Groundwater Investigation Work Plan
Revision 1

Hercules, Inc. Site
#356001
Port Ewen, New York

Prepared for:

Hercules, Inc.
Dyno Nobel, Inc.

Prepared by:

EHS Support

October 2021

EHS Support

I, Kristin A. VanLandingham, P.E., certify that I am currently a NYS-registered professional engineer and that this *Groundwater Investigation Work Plan – Revision* dated October 2021 for the Hercules, Inc. site located in Port Ewen, New York was prepared in accordance with all applicable statutes and regulations, and in conformance with the DER *Technical Guidance for Site Investigation and Remediation* (DER-10).

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Date

Table of Contents

List of In-text Tables

List of Attached Tables

List of Attached Figures

List of Appendices

Acronyms

amsl	above mean sea level
AOC	area of concern
ASP	Analytical Services Protocol
bgs	below ground surface
CAMP	Community Air Monitoring Plan
CFR	Code of Federal Regulations
CPT	cone penetrometer testing
CSM	Conceptual Site Model
CVOC	chlorinated volatile organic compound
DDNP	diazodinitrophenol
DER	Division of Environmental Remediation
DNAPL	dense non-aqueous phase liquid
DUSR	data usability summary report
ECD	electron capture detector
FID	flame-ionization detector
ft	foot or feet
GPS	global positioning system
GQS	groundwater quality standards
HASP	Health and Safety Plan
HMX	cyclotetramethylene tetranitramine
HSWA	Hazardous and Solid Waste Amendments
IDW	investigation-derived waste
LMNR	lead mononitro-resorcinol
MIP	membrane interface probe
MS	matrix spike
MSD	matrix spike duplicate
NAD83	North American Datum of 1983
NAVD88	North American Vertical Datum of 1988
NGVD	National Geodetic Vertical Datum of 1929
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OSHA	Occupational Safety and Health Administration
PBX	polymer bound explosive
PETN	pentaerythritol tetranitrate
PID	photoionization detector
PPE	personal protective equipment
PRAP	Proposed Remedial Action Plan

PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
RDX	cyclotrimethylene trinitramine
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RI	remedial investigation
SAP	Sampling and Analysis Plan
SWMU	solid waste management unit
TCE	trichloroethene
USCS	Unified Soil Classification System
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

1 Introduction

This Groundwater Investigation Work Plan ("Work Plan") was prepared on behalf of Hercules, Inc. ("Hercules"), a wholly owned subsidiary of Ashland LLC ("Ashland"), and Dyno Nobel, Inc. ("Dyno Nobel"), herein referred to as "the Parties", for the Hercules, Inc. site (the "Site") in accordance with New York State Department of Environmental Conservation (NYSDEC) Administrative Order on Consent ("Consent Order") Index # CO 3-20180508-85 effective August 3, 2018. The Site is located at 161 Ulster Avenue, approximately one mile south of the Village of Port Ewen in Ulster County, New York (**Figure 1-1**) and is listed on the New York State Inactive Hazardous Waste Site Index as Site No. 356001.

This Work Plan responds to NYSDEC's demands that identified data gaps to be addressed as part of a supplemental remedial investigation (RI) (NYSDEC, 2019a). NYSDEC's request regarding groundwater near and around the former Shell Plant, related to chlorinated volatile organic compounds (CVOCs), stated:

> *3. Groundwater – If soils collected in the data gap investigation document elevated concentrations of contaminants, additional MWs may be necessary. Also, and in consideration of the already agreed-to installation of sentinel monitoring wells to the south of the site, the bedrock aquifer has not been satisfactorily characterized at the site. The Department requests additional bedrock wells be installed at the site for the purpose of understanding the hydrogeology of the bedrock aquifer and its relationship to the overburden aquifer on-site. A top-of-rock contour map should also be prepared to help understand the geology and how it affects groundwater flow and potential DNAPL migration at the site. A sufficient number of bedrock wells, along with locations and design of the coring program, should be proposed to fully characterize the bedrock aquifer. Bedrock coring and/or down-hole geophysics should also be proposed to facilitate understanding of the existing fracture sets at the site, particularly those significant enough to convey groundwater.*

The NYSDEC letter (NYSDEC, 2019a) responded to public comments on the NYSDEC Proposed Remedial Action Plan (NYSDEC, 2019b). Specifically, several stakeholders expressed concerns regarding the potential off-site migration of CVOCs in groundwater originating in the vicinity of the former Shell Plant.

1.1 Purpose

This Work Plan characterizes the hydrogeology in the vicinity of the former Shell Plant at the Site, including the bedrock aquifer, with the goal of properly locating sentinel monitoring wells to monitor CVOCs as requested by NYSDEC. A preliminary Groundwater Conceptual Site Model (CSM) was developed which focuses on causes, fate, and transport of CVOCs in groundwater in the vicinity of the former Shell Plant. The CSM will aid in designing investigation activities needed to collect the data to properly cite sentinel monitoring wells requested by NYSDEC. The CSM is included as **Appendix A**.

The preliminary CSM uses existing regional and Site-specific data to aid in documenting our understanding of the current subsurface conditions, groundwater quality, and groundwater flow paths beneath the Site and will assist in targeting supplemental investigations to further refine our understanding. The CSM will be revised and updated based on the results of forthcoming supplemental investigations, proposed within, with the goal of developing a CSM that can support the selection, design, and implementation of Site remediation and long-term groundwater monitoring.

1.2 Goals

Overarching project goal:

- Collect sufficient information to refine the CSM.
- Delineate the nature and extent of CVOCs in the vicinity of the former Shell Plant.
- Properly locate sentinel monitoring wells for use in the long-term groundwater monitoring program and the Site's final corrective measures.

Specific Investigation goals:

- Collect additional Site data to update the CSM.
- Prepare a Groundwater Investigation Report and the placement of sentinel groundwater monitoring wells to monitor for CVOCs in the vicinity of the former Shell Plant. The expected outcomes of the Groundwater Investigation Report are to:
  - Define suspected CVOCs source area(s), if any, present around the former Shell Plant.
  - Install a sufficient monitoring well network to clearly define the CVOCs plume based on Site-specific hydrogeologic conditions, including bedrock fracture orientation.

1.3 Work Plan Organization

This Work Plan is structured to allow for streamlined completion of investigation tasks through an iterative and integrated investigation approach that engages project stakeholders and fosters more efficient and effective decision-making. Interim project updates will be provided at key decision points to stakeholders to assist in the identification of additional data collection needs.

The structure of this Work Plan is as follows:

- **Section 2**: Site Background – Provides understanding of past Site use and regulatory history relevant to this Work Plan.
- **Section 3**: Current Site Understanding – Summarizes the current Site understanding based on development of the CSM.
- **Section 4**: Investigation Program – Summarizes the data acquisition and evaluation for each specific work task including a summary of data gaps and additional data collection activities. Specific work tasks include:
  - Field Preparation and Site Management
  - Surface Geophysics Program
  - Borehole Geophysics Program
  - Cone Penetrometer Testing / Membrane Interface Probe (CPT/MIP) Characterization Program
  - Conventional Drilling Program and Well Installation
  - Groundwater Monitoring Program
  - Aquifer Testing
- **Section 5**: Additional Work Plan Documents – Describes the four companion documents that detailed the methods and procedures to be used during the on-site RI.
- **Section 6**: Project Organization, Deliverables, and Schedule – Summarizes the anticipated field and deliverables schedule as well as anticipated report content.

- **Section 7**: References – Lists the reference documents cited in this Work Plan.

2 Site Background

2.1 Site Physical Setting

The Site is in a small valley bordered on the west by Hussey Hill and on the east by a low ridge adjacent to the Hudson River. Hussey Hill rises to an elevation more than 900 feet above mean sea level (ft amsl) per National Geodetic Vertical Datum of 1929 (NGVD) and drops steeply to the western edge of the developed portion of the Site to an elevation of approximately 200 ft amsl. The developed or active portion of the Site then grades gently to the valley floor, with the elevation of the Site dropping 50 ft (to an elevation of approximately 150 ft amsl). The land east of the Site then gently rises again to the ridge overlooking the Hudson River, which sits at an elevation of approximately 250 ft amsl. The Hudson River is located approximately 1.5 miles east of the Site, at an elevation of approximately 5 ft amsl. Esopus Lake, another major local feature, is located approximately one mile east of the Site at an elevation of 185 ft amsl.

The Dyno Nobel property encompasses approximately 412 acres, shown by the blue property boundary on **Figure 1-1**, and the Site consists of approximately 134 acres as delineated by the red boundary on **Figure 2-1**. Most of the remaining 250+ acres are naturally vegetated with cover types ranging from old fields to forested areas.

As shown on **Figure 2-1**, the developed areas of the Site (within the red Site boundary) include the active or formerly active portions of the facility used for industrial operations. Areas to the west of the railroad tracks are highly disturbed by active Site operations and are characterized exclusively by an industrial cover type. This area is referred to as the Active Plant Area. In a smaller portion of the developed Site to the east of the railroad tracks, there is a mix of cover types that include pavement, palustrine wetlands, and deciduous and successional forest. This area is referred to as the Wetlands Complex.

A stream and wetlands exist in the center of the valley with the drainage occurring to the north to an unnamed tributary of Plantasie Creek. The wetlands dominate the low-lying areas of the valley and are located to the east, northeast, and southeast of the developed portion of the Site, at an elevation of approximately 145 ft amsl. There is an active rail line running north to south, which bisects the developed area of the Site and separates the current operational areas of the facility from the Wetlands Complex. Only parking, office, and storage areas are located east of the rail line.

2.2 Operational History

Manufacturing operations at the facility involved the manufacture of blasting cap components – consisting primarily of metal shells, insulated wire, and plastic tubing – and the assembly of these components into various types of blasting caps or initiating devices using purchased explosives. Raw materials included explosives, chemicals, uncoated wire, and metal sheets and were procured from off-site sources. Raw explosives were stored as powders under water (to reduce the possibility of explosion) in wooden vats located within an underground concrete vault in the Tank House. As of 1991, explosive materials used at the facility included pentaerythritol tetranitrate (PETN), diazodinitrophenol (DDNP), cyclotrimethylene trinitramine (RDX), cyclotetramethylene tetranitramine (HMX), polymer bound explosive (PBX), tetryl, tetrazene, black powder, nitrocellulose, double base propellant, lead azide, lead mononitro-resorcinol (LMNR), and lead styphnate. These explosive materials were combined with barium salts, chromates, lead oxides, perchlorates, molybdenum, tungsten, silicon, sirconium, and boron powders to make the desired product. Prior to 1988, additional starting materials – including selenium, tellurium and lead powders – were used in earlier product designs. Mercury fulminate was formerly used on-site in the production of certain devices prior to the late 1950s.

In addition to using the purchased explosives outlined above, the explosive DDNP was manufactured at the facility. To produce DDNP, picramic acid was diazotized in a batch process using nitric acid. The facility estimated that approximately 150 to 200 pounds of the product were manufactured per batch. The reaction was carried out in a stainless-steel horizontal tank with water as the solvent. The final step of the process was to treat the water by wet oxidation in two stainless-steel treatment tanks. It was then discharged to the local wastewater treatment plant under a pretreatment permit.

Metal stamping and machining operations using aluminum and brass also took place at the facility. Copper was also annealed on-site prior to 1991. Uncoated wire and raw plastics were also used in the manufacturing process.

Waste generated at the facility included process waters, sludges, and wastewaters from explosive powder processing cleanup, off-specification finished product, explosive-contaminated packaging, degreasing solvents, and general household refuse. Early housekeeping practices at the facility are believed to have resulted in the systematic release of wastewater potentially contaminated with any or all the explosive materials and degreaser solvents used over the course of its operational history. Water accumulated in settling basins, containers, and tanks were disposed of on the surrounding soil as a matter of course between 1912 until at least 1972. Degreaser solvents containing trichloroethene (TCE) were stored on-site prior to shipment off-site for disposal; however, historical practices allowed the discharge of these solvents directly to on-site drainage ditches. Testing of detonators also resulted in potential releases.

Past practices allowed for liquid waste discharge directly into drainage sumps on-site while potentially energetic materials were neutralized via open burning and detonation. Waste energetic materials were washed into waste powder catch basins and collected for neutralization by either burning or detonation. Steam condensate was collected and treated using gravity filtration to recover energetic materials and then discharged to the ground. Water from catch basins, collection tanks, and treated steam condensate was routinely discharged to the ground in the past. The Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) Report (Eckenfelder, 1994) provides additional details regarding historical waste handling and disposal practices, along with specific locations.

During the 1980s and 1990s, production at the facility dropped sharply. In 2003, the number of employees was significantly reduced following a merger of Dyno Nobel with a subsidiary of Ensign-Bickford Industries. The detonator manufacturing ceased at the Site on June 28, 2010. Dyno Nobel personnel who support other company operations continue to occupy the Site administrative buildings. In 2012, Dyno Nobel began leasing the facility to Maine Drilling and Blasting, a joint venture with Dyno Nobel, who provides blasting services for the construction and quarry markets. Maine Drilling and Blasting operations involve the blending of emulsions and ammonium nitrate, storage and distribution of packaged explosives and bulk blasting agents, and on-site maintenance and repairs to company delivery vehicles.

2.3 Regulatory Background

Since 1983, the Site has undergone extensive investigation activities under the oversight of the NYSDEC. NYSDEC issued a RCRA Order on Consent with Dyno Nobel on April 15, 1996 that obligated Dyno Nobel to conduct a RCRA Facility Investigation (RFI) of identified solid waste management units (SWMUs) and areas of concern (AOCs) at the Site. The Site has since been investigated using a rigorous investigation rationale (RCRA Corrective Action Process), which was developed by the United States Environmental Protection Agency (USEPA) after passing the Hazardous and Solid Waste Amendments (HSWA) in 1984 and is administered by NYSDEC. The investigation rationale first used available files provided by USEPA, NYSDEC, and Hercules/Dyno Nobel, at a minimum, to research facility operations to identify areas of potential concern that may require further investigation by visual inspection and/or sampling.

In addition, over 1,000 soil samples and about 700 groundwater samples have been collected at the Site along with numerous sediments, surface water, and ecological samples. This work has led to a clear understanding of historical operations and AOCs and focus for investigation and future remediation. Over the course of these investigations at the Site, a total of 56 SWMUs and 15 AOCs have been identified. **Figure 2-2** shows the SWMU and AOC locations.

Pursuant to the RCRA corrective action obligations under RCRA Permit No. 3-5122-00042/00019, a remedy evaluation was performed for these SWMUs and AOCs. The evaluation and recommendation for corrective action measures was submitted in the *Revised Corrective Measures Study Report* (CMS Report; EHS Support, 2014) and approved by NYSDEC (NYSCEC, 2014).

On July 24, 2018, the NYSDEC executed a Consent Order, and by its express terms, the Consent Order became effective on the 10th day after it was signed (i.e., August 3, 2018). The Consent Order was intended to integrate the Parties' inactive hazardous waste disposal Site remedial program obligations and RCRA corrective action obligations.

Subsequently, a Proposed Remedial Action Plan (PRAP) was prepared by NYSDEC and issued for public comment on February 22, 2019. Three public meetings/outreach sessions were held by NYSDEC on March 11, 2019, June 27, 2019, and July 18, 2019. Based on public response during the public meetings/outreach sessions, NYSDEC postponed the selection of a final remedy for the Site and issuance of a revised PRAP.

3 Current Site Understanding

As stated in **Section 1**, a preliminary groundwater CSM (**Appendix A**) was prepared using existing soil, groundwater and surface water data, previous studies and reports for the Site, and regional information to develop an understanding of the regional and Site geology and hydrogeology, as well as the distribution of CVOCs in soil and groundwater at the Site. The CSM identified data gaps related to the nature, extent, fate and transport of CVOCs at the Site, specifically near the former Shell Plant. The following paragraphs summarize the current Site understanding presented in the CSM (**Appendix A**). The CSM is represented on a conceptual cross-section included as **Figure 3-1**.

The CSM identified four major geologic deposits under the Site. The uppermost unit consists of a lacustrine silts and clays. The lacustrine silts and clays are encountered at a thickness between 10 and 50 feet). The next unit encountered is ablation glacial till consisting of mostly silts and clay material. The glacial till thickness is variable across the Site between 1 to 28 feet. The third unit encountered is the glacial outwash deposit that consists of sand and gravel deposits. The thickness is inconsistent across the Site, on the western portion of the Site is a suspected buried glacial kame terrace deposit (i.e., north-south running bench of sand and gravel) ranges from 10 to 17 feet in thickness. Additional glacial outwash deposits greater than 1 foot thick are present near the former Shell Plant and within the wetlands complex that represented buried kame (i.e., isolated sand and gravel hill). Across the rest of the Site, the glacial outwash is thin (0.5 feet thick) or not present. Below the glacial outwash is bedrock that consists of a fractured black shale. The bedrock has been uplifted and overturned, the strike is generally north-south, and the dip angle is to the east at approximately 30 to 70 degrees. The bedrock topography varies across the Site from about 10 feet below grade in the wetlands complex area to 60 feet below grade in the center of the Site. The bedrock topography then increases on the far west of the Site where the shale bedrock terminates in a thrust fault. The trust fault serves as the contact between the shale and quartzite bedrock that makes up Hussy Hill.

Off-site other geologic units are encountered. West of the Site is the previously mentioned Hussey Hill that is made up of quartzite bedrock and stands at an elevation of 850 feet above mean sea level (700 feet higher than the Site). East of the wetlands complex and south of the Site the upper unit is a basil till unit (deposited below glaciers) that is separate and distinct from the abolition till encountered at the Site. The basil till to the east is 100 feet higher in elevation than the wetlands complex due to a series of glacial drumlins. The till to the south of the Site marks the boundary of the post glacial lake that previously extended over the Site and wetlands complex and deposited the lacustrine silt and clay present on-site.

The CSM has identified three groundwater hydrogeologic units present at the Site. The hydrogeologic units are:

- Unit 1 – Consists of the lacustrine silts and clays and glacial till deposits. Generally, this Unit is water bearing but has low transmissivity relative to the other units. The unit grades to a silt and sand deposit north of the Site and is bound to the west by Hussey Hill, to the east by the basil till/glacial drumlin deposits, and to the south by the glacial till deposits.
- Unit 2 – Consists of the glacial outwash unit. This unit is most laterally extensive on the western portion of the Site near Hussey Hill. This unit is consistent with a glacial Kame/Kame Terrace deposit mapped by the State of New York. The aquifer extends to the north of the Site all the way to the town of Port Ewen. The aquifer is bound to the west by Hussey Hill to the east by the basil till/glacial drumlin deposits and to the south by the glacial till deposits.

- Unit 3 – Consists of the fractured shale bedrock aquifer.

The hydraulic gradients are consistently to the east across the Site toward the wetland complex. Hussey Hill to the west is a groundwater recharge boundary and the glacial drumlin to the east of the Site is also a groundwater recharge boundary. Groundwater discharges to the wetlands complex and follows the surface water flow to the north once in the wetlands complex. In the area of the former Shell Plant, there is an average upward vertical gradient between the top and bottom of Unit 1 (silts and clays). There is downward gradient between Unit 1 and Unit 2 (glacial outwash) and a downward gradient between Unit 2 and Unit 3 (bedrock).

