disinfection processes. Due to its ubiquitous nature, the presence of low concentrations of chloroform is potentially attributable to laboratory contamination or a drinking water source.

The MTBE concentrations did not exceed the DC RBCA screening value of 22 ug/L for a resident adult.

PCE and TCE exceeded their EPA RSL values of 11 ug/L and 0.49 ug/L, respectively, in one groundwater sample. PCE also exceeded its MCL value of 5 ug/L for drinking water. However, concentrations of PCE and TCE in groundwater were limited to the MW-1 location, which is located a significant distance from the proposed geothermal well field. The source and full extent of the chlorinated compound release is unknown.

In general, the highest concentrations of contaminants of concern in groundwater were identified in the monitoring well nearest the former UST area. The laboratory only identified estimated concentrations of contaminants within the proposed geothermal field.

### TAL Metals (dissolved)

During groundwater sampling, groundwater samples were filtered using a 0.45 micron filter in order to determine dissolved metal concentrations. The samples were analyzed for total dissolved TAL metals. The laboratory reported that multiple dissolved metals were identified in the groundwater samples including arsenic, barium, chromium, and selenium. Arsenic was the only metal identified in the groundwater samples at concentrations exceeding its EPA RSLs. The concentrations of arsenic in groundwater are consistent with background concentrations in the greater Washington DC area and do not pose a significant risk to human health or the environment.

The laboratory results are summarized in Table 4 and the laboratory reports are included in Appendix VI.

## **5.0 SUMMARY AND RECOMMENDATIONS**

### **5.1 Summary**

The proposed geothermal well field is located at 4301 13<sup>th</sup> Street NW Washington, DC, and is further identified as District of Columbia Square 2915, Lot 0802. The property is owned and operated by the Washington, DC DGS. The study area is located within the current Roosevelt High School Campus. The site includes four separate buildings as well as athletic fields, lawn areas, and an asphalt parking lot.

A renovation and modernization of Roosevelt High School is currently underway and will include the installation of a geothermal well field within the existing athletic field located on the north side of the property. Once construction of the geothermal wells is complete, the athletic field will be restored to its original condition.

In order to evaluate the environmental conditions present in the subsurface in the vicinity of the proposed geothermal field, DDOE requested environmental investigation including the installation of groundwater monitoring wells. ECS installed four monitoring wells in the vicinity of the proposed geothermal well field and two monitoring wells in the vicinity of previously removed USTs. The monitoring wells were installed using a truck-mounted auger drill rig, which utilized continuous flight, HSA to advance each bore hole. The monitoring wells were installed to depths ranging between 17 to 40 feet bgs and were constructed with 0.020-inch machine slot screen and PVC casing. Each well was constructed with machine slot screen installed in the bottom 10 feet of each monitoring well.

During drilling operations, soil samples were collected at five foot intervals until the bottom of the boring. Two soil samples were selected from each boring for laboratory analysis. The soil samples were submitted to an independent laboratory for analysis of TPH DRO, TPH GRO, VOCs, and/or RCRA metals. The laboratory reported concentrations of TPH DRO in four of the soil samples collected at concentrations above the laboratory reporting limit, with one of the four soil samples containing a concentration exceeding the DC RBCA screening value. The laboratory also reported detectable concentrations of some VOCs and metals in the soil samples. Of those detected, benzene, arsenic, and lead were at concentrations exceeding their respective screening levels in one or more samples. As such, soil cuttings from drilling operations should determine the concentrations of total petroleum hydrocarbons and metals. Any soil that exceeds the Tier 0 screening level of 100 mg/kg for TPH DRO or 100 mg/kg for TPH GRO or exceeds the acceptance criteria established by the clean fill soil disposal facility will be disposed of at an appropriate facility licensed to receive the waste.

Approximately one week following monitoring well installation, groundwater samples were collected from each well. The groundwater samples were collected from the top and bottom of the water column for shallow wells and from the bottom of the water column for



deep wells using low-flow sampling procedures and a calibrated Horiba U-52 meter capable of monitoring 11 groundwater parameters in combination with a QED bladder pump. The groundwater parameters were recorded and samples were collected once well stabilization was achieved. The groundwater samples were analyzed for VOCs, TPH GRO and TPH DRO, PAHs, EDB, and total dissolved metals

The laboratory reported concentrations of four VOCs (MTBE, chloroform, PCE, and TCE) in groundwater. MTBE was not detected at concentrations exceeding the DC RBCA screening value. Concentrations of chloroform, PCE and TCE exceeded EPA Region 3 screening values. The source and full extent of the chlorinated compound release is unknown. However, concentrations of PCE and TCE in groundwater were limited to the MW-1 location, which is located a significant distance from the proposed geothermal well field. Additional investigation would be required to identify the source and extent of the release. Consequently the presence of chlorinated compounds in the subsurface at the MW-1 location, which is not within the proposed geothermal well field, should not require special drilling procedures during the installation of the geothermal wells and should not prevent the installation of the geothermal wells from proceeding. The concentrations of dissolved metals were compared to the EPA Region 3 screening values. Arsenic was the only metal detected at concentrations exceeding RSLs. The laboratory did not identify concentrations of TPH GRO in groundwater above the laboratory reporting limit. TPH DRO was detected at a concentration of 0.21 mg/L in MW-5; however, the concentration did not exceed the DC RBCA screening level.