Chemically there are several areas of the Site where CVOCs were historically used, stored and disposed of; however, previous investigations have only identified releases of CVOCs near the former Shell Plant associated with SWMUs 37 (Drum Storage Area), SWMU 24 (Wastewater Treatment) SWMU 25 (Settling Lagoon), and SWMU 30 (Drainage Ditch) (**Figure 3-2**). The nature and extent of potential source areas have not been defined in the vicinity of the former Shell Plant or associated SWMUs (**Data Gap 1**). CVOCs were not detected in surface water downgradient of the former Shell Plant area. Previous investigations and ongoing groundwater monitoring activities have detected CVOCs in groundwater above the NYDEC Class GA groundwater quality standards (GQS) in Unit 1 (silts and clays). The extent of CVOCs in Unit 1 has not been delineated vertically (**Data Gap 2**). CVOCs have not been detected in Unit 2 (glacial outwash). CVOCs have been detected in one of the three bedrock wells (Unit 3), but concentrations have not been reported above the NYDEC Class GA GQS. It is not clear if the existing bedrock wells are positioned correctly to monitor the dissolved phase plume and the relationship between the dissolved phase plume in Unit 1 (silts and clays) and the dissolved phase plume in Unit 3 (bedrock) is unknown (**Data Gap 3**). The connectiveness and orientation of fractures in the bedrock aquifer (Unit 3) is unknown (**Data Gap 4**). As occurrence of groundwater and groundwater flow direction in bedrock aquifers can be highly variable the nature and extent of the dissolved phase plume in the bedrock aquifer is unknown (**Data Gap 5**).

Based on the current understanding, the CSM identified the following Data Gaps:

- **Data Gap 1 – Nature and extent of source material originating from the former Shell Plant.**
- **Data Gap 2 – Nature and extent of dissolved phase CVOCs in the overburden.**
- **Data Gap 3 - Fate and transport of the dissolved phase plume between glacial outwash and bedrock.**
- **Data Gap 4 – Physical properties of bedrock related to fate and transport of CVOCs, including degree of fracturing/weathering, identification of hydraulically significant features, hydraulic properties, and interconnectivity of fractures.**
- **Data Gap 5 – Nature and extent of dissolved phase CVOCs in the bedrock.**

3.1 Scope of Work

Table 3-1 details the scope of the work to fill each data gap, the data objectives, and rationale for the scope of work. The proposed scope of work includes the following:

- Conduct surface geophysical study to further detail the top of bedrock and major fractures intersecting the glacial outwash in the vicinity of the former Shell Plant (Data Gap 3).

- Perform MIP/CPT investigation of the suspected source areas around the former Shell Plant to the top of bedrock (Data Gaps 1 and 2).
- Obtain confirmation soil borings to confirm and quantify the CPT results (Data Gap 1 and 2).
- Use borehole geophysics to determine the nature, density, orientation, and water-bearing potential of the three open bedrock wells near the former Shell Plant (Data Gap 4).
- Conduct packer/pump testing to determine the hydrogeologic properties of Unit 3 (bedrock), connectivity of the fractured bedrock, and the overburden deposits (Data Gaps 3, 4, and 5).
- Perform long-term water level study to confirm the hydraulic gradients and connection between hydrostratigraphic units and surface water (Data Gap 3).
- Install monitoring well(s) for long-term monitoring of the dissolved phase CVOC plume in the vicinity of the former Shell Plant. May include bedrock wells or overburden wells as needed based on the results of the source area investigation (Data Gaps 2 and 5).
    - Overburden and bedrock wells will be continuously cored to allow for confirmation of geology.
    - Borehole geophysics will be conducted on each bedrock well installed. Packer testing will be conducted to confirm connection of bedrock wells installed (Data Gap 3).
- If a source to continued dissolution to groundwater is detected during the source investigation, conduct soil boring and sampling to determine the state and mobility of the source (Data Gap 1).
- Installation of sentinel wells (as needed) in the bedrock or overburden aquifers to delineate the nature and extent of the dissolved phase plume (Data Gaps 2 and 5).

4 Investigation Program

The following sections describe the work required to address the additional data needs outlined in **Section 3**. Soil sampling, groundwater sampling, well installation, and other field methods to be used are documented in the Site-specific Sampling and Analysis Plan (SAP) (**Appendix B**). Sample and laboratory quality control procedures are included in the Site-Specific Quality Assurance Project Plan (QAPP) (**Appendix C**).

4.1 Field Preparation and Site Management

The following tasks at a minimum will be conducted prior to and/or during the implementation of the scope of work.

4.1.1 Health and Safety

The Health and Safety Plan (HASP) describes procedures that will allow personnel to work safely and respond quickly and appropriately to Site emergencies. The HASP has been developed for the groundwater scope of work (**Appendix D**). All Site work will be conducted in accordance with Occupational Safety and Health Administration (OSHA) regulations in the Code of Federal Regulations (CFR), Title 29 Parts 1904, 1910, and 1926.

The HASP requires personnel working on project-related field tasks to be trained in accordance with OSHA regulations and provide guidance for safely executing fieldwork tasks. A copy of the HASP will be kept on-site during all fieldwork activities and will be reviewed by the field staff prior to daily work activities.

4.1.2 Community Air Monitoring

Air monitoring will be conducted during intrusive work in accordance the Site-specific Community Air Monitoring Plan (CAMP) (**Appendix E**). The CAMP was developed to conform with the guidelines presented by the New York State Department of Health (NYSDOH) in Appendix 1A of the NYSDEC, Division of Environmental Remediation (DER)-10, *Technical Guidance for Site Investigation and Remediation* (NYSDEC, 2010).

4.1.3 Borehole Clearance

Borehole clearance will be performed at all locations where intrusive activities are proposed to evaluate the presence of utilities and/or obstructions. Borehole clearance methods are described in the project SAP (**Appendix B**) and below.

Underground utilities, including electric lines, gas lines, storm and sanitary sewers, and communication lines will be identified in the work area prior to initiation of drilling and other subsurface work. Underground utilities will be located as follows:

- Drilling locations will be flagged or marked out with white paint.

- Dig Safely of New York (800) 962-7962 will be contacted to initiate the locating activities. New York State law requires that Dig Safely of New York be notified at least 2 working days, and not more than 10 working days, before subsurface work is conducted.
- Companies with subsurface utilities present will locate and mark out the subsurface utility lines.
- Geophysical methods will be used to further evaluate the potential presence of underground utilities in each proposed investigation location.
- Subsurface investigation locations will be hand cleared to 5 ft below ground surface (bgs) prior to advancing borings with mechanized equipment.
- Locations that are over concrete (example the former Shell Plant slab) will be cored with mechanical equipment following the geophysical survey. After removing the concrete core, the material below the slab will be hand cleared to a depth of 5 ft.

4.1.4 Equipment Decontamination

Decontamination procedures for field personnel and equipment will be followed to protect the health and safety of those present, to maintain sample integrity, and to minimize the movement of potential contamination between the work area and off-site locations. Equipment used on-site will be decontaminated prior to beginning work, between sampling locations and/or uses, and prior to demobilizing from the Site. In addition, care will be taken so as not to allow anything to encounter a sample or sample area, which may affect its composition. Standard decontamination procedures are outlined in the SAP (**Appendix B**).

4.1.5 Waste Management

Investigation-derived waste (IDW) generated during the field operations will be managed in accordance with the SAP (**Appendix B**). The following are types of IDW that will be containerized in United States Department of Transportation (USDOT)-approved 55-gallon steel drums or a bulk tank:

- Decontamination fluids
- Drill cuttings
- Development and purge water
- Personal protective equipment (PPE) (may also be collected in cardboard yard box, or plastic garbage bags)
- Disposable sampling equipment
- Construction debris

The drums will be labeled with the type of IDW, locations collected, and date. The drums (or roll-off container) will be stored inside the locked warehouse. IDW will be disposed of as per the requirements of Section 3.3(e) of DER-10 (NYSDEC, 2010).

Subsequently, waste soils and water will be characterized with laboratory analyses. The analyses for the waste characterization and profiling are described in the SAP (**Appendix B**). Waste transportation and disposal of all contaminated wastes will be managed by EHS Support on behalf of the Parties. Waste will be transported under proper labels, manifest, and profile to a disposal facility, as approved by Hercules. Proper labels, manifests, and profiles will be dependent upon results of waste characterization described in the SAP (**Appendix B**).

4.1.6 Post Investigation Survey

Borings and newly installed monitoring wells will be surveyed by a New York licensed surveyor following completion of the work. The borings and wells will be surveyed for horizontal and vertical controls to the following datums:

- Horizontal: New York State Plane Coordinate System, North American Datum of 1983 (NAD83).
- Vertical: Top of the well casing and ground surface elevation to the nearest 0.01-foot relative to the North American Vertical Datum of 1988 (NAVD88).

4.1.7 Borehole Abandonment Surface Restoration

Following completion of drilling activities, boreholes will be abandoned in accordance with methods included in the SAP (**Appendix B**). The surface at all drilling locations will be restored to match the surrounding grade.

4.2 Scope of Work

4.2.1 Surface Geophysics

Determining the lithologic contacts, potential dense non-aqueous phase liquid (DNAPL) migration pathways, and hydraulic connection of the overburden and fracture bedrock units is central to closing **Data Gap 3** as presented in the CSM (**Appendix A**) and **Figure 3-1**. The lithologic contacts, bedrock surface, and identification of major water-bearing fractures at the bedrock surface can all be identified in high resolution with surface geophysical techniques. To identify the depths and thicknesses of each individual unit and identify fractures/faults and water-bearing zones, a combination of electrical resistivity imaging and seismic refraction will be conducted, as shown in **Figure 4-1**. The exact locations of the geophysical lines are subject to field conditions.

The surface geophysical investigations will be conducted by a qualified subcontractor. Prior to conducting the survey, the geophysical lines will be mowed or cleared of vegetation and obstructions to allow placement of surface equipment. Geophysical lines that cross roadways will require drilling of ¼-inch diameter holes that will be returned to like conditions following drilling.

The geophysical subcontractor will interpret the data and use it to develop a series of cross sections and plan view figures showing the depth of the formation bedrock and water-bearing features. The results of relevant area will be field verified during the confirmation soil boring activities (**Section 4.2.4**).

4.2.1.1 Electrical Resistivity

Electrical resistivity imaging is performed by driving a harmless, very low amperage (e.g., 1 milliamp) direct electrical current in the ground between steel spike electrodes. The location of the steel electrode spikes will be recorded with a global positioning system (GPS), or equivalent. Since fractures (particularly water-bearing ones) typically represent zones of elevated electrical conductivity (relative to intact/impermeable resistive bedrock), by mapping the flow of electrical current in the ground, the structure of fractures, water-bearing zones, or other electrically exotic features can be imaged. Resistivity can also locate highly resistive chemicals, such as DNAPLs, when they have a sufficient areal extent (USEPA, 2004). A suspected DNAPL area may return as an anomaly relative to the rest of the formation that would need to be field verified.

The flow of electrical current is mapped by measuring the electrical potential at the ground surface using a very high impedance microvolt meter. From the electrical image, the trace and dip of identified fractures or features can be measured. Electrical resistivity is a qualitative tool and requires professional judgement and interpretation. Electrical resistivity will be used to identify the water-bearing zones in the glacial till, the extent of the glacial outwash, any open fractures in the bedrock as well as the bedrock surface.

4.2.1.2 Seismic Refraction

Seismic refraction surveys measure the subsurface travel times of seismic waves from a surficial shock source to a linear array of ground motion sensors or geophones. The travel times can be inverted to provide a cross-sectional profile of the density stratification beneath the geophone array, as well as estimates of the rippability of each stratum. Multifold data collection (e.g., with multiple shot-points per geophone spread) and an iterative ray-tracing inversion routine capable of accurately mapping undulating or irregular interfaces will be used.

Seismic refraction can map depths up to 1/5 the length of the greatest geophone distance. The deepest depth to bedrock in the trench is 85 ft bgs at MW-12D. All proposed geophysical surface lines are planned to be over 500 ft (100-ft depth).

The ability to perform the seismic refraction survey may be limited based on background vibrations from Site activities and the active rail line to the east of the former Shell Plant. Additionally, seismic refraction may be limited in identifying zones of variable hardness at the Site (i.e., glacial outwash and glacial till). Seismic refraction can only identify the stratigraphic boundaries of increasing velocity with depth so the presence of the glacial outwash gravel layer or soft zones of glacial till may not be resolved in the survey. Advanced computer processing techniques do allow detection and delineation of laterally restricted low velocity zones (e.g., gravel zones or soft areas of glacial till) and will be used as needed to resolve the layers present.

4.2.2 CPT/MIP Investigation Program

The nature and extent of the release was identified as part of Data Gaps 1 and 2. The CPT/MIP combination tool can rapidly characterize the relative level of Site related constituents in the subsurface in a data-driven fashion. The CPT information can be used to determine the stratification of constituents in specific layers that will help understand the nature and mobility of the residual source.

The CPT/MIP characterization program is intended to achieve the following data objectives:

1. Detailed geologic profiling of Unit 1 – lacustrine silt and clay (till)
2. Detailed geologic profiling of Unit 2 – glacial outwash (sands and gravels)
3. Detailed characterization of Unit 2 contacts with the bedrock
4. Screening level profiling of Site related constituent mass distribution
5. Refined conceptualization of the suspected source areas
6. Develop basis for co-located confirmation soil sample collection

An overview of CPT/MIP technologies and the Site characterization program is described in further detail in the following paragraphs. Methods used for drilling and borehole abandonment are included in the SAP (**Appendix B**). The proposed locations of the CPT/MIP borings are provided on **Figure 4-2**.

CPT is a process whereby soil characteristics are determined as a cylindrical steel cone is hydraulically advanced into the subsurface to identify soil types. CPT is typically conducted with a truck mounted unit and does not produce drill fluids or drill cuttings. Using electronic strain gauges that measure physical soil properties, the acquired data produces a continuous, real-time stratigraphic record without the subjectiveness of conventional soil logging. The CPT tooling can also be equipped with a pore pressure sensor which aids in the identification of fine-grained stringers and units in the formation. The use of friction ratios (the ratio of tip to sleeve pressures) and pore pressures will provide a high-resolution assessment of Site geology. The CPT will be equipped with a MIP system comprised of a photoionization detector (PID), flame-ionization detector (FID), and electron capture detector (ECD) to delineate total volatile organic compounds (VOCs) during borehole advancement.

The CPT/MIP investigation will be conducted at and around SWMUs 24, 30, and 37 and at the former Shell Plant (**Figure 4-2**). Twelve (12) CPT/MIP borings will initially be advanced as part of investigation activities with target depths to the bottom of the Glacial Outwash (Unit 2) layer (**Table 4-1**). Ultimately, the depth of the CPT/MIP borings will be determined in the field based on the interpreted Unit 2 layer, MIP results, or physical limits of the equipment. The CPT/MIP investigation will continue in a data-driven fashion in a series of step-out borings from the initial 12 locations to fully characterize the source areas and dissolved phase plumes. The source area/dissolved phase plume will be considered characterized based on non-response by the MIP tool. To limit the potential for false positive MIP responses, the CPT/MIP tooling will be advanced slowly past depth intervals of significant response s and/or advancement will be stopped to allow purging of residuals prior to advancing further.

Should MIP responses indicate the presence of potential DNAPL (based on off-scale ECD responses), the CPT/MIP boring will be terminated above the Glacial Outwash layer and in Unit 1 (**Table 4-1** for maximum boring depths) and MIP responses will be confirmed via conventional drilling methods (**Section 4.2.3**). Step-out boring depths will be determined in the field based on the closest boring to the well.

Once the target depth has been reached, the CPT/MIP boring will be grouted using the retraction grouting method, or equivalent, as detailed in USEPA Guidance, *Expedited Site Assessment Tools for Underground Storage Tank Sites: A Guide for Regulators, Chapter V Direct Push Technologies* (USEPA, 2016). Retraction grouting will prevent potential downward contaminant migration. Borings will be grouted using a Portland cement and bentonite slurry as detailed in the SAP (**Appendix B**).

4.2.3 Confirmation Sampling Program

Following completion of CPT/MIP activities, a drilling contractor will be retained to advance confirmation soil borings to assess lithology and constituent distribution. In conjunction with the CPT/MIP program, these results will be used to close Data Gaps 1 and 2. Boreholes will be advanced via direct push (depth and soil condition dependent) or sonic drilling technologies adjacent to the known areas of interest as shown in **Figure 4-2**. The objectives of advancing these screening boreholes are as follows:

- Conduct detailed logging of soils to confirm CPT interpretations and field screening observations.
- Collect soil and groundwater samples for chemical analysis to provide a quantitative dataset, confirm MIP responses, and further characterize mass distribution both vertically and laterally within the till and glacial outwash.
- Perform field screening of soil cores for potential DNAPL using test kits containing SUDAN IV Dye or equivalent, if appropriate.

Soil sampling will be conducted in accordance with the SAP (**Appendix B**). Soil will be logged continuously to the bottom of the Glacial Outwash to confirm the contact between the till/glacial outwash and glacial outwash/bedrock as identified in the surface geophysics and CPT log. An outer casing will be used to prevent potential downward migration of impacts and minimize slough from entering the borehole. Soils will be logged by a field geologist using the Unified Soil Classification System (USCS) and measured for VOC headspace vapors using a PID consistent with the field classification and sampling in the SAP (**Appendix B**). Soils may be tested using SUDAN IV DNAPL test kits to show the presence or absence of free phase product, if appropriate. DNAPL field screening will be conducted from depths that show elevated PID response and following sample collection for chemical analysis. Field screening is a presence/absence test for the presence of free phase product.

Based on results from the co-located CPT/MIP responses and soil screening observations, core photography, and detailed core logging, samples will be selected for chemical analysis and submitted to a New York-certified laboratory in accordance with the SAP (**Appendix B**) for the following suite of analyses to aid in the quantification of contaminant mass distribution:

- VOCs by USEPA Method 8260D (with USEPA Method 5035 for field preservation)

In addition, discrete depth intervals will be selected for groundwater sampling with a Hydropunch (or equivalent) depth-discrete sampler as detailed in the SAP (**Appendix B**). Hydropunch samples will be used to confirm the results of the MIP/CPT investigation and delineation of the dissolved phase plume in Unit 1 and Unit 2. Intervals will be selected to confirm a range of detections (high concentrations and low concentrations) identified in the MIP/CPT program. Groundwater samples will be analyzed by USPEPA Method 8260D.

4.2.4 Borehole Geophysics and Down Well Tests

The anisotropy of the bedrock aquifer and how the bedrock aquifer hydraulic properties require additional evaluation. Bedrock wells MW-20R, MW-21R, and MW-22R are all open borehole wells and can be characterized with borehole geophysics. Each of these methods consists of vertical logging of boreholes by lowering various instrumentation down the borehole. To determine the frequency, nature, orientation, and flow potential, the following geophysical suites will be conducted on each well:

Table 4-2 Borehole Geophysical Methods

Geophysical Method	Data Collected
Video Log	Open and flowing fractures, leaking or broken casing, major lithologic changes in bedrock.
Caliper Log	Measures the changes in the borehole diameter that can be correlated to major fractures or zones of weakness. May be used to correct televiewer orientation in non-vertical boreholes.
Temperature profiling	Measures the temperature of the borehole fluid to identify where groundwater flow may be entering the borehole.
Optical Televiewer	Identifies fracture zones and fracture orientation (dip and dip angle).
Acoustic Televiewer (contingency)	Used as replacement of optical televiewer if groundwater is murky or not clear.
Heat Pulse Flow Meter	Measures inner borehole flow to determine what fractures contribute water or lose water under static and pumping conditions.

Borehole geophysics will be conducted by a qualified subcontractor. Generally, geophysics are conducted by positioning a tripod or pulley over the borehole to be logged, to guide the logging probe into the borehole. The depth bgs is measured by “zeroing” the measuring device prior to deployment. Depths will be automatically recorded electronically as the probe is advanced in the borehole. The logging cable and equipment shall be decontaminated between boreholes in accordance with the procedures presented in the SAP (**Appendix B**).

The video log is typically recorded first to visually inspect the borehole for obstructions or area that may collapse. The video log is recorded with a video file, observed during deployment and logged by the field oversight. The subcontractor lowers the camera as smoothly as possible while observing the image on a video monitor. Unusual features observed on the monitor and judged to be of interest shall be re-inspected, by raising the camera and re-lowering it to the desired depth. Items that will be noted include broken or leaking well casings, major lithology changes, major fractures, murky or cloudy conditions, and flowing fractures as evidenced by moving particulates in the water.

Geophysical logging (caliper, temperature, and televiewer) is performed by attaching the logging probe to the cable on the tripod. The log is automatically generated by a logging software. All depths shall be measured from below the ground surface. Logging is performed at a speed suitable for the data being recorded. Acoustic and optical televiewer probes shall be used only after less-expensive logging probes (typically including at least a caliper log) have been lowered and raised through the borehole.

Heat-pulse flowmeter logging will be performed at discrete intervals identified during other geophysical methods. The flowmeter measurement depths shall be selected above and below suspected bedrock fractures, based on visual inspection of the video, preliminary caliper, and fluid temperature logs. Both ambient and stressed (pumping) flowmeter data will be recorded. The ambient measurements shall be obtained during the downward run, and the pumping measurements shall be obtained during the upward run. For the pumping measurement a submersible pump will be lowered above the flow meter and pumped at a low rate to minimize drawdown but at a greater rate than the flow rates measured during the ambient test. The ambient test determines if there is inner borehole flow during normal conditions. The stressed test will help identify any water-bearing feature, specifically those that may contribute groundwater during sampling.

4.2.5 Long-Term Water Level Study

Data gaps were identified with regards to the connection of the overburden (hydrostratigraphic units 1 and units 2) as well as hydraulic connection between the glacial outwash (unit 2) and the bedrock (unit 3); therefore, a long-term water level study is proposed. The objective of the long-term water level study is to determine seasonal horizontal and vertical gradients in the three hydrostratigraphic units around the Shell Plant (Data Gap 3).

To achieve this objective, existing groundwater monitoring wells around the former Shell Plant will have pressure transducers installed to monitor water levels and temperature (recorded every 6 hours). The list of wells included in the study are shown on **Table 4-1** and **Figure 4-3**. The data will be used to create a series of hydrographs that demonstrate the hydraulic potential between zones over one calendar year. This data will be combined with precipitation and weather data to analyze the seasonal gradients present at the Site.

To monitor the runoff associated with snowmelt and precipitation, three surface water piezometers will be installed (**Figure 4-3**). One piezometer will be installed to the west of the former Shell Plant in the drainage ditch that conveys stormwater from the Site to the wetlands complex. The second piezometer will be installed north of the former Shell Plant to the west of railroad tracks within the drainage. The third piezometer will be installed in the topographic low to the east of the former Shell Plant. This topographic low is within SWMU 30 and periodically floods. Flood water discharge to the east of the railroad track where historical surface water samples, SW-2 and SW-3, were collected (**Figure 4-3**).

Select surface water locations will have piezometers installed with transducers to monitor the elevation of the surface water. At the proposed piezometer locations, a rebar support will be installed within the middle of the surface water body. A 1-inch diameter polyvinyl chloride (PVC) screen will be affixed to the rebar with hose clamps. The top of casing at the piezometers will be surveyed as discussed in **Section 4.1.6**.

4.2.6 Pump Testing

Data gaps related to the bedrock hydrogeology connection, as well as the nature and extent of CVOCs, have been identified in the CSM, **Appendix A** and on **Table 3-1**. These data gaps include:

- Data Gap 3 – Fate and transport of the dissolved phase plume between glacial outwash and bedrock**.**
- Data Gap 4 - Physical properties of bedrock related to fate and transport of CVOCs, including degree of fracturing/weathering, identification of hydraulically significant features, hydraulic properties, and interconnectivity of fractures.
- Data Gap 5 – Nature and extent of dissolved phase CVOCs in the bedrock.

To help close these data gaps, testing of bedrock aquifer will be conducted to:

- Identify major water-bearing features.
- Confirm inner connection of the existing bedrock monitoring wells.
- Confirm the connection to the glacial outwash.

- Define the aquifer properties of the bedrock aquifer.

In addition, vertical sampling of the bedrock well (one sampler per packer zone) will be conducted during aquifer testing to identify variability in the CVOC distribution in various fractures/fracture zones. This data will be used to cite new bedrock wells as appropriate along groundwater flow pathways.

To achieve these goals, aquifer testing will be conducted in bedrock well MW-21R in accordance with the procedures described in the SAP (**Appendix B**). MW-21R was selected as the pumping well since it is the only well that has detectable concentrations of CVOCs. Observation wells planned for the pump test have been designated on **Table 4-4**. The pumping well and bedrock monitoring well will include straddle packers (as needed) to isolate specific fracture zones identified during borehole geophysical logging. Up to three packer intervals may be tested based on the results of the geophysical investigation. Packers will not be used in screened monitoring wells.

After the constant rate has been achieved a groundwater sample will be collected if at least three packer volumes have been removed. If the packer interval does now produce sufficient water to maintain a constant 0.5 gallon per minute pump rate, the interval may not be sampled and will be considered a low flow zone. The groundwater sample will be analyzed for VOCs by USEPA Method 8260D. Analytical testing limits and constituents are included in the QAPP (**Appendix C**).

The bedrock borehole groundwater samples will be collected directly from the packer testing equipment that utilizes an electric submersible pump and poly tubing. During packer testing, water is pumped by a submersible pump through poly tubing and discharged to a storage tank. Field parameters will be measured in the purge water by collecting a sample in a container. Following the completion of the packer testing and monitoring of parameters, the groundwater sample will be collected from the poly tubing into the appropriate sample container.

The resulting pressure transducer data from the observation wells (**Table 4-3**) will be used to identify inner-connected fracture zones and connection of the overburden based on pressure response. The pump drawdown data and hydraulic recovery data will be used to estimate the fracture/fracture zone yield, transmissivity, and other hydraulic parameters. Analytical data will be used to determine variable CVOC concentrations across fractures/fracture zones and provide a basis for horizontal and vertical placement of additional monitoring wells.

4.2.7 Sentinel Well Installation and Sampling

Data gaps related to the nature and extent of CVOCs, have been identified in the CSM, **Appendix A** and on **Table 3-1**. These data gaps include:

- Data Gap 3 – Fate and transport of the dissolved phase plume between glacial outwash and bedrock**.**
- Data Gap 5 – Nature and extent of dissolved phase CVOCs in the bedrock.

To fill these data gaps additional monitoring wells will be installed. The sentinel well objectives are:

- Monitor groundwater flow pathways in the fractured rock that are positioned downgradient of source areas and/or within fracture networks most likely to act as groundwater pathways from the source areas.

The location, depth, and construction details of the monitoring wells will be determined based on the results of the borehole geophysics and packer testing. The bedrock wells will be constructed by advancing the drilling equipment a minimum of 5 feet into the top of bedrock. A steel casing will then be installed to the bottom of the borehole and grouted in place. A rock core will be advanced though the casing into bedrock and returned for characterization in the field. Following installation, borehole geophysics and/or packer testing may be recommended to complete characterization of the bedrock borehole (as needed). The methods used for installation are included in **Appendix B**.

Following installation, the monitoring wells will be sampled for VOCs in accordance with the procedures presented in **Appendix B**.

4.2.8 QA/QC Analyses

Field and laboratory quality control samples will be collected and analyzed to document the accuracy and precision of the samples. The quality assurance/quality control (QA/QC) samples, summarized in the QAPP (**Appendix C),** include trip blanks, field equipment blanks, field duplicates, and matrix spikes/matrix spike duplicates (MS/MSDs).

The data quality level for the investigation will be consistent with procedures outlined in the NYSDEC Analytical Services Protocol (ASP) July 2005 methodologies. A full ASP Category B data package will be prepared by the laboratory for all OU1 samples. The data will be reviewed and validated – in accordance with Section 2.0 of Appendix 2B (*Guidance for Data Deliverables and the Development of Data Usability Summary Reports)* in DER-10 (NYSDEC, 2010) and the USEPA Contract Laboratory Program National Functional Data Validation Standard Operating Procedures for Data Evaluation and Validation – and a data usability summary report (DUSR) will be prepared by a qualified chemist. Additional QA/QC information is provided in the QAPP (**Appendix C)**. All third-party validated data will be uploaded to the NYSDEC's environmental data management system (EQuIS) upon submittal of the final RI Report.

5 Additional Work Plan Documents

The following four companion documents have been prepared to detail the methods and procedures to be used during the on-site RI. Each of the documents is included as an appendix to this work plan.

5.1 Sampling and Analysis Plan

All sampling and analyses will be conducted in accordance with the methods described in the Site-specific SAP (**Appendix B**). The SAP provides a description of the objectives and methods for each of the investigation field activities.

5.2 Quality Assurance Project Plan

In addition to the SAP, a full QAPP has been developed for use on this project. The QAPP (**Appendix C**) identifies the QA objectives for the measurement data, the QA/QC procedures to be used in the field, the sample chain-of-custody methods to be used, and the analytical procedures to be followed. The QAPP will also include a description of the way each type of data is to be used.

5.3 Site-Specific Health and Safety Plan

A Site-specific HASP has been prepared to outline health and safety risks and procedures for all Site workers and visitors. Included in the HASP (**Appendix D**) is information regarding physical and chemical hazards at the Site, emergency procedures and contact information, incident reporting procedures, and the route to the closest hospital.

5.4 Community Air Monitoring Plan

A CAMP has been developed for this project to be followed during all invasive fieldwork (soil borings, borings for well installation, and test pitting). Included in the CAMP (**Appendix E**) is a description of methods that may be used to control odors during the RI if needed.

6 Project Organization, Deliverables, and Schedule

6.1 Project Organization

This Work Plan will be implemented for the Parties by EHS Support, an environmental contractor (“Contractor”), who will arrange for field investigation and analytical services and provide an on-site field representative(s) to oversee all subcontractors under the direction of the NYSDEC. Contractor will also perform the data interpretation and reporting tasks. Key contacts for this project are as follows:

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Contractor Client/Technical Manager
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Contractor Project Director/Project Engineer
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Email: k.vanlandingham@ehs-support.com

Contractor Quality Assurance Officer
Chrissy Peterson
EHS Support LLC
Telephone: (412) 925-1385
Email: chrissy.peterson@ehs-support.com

6.2 Deliverables

Upon completion of the groundwater investigation, a Groundwater Investigation Report ("Report") will be prepared and submitted to NYSDEC for review and approval. The Report will incorporate the data collected pursuant to this Work Plan – along with any addenda or supplements to this Work Plan – and will provide the following:

- Further definition of the geology/hydrogeology of the overburden geology (Units 1 and 2) present beneath the Site using the results of the surface geophysical, CPT, long-term water level study and soil boring program.
- Further definition of the nature (fracture density, orientation, interconnection, and hydrogeologic properties) of the bedrock (Unit 3) at the Site using the results of the surface geophysics, borehole geophysics, and packer testing programs.
- Definition of the CVOCs source area(s) around the former Shell Plant using the results of the surface geophysical, CPT/MIP, and confirmation laboratory analyses.
- Recommendations for additional investigation work, if necessary.
- Recommendations on number and placement of additional monitoring wells sufficient to clearly define the CVOC's plume based on Site-specific hydrogeologic conditions, including bedrock fracture orientation.

6.3 Schedule

Within 30 days of the NYSDEC approval of the final Work Plan, an estimated project schedule will be developed by the Parties in cooperation with the NYSDEC project manager and submitted to NYSDEC. This schedule will become part of the approved Work Plan. The Parties and their technical consultants will establish routine communication with the NYSDEC technical staff to assist resolving any issues that may delay the schedule. The Parties cannot be held responsible for any delays due to inclement weather, subcontractor availability, COVID-19 travel restrictions, permit acquisition, NYSDEC review and approval time, NYSDEC availability for splitting samples, applicable citizen participation requirements, or any other delays outside of the Parties' control.

7 References

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USEPA. 2004. "Site Characterization Technologies for DNAPL Investigations" (EPA 542-R-04-017).

USEPA. 2016. Expedited Site Assessment Tools for Underground Storage Tank Sites: A Guide for Regulators (EPA 510-B-16-004). October.

Tables

Table 3-1
Sample Rationale and Scope
Groundwater Investigation
Hercules, Inc.
Ulster County, New York

Scope Items	Data Gap Number	Data Gap	Area of Focus	Data Objectives/Rationale	Summary of Scope of Work	Contingency Scoping Considerations
Phase 1						
Surface Geophysics	3	Fate and transport: hydraulic connection between glacial outwash and bedrock	Bedrock and overburden	1. Map the depth to bedrock and location of the bedrock trough around the former release areas. 2. Map glacial outwash contacts in the area of the Shell Plant. 3. Identify any water bearing fractures or structures that may allow hydraulic connection to the glacial outwash.	-Install 4 Electrical Resistivity and Seismic Refraction transects to determine the depth of lithologic unit contacts, identify any open fractures or faults in the area of the Shell Plant. -Install 2 survey lines perpendicular to bedrock strike/the structural trough. -Install 2 survey lines parallel to strike to characterize the area directly below the SWMUs and to the east of the Shell Plant.	Seismic refraction survey may be limited based on lithology.
MIP/CPT	1	Nature and extent of potential source material originating from the former Shell Plant	Overburden	1. Detailed geologic profiling of lacustrine clay and silt, glacial till, glacial outwash, and bedrock contacts. 2. Profiling of contaminant mass distribution and areas of potential DNAPL. 3. Refine lateral and vertical limits of the source area.	- Advance CPT/MIP borings to the top of bedrock along transects around the footprints of the Shell Plant and SWMUs 37, 34, and 30. - If MIP responses are indicative of the presence of DNAPL (i.e., Maxed out MIP response), terminate boring at bottom of the glacial till (silt/clay) unit and confirm MIP responses with confirmation soil sampling via conventional drilling methods. - Further confirmation sampling will be conducted below MIP locations indicative of DNAPL with confirmation sampling drilling that can properly seal off the formation and prevent cross contamination. - To ensure MIP tooling characterizes zones following potential advancement through DNAPL and/or high sorbed contaminant mass zones, the CPT/MIP tooling will be advanced slowly past the interval and/or advancement stopped to allow purging of residual prior to advancing further. - All CPT/MIP locations to be grouted immediately following retraction of rods to prevent potential contaminant migration. - CPT/MIP program to be conducted ahead of confirmation soil sampling program, but with programs overlapping to enable ground-truthing of CPT/MIP data and advancement of additional CPT/MIP locations, if necessary.	Limit the depth of borings where DNAPL is suspected to not penetrate the glacial till unit.
	2	Nature and extent of the dissolved-phase CVOCs in the overburden (Units 1 and 2).	Overburden	4. Vertically profile overburden around the source area to confirm nature and extent of the dissolved-phase CVOC plume. 5. Vertically profile the overburden to the top of bedrock to determine potential communication between the overburden/bedrock.		
Confirmation Borings	1	Nature and extent of potential source material originating from the regulated units.	Overburden	1. Conduct detailed logging of soils to confirm CPT interpretations of soil type. 2. Collect petrophysical and chemical data to provide quantitative dataset and confirm MIP characterization of distribution of impacts.	- Sonic drilling core from select CPT/MIP locations to confirm and quantify the results. The soil coring program will be focused on areas and depths with potential DNAPL, and locations to confirm delineation of the dissolved phase plume. The scope of work will include: 1. Detailed conventional logging of soil cores for comparison to CPT characterization. 2. Field screening of soil samples to define the vertical extent of impacts (if present) and determine depth of sampling. 3. A minimum of 2 soil samples for both chemical and petrophysical testing to be collected from each soil core indicating the highest MIP response and underlying lower response zone to quantitatively define vertical contaminant mass distribution. 4. Groundwater samples will be collected to confirm/quantify MIP results and delineation of the dissolved phase. 5. Chemical analysis of the samples will include the following analytes: - VOCs by USEPA Method 8260D	As DNAPL is suspected, each boring will be cased/abandoned in a manner to prevent cross communication between units
	2	Nature and extent of the dissolved phase COCs in the overburden (Units 1 and 2).	Overburden	3. Further characterize mass distribution both vertically and laterally. 4. Evaluate potential relationship between mass distribution and soil type. 5. Confirm results of delineation of the dissolved-phase plume with select dissolved-phase sample collection. 6. Vertical profiling and analytical sampling program will determine fate and transport pathways from the overburden to bedrock, if any.		
Borehole Geophysics	4	Physical properties of bedrock; including degree of fracturing/weathering, identification of hydraulically significant features, hydraulic properties, and interconnectivity of fractures.	Bedrock	1. Identify water bearing fractures in the open rock wells installed at the Site. 2. Determine fracture density, orientation trends, and caricature. 3. Project major water bearing fractures identified to the bedrock glacial outwash surface to determine the recharge location.	- Conduct Geophysical survey on the existing three bedrock wells. - Geophysical tools to be used include camera logging, three arm caliper, acoustic/optical televiewer, and heat pulse flow meter. - Geophysical results will be used to create logs and figures that show the fracture network density, openness ranking, and orientation.	
Packer Testing	3	Fate and transport: hydraulic connection between glacial outwash and bedrock.	Bedrock	1. Confirm connection or non-connection with existing groundwater wells vertically into the glacial outwash and laterally in the bedrock.	- Conduct pump test on MW-21R to confirm connection. - Packers will be placed at intervals in MW-20R, MW-21R, and MW-22R based on borehole geophysics to isolate specific fracture networks. - Packer intervals and cluster glacial outwash wells will be monitored with pressure transducers to determine connection during pump test. - Pump test will be conducted as a constant test from MW-21R, the pump rate may be adjusted to allow for steady state drawdown during the test. - Multiple packer intervals may be tested to based on geophysics. - A groundwater sample for VOCs by method 8260D will be collected from each packer interval tested.	
	4	Physical properties of bedrock; including degree of fracturing/weathering, identification of hydraulically significant features, hydraulic properties, and interconnectivity of fractures.	Bedrock	2. Identify major water bearing fracture or fracture networks in the bedrock. 3. Calculate water aquifer properties of the bedrock (transmissivity, storativitiy). 4. Confirm inner borehole hydraulic head and gradient.		
	5	Nature and Extent of the dissolved phase COCs in bedrock (Unit 3).	Bedrock	5. Determine if isolated fracture/fracture zones impacted relative to other zones.		
Long Term Water Level Study	3	Fate and transport relationship of the dissolved phase between surface water and groundwater interaction.	Overburden	1. Determine seasonal horizontal and vertical gradients in the three hydrostratigraphic units around the Shell Plant.	- Monitoring water levels and temperature of select wells using pressure transducers. Pressure transducers will record hydraulic head and temperature of groundwater every 6 hours for four seasons. - Set stream piezometer in the drainage ditch to the west of the former Shell Plant to monitor surface water runoff levels. - Set ponded water piezometer in the former lagoon (SWMU 30) to monitor accumulating runoff.	
Phase 2						
Groundwater Well Installation	2	Nature and extent of the dissolved phase COCs in the overburden (Units 1 and 2).	Overburden	Data quality objectives/rational will be developed based on results of the Phase 1 investigation.	-Installation of sentinel wells as needed to monitor the groundwater CVOC plume. The exact location and depth of the sentinel wells will be proposed in a letter to NYSDEC following Phase 1 activities	
	5	Nature and extent of the dissolved-phase CVOCs in bedrock (Unit 3).	Bedrock			
Mobility Testing	1	Nature and extent of source material originating from the former Shell Plant.	Overburden	1. Quantify amount of contaminant mass as source material. 2. Quantify source material mass and potential mobility (or lack of mobility) under a range of scenarios to support remedial decision-making.	- If a source is detected during Phase 1, collect undisturbed soil cores and freeze on dry ice for advanced testing from 25% of MIP/CPT locations to validate presence of source and quantify mass present. This scope of work will be conducted with a duel tube geoprobe rig. Sample depths and locations will be predetermined from the CPT/MIP log.	