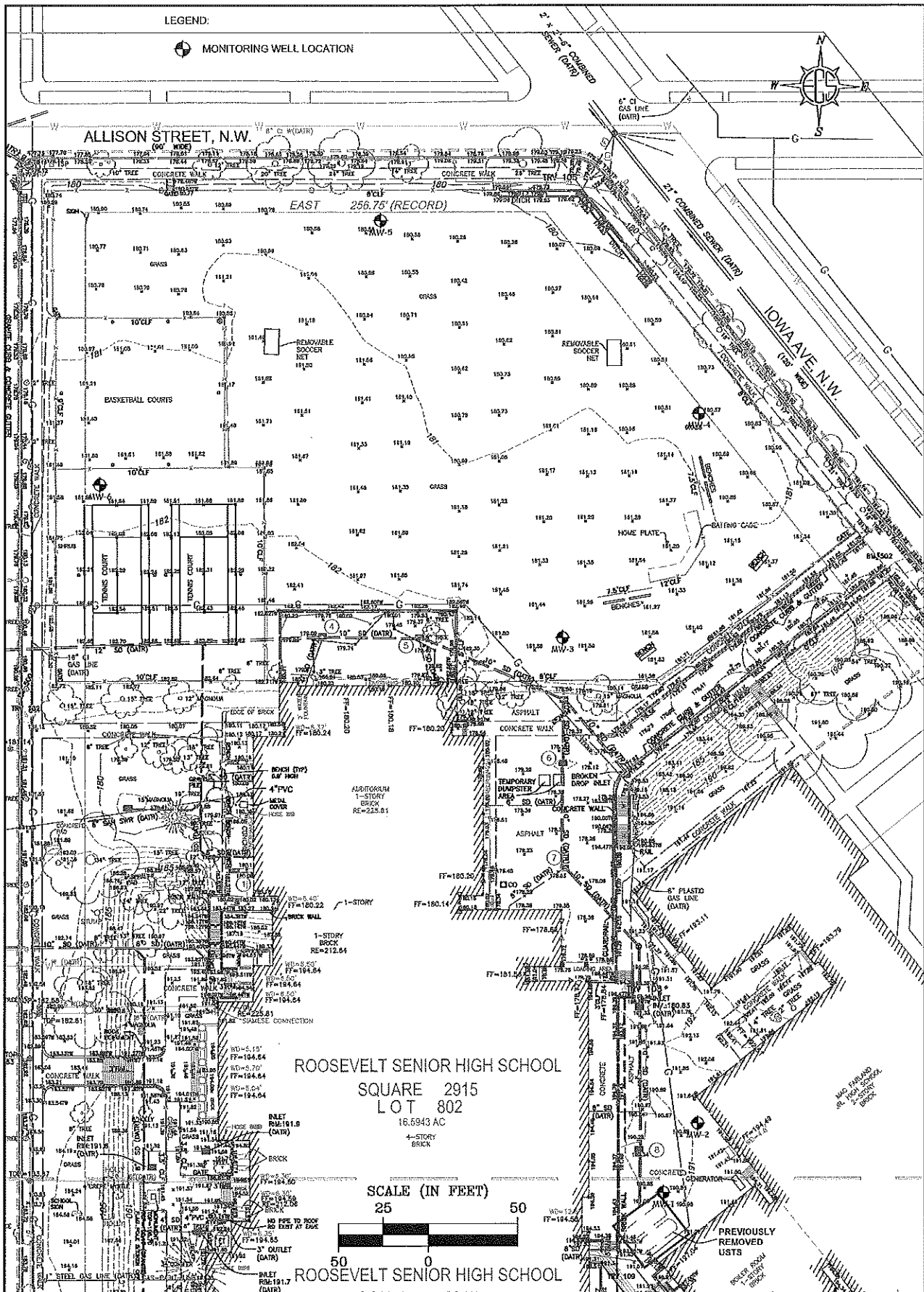
## **5.2 Recommendations**

Based on the results of the environmental assessment conducted in the vicinity of the proposed geothermal field, none of the concentrations of TPH DRO, TPH GRO, VOCs or metals prevent the installation of the geothermal wells. The concentrations of contaminants of concern in groundwater in the vicinity of the proposed geothermal field are minimal and should not require the installation of a permanent outer casing. However, ECS recommends the following precautions and additional characterization activities occur:

- During geothermal drilling operations, the soil generated as drill cuttings should be field screened and/or laboratory tested by an environmental professional. The field screening of the fill material will consist of an environmental technician conducting site visits during drilling operations to screen the soil stockpiles using a PID and a Hanby colorimetric field kit to determine VOC and petroleum hydrocarbon concentrations. Laboratory samples will also be collected from the soil stockpiles and the samples will be analyzed for the primary contaminants of concern identified during this environmental site characterization. Through the onsite field screening and laboratory testing, the proper waste stream of the fill material can be determined.