COC = constituent of concern
CPT = cone penetrometer testing
CVOC = chlorinated volatile organic compound
DNAPL = dense non-aqueous phase liquid
MIP = membrane interface probe
NYSDEC = New York State Department of Environmental Conservation
SWMU = solid waste management unit
USEPA = United States Environmental Protection Agency
VOC = volatile organic compound

Table 4-1
CPT/MIP Locations
Groundwater Investigation
Hercules, Inc.
Ulster County, New York

Proposed CPT/MIP Boring	Existing Monitoring Well/Hydropunch Location				
	Co-Located Well	Surface Elevation feet amsl	TOC Elevation feet amsl	Max depth if DNAPL Detected feet bsl	Estimated top of Rock feet bsl
B1	HP-3	164.4	-	43	61
B2	HP-4	164.6	-	44	61
B3	MW-3	164.80	167.20	45	58.00
B4	MW-4B	155.90	158.30	36	37.5
B5	HP-10	156.8	-	37	-
B6	MW-4A	156.30	158.90	36	37.5
B7	HP-13	163	-	43	61
B8	MW-3	164.8	167.2	44	58
B9	NA	NA	NA	44	NA
B10	NA	NA	NA	43	NA
B11	HP-1	163.4	-	47	58
B12	HP-13	163	-	43	61

Notes
"-" Not included
amsl = above mean sea level
bsl = below surface level
CPT = cone penetrometer testing
DNAPL = dense non-aqueous phase liquid
MIP = membrane interface probe
NA = Not Available
TOC = top of casing

Table 4-3
Hydrostratigraphic Unit Assignment
Groundwater Investigation
Hercules, Inc.
Ulster County, New York

Well ID	Surface Elevation	TOC Elevation	Depth to top of screen/open hole		Depth to Bottom of screen		Assigned Screen Unit	Hydrostratigraphic unit	Rationale
	feet amsl	feet amsl	ft bls	ft amsl	ft bls	ft amsl	ft	ft	
MW-3	164.80	167.20	16	148.80	26	138.80	t	1	Shell Plant
MW-4A	156.30	158.90	13.5	142.80	23.5	132.80	t	1	Shell Plant
MW-4B	155.90	158.30	17	138.90	27	128.90	t	1	Shell Plant
MW-11D	161.40	163.90	55	106.40	65	96.40	go	2	Background
MW-11S	162.10	164.40	14	148.10	24	138.10	t	1	Background
MW-12D	166.00	168.40	74	92.00	84	82	go	2	Western boundary
MW-12S	166.50	168.90	15	151.50	25	141.50	t	1	Western boundary
MW-20D	158.40	161.40	44	114.40	54	104.40	go	2	Shell Plant
MW-20R	158.00	161.00	59	99.00	77	81.00	Qag	3	Shell Plant
MW-21D	161.10	164.10	49	112.10	59	102.10	go	2	Shell Plant
MW-21R	159.80	162.80	66	93.80	86	73.80	Qag	3	Shell Plant
MW-22D	148.90	151.90	27	121.90	32	116.90	go	2	Eastern boundary
MW-22R	148.60	151.60	35	113.60	55	93.60	Qag	3	Eastern boundary
MW-25S	156.70	159.71	10	146.70	30	126.70	t	1	Eastern boundary
MW-26D	150.96	153.70	47	103.96	58	92.96	go	2	Background
MW-26S	151.70	154.49	10	141.70	20	131.70	t	1	Background
PZ-1	NA	NA	NA	NA	NA	NA	Surface Water	NA	Drainage ditch
PZ-2	NA	NA	NA	NA	NA	NA	Surface Water	NA	Drainage ditch
PZ-3	NA	NA	NA	NA	NA	NA	Surface Water	NA	SWMU-30

amsl = above mean sea level
bls = below land surface
ft = feet
go = glacial till
NA = not applicable

Qag = Austin Glen Formation
SWMU = solid waste management unit
t = till
TOC = top of casing

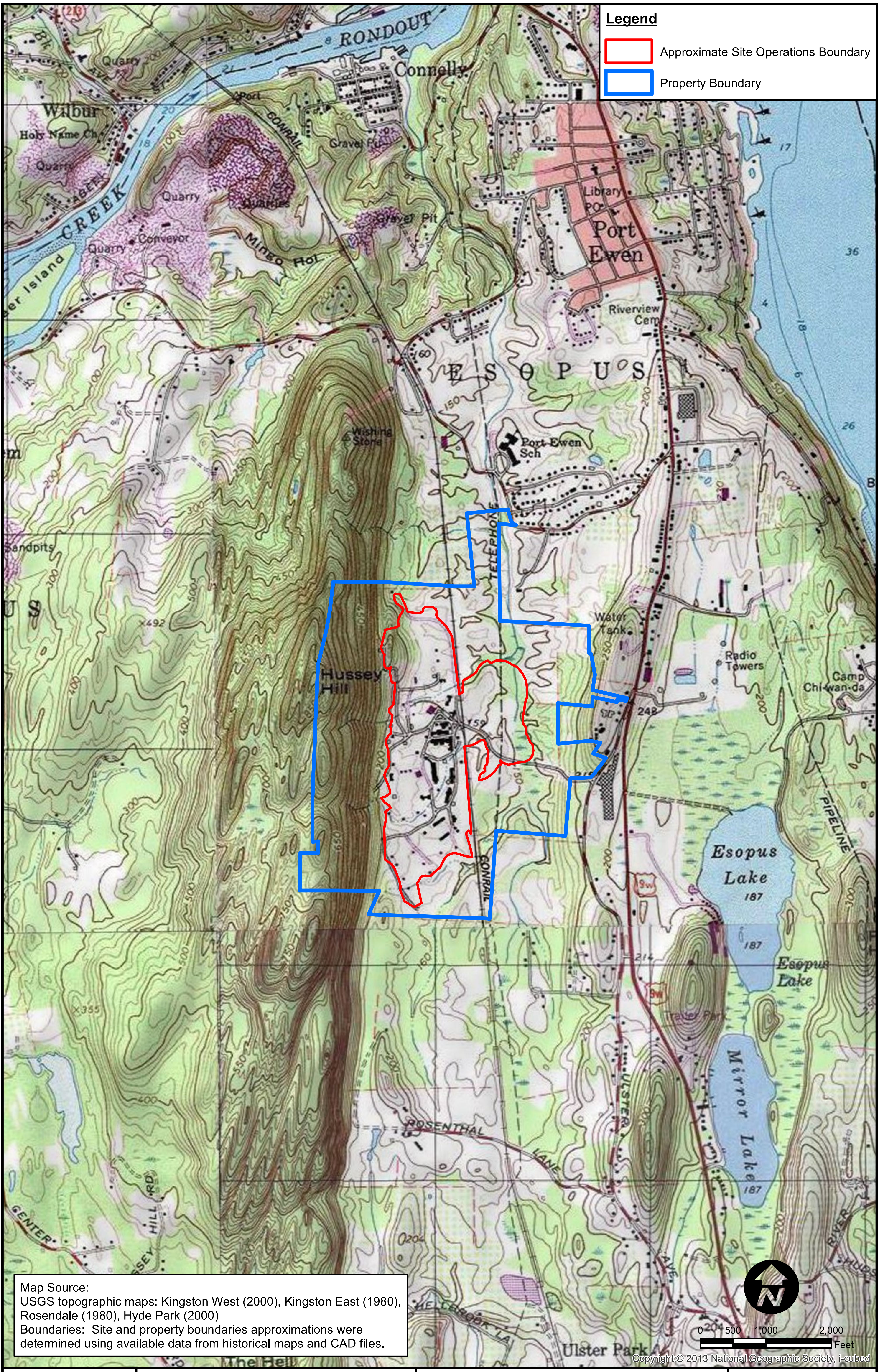
Table 4-4
Pump Test Program
Groundwater Investigation
Hercules, Inc.
Ulster County, New York

Well ID	Purpose	Assigned Screen Unit	Distance to Pumping Well	Surface Elevation	TOC Elevation	Depth to top of screen/open hole		Depth to Bottom of screen		Packer Top		Packer Bottom	
			feet	feet amsl	feet amsl	feet bls	feet amsl	feet bls	feet amsl	feet TOC	feet amsl	feet TOC	feet amsl
Pumping Well													
MW-21R	Determine hydrogeologic properties of Unit 3	Unit 3	0.00	159.80	162.80	66	93.80	86	73.80	tbd	tbd	tbd	tbd
										tbd	tbd	tbd	tbd
										tbd	tbd	tbd	tbd
Bedrock Observation Wells													
MW-20R	Determine hydraulic connection of bedrock aquifer	Unit 3	218.00	158.00	161.00	59	99.00	77	81.00	tbd	tbd	tbd	tbd
										tbd	tbd	tbd	tbd
										tbd	tbd	tbd	tbd
MW-22R	Determine hydraulic connection of bedrock aquifer	Unit 3	304.00	148.60	151.60	35	113.60	55	93.60	tbd	tbd	tbd	tbd
										tbd	tbd	tbd	tbd
										tbd	tbd	tbd	tbd
Screened Monitoring Wells													
MW-21D	Determine hydraulic connection between Unit 3 and Unit 2	Unit 2	7.00	161.10	164.10	49	112.10	59	102.10	NA	NA	NA	NA
MW-20D		Unit 2	210.00	158.40	161.40	44	114.40	54	104.40	NA	NA	NA	NA
MW-22D		Unit 2	300.00	148.90	151.90	27	121.90	32	116.90	NA	NA	NA	NA
MW-13D		Unit 2	655.00	160.20	162.40	35	125.20	45	115.20	NA	NA	NA	NA
MW-12D		Unit 2	675.00	166.00	168.40	74	92.00	84	82.00	NA	NA	NA	NA
MW-3	Determine hydraulic connection between Unit 3 and Unit 1	Unit 1	102	164.80	167.20	16	148.80	26	138.80	NA	NA	NA	NA
MW-4B		Unit 1	223	155.90	158.30	17	138.90	27	128.90	NA	NA	NA	NA
MW-4A		Unit 1	307	156.30	158.90	13.5	142.80	23.5	132.80	NA	NA	NA	NA
MW-25S		Unit 1	340.00	156.70	159.71	10	146.70	30	126.70	NA	NA	NA	NA
MW-13S		Unit 1	670.00	160.10	162.50	15	145.10	25	135.10	NA	NA	NA	NA
MW-12S		Unit 1	675.00	166.50	168.90	15	151.50	25	141.50	NA	NA	NA	NA
Background Wells													
MW-1	Adjust drawdown to background conditions	Unit 3	2030.00	225.00	227.40	9.5	215.50	34	191.00	NA	NA	NA	NA
MW-6		Unit 2	1330	178.40	180.90	57	121.40	67	111.40	NA	NA	NA	NA
MW-26D		Unit 2	1840.00	150.96	153.70	47	103.96	58	92.96	NA	NA	NA	NA
MW-7		Unit 1	1074	170.50	172.80	33.5	137.00	43.5	127.00	NA	NA	NA	NA
MW-26S		Unit 1	1840.00	151.70	154.49	10	141.70	20	131.70	NA	NA	NA	NA

amsl = above mean sea level
bls = below land surface
NA = Not Assigned
tbd = to be determined
TOC = top of casing

Unit 1 = lacustrine silt and clay/till
Unit 2 = glacial outwash
Unit 3 = fractured shale bedrock

Figures



Map Source:
USGS topographic maps: Kingston West (2000), Kingston East (1980), Rosendale (1980), Hyde Park (2000)
Boundaries: Site and property boundaries approximations were determined using available data from historical maps and CAD files.

EHS Support	HERCULES INC. SITE ULSTER COUNTY, NEW YORK REGISTRY NO. 356001	SITE LOCATION MAP	FIGURE 1-1

Reviewed By: K. VanLandingham

J:\EHSS_GIS\C00363_AshlandPortEwen\01_ANALYSIS\20190605_PublicOutreachPosters\11x17_Figures\Figure 1-1 - Site Location Map.mxd

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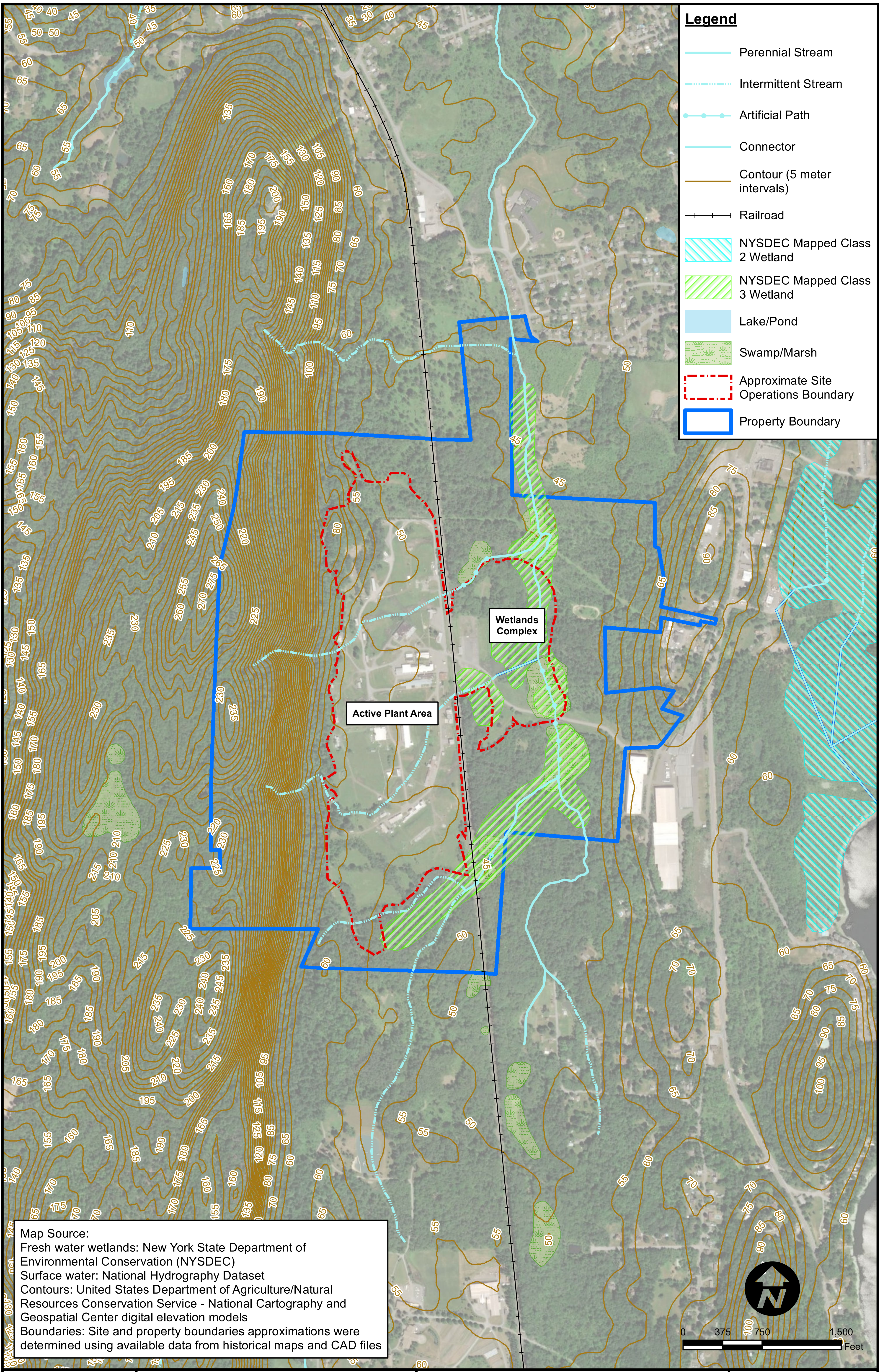

Map Source:
Fresh water wetlands: New York State Department of Environmental Conservation (NYSDEC)
Surface water: National Hydrography Dataset
Contours: United States Department of Agriculture/Natural Resources Conservation Service - National Cartography and Geospatial Center digital elevation models
Boundaries: Site and property boundaries approximations were determined using available data from historical maps and CAD files

Reviewed By: K. VanLandingham

EHS Support	HERCULES INC. SITE ULSTER COUNTY, NEW YORK REGISTRY NO. 356001	SITE SETTING	FIGURE 2-1

J:\EHSS_GIS\C00363_AshlandPortEwen\01_ANALYSIS\20190605_PublicOutreachPosters\11x17_Figures\Figure 2-1 - Site Setting.mxd