- Any soil that is determined to be petroleum or metals-impacted through field screening or laboratory analysis should be disposed of at an acceptable disposal facility licensed to receive the waste.
- Based on the results of the groundwater sampling, the monitoring wells within the geothermal field can be abandoned to make way for the installation of the geothermal wells. The monitoring wells located in the vicinity of the former USTs should remain onsite to be incorporated in any future site characterization activities.

**FIGURES**



DATE	SHEET	PROJECT NO.	SCALE	ENGINEER	EGS REVISIONS
02/29/14	FIG. 1	232258	1"=50'	JMB DJB	

ENVIRONMENTAL MONITORING  
 WELL LOCATIONS  
 FIGURE 1

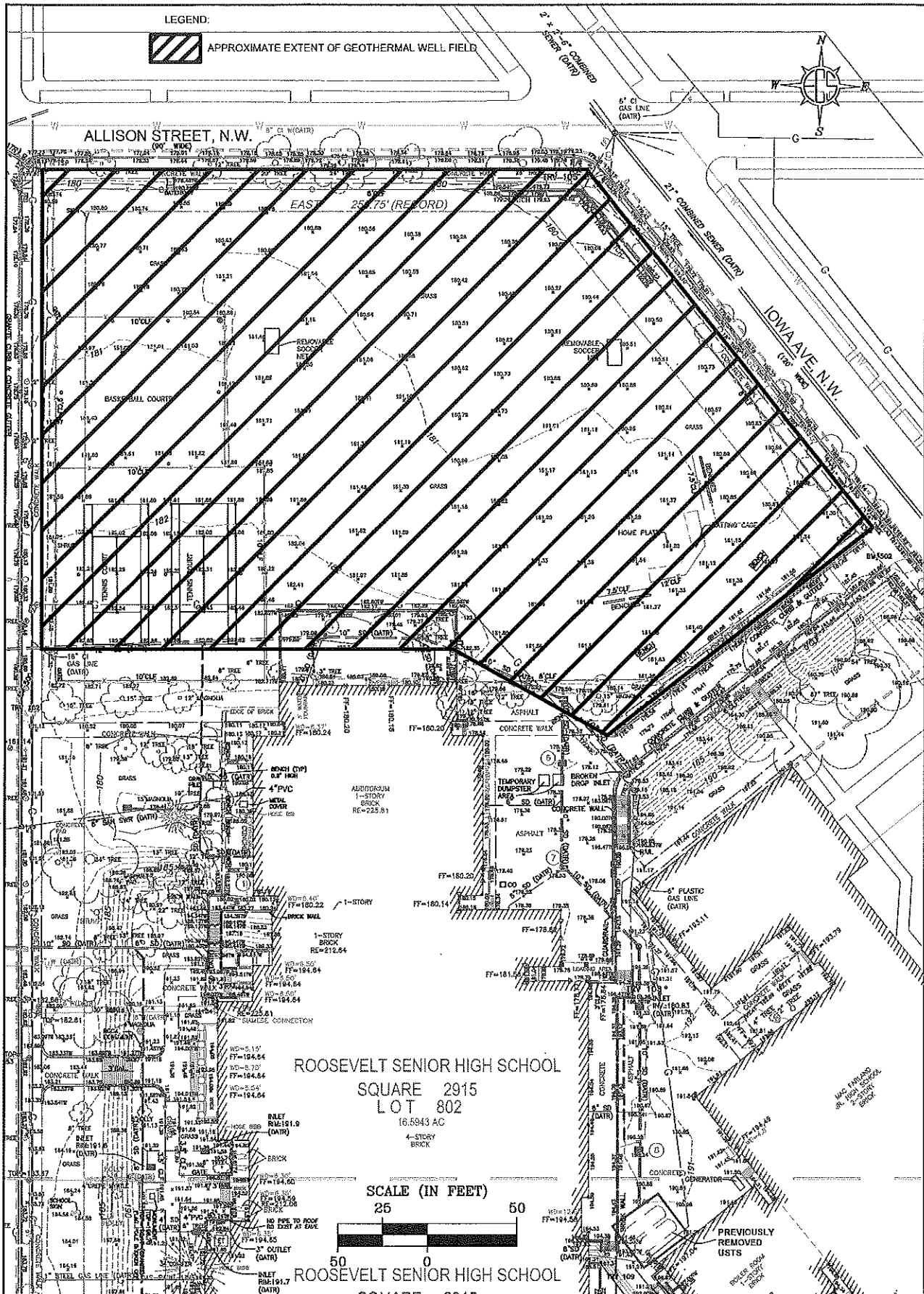


ENVIRONMENTAL SITE ASSESSMENT  
 ROOSEVELT HIGH SCHOOL  
 WASHINGTON, DC

LEGEND:



APPROXIMATE EXTENT OF GEOTHERMAL WELL FIELD



ROOSEVELT SENIOR HIGH SCHOOL

SQUARE 2915  
LOT 802

16.5943 AC  
4-STORY BRICK

SCALE (IN FEET)

25 50



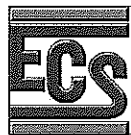
ROOSEVELT SENIOR HIGH SCHOOL

DATE	SHEET	PROJECT NO.	SCALE	ENGINEER	DRAWING	ESS REVISIONS
03/24/14	FIG 2	23253	1"=50'	JKB	JKR	

GEOTHERMAL WELL

FIELD DIAGRAM

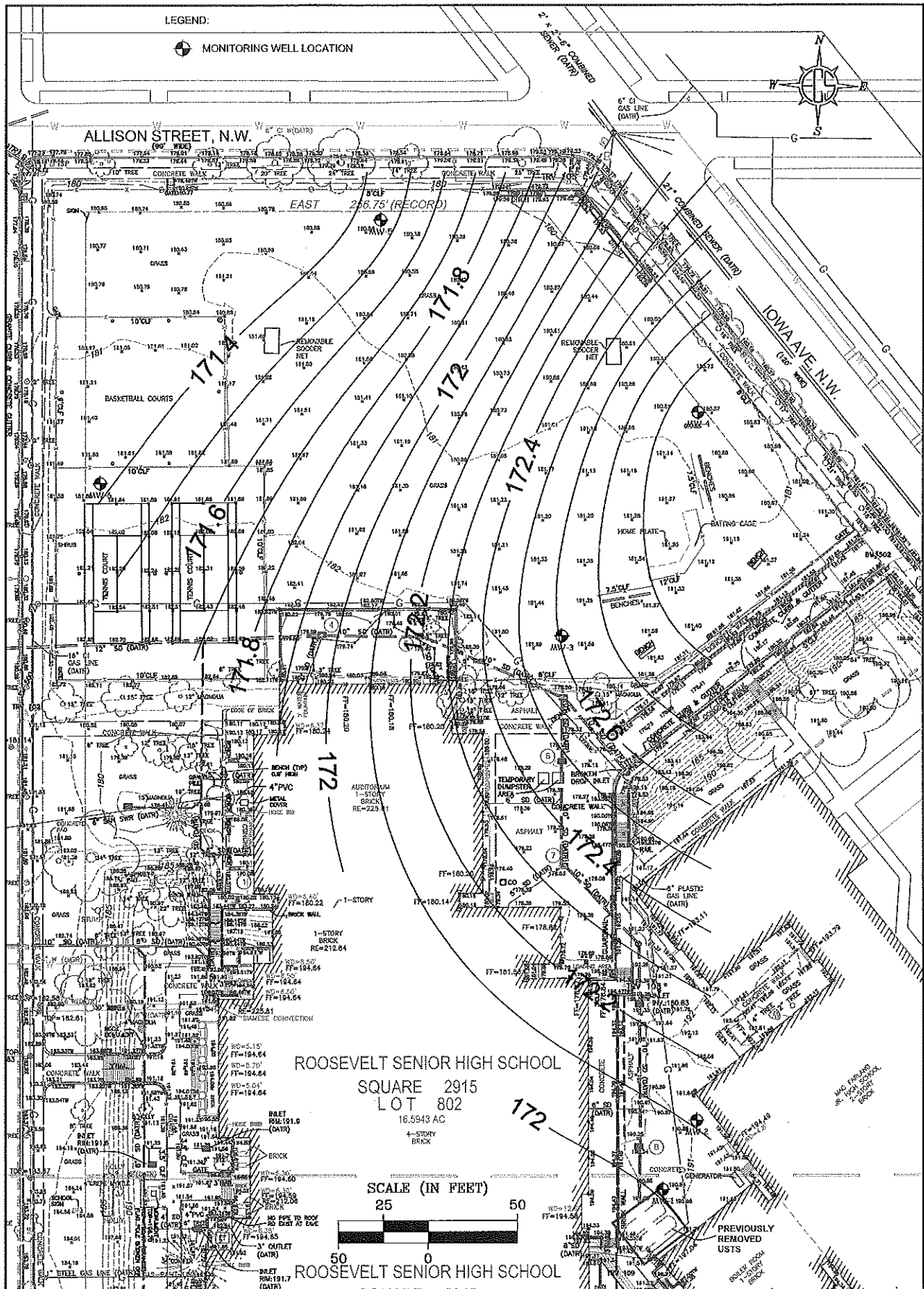
FIGURE 2



ENVIRONMENTAL SITE ASSESSMENT

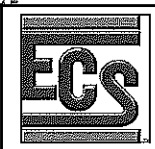
ROOSEVELT HIGH SCHOOL

WASHINGTON, DC



DATE	SHEET	PROJECT NO.	SCALE	ENGINEER	DRAWING	EGS REVISIONS
	FIG. 3	23255	1"=50'	JMB	JKR	

POTENTIOMETRIC  
SURFACE MAP  
FIGURE 3



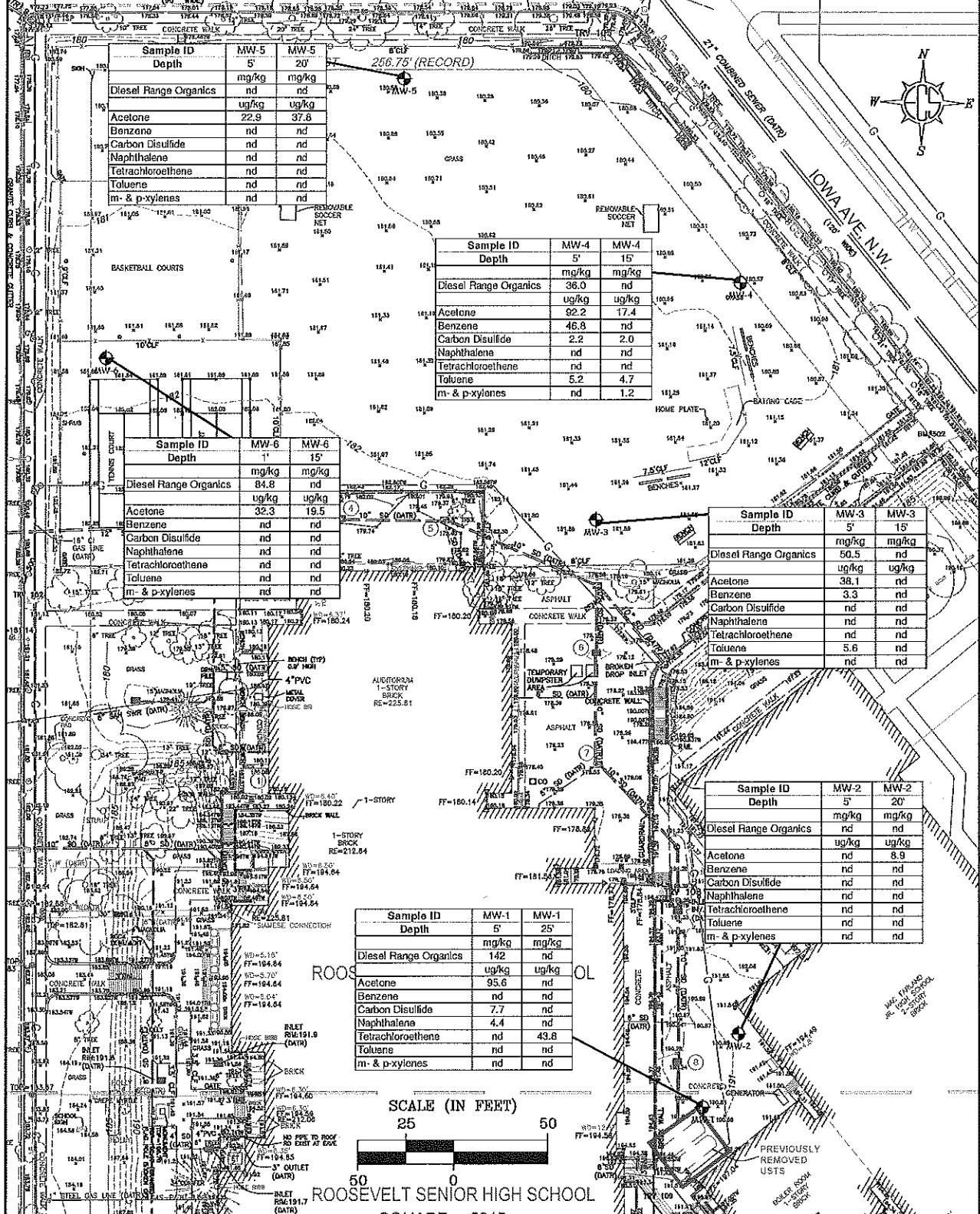
ENVIRONMENTAL SITE ASSESSMENT  
ROOSEVELT HIGH SCHOOL  
WASHINGTON, DC

LEGEND:

MONITORING WELL LOCATION

Notes:  
 Select compounds present at concentrations above the laboratory reporting limit are included in the figure  
 All results are in milligrams per kilogram (mg/kg) or micrograms per kilogram (ug/kg)  
 nd- below laboratory detection limit

ALLISON STREET, N.W.