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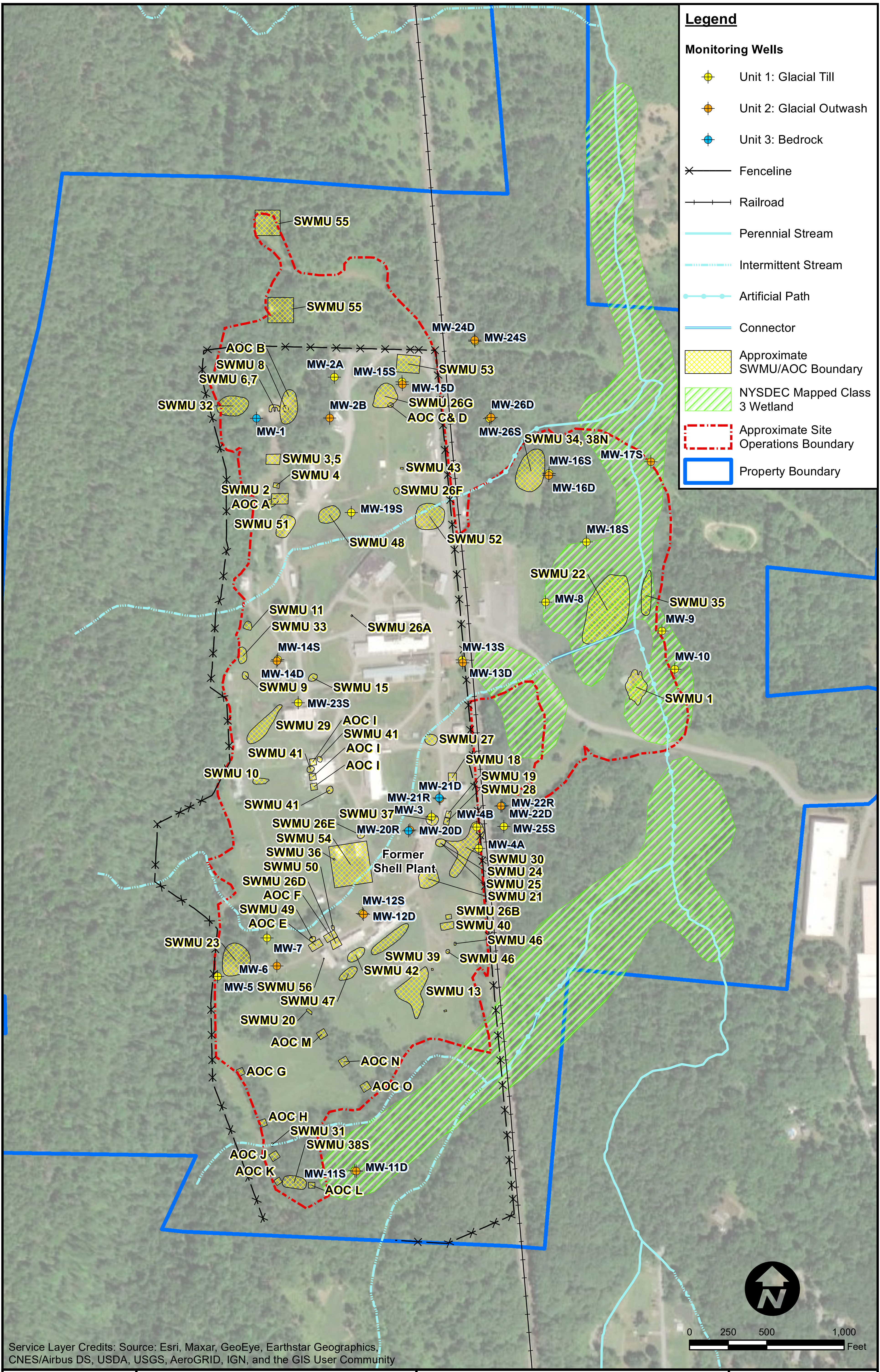

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

J:\EHSS_GIS\C00363_AshlandPortEwen\01_ANALYSIS\20190605_PublicOutreachPosters\11x17_Figures\Figure 2-2 - Site Layout.mxd

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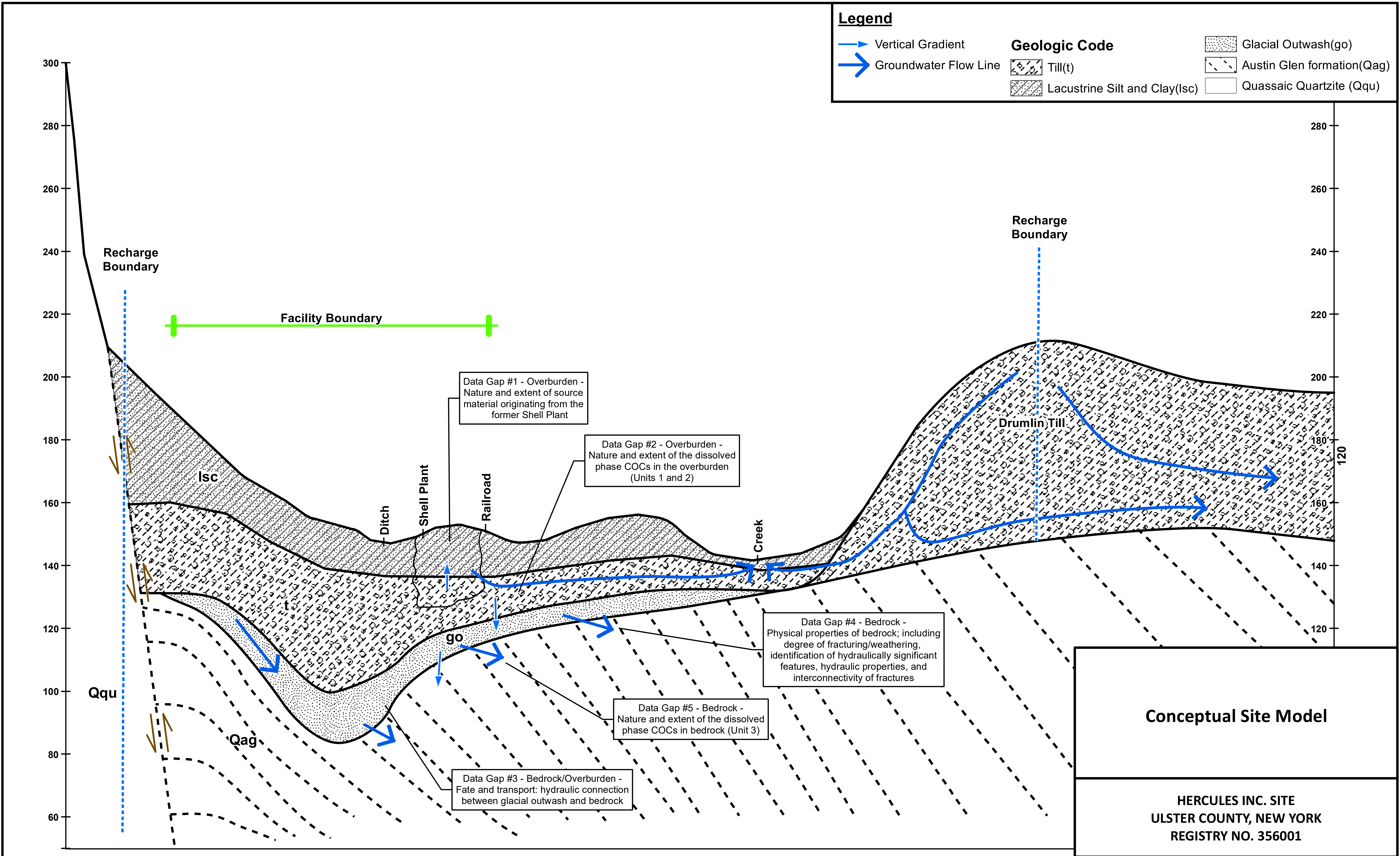
EHS Support	HERCULES INC. SITE ULSTER COUNTY, NEW YORK REGISTRY NO. 356001	SITE LAYOUT	FIGURE 2-2



Conceptual Site Model

HERCULES INC. SITE
ULSTER COUNTY, NEW YORK
REGISTRY NO. 356001

EHS Support

Figure 3-1

Reviewed By: K. VanLandingham

J:\EHSS_GIS\C00363_AshlandPortEwen\01_ANALYSIS\20200305_CSM_Figures\CSM_CrossSection.mxd

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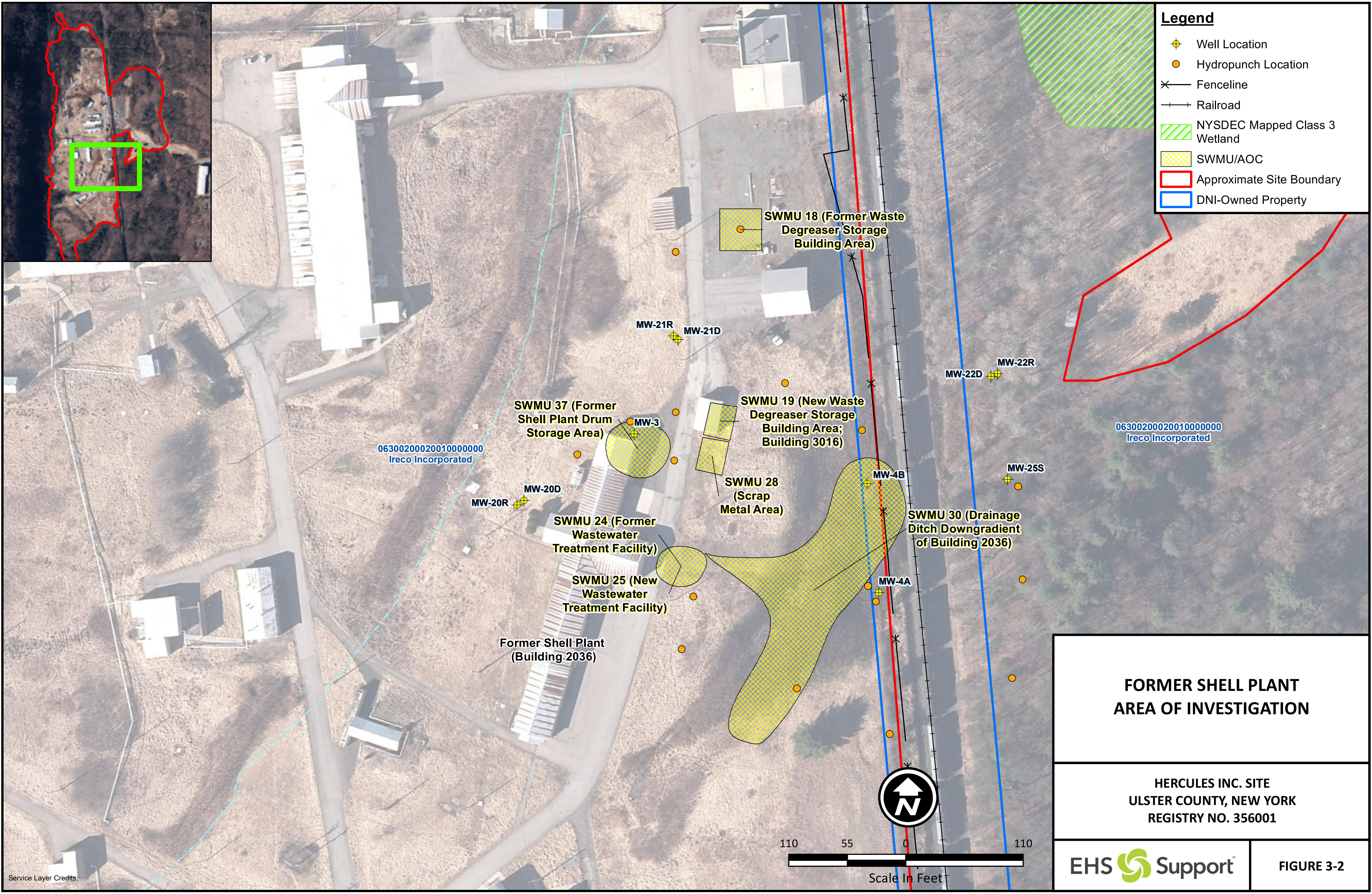

FORMER SHELL PLANT AREA OF INVESTIGATION

HERCULES INC. SITE
ULSTER COUNTY, NEW YORK
REGISTRY NO. 356001

EHS Support

FIGURE 3-2

Reviewed By: K. VanLandingham

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J:\EHSS_GIS\C00363_AshlandPortEwen\01_ANALYSIS\20201207_DataGapWP_Figures\Figure 3 - Surface Geophysics.mxd

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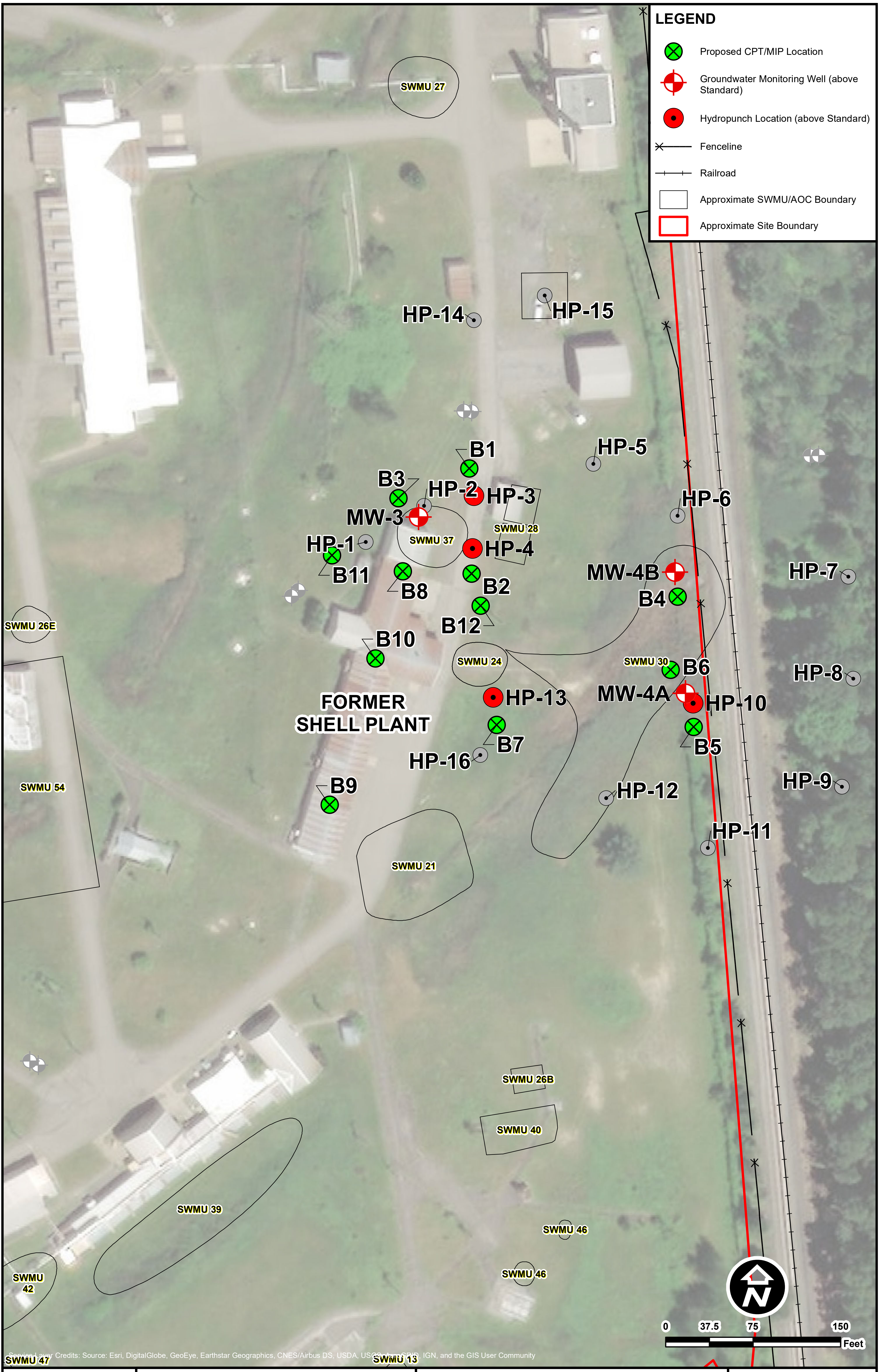
EHS Support

HERCULES INC. SITE
ULSTER COUNTY, NEW YORK
REGISTRY NO. 356001

SURFACE GEOPHYSIC LOCATIONS

FIGURE 4-1



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EHS Support

HERCULES INC. SITE
ULSTER COUNTY, NEW YORK
REGISTRY NO. 356001

CPT/MIP LOCATIONS

FIGURE 4-2

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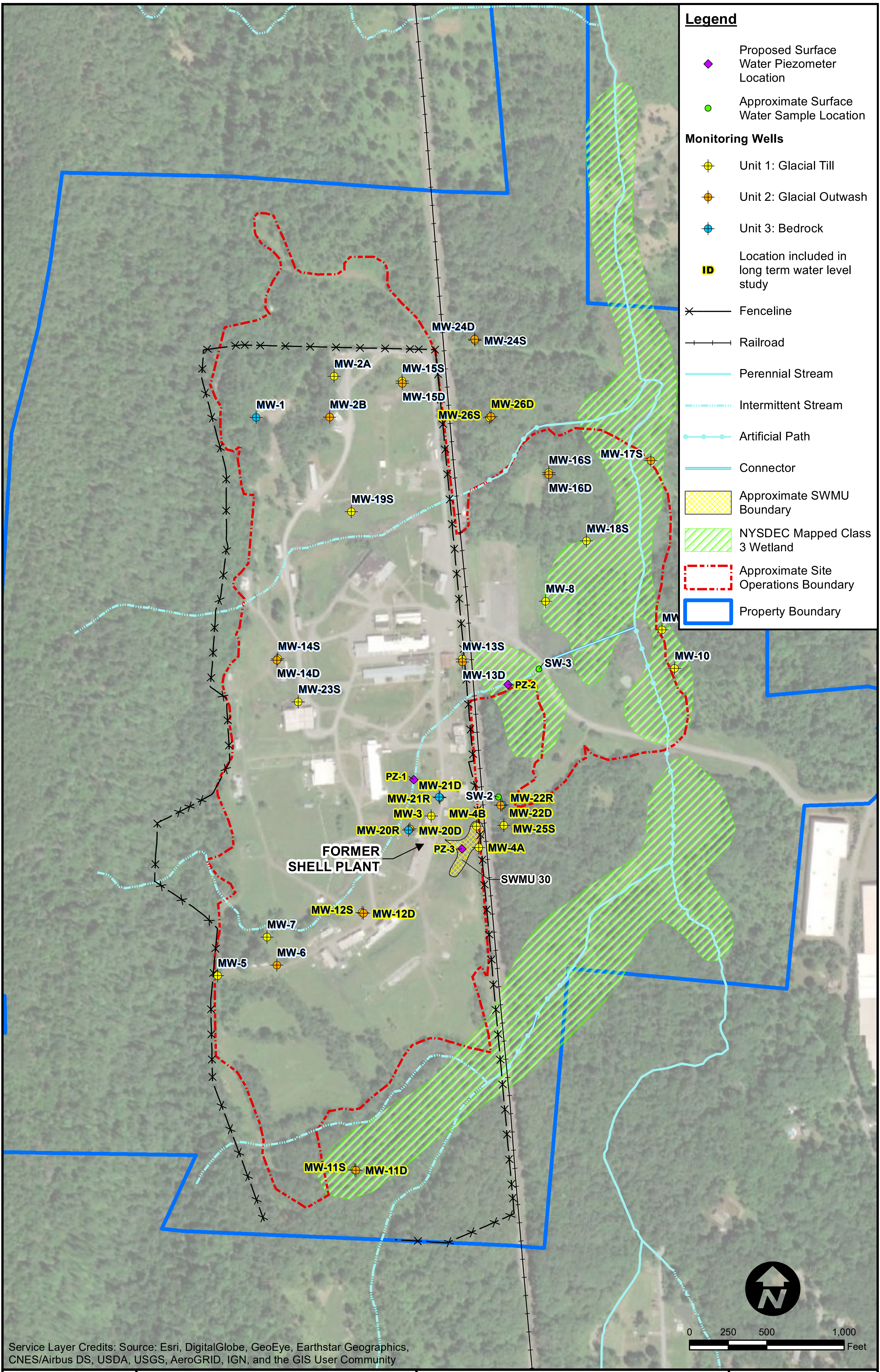

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Reviewed By: K. VanLandingham

EHS Support	HERCULES INC. SITE ULSTER COUNTY, NEW YORK REGISTRY NO. 356001	LONG TERM WATER LEVEL STUDY LOCATIONS	FIGURE 4-3

Appendix A Groundwater Conceptual Site Model

MEMO

To: Project File

From: Tim Davis, Environmental Professional, EHS Support LLC

Date: May 18, 2021

Re: Groundwater Conceptual Site Model, Hercules, Inc. Site (#356001), Ulster County, New York

---

1 Introduction

This preliminary Conceptual Site Model (CSM) was prepared on behalf of Hercules, Inc. ("Hercules"), a wholly owned subsidiary of Ashland LLC ("Ashland"), and Dyno Nobel, Inc. ("Dyno Nobel"), herein referred to as "the Parties", for the Hercules, Inc. site (the "Site"). The Site is located at 161 Ulster Avenue in Port Ewen, Ulster County, New York facility and is approximately one mile south of the Village of Port Ewen in Ulster County, New York (**Figure 1-1**). The Site is listed on the New York State Inactive Hazardous Waste Site Index as Site No. 356001.

The Site has undergone extensive investigation activities since as early as 1983 under the oversight of the New York State Department of Environmental Conservation (NYSDEC). NYSDEC issued a Resource Conservation and Recovery Act (RCRA) Order on Consent with Dyno Nobel on April 15, 1996 that obligated Dyno Nobel to conduct a RCRA Facility Investigation (RFI) of identified solid waste management units (SWMUs) and areas of concern (AOCs) at the Site. The Site has since been investigated using a rigorous investigation rationale (RCRA Corrective Action Process) developed by the United States Environmental Protection Agency (USEPA), after the passing of the Hazardous and Solid Waste Amendments (HSWA) in 1984, and administered by NYSDEC. The investigation rationale first utilized available files provided by USEPA, NYSDEC, and Hercules/Dyno Nobel, at a minimum, to research facility operations to identify areas of potential concern that may require further investigation by visual inspection and/or sampling.

In addition, over 1,000 soil samples and about 700 groundwater samples have been collected at the Site along with numerous sediments, surface water, and ecological samples. This work has led to a clear understanding of historical operations and areas of concern and focus for investigation and future remediation. Over the course of these investigations at the Site, a total of 56 SWMUs and 15 AOCs have been identified.

Pursuant to the RCRA corrective action obligations under RCRA Permit No. 3-5122-00042/00019, a remedy evaluation was performed for those SWMUs and AOCs requiring additional corrective measure study (CMS) and the evaluation along with a recommendation for corrective action was submitted in the *Revised Corrective Measures Study Report* dated January 2014 (CMS Report; EHS Support, 2014) and approved by NYSDEC in a letter dated June 5, 2014.

On July 24, 2018, NYSDEC executed a Consent Order, and by its express terms, the Consent Order became effective on the 10th day after it was signed (i.e., August 3, 2018). The Consent Order was intended to integrate the Parties' inactive hazardous waste disposal Site remedial program obligations and RCRA corrective action obligations.

A Proposed Remedial Action Plan (PRAP) was prepared by NYSDEC and issued for public comment on February 22, 2019. Three public meetings/outreach sessions were held by NYSDEC on March 11, 2019, June 27, 2019, and July 18, 2019. Based on public response during the public meetings/outreach sessions, NYSDEC has postponed the selection of a final remedy for the Site and issuance of a revised PRAP.

During the public comment period, several stakeholders expressed concerns regarding the potential off-site migration of chlorinated volatile organic compounds (CVOCs) in groundwater originating in the vicinity of the former Shell Plant. In response to public comments, NYSDEC prepared a letter dated December 11, 2019 which identified data gaps that must be addressed as part of a supplemental Remedial Investigation (RI) (NYSDEC, 2019). For groundwater near and around the former Shell Plant related to CVOCs, the NYSDEC specific request was as follows:

> *3. Groundwater – If soils collected in the data gap investigation document elevated concentrations of contaminants, additional MWs may be necessary. Also, and in consideration of the already agreed-to installation of sentinel monitoring wells to the south of the site, the bedrock aquifer has not been satisfactorily characterized at the site. The Department requests additional bedrock wells be installed at the site for the purpose of understanding the hydrogeology of the bedrock aquifer and its relationship to the overburden aquifer on-site. A top-of-rock contour map should also be prepared to help understand the geology and how it affects groundwater flow and potential DNAPL migration at the site. A sufficient number of bedrock wells, along with locations and design of the coring program, should be proposed to fully characterize the bedrock aquifer. Bedrock coring and/or down-hole geophysics should also be proposed to facilitate understanding of the existing fracture sets at the site, particularly those significant enough to convey groundwater.*

Therefore, EHS Support LLC ("EHS Support") has developed this preliminary CSM which focuses on causes, fate, and transport of CVOCs in groundwater in the vicinity of the former Shell Plant.

This preliminary CSM uses existing regional and Site-specific data to aid in documenting our understanding of the current subsurface conditions, groundwater quality, and groundwater flow paths beneath the Site and will assist in determining where supplemental investigations may be needed to further refine our understanding. This CSM will be revised and updated based on the results of forthcoming supplemental investigations, with the goal of ultimately developing a CSM that can support the selection, design, and implementation of Site remediation and long-term groundwater monitoring.

2 Site Location and History

The Site is in a small valley bordered on the west by Hussey Hill and on the east by a low ridge adjacent to the Hudson River. Hussey Hill rises to an elevation more than 900 feet (ft) above mean sea level (amsl) National Geodetic Vertical Datum of 1929 (NGVD) and drops steeply to the western edge of the developed portion of the Site to an elevation of approximately 200 ft amsl. The developed or active portion of the Site then grades gently to the valley floor, with the elevation of the Site dropping 50 ft (to an elevation of approximately 150 ft amsl). The land east of the Site then gently rises again to the ridge overlooking the Hudson River, which sits at an elevation of approximately 250 ft amsl. The Hudson River is located approximately 1.5 miles east of the Site, at an elevation of approximately 5 ft amsl. Esopus Lake, another major local feature, is located approximately 1 mile east of the Site at an elevation of 185 ft amsl.

The Dyno Nobel property encompasses approximately 412 acres, shown by the yellow boundary on **Figure 1-1**, and the Site consists of approximately 134 acres as delineated by the red boundary on **Figure 2-1.** Most of the remaining 250+ acres are naturally vegetated with cover types ranging from old fields to forested areas.

As shown on **Figure 2-1**, the developed areas of the Site (within the red Site boundary) include the active or formerly active portions of the facility used for industrial operations. Areas to the west of the railroad tracks are highly disturbed by active Site operations and are characterized exclusively by an industrial cover type. This area is referred to as the Active Plant Area. In a smaller portion of the developed Site to the east of the railroad tracks, there is a mix of cover types that include pavement, palustrine wetlands, and deciduous and successional forest. This area is referred to as the Wetlands Complex.

A stream and wetlands exist in the center of the valley with the drainage occurring to the north to an unnamed tributary of Plantasie Creek. The wetlands dominate the low-lying areas of the valley and are located to the east, northeast, and southeast of the developed portion of the Site, at an elevation of approximately 145 ft amsl. There is an active rail line running north to south, which bisects the developed area of the Site and separates the currently operational areas of the facility from the Wetlands Complex. Only parking, office, and storage areas are located east of the rail line.

2.1 Operational History

Manufacturing operations at the facility involved the manufacture of blasting cap components – consisting primarily of metal shells, insulated wire, and plastic tubing – and the assembly of these components into various types of blasting caps or initiating devices using purchased explosives. Raw materials included explosives, chemicals, uncoated wire, and metal sheets and were procured from off-site sources. Raw explosives were stored as powders under water (to reduce the possibility of explosion) in large wooden vats located within an underground concrete vault in the Tank House. As of 1991, explosive materials used at the facility included pentaerythritol tetranitrate (PETN), diazodinitrophenol (DDNP), cyclotrimethylene trinitramine (RDX), cycoltetramethylene tetranitramine (HMX), polymer bound explosive (PBX), tetryl, tetrazene, black powder, nitrocellulose, double base propellant, lead azide, lead mononitro-resorcinol (LMNR), and lead styphnate. These explosive materials were combined with barium salts, chromates, lead oxides, perchlorates, molybdenum, tungsten, silicon, sirconium, and boron powders to make the desired product. Prior to 1988 additional starting materials – including selenium, tellurium and lead powders – were used in earlier product designs. Mercury fulminate was formerly used on-site in the production of certain devices prior to the late 1950s.

In addition to using the purchased explosives outlined above, the explosive DDNP was manufactured at the facility. To produce DDNP, picramic acid was diazotized in a batch process using nitric acid. The facility estimated that approximately 150 to 200 pounds of the product were manufactured per batch. The reaction was carried out in a stainless-steel horizontal tank with water as the solvent. The final step of the process was to treat the water by wet oxidation in two stainless-steel treatment tanks. It was then discharged to the local wastewater treatment plant under a pretreatment permit.

Metal stamping and machining operations using aluminum and brass also took place at the facility. Copper was also annealed on-site prior to 1991. Uncoated wire and raw plastics were also used in the manufacturing process.

Waste generated at the facility included process waters, sludges, and wastewaters from explosive powder processing cleanup, off-specification finished product, explosive-contaminated packaging, degreasing solvents, and general household refuse. Early housekeeping practices at the facility are believed to have resulted in the systematic release of wastewater potentially contaminated with any or all the explosive materials and degreaser solvents used over the course of its operational history. Water accumulated in settling basins, containers, and tanks were disposed of on the surrounding soil as a matter of course between 1912 until at least 1972. Degreaser solvents containing trichloroethene (TCE) were stored on-site prior to shipment off-site for disposal; however, historic practices allowed the discharge of these solvents directly to on-site drainage ditches. Testing of detonators also resulted in potential releases.

Past practices allowed for the discharge of liquid wastes directly into drainage sumps on-site while potentially energetic materials were neutralized via open burning and detonation. Waste energetic materials were washed into waste powder catch basins and collected for neutralization by either burning or detonation. Steam condensate was collected and treated using gravity filtration to recover energetic materials and then discharged to the ground. Water from catch basins, collection tanks, and treated steam condensate was routinely discharged to the ground in the past. The RCRA Facility Assessment (RFA) Report (Eckenfelder, 1994) provides additional details regarding historical waste handling and disposal practices, along with specific locations.

During the 1980s and 1990s, production at the facility dropped sharply, and in 2003 the number of employees was significantly reduced following a merger of Dyno Nobel with a subsidiary of Ensign-Bickford Industries. The detonator manufacturing ceased at the Site on June 28, 2010. Dyno Nobel personnel who support other company operations continue to occupy the Site administrative buildings. In 2012, the Dyno Nobel began leasing the facility to Maine Drilling and Blasting, a joint venture with Dyno Nobel, who provide blasting services for the construction and quarry markets. Maine Drilling and Blasting operations involve the blending of emulsions and ammonium nitrate, storage and distribution of packaged explosives and bulk blasting agents, and on-site maintenance and repairs to company delivery vehicles.

2.2 Investigation History

As previously discussed, the Site has undergone extensive investigation activities since as early as 1983 under the oversight of the NYSDEC. Over 1,000 soil samples and about 700 groundwater samples have been collected at the Site along with numerous sediments, surface water, and ecological samples. This work has led to a clear understanding of historical operations and AOCs and focus for investigation and future remediation. Over the course of these investigations at the Site, a total of 56 SWMUs and 15 AOCs have been identified. Of these SWMUs and AOCs, 46 were considered in the Revised CMS Report

(EHS Support, 2014). The remaining SWMUs and AOCs were assigned as no further action (NFA) and not considered. **Figure 2-2** depicts the location of the SWMUs and AOCs.

2.2.1 Groundwater Investigation

A groundwater investigation was conducted at the Site in 1995 to:

- Obtain a better understanding of the Site hydrogeology (including groundwater flow direction, hydraulic conductivity, and vertical and horizontal gradients).
- Estimate the horizontal extent of groundwater impacts in the vicinity of the Shell Plant.
- Recommend the location of monitoring wells associated with the Shell Plant based on data obtained from the investigation.
- Evaluate the potential for off-site migration of constituents that may be associated with the detonation (shooting) pond.
- Determine groundwater use near the Site (including the use and location of private wells, as well as the availability of public water supplies).

The results of this investigation were reported in the Groundwater Investigation Report (Eckenfelder, 1996) and are summarized in **Sections 3** and **4** of this CSM.

Water quality data collected from wells located throughout the facility yielded highly variable concentrations of inorganics. The variability in inorganics results was attributed to the turbidity of water samples collected from the low permeability silty clay and clay deposits. As discussed in the Groundwater Investigation Report (Eckenfelder, 1996), the unfiltered samples were turbid even when low flow purging techniques were used to collect the samples. The turbidity of samples resulted in elevated inorganics results, which exceed groundwater standards throughout the facility but are not considered representative of groundwater. As a result, typically filtered samples are used to define the metal concentrations in groundwater at the Site. The filtered samples indicate limited exceedances for several inorganic constituents of potential concern (COPCs), including selenium and barium, at a few locations within the immediate vicinity of individual SWMUs.

The organic analytical data confirm the presence of TCE and its degradation products near the Shell Plant (SWMUs 24, 30, and 37; **Figure 2-3**) at concentrations above Class GA Groundwater Quality Standards (GQS). However, volatile organic compounds (VOCs) were not detected in wells and HydroPunch® samples located downgradient of these SWMUs, indicating that the extent of groundwater impacts is limited to the vicinity of the Shell Plant. Although, VOCs were detected at a few locations scattered across the facility, the reported values were below both their respective Practical Quantitation Limits (PQLs) and GQS.

Semi-annual groundwater monitoring from select monitoring wells has been performed at the Site since Spring 2001. The monitoring well network includes monitoring wells located in the vicinity of the Shell Plant (MW-3, MW-4A, MW-4B, MW-21R, MW-21D, MW-22R, MW-22D, and MW-25S), which are monitored for VOCs and monitoring wells located downgradient of SWMUs/AOCs located in the northern Active Plant Area (MW-2B, MW-15S, MW-15D, MW-16S, MW-24S, MW-24D, MW-26S, and MW-26D), which are monitored for inorganics. Monitoring well locations are provided on **Figure 2-2**. Results of this routine monitoring are discussed in **Section 4**.

2.3 Surface Drainage

Although the Site is surrounded by steep hills, the active area of the Site is in a topographic low with limited relief across the Site (**Figure 2-1**). Annual precipitation in this area averages approximately 47 inches per year. Water entering the Active Plant Area of the Site comes from direct precipitation and runoff from Hussey Hill. Most of the water is expected to come from Hussey Hill since the generally flat topography of the Site and vegetation covering much of the area limits the amount of overland flow in this area. Surface water flows across the Site primarily through the two drainage ways crossing the Site from west to east.

The drainage ways flow across the Site from west to east and enter the Wetlands Complex through culverts below the railway. Surface water flows into the Wetlands Complex from both the Active Plant Area (through the culverts described above) and from intermittent and perennial tributaries, which feed the Wetlands Complex from the south. The outlet from the Wetlands Complex is a perennial stream that discharges to an unnamed tributary of Plantasie Creek. This tributary and others of the Plantasie Creek systems flow northward into Rondout Creek approximately two miles north of the Site. Rondout Creek discharges into the Hudson River north of Port Ewen, New York (**Figure 1-1**).

3 Geology and Hydrogeology

The following sections describe the geologic setting of the region surrounding the Site, correlate the regional geology with Site-specific observations, and describe the observed hydrogeology relationships at the Site.

3.1 Regional Geology and Hydrogeology

The Site is located within the Hudson River Valley and is part of the Hudson-Mohawk Lowlands. The Hudson-Mohawk Lowlands extend almost the entire north-south length of eastern New York. The Site is near one of three ridges present within the lowlands, (i.e., Hussey Hill to the west). Hussey Hill is the northern-most portion of the Marlboro Mountains. The bedrock is mostly covered with glacial and post glacial deposits. The following sections describe the geologic history of the Site as relevant to the Site groundwater fate and transport.

3.1.1 Surficial Geology

The surficial geology at the Site is shown on **Figure 3-1** based on the Surface Geologic Map of New York, Lower Hudson Sheet (Cadwell, et. al, 1991). Units are described in this section from top to bottom (youngest to oldest) as encountered at the Site. The depositional history and properties of the glacial deposits are taken from the *Geotechnical Design Manual Chapter 3, Geology of New York State*, by the New York Department of Transportation (NYDOT, 2013).

Lacustrine Silt and Clay

The Site is overlain by lacustrine silt and clay (lsc) as shown on **Figure 3-1**. The Surface Geology Map of New York describes these units as laminated. The laminations in lacustrine units are called varved (i.e., annually deposited sediment). NYDOT described a single varve consisting of two strata composed of a clay and a silt pair. Varve deposits may by very thick or may be thin depending on the deposition of that year. The silts and clays were deposited under water and remain in a loose state. They are often loose, compressible, and consist of a grey soupy material. When dried the silts and clays may change from a grey soupy material to a brown oxidized, blocky structured material that is hard. These areas are usually underlain by soft, wet, weak silts and clays. Varying degrees of wetness occur. A high-water table is characteristic. Very often, these deposits have greater permeability in a horizontal direction than in a vertical direction, but the permeability is low in all directions.

Lacustrine Sand and Silt

Lacustrine sand and silt (ls) are mapped to the north of the Site (**Figure 3-1**). These materials were deposited by streams, which deposited their coarse materials as deltas. The sand and silt are interbedded and gradational to the lacustrine clay deposits further from the mouth of the river feeding the lake. The lacustrine sands and silt deposits have a higher permeability than the lacustrine deposits (NYDOT, 2013).