Sample ID	MW-5	MW-5
Depth	5'	20'
Diesel Range Organics	nd	nd
Acetone	22.9	37.8
Benzene	nd	nd
Carbon Disulfide	nd	nd
Naphthalene	nd	nd
Tetrachloroethene	nd	nd
Toluene	nd	nd
m- & p-xylenes	nd	nd

Sample ID	MW-4	MW-4
Depth	5'	15'
Diesel Range Organics	36.0	nd
Acetone	62.2	17.4
Benzene	46.8	nd
Carbon Disulfide	2.2	2.0
Naphthalene	nd	nd
Tetrachloroethene	nd	nd
Toluene	5.2	4.7
m- & p-xylenes	nd	1.2

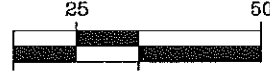
Sample ID	MW-6	MW-6
Depth	1'	15'
Diesel Range Organics	84.8	nd
Acetone	32.3	19.5
Benzene	nd	nd
Carbon Disulfide	nd	nd
Naphthalene	nd	nd
Tetrachloroethene	nd	nd
Toluene	nd	nd
m- & p-xylenes	nd	nd

Sample ID	MW-3	MW-3
Depth	5'	15'
Diesel Range Organics	50.5	nd
Acetone	38.1	nd
Benzene	3.3	nd
Carbon Disulfide	nd	nd
Naphthalene	nd	nd
Tetrachloroethene	nd	nd
Toluene	5.6	nd
m- & p-xylenes	nd	nd

Sample ID	MW-2	MW-2
Depth	5'	20'
Diesel Range Organics	nd	nd
Acetone	nd	8.9
Benzene	nd	nd
Carbon Disulfide	nd	nd
Naphthalene	nd	nd
Tetrachloroethene	nd	nd
Toluene	nd	nd
m- & p-xylenes	nd	nd

Sample ID	MW-1	MW-1
Depth	5'	25'
Diesel Range Organics	142	nd
Acetone	95.6	nd
Benzene	nd	nd
Carbon Disulfide	7.7	nd
Naphthalene	4.4	nd
Tetrachloroethene	nd	43.8
Toluene	nd	nd
m- & p-xylenes	nd	nd

SCALE (IN FEET)

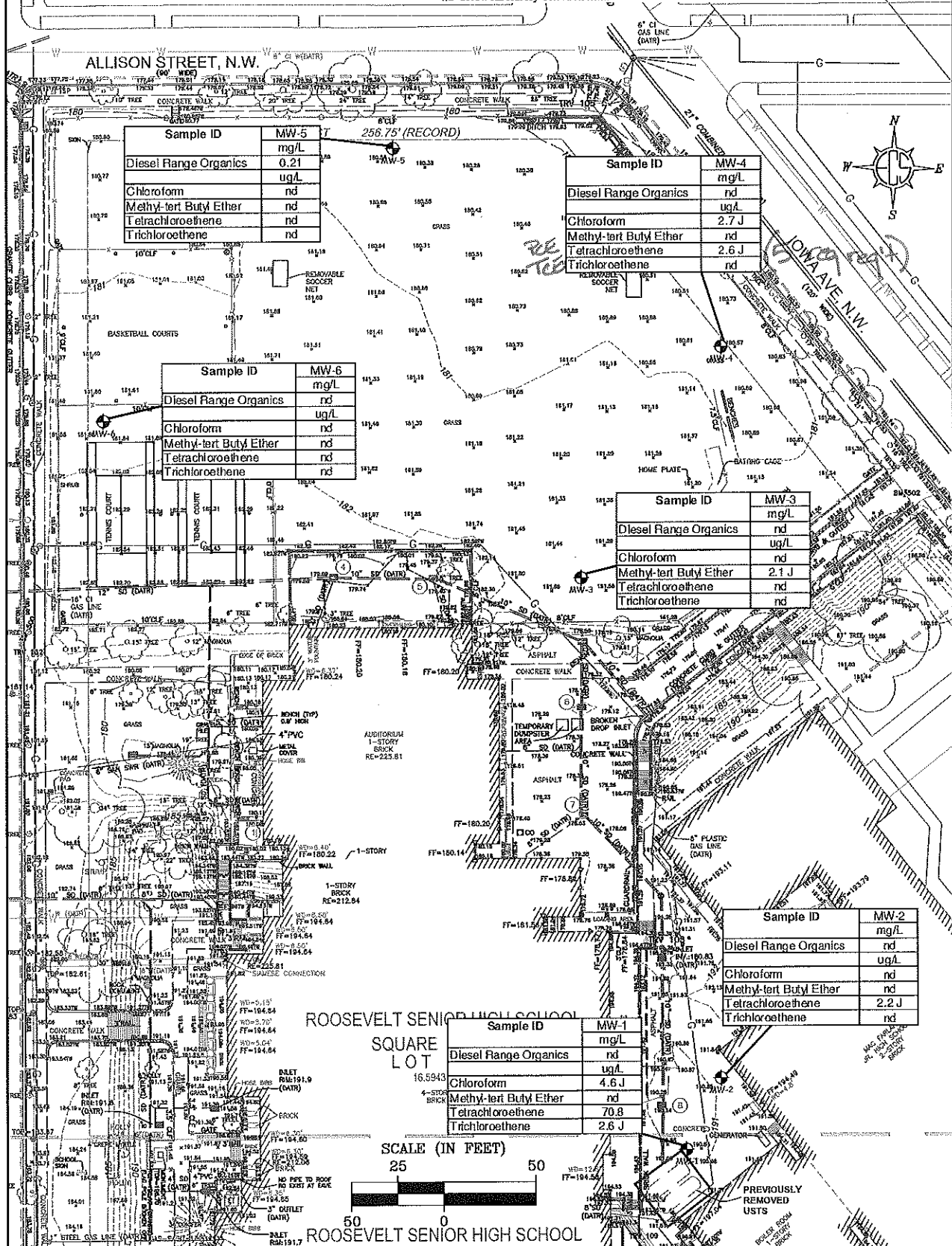


LEGEND:

MONITORING WELL LOCATION

Notes:

Select compounds present at concentrations above the laboratory reporting limit are included in the figure  
 All results are in milligrams per liter (mg/L) or micrograms per liter (ug/L)  
 nd- below laboratory detection limit



Sample ID	MW-5
Diesel Range Organics	0.21 mg/L
Chloroform	nd
Methyl-tert Butyl Ether	nd
Tetrachloroethene	nd
Trichloroethene	nd

Sample ID	MW-4
Diesel Range Organics	nd
Chloroform	2.7 J
Methyl-tert Butyl Ether	nd
Tetrachloroethene	2.6 J
Trichloroethene	nd

Sample ID	MW-6
Diesel Range Organics	nd
Chloroform	nd
Methyl-tert Butyl Ether	nd
Tetrachloroethene	nd
Trichloroethene	nd

Sample ID	MW-3
Diesel Range Organics	nd
Chloroform	nd
Methyl-tert Butyl Ether	2.1 J
Tetrachloroethene	nd
Trichloroethene	nd

Sample ID	MW-2
Diesel Range Organics	nd
Chloroform	nd
Methyl-tert Butyl Ether	nd
Tetrachloroethene	2.2 J
Trichloroethene	nd

Sample ID	MW-1
Diesel Range Organics	nd
Chloroform	4.6 J
Methyl-tert Butyl Ether	nd
Tetrachloroethene	70.8
Trichloroethene	2.6 J

SCALE (IN FEET)





**TABLES**

**Table 1**  
**Potentiometric and Gauging Data**  
**Roosevelt High School**  
**Washington, DC**

Well ID	Date	TOC Elevation (ft)	Depth to LNAPL (ft) from TOC	Depth to DNAPL (ft) from TOC	Depth to Water (ft)	Hydrocarbon Surface Elevation (ft)	Water Surface Elevation (ft)	Hydrocarbon Thickness (ft)
MMW-1	8/27/2014	190.50	nd	nd	18.55	nd	171.95	nd
MMW-2	8/27/2014	190.61	nd	nd	18.51	nd	172.10	nd
MMW-3	8/27/2014	182.42	nd	nd	9.72	nd	172.70	nd
MMW-4	8/27/2014	180.97	nd	nd	7.88	nd	173.09	nd
MMW-5	8/27/2014	181.26	nd	nd	10.00	nd	171.26	nd
MMW-6	8/27/2014	181.84	nd	nd	10.49	nd	171.35	nd

Notes:

TOC - Top of Casing

ft - feet

LNAPL - Light Non-Aqueous Phase Liquid

DNAPL - Dense Non-Aqueous Phase Liquid

nd - not detected

**Table 2**  
**Total Petroleum Hydrocarbons, Polychlorinated Biphenyls, and Volatile Organic Compounds Detected in Soil**  
 Roosevelt High School  
 Geothermal Well Field  
 Environmental Site Assessment  
 Washington, DC

Chemical Name	Sample ID Sample Depth Sample Date	MW-1 5' 8/13/2014	MW-1 25' 8/13/2014	MW-2 5' 8/13/2014	MW-2 20' 8/13/2014	MW-3 5' 8/11/2014	MW-3 15' 8/11/2014	MW-4 5' 8/11/2014	MW-4 15' 8/11/2014	MW-5 5' 8/13/2014	MW-5 20' 8/14/2014	MW-6 1' 8/14/2014	MW-6 15' 8/14/2014
<b>Total Petroleum Hydrocarbons</b>	<b>Screening Level (mg/kg)</b>	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
<b>Diesel Range Organics</b>	100*	142	nd	nd	nd	50.5	nd	36.0	nd	nd	nd	84.8	nd
<b>Volatile Organic Compounds</b>	<b>Screening Level (ug/kg)</b>	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
<b>Acetone</b>	61,000 **	95.6	nd	nd	8.9	38.1	nd	92.2	17.4	22.9	37.8	32.3	19.5
<b>Benzene</b>	5*	nd	nd	nd	nd	3.3	nd	46.8	nd	nd	nd	nd	nd
<b>Carbon Disulfide</b>	770,000***	7.7	nd	nd	nd	nd	nd	2.2	2.0	nd	nd	nd	nd
<b>Naphthalene</b>	631,000**	4.4	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
<b>Tetrachloroethene</b>	24,000***	nd	43.8	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
<b>Toluene</b>	9600*	nd	nd	nd	nd	5.6	nd	5.2	4.7	nd	nd	nd	nd
<b>m- &amp; p-Xylenes</b>	3860*	nd	nd	nd	nd	nd	nd	nd	1.2	nd	nd	nd	nd
<b>Polychlorinated Biphenyls</b>	<b>Screening Level (ug/kg)</b>	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
<b>Aroclor-1254</b>	240***	194	ns	ns	nd	nd	ns	ns	nd	nd	ns	nd	ns