Till

Till (t) deposits are shown on **Figure 3-1** and are present to the east and south of the Site. Glacial till is the unsorted, generally unstratified but often layered, usually long-graded material carried by and deposited directly from the ice. Though not differentiated on the map, ablation till is material that was carried on or near the surface of glaciers and was dropped as the glacier melted. Basal till was carried at the base of a glacier and was overridden and compacted by glaciers. Ablation tills were not overridden by glaciers and are generally less compact and are generally more permeable. Ablation tills often grade into stratified associated kames and kame terraces. The ablation tills (till plain) have a lower in-place density and greater permeability than do the basal tills in the same area (NYDOT, 2013).

Till deposits have highly variable textures and mixtures of sediment sizes. The material could be dominated by any combination of sand, silt, and clay. Material sizes range up to cobbles or boulders. NYDOT states that till from sandstones will generally be stony and dominantly sandy. Tills from interbedded sandstone, siltstone, and shale will be stony mixtures of sand, silt, and clay. Soils from shales will be silts and clays. Soils from crystalline areas will be stony and bouldery and will contain sand, some silt, and little, if any, clay. All these rock types (sandstones, mudstone, shale, and crystalline bedrock) are possible in the general area of the Site as discussed later in **Section 3.2**.

Glacial Outwash

The last unconsolidated deposit of importance is the glacial outwash (go) deposit. Water-sorted outwash and kame terrace deposits consist of sand and gravel and are not exposed to the surface at the Site; therefore, this unit is not shown on **Figure 3-1**. This unit is mapped on *Potential yields of wells in unconsolidated aquifers in upstate New York – lower Hudson Sheet*” (Bugliosi and Trudell, 1988) and shown on **Figure 3-2** as a “kame, kame terrace, kame moraine, outwash or alluvium type aquifer.” Glacial outwash units were deposited by streams fueled by glacial meltwater, flowing on, within, and beyond the glacier (glacio-fluvial deposits). Glacial outwash is generally comprised of well to poorly sorted cobbles, gravels, and sands. Stratification is not always horizontal as braided streams were common. Where these deposits occupy extensive mostly valley side positions (on the east side of Hussey Hill), they may be called kame terraces. Kame terraces form when ice lays in the valleys and deposition occurs all on the valley side (NYDOT, 2013). The exact depositional history of the glacial outwash is unknown; therefore, for the purposes of this CSM, the unit will be described more generally as a “glacial outwash.” The glacial outwash is deposited above the bedrock but below the till and lacustrine deposits.

The glacial outwash near the Site is mapped by the State of New York as an unconsolidated aquifer of unknown yield and potential (Bugliosi and Trudell, 1988). There are three public supply wells installed in the glacial outwash north (two wells) and south (one well) of the Site as shown on **Figure 3-2**. In addition, five private water wells are installed in the glacial outwash north (three wells) and south (two wells) of the Site (**Figure 3-2)**. Water supply wells are discussed further in **Section 5**. The glacial outwash deposit is the only unconsolidated deposit this is likely to have the permeability and yield to be of water resource and hydrogeological importance.

3.1.2 Bedrock Geology

The Site bedrock geology is shown on **Figure 3-3**. Descriptions of the geologic units are taken from the New York State Geological Association (Pratt, 2009), New York Geological Survey (Fisher et al., 1970; Balk, 1936). Discussion of the structural geology is taken from the New York Geologic Survey (Marshak, 1990).

The unconsolidated bedrock units are underlain by two bedrock units of middle Ordovician age. The younger Quassaic formation (Oqu) and the older Austin Glen formation (Oag). They are separated by a thrust fault that is obscured by unconsolidated sediments at the Site.

The Quassaic Group consists of massive pink and green quartzite, sandstone, and conglomerates. Beds grade upward into green-grey sandstones with tabular cross-lamination common and few green-grey shale interbeds. The Quassaic Group when deposited was some 3,000 meters thick. The Quassaic Group is at a stratigraphic high point; thus, no known unit overlies it (Waines, 1986). The Quassaic group makes up the cliffs and outcrops west of the Site forming Hussey Hill (northern portion of the Marble Mountains). Beds on the western side of hills grade conformably into younger late Ordovician Martinsburg Formation shales. The eastern boundary of the Quassaic group on the Site side of Hussey Hill is bounded by the Esopus Thrust fault (Pratt, 2009), which was traced from Newburgh north into the township of Esopus and continues north toward Port Ewen. Near the Site this fault is covered by unconsolidated sediments (Pratt, 2009). The thrust fault separating the two units is shown on **Figure 3-3**; however, the exact location of the contact is approximate and has not been identified by Site investigations.

Structurally the Quassaic Group strikes 10 to 30 degrees and make up a large asymmetric syncline, which is continuous along the strike for at least 24 miles (Pratt, 2009). The eastern limb beds (forming the eastern Site-facing portion of Hussey Hill) are overturned and dip east between 76 to 64 degrees. The western limb beds (not related to the Site) dip west between 53 and 60 degrees (Marshak, 1990).

The Austin Glen formation (Oag) is part of the Normanskill Group. Its thickness is estimated at less than 190 feet. Estimates of its thickness are difficult due to the major faulting, lack of marker beds, and incomplete stratigraphic sequences. Beds consists of alternating sequences of laminated and cross-stratified thin grey phyllarenite (sandstone), calcareous grey to dark-grey siltstones, and blue-grey and black shales. Sandstone and siltstone beds are typically less than 3 feet thick but can range from less than 1 inch to 6 feet. Shale beds vary in thickness from less than 1 inch to less than 3 feet (Pratt, 2009).

Thrust faults are numerous in the Austin Glen formation and no continuous sections are larger (in thickness) than 65 feet. The formation is overturned near the Site with dip angles to the east between 30 and 47 degrees depicted near Port Ewen and strikes between 0 to 30 degrees east (Marshak, 1990).

3.1.3 Surface Landforms

To understand the landforms that may impact hydrogeology and groundwater flow boundaries at the Site, a geomorphology assessment was completed of the local topography. The landforms noted are shown on **Figure 3-4**.

The Site is positioned in a valley between the rocky Hussey Hill to the west and a gentle rise in topography forming a series of elongated hill tops to the east. Hussey Hill is formed by the exposed bedrock of the Quassaic formation. The steep east-facing ridge near the Site is characteristic to tectonic uplift. The structural geology of Hussey Hill was further described in **Section 3.1.2**.

As discussed in **Section 2.2,** the surface water bodies located east and at the base of the elongated hills flow north. The presence of wetlands to the east and adjacent of the Site signify poorly drained soils characterized by the lacustrine silt and clay. Beyond the wetlands to the east are a series of elongated hills known as glacial drumlins. Drumlin is a glacial landform that is composed of basal glacial till that form under glaciers. Among the drumlins are a series of round glacial kettle lakes connected by wetlands and south flowing streams. Further to the east is the Hudson River, which also flows to the south. The glacial drumlins and associated till deposits are likely key boundary conditions to groundwater flow to the east.

The presence of drumlins to the east of the Site is relevant as the higher topography (higher potential groundwater recharge) and greater compaction (i.e., lower hydraulic conductivity) make the drumlins the eastern hydrogeologic barrier (boundary condition) for groundwater in the unconsolidated sediments between the Site and the Hudson River. USEPA has produced a conceptual model for groundwater flow near drumlins that should generally match the conditions at the Site (**Figure 3-5**).

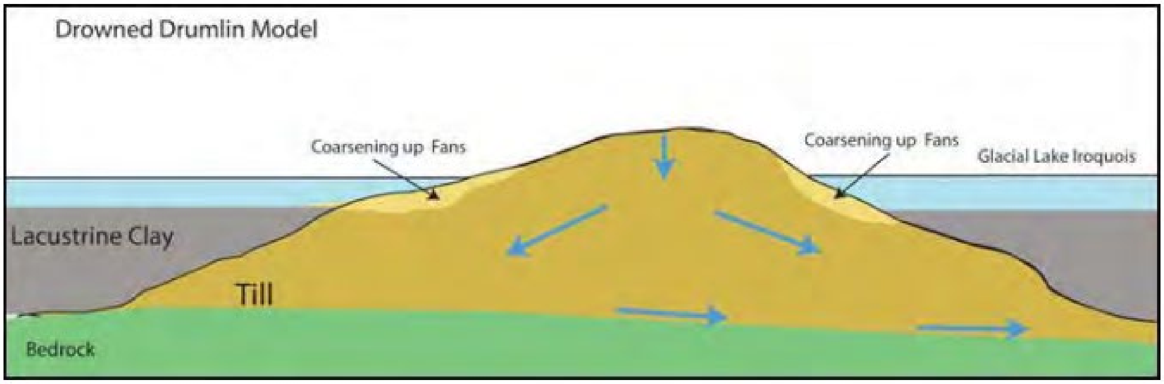

Figure A17. Conceptual summary cross section – Drowned Drumlin Model. Blue arrows are interpreted groundwater flow.

Figure 3-5 Glacial Drumlin Hydrogeology (source: USEPA, 2017)

At the Site, the drumlin and associated basil till would behave like the model presented in **Figure 3-5**. The drumlin till would be deposited on bedrock as they are under the glacier formation. The drumlin would be partly buried to the west by the lacustrine clay overlaying the Site. Recharge from the higher drumlin creates a recharge boundary that prevents groundwater in the later deposited unconsolidated sediments (located west of the drumlins) from flowing east to the Hudson River. The western side of the drumlin till likely discharges to the west and confluences with groundwater originating from the Site, forming the wetlands complex. Groundwater under the wetlands complex would then flow north following the direction of surface water flow. The presence of the drumlin field often results in the formation of wetlands like those observed in the wetlands complex at the Site (NYDOT, 2013).

Further evidence of glacial landforms is the presence of rounded kettle lakes among the drumlin fields. Kettle lakes are characterized by their rounded shape and carved out of the underlying sediment/bedrock by receding glaciers. The kettle lakes are at a higher elevation than the wetlands complex at the Site (higher recharge) and drain southward, further evidence supporting the hydraulic boundary formed by the glacial till to the east of the Site.

3.1.4 Site Geology

A comprehensive evaluation of the Site boring logs (**Attachment A**) was conducted, and the depth and elevation of the geologic units were documented and are presented in **Table 3-1**. Geologic cross sections have also been created using borings logs and well construction information for the Site and are included in **Attachment B**. Four main geologic units encountered at the Site are the lacustrine silt and clay, till, glacial outwash, and Austin Glen formation (interbedded sandstone, siltstone, and shale). The geologic data is limited by the spatial distribution of wells and therefore the boundaries between these levels are interpolated.

The upper 10 to 50 feet of soil generally consists of lacustrine silt and clay units (**Table 3-1**). This unit is described as a moist, brown, silty clay with trace of fine sand. Grading to soft grey clay and silt. Extremely soft sediments were identified in the lacustrine silt and clay deposits noted by “Top of Soft Zone” presented in **Table 3-1**. The extremely soft sediments are defined as sediments where the split spoon sample rod used during drilling advances though the sediments without active hammering. These areas are noted on the boring logs (**Attachment A**) with WOR (weight of rod) or WHO (weight of hammer) in the blow count column. The NYDOT notes that the lacustrine sediments were deposited in a loose state and oxidation and drying have changed the original materials from a grey soupy material to a brown oxidized, blocky structured material. These areas are usually underlain by soft, wet, weak, highly compressible material.

Stratigraphically below the lacustrine deposits is a glacial till unit that greatly varies in thickness up to over 25 feet in some areas. The till is not universally deposited across the Site. The till below the Site is likely ablation in deposition and distinctly separate from the basil till deposits to the east and south of the Site. Ablation tills typically grade to kame or kame terrace deposits (or glacial outwash) (NYDOT, 2013). The unit contains poorly sorted sediment ranging from gray silty clay to sand. It is thickest near well MW-13D (28.5 feet) in the middle of the Site, but very thin (1 to 5 feet thick) Site-wide and at the northern edge of the Site (**Table 3-1**).

Below the till and lacustrine deposits, the bedrock is a sand and gravel layer that comprises the glacial outwash unit that corresponds with the Kame Terrace aquifer shown on **Figure 3-2**. This unit is identified at 15 well clusters across the Site and is overlain by glacial till and lacustrine deposits. The glacial outwash surface elevation is mapped on **Figure 3-6** and the glacial outwash thickness is shown on **Figure 3-7**. The surface elevation generally follows the surface of the structural bedrock valley with a similarly shaped valley or trough with elevation low points at well MW-12D (86 ft amsl) and well MW-26D (106 ft amsl or 45 feet below grade). The highest elevations are observed in the northeast portion of the Site near wells MW-2A and MW-2B (over 140 ft amsl or 25 feet below grade) and another high elevation on the eastern portion of the Site at well MW-18S (138 feet amsl or 6 feet below grade).

The glacial outwash sediment thickness is shown on **Figure 3-7**. The glacial outwash was not encountered at four wells (MW-1, MW-7, MW-9, and MW-19) even though bedrock was encountered at these locations indicating that the glacial outwash pinches out to the west and eastern portions of the Site. The glacial outwash was less than 5 feet thick in an additional four well clusters (MW-24D, MW-17S, MW-16S/D, and MW-13S/D). The glacial outwash unit is greater than 10 feet thick in the center to western portion of the Site before it pinches out towards the west near Hussey Hill. This depositional structure is consistent with a kame terrace deposit that is formed by glacial melt driven fluvial deposition between a glacier edge and a mountain face (Hussey Hill). Additional thick mounds of glacial outwash were interpreted near well MW-21D by the Shell Plant and well MW-18S in the Wetlands Complex. It is unknown if these thick sequences of glacial outwash sediments are all connected or separate as depicted on **Figure 3-7**. These mounds are consistent with potential buried kame deposits that form under glaciers.

General conceptualizations of glacial outwash and glacial Kame deposits formations are shown below on Figure 3-8. Kame terrace deposits develop along the margin of glaciers, similar to the west side of the Site against Hussey Hill. The sand deposits at the Site would be laterally continuous in the north-south direction and discontinuous in the east-west directions. Kame hill deposits are not laterally continuous and are limited to their immediate vicinity. Ablation till deposits (noted as flowed diamicts on **Figure 3-8**) form around the margins of these deposits. Following deposition these sediments at the Site were buried by lacustrine deposits. As discussed further in Section 4, the glacial outwash deposits would generally be more transmissive for groundwater flow while the lacustrine and glacial till deposits would be less transmissive.

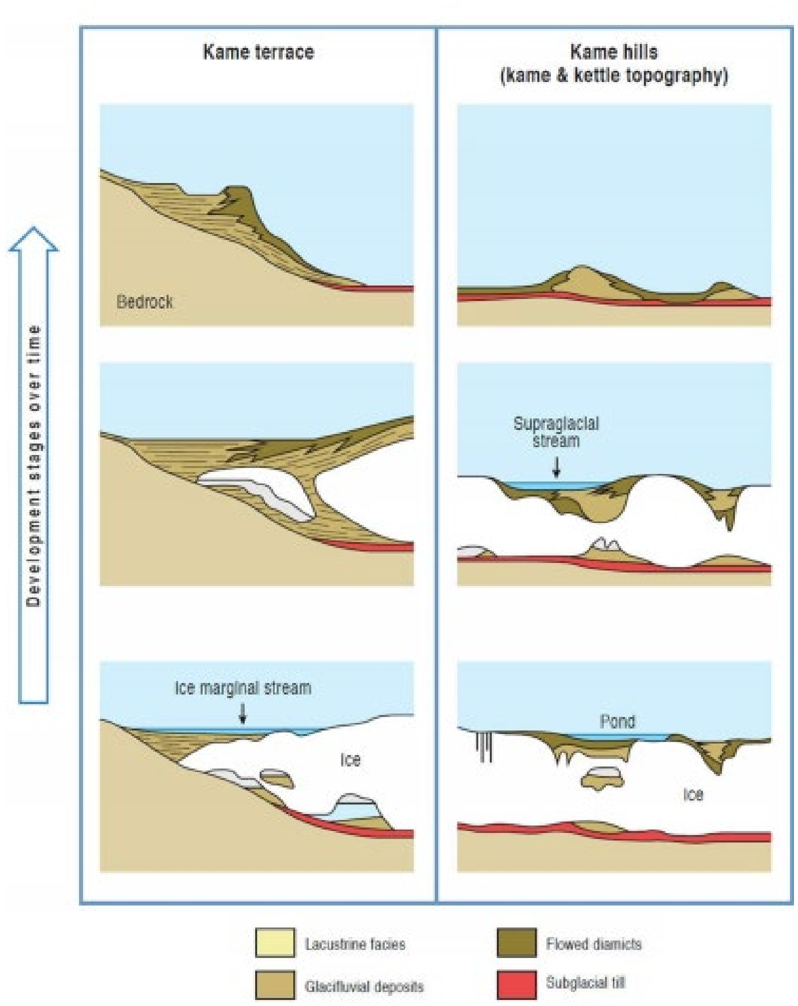

Figure 3-8 Kame Terrace and Kame Hill Development (source: Evans et.al, 2017)

The bedrock surface elevation has been mapped on **Figure 3-9** using the interpretation from the boring logs summarized on **Table 3-1**. The hydropunch borings (HP designation) shown on **Table 3-1** were omitted from contouring as the direct push methods used may encounter refusal prior to bedrock and the observations were not visually verified. Top of bedrock (surface) elevations across the Site range from approximately 224 ft amsl near monitoring well MW-1, where bedrock outcrops in adjacent areas, to 80 ft amsl near the center of the Site at well MW-12D. Moving eastward, the bedrock then rises beneath the Wetlands Complex to an elevation of approximately 130 ft amsl near MW-17S. The bedrock contour map (**Figure 3-9**) has been developed like past interpretations of the bedrock surface showing a trough structure (buried valley) oriented in a northeastward direction generally along formation strike (0 to 30 degrees east). The trough structure (buried valley) is near the thrust fault forming the contact between the Quassaic and the Austin Glen formation under the Site.

The bedrock encountered beneath the Site consists of shale of the Austin Glen formation. Rock from the Quassaic Group has not been encountered at the Site, even west of the formation contact (shown on **Figure 3-3**). It is possible that the formation contact depicted on the geologic map is further to the west near Hussey Hill or that the shale of the Austin Glen formation has overridden the Quassaic Group due to the thrust fault.

3.2 Site Hydrogeology

There are three hydrostratigraphic units identified at the Site.

- **Unit 1** contains the lacustrine silt and clay and the glacial till. This unit is characterized by mostly silt and clay soils with variable loose saturated soils. Unit 1 has a variable thickness of 6 to 80 feet.
- **Unit 2** contains the glacial outwash consisting of sands and gravels. Unit 2 has a variable thickness between 0.5 to 14 feet thick.
- **Unit 3** contains a fractured shale bedrock aquifer (the Austin Glen formation).

Historically, potentiometric surface interpretations have been conducted by dividing the water-bearing zone into three units by depth (shallow overburden, deep overburden, and bedrock) regardless of what hydrostratigraphic unit those wells are screened in. As part of this CSM, each well was assigned to a hydrostratigraphic unit (based on lithology and not depth) as noted in **Table 3-1**. For wells that are screened across multiple units, most notable where the glacial outwash is thin, the more transmissive lithologic unit was assigned to that well.