Notes:  
 Only compounds present at concentrations above the laboratory reporting limit are included in the table  
 TPH results are in milligram per kilogram (mg/kg)  
 VOC and PCB results are in micrograms per kilogram (ug/kg)  
 ne - not established  
 nd - below laboratory detection limit  
 ns - not sampled  
 \* D.C. Tier 0 Screening level  
 \*\* - D.C. Risk-Based Corrective Action Technical Guidance, Table 5-9 Risk-Based Screening for a Resident Adult, Sub-Surface Soil, Outdoor Inhalation, Updated June 2011  
 \*\*\*- EPA Region 3 Regional Screening Level (RSL) for Residential Soil (May 2014)  
**Screening level exceeded**

Table 3  
 Resource Conservation and Recovery Act (RCRA) 8 Metals in Soil  
 Roosevelt High School  
 Geothermal Well Field  
 Environmental Site Assessment  
 Washington, DC

Chemical Name	Sample ID Sample Depth Sample Date	MW-1 5' 08/13/2014	MW-2 20' 08/13/2014	MW-3 5' 08/11/2014	MW-4 15' 08/11/2014	MW-5 5' 08/13/2014	MW-6 1' 08/14/2014
Arsenic	0.67*	mg/kg <b>2.88</b>	mg/kg 0.515	mg/kg <b>12.7</b>	mg/kg <b>1.06</b>	mg/kg <b>3.49</b>	mg/kg <b>6.79</b>
Barium	15,000*	79.8	5.54	378	17.1	83.6	117
Cadmium	ne	nd	nd	0.327	nd	nd	0.229
Chromium	ne	20.8	1.67	31.7	4.81	21.9	25.3
Lead	400*	34.3	2.43	<b>1.680</b>	4.63	19.5	102
Mercury	9.4*	0.0876	nd	0.113	nd	0.0469	0.1
Selenium	390*	2	0.823	4.79	1.94	2.29	2.75
TCLP Metals	Screening Level (mg/L)**	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Barium	100	na	na	0.784	na	na	na
Lead	5	na	na	0.602	na	na	na

Notes:

- Only compounds present at concentrations above the laboratory reporting limit
- All results are in milligram per kilogram (mg/kg) or milligrams per liter (mg/L)
- nd - below laboratory detection limit
- ne - not established
- na - not analyzed
- \* - EPA Region 3 Regional Screening Level (RSL) for Residential Soil (May 2014)
- \*\* - EPA Maximum Concentration of Contaminants for Toxicity Characteristic

**Exceeds EPA Region 3 RSL**

**Table 4**  
**Total Petroleum Hydrocarbons, Volatile Organic Compounds, and Target Analyte List Metals in Groundwater**  
**Roosevelt High School**  
**Geothermal Well Field**  
**Environmental Site Assessment**  
**Washington, DC**

**Total Petroleum Hydrocarbons Detected in Groundwater**

Chemical Name	Sample ID	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6
	Sample Date	8/19/14	8/19/14	8/19/14	8/19/14	8/19/14	8/19/14
Diesel Range Organics	Screening Level (mg/L)	245*	nd	nd	nd	nd	0.21

**Volatile Organic Compounds Detected in Groundwater**

Chemical Name	Sample ID	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6
	Sample Date	8/19/14	8/19/14	8/19/14	8/19/14	8/19/14	8/19/14
Chloroform	Screening Level (ug/L)	0.22**	4.6 J	nd	nd	2.7 J	nd
Methyl-tert Butyl Ether	22*	nd	nd	2.1 J	nd	nd	nd
Tetrachloroethene	11**	70.8	2.2 J	nd	2.6 J	nd	nd
Trichloroethene	0.49**	2.6 J	nd	nd	nd	nd	nd

**TAL Metals Detected in Groundwater**

Chemical Name	Sample ID	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6
	Sample Date	8/19/14	8/19/14	8/19/14	8/19/14	8/19/14	8/19/14
Arsenic	Screening Level (mg/L)**	0.000052	nd	0.001	nd	nd	0.002
Barium	3.8	0.165	0.16	0.046	0.04	0.109	0.132
Chromium	22	nd	nd	nd	nd	0.033	nd
Selenium	0.1	0.001	0.006	nd	0.004	0.002	nd

**Notes:**

All results are in micrograms per liter (ug/L) or milligrams per liter (mg/L)  
 nd - below laboratory detection limit; ne - not established  
 J - Detected but below the reporting limit; result is an estimated concentration  
 \* - D.C. Risk-Based Corrective Action Technical Guidance, Table 5-9 Risk-Based Screening for a Resident Adult; Groundwater, Domestic Use of Water (Ingestion and Inhalation), Updated June 2011