3.2.1 Hydraulic Gradients

The depth to groundwater and the calculated groundwater elevation data collected from 2012 to 2019 is presented in **Table 3-2**. Site-wide groundwater elevation data has not been collected regularly; however, a more expansive gauging event was conducted in 2020. Groundwater elevation contour maps for the 2020 gauging event for Unit 1, Unit 2, and Unit 3 are included in **Attachment C**. The hydraulic gradient of all three units is generally to the east from the Site toward the Wetland Complex. The estimated horizontal hydraulic gradient for the hydrostratigraphic units is:

- Unit 1 (glacial till) = 0.01 foot per foot
- Unit 2 (glacial outwash) = 0.04 foot per foot
- Unit 3 (bedrock) = 0.03 foot per foot

The vertical gradients for each well cluster were calculated and presented in **Table 3-3**. Positive numbers on **Table 3-3** indicate an upward hydraulic gradient while negative numbers indicate a downward hydraulic gradient. Vertical gradients between the top of Unit 1 and the bottom of Unit 1, calculated at MW-15S/15D, MW-24S/24D, and MW-2A/2B, were generally upward with a range between 0.004 foot per foot and 0.853 foot per foot. Groundwater in this unit on average has the hydraulic potential to discharge upward during these gauging events; however, there are both upward and downward event these locations. The vertical gradient may be influenced by season fluctuations or precipitation events. The vertical gradient between Unit 1 (silts and clays) and Unit 2 (glacial outwash) was calculated at six well clusters (MW-26S/26D, MW-11S/11D, MW-12S/12D, MW-13S/13D, MW-14S/14D, and MW-16S/16D). The average vertical gradient was downward in each well cluster, except for wells MW-11S/11D (upward with a gradient of 0.004 foot per foot) located on the southern portion of the Site. The downward gradients ranged from -0.021 to -0.523 foot per foot. The downward gradient indicated that groundwater from Unit 1 recharged groundwater in Unit 2. Very few individual gauging events (four wells of 21 measurements) showed an upward gradient indicating that the average range is typical for the Site. The vertical gradients between Unit 2 (glacial outwash) and Unit 3 (bedrock) were downward as measured at wells MW-20D/20R, MW-21D/21R, and MW-22D/22R. The gradients ranged from -0.055 to -0.033 foot per foot. The average gradients indicate the bedrock is recharged by the overlying glacial outwash. No event measured an upward gradient between the bedrock and the glacial outwash.

3.2.2 Hydraulic Conductivity and Velocity

The hydraulic conductivity of the wells was calculated (estimated) from a series of slug tests performed as part of the RFI. The hydraulic conductivity data is presented in **Table 3-4**. A summary (range) of the hydraulic conductivity values estimated for each hydrostratigraphic unit is as follows:

- Unit 1 (glacial till) = 0.001 ft/day to 8.2 ft/day
- Unit 2 (glacial outwash) = 2 ft/day to 53.9 ft/day
- Unit 3 (bedrock) = 0.2 ft/day (based on one well; MW-1)

Using Darcy's Law and estimates for hydraulic conductivity, horizontal gradient, and effective porosity, groundwater velocity estimates can be calculated. For Unit 1, horizontal gradient is estimated at 0.04 ft/ft, effective porosity is approximately 35% for sand and gravel (Wolff, 1982), and average hydraulic conductivity is 1.1 ft/day (**Table 3-4**). Therefore, these parameters yield an approximate horizontal groundwater velocity of 0.13 ft/day (48 ft/year). There is insufficient data for Unit 2 to estimate groundwater velocity (effective porosity is unknown). Also, there is insufficient data for Unit 3 to estimate groundwater velocity (only one hydraulic conductivity and no porosity is known).

3.2.3 Bedrock Hydrogeology

Descriptions of the bedrock in wells MW-1, MW-20R, MW-21R and MW-22R are included on the boring logs in **Attachment A**. At all four bedrock wells, the transition from the unconsolidated overburden sediments to shale bedrock is abrupt. There was no residuum or weathered transition zone between the overburden and bedrock noted. This abrupt transition is likely due to the past glaciation scraping residuum from competent rock prior to deposition of the glacial outwash and till deposits.

All four bedrock wells are noted to be installed in gray shale bedrock, consistent with descriptions of the Austin Glen formation. Core descriptions are included for MW-20R and MW-21R (**Attachment A**). The core description of each well noted to have steep angle fractures, near horizontal fractures, and badly fractured zone where there is not an apparent orientation. There is oxidation staining, calcite mineralization, and clay infilling noted on down high angle and near horizontal fracture surfaces indicating there is potential groundwater flow at each orientation. Some apparent fractures are completely filled and noted as calcite veins.

As noted in **Section 3.2.1**, there is downward vertical gradient from the glacial outwash to the bedrock (0.03 foot per foot) that is a similar order of magnitude as the horizontal gradients in both units. Typically, vertical groundwater movement is limited by lower hydraulic conductivity across the bedding planes of sedimentary deposits. In this setting the bedding planes of the glacial outwash have been slumped post deposition as glaciers melt (see **Figure 3-8**). This means in the glacial outwash the vertical gradient may be as influential as the horizontal gradient as the preferential conductivity has been destroyed. The bedding planes in the bedrock unit are uplifted and near vertical (70 to 30 degrees) meaning the likely higher conductivity direction is in the near vertical direction meaning that preferential flow may be down dip or along strike in the horizontal direction until a cross-strike horizontal fracture is encountered.

Generally, when deformed sedimentary rock can form systematic sedimentary joints and fractures, These typically occur in strike-parallel joints that follow weakness along the bedding planes (i.e., likely due north to North 10 degrees East and dipping between 30 and 76 degrees east [Marshak, 1990]) and cross-strike joints that tend to exist at a high angle to strike and cut across bedding planes (likely equivalent to the near horizontal fractures noted on the boring logs. The exact orientation of these fractures is not known. In addition, intensely faulted and folded rock like the overturned and faulted beds of the Austin Glen formation may be so intensely fractured that systematic joints are not able to be determined (Van der Pluijim, 2004). Shales are typically low permeability (primary porosity), and fluid flow of any volume is though fractures, joints, or along bedding planes. The primary porosity may allow for diffusion of dissolved CVOCs into the rock matrix (USGS, 1999).

4 Nature and Extent of Contamination

As discussed earlier, NYSDEC has requested the installation of additional bedrock groundwater monitoring wells “for the purpose of understanding the hydrogeology of the bedrock aquifer and its relationship to the overburden aquifer on-site”. In addition to this request, concerns regarding potential off-site migration of CVOCs from the former Shell Plant area have been expressed by off-site property owners using regional groundwater as a potable water source.

For these reasons and because there are limited exceedances of inorganics at only a few locations within the immediate vicinity of their source SWMUs and/or AOCs, this section focuses on the nature and extent of CVOCs in soil, groundwater, and surface water near the former Shell Plant. CVOCs are the major constituents of concern in this area.

4.1 Potential Source Areas

According to the RFA performed at the Site from 1991 through 1993 (Eckenfelder, 1994), CVOCs were allegedly disposed of at the Site at the following locations (**Figure 2-3**):

- Metal stamping operations in the former Shell Plant (Building 2036) used degreaser solvents. Shell Plant was in operation as early as November 1927. Soil and groundwater investigations were performed in the vicinity of the former Shell Plant in 1995 (Eckenfelder, 1996) with additional groundwater investigation during the RFI performed from 1997 through 1999 (Brown and Caldwell, 1999). Further evaluation of specific units in the vicinity of the former Shell Plant were recommended in the RFI Report (Brown and Caldwell, 1999) as discussed below.
- Previous owners (Hercules) reportedly stored decreasing solvents adjacent to the former Shell Plant, at the Former Shell Plant Drum Storage Area (SMWU 37). Facility representatives indicate that stressed vegetation was observed in the area prior to removal of the drums in the late 1970s. Soil and groundwater investigations were performed in the vicinity of this unit in 1995 (Eckenfelder, 1996) with additional groundwater investigation during the RFI performed from

1997 through 1999 (Brown and Caldwell, 1999). This unit was recommended for further evaluation in the RFI Report (Brown and Caldwell, 1999).

- Process/waste waters from Shell Plant were pretreated to neutralize and remove copper at the former and new wastewater treatment facilities (SWMUs 24 and 25).
  - Before 1980, the waste waters and sludges generated at the former wastewater treatment facility were discharged into a settling lagoon (SWMU 24). The lagoon emptied into the Drainage Ditch downgradient of the Shell Plant (SWMU 30). Soil and groundwater investigations were performed in the vicinity of these units in 1995 (Eckenfelder, 1996) with additional groundwater investigation during the RFI performed from 1997 through 1999 (Brown and Caldwell, 1999). These units were recommended for further evaluation in the RFI Report (Brown and Caldwell, 1999).
  - The new Wastewater Treatment Facility (SWMU 25) was put into service in 1980 and process waters neutralized by the treatment facility were discharged to the City of Kingston publicly owned treatment works (POTW) via the Sanitary Sewer System (SWMU 27). The treatment facility was taken out of service in 1992 when neutralization of process waters was no longer needed; however, process wash water from the former Shell Plant continued to pass through the treatment facility until 1993 when wastewaters were piped directly to the sanitary sewer. There were no known releases associated with this unit and no further action was recommended (Eckenfelder, 1994).
- Waste degreaser was drummed and stored at the Waste Degreaser Storage Building (SWMU 18) from about 1978 until 1990. The drums were stored at the unit for less than 90 days prior to being shipped off-site for reclamation. There were no known releases associated with this unit; however, soil and groundwater investigations were performed at this unit in 1995 (Eckenfelder, 1996) and no further investigation was recommended (Eckenfelder, 1997).
- The waste degreaser building was replaced by the New Waste Degreaser Storage Building (SWMU 19) in 1990. The unit is an enclosed building and there are no known releases associated with this unit. However, soil and groundwater investigations were performed at this unit in 1995 (Eckenfelder, 1996) and no further investigation was recommended (Eckenfelder, 1997).

Based on CVOC groundwater concentrations at MW-4A (near SWMU 30), that had greater than 1% of solvent phase solubility for primary parent products TCE and 1,1,1-trichloroethane (1,1,1-TCA), there is the possibility for residual material to be present in the subsurface at the Site. Persistent concentrations of TCE in the groundwater at wells MW-3, MW-4A, and MW-4B, 30 years after the release event(s), indicate a potential for residual material. This indicates that a steady dissolution of source material, even as the chemicals degrade in the dissolved phase. However, dense non-aqueous phase liquid (DNAPL) has not been identified in any borings or wells drilled at the Site.

4.2 Extent of Soil Impacts

During the 1995 groundwater investigation (Eckenfelder, 1996), soil samples were collected every 5 ft to boring depth at 16 hydropunch locations (**Figure 4-1**). Soil samples were placed in a glass jar, sealed with aluminum foil and the jar lid, and allowed to equilibrate to room temperature before field screening for VOCs with a photoionization detector (PID). Results of the PID readings are reported on the boring logs presented in **Attachment A**. At total of nine soil samples from five hydropunch locations (HP-1, 3, 10, 12, and 13) exhibited concentrations greater than 50 parts per million (ppm), which could be indicative of the presence of VOCs. However, no confirmatory soil samples were collected for laboratory analyses.

Therefore, the nature and extent of CVOCs in soil has not been completed. Note, soil source areas have not been completely identified.

4.3 Extent of Groundwater Impacts

Monitoring wells MW-3, MW-4A, MW-4B, and MW-23S (Unit 1 wells); MW-21D and MW-22D (Unit 2 wells); and MW-21R and MW-22R (Unit 3 wells) adjacent to the Shell Plant have been sampled semi-annually since 2002. The groundwater results from 2011 to 2019 are summarized on **Table 4-1**. The most recent results are shown on **Figure 4-2**. CVOC concentrations greater than their respective NYDEC Class GA GQS are stable in groundwater and localized near the former Shell plant at suspected CVOC source areas; SWMU 24 (Former Wastewater Treatment Facility), SWMU 30 (Drainage Ditch downgradient of Building 20136 [former Shell Plant]), and SWMU 37 (Former Shell Plant Drum Storage Area) (**Figure 4-2**), as evidenced in the 1995 groundwater investigation (Eckenfelder, 1996) and the semi-annual groundwater monitoring.

Other wells in the vicinity of the former Shell Plant, notably MW-20D (Unit 2) and MW-20R (Unit 3), were sampled one time in 1997 as documented in the RFI Report (Brown and Caldwell, 1999). No CVOCs were detected during the 1997 sampling event. The RFI results for all wells sampled for CVOCs at that time are included as **Attachment D**.

The hydrostratigraphic Unit 1 (glacial till) wells listed below had detectable concentrations of CVOCs above NYSDEC Class GA GQS in 2019 (**Figure 4-2**):

- **MW-3:** Located adjacent to SWMU 37 and has exceedances of:
    - 1,1,1-TCA (7,000 micrograms per liter [μg/L])
    - 1,1-dichloroethane (DCA) (98 J μg/L where J qualifier denotes an estimated value)
    - 1,1-dichloroethene (DCE) (19,000 μg/L)
    - 1,2-DCA (130 J μg/L)
    - TCE (27,000 μg/L)
    - cis-1,2-DCE (960 μg/L)
- **MW-4A:** Located east of SWMU 30 and has concentrations of CVOCs above NYDEC Class GA GQS:
    - TCE (170,000 μg/L)
    - cis-1,2-DCE (79,000 μg/L)
    - trans-1,2-DCE (910 μg/L)
    - Vinyl chloride (1,700 μg/L)
    - 1,1-DCE (93 J μg/L)
- **MW-4B:** Located east of SWMU 30 and has concentrations of TCE (45,000 μg/L) and cis-1,2-DCE (530 μg/L) above NYDEC Class GA GQS.
- **MW-25S:** Located east of MW-4B and has no detections of CVOCs since one-time detections in November 2015.

Hydrostratigraphic Unit 2 wells (MW-21D and MW-22D) and Unit 3 well MW-22R have not had consistent detections of CVOCs or exceedances of NYSDEC Class GA GQS. Well MW-21R has had CVOC concentration detections below NYSDEC Class GA GQS of TCE (2.9 μg/L) and cis-1,2-DCE (2.2 μg/L).

A hydropunch groundwater investigation was conducted in 1995 to characterize the groundwater plume at variable depths, where 16 direct push boring were installed. The results of the hydropunch investigation are included in **Attachment D**. The hydropunch locations are shown on **Figure 4-1** and locations that had CVOC exceedances of NYSDEC Class GA GQS are highlighted red. Only 4 of 15 hydropunch locations exceeded the NYSDEC Class GA GQS for CVOCs, locations that were not exceedances are shown as grey circles. The hydropunch investigation did not characterize the groundwater below the glacial till (no groundwater samples collected) and in most cases only characterized the top portion of the glacial till. Therefore, vertical characterization of the groundwater at the hydropunch boring locations has not been completed.

The hydropunch sampling event generally confirmed the results of the groundwater well sampling, indicating the CVOCs are present in the glacial till around SWMUs 24, 28, 30, and 37. Hydropunch borings HP-3, HP-4, HP-13, and HP-10 all detected groundwater CVOC concentrations above the NYSDEC Class GA GQS. Additional information captured by the hydropunch boring program and not determined by the monitoring wells include:

- Boring HP-4 sampled at 42 to 43 ft below ground surface (bgs) near the bottom of the glacial till (deeper than well MW-3 as shown on cross-section B-B’, **Attachment B**), exceeded NYSDEC Class GA GQS with a TCE concentration of 900 μg/L.
- The deeper interval below boring HP-3 (43 to 44 ft bgs) was sampled but CVOCs were not detected.
- Chlorinated ethanes (i.e., 1,1,1-TCA and degradation products) were detected at boring HP-4, like well MW-3, but not boring HP-3.
- Boring HP-13 installed near SWMU-24, where there is not an existing well, had concentrations of TCE in the deeper 43 to 44 ft bgs above NYDEC Class GA GQS located near the bottom of the glacial till unit at concentration of 6,900 μg/L. The shallow groundwater sample at HP-13 (22 to 22.5 ft bgs) had lower concentrations (TCE at 8.3 μg/L).
- Chlorinated ethanes were detected in the deep interval of boring HP-13 but not the shallow interval.
- Boring HP-10 installed near well MW-4A in SWMU-30 had the highest concentrations of TCE at 46,000 μg/L in the 37 to 37.5 ft depth interval. Only TCE and its degradation products were reported at HP-10 like wells MW-4A and MW-4B.
- The deepest interval at boring HP-10 had the highest concentrations of TCE and degradation products.
- Boring HP-8 located directly east across the railroad tracks from boring HP-10, had a shallow and deep interval sampled that did not detect concentrations of CVOCs above the laboratory NYSDEC Class GA GQS. This boring generally delineates the glacial till to depth in the east direction.
- Boring HP-1 located directly west of well MW-3 had a shallow and deep interval sampled that did not report concentrations of CVOCs above the laboratory reporting limit. This boring generally delineates the glacial till to depth in the west direction.

4.4 Surface Water Results

Surface water was sampled and analyzed for CVOCs in 1995 at two locations (SW-2 and SW-3) as shown on **Figure 4-2** (Eckenfelder, 1996). CVOCs were not detected above laboratory reporting limits in these surface water samples. No other surface water sampling to the drainage ditch to the west of the former Shell Plant or in the wetlands complex has been conducted.

SW-2 and SW-3 were collected from the surface water body that formally extended from SWMU-30 east of the rail line. The status of this surface water body and the culvert under the rail line is unknown; however, the area around MW-4A and MW-4B periodically floods, indicating that the drainage and culvert under the rail line is currently inactive. Another proposed sample (i.e., SW-1) was not collected as the drainage south of SW-2 was dry at the time of sampling. The relationship between shallow groundwater and surface water in the vicinity of the CVOC plume has not been assessed.

5 Receptor Survey

A description of potential receptors is provided in the following sections. This includes discussion of groundwater and well use, as well as wetlands. The locations of potential receptors (i.e., private and public supply wells) are shown on **Figure 3-2.**

5.1 Groundwater Use

Groundwater is not used as a source of drinking water on-site; bottled drinking water is available in each building and potable water is provided to the facility by the Port Ewen Water District. Groundwater obtained prior to 2003 from an upgradient well about 1,000 feet southwest of the Shell Plant Building was used for showers, sinks, and sanitation. According to communications from the Environmental Manager at Dyno Nobel, this groundwater source was tested each month for chlorinated compounds and coliform, and at least once a year for lead and other CVOCs. The most recent data from 2002 tests show no detection of CVOCs in the well water.

Off-site, a survey of receptors, including public and private supply wells, are identified on the Environmental Data Resources Inc (EDR) GeoCheck Report included in **Attachment E**. EDR searched relevant databases for private well information including United States Geological Survey (USGS) well information, federal public water supply database, and state databases. The location of the public and private wells is shown on **Figure 3-2**. The EDR report identified five private wells in the USGS database and three public supply wells within 1 mile of the Site. There were no wells identified in the State of New York databases. The wells are located between ½ mile to 1 mile north or south of the Shell Plant and are positioned side-gradient of the Shell Plant.

The five private wells in the USGS database are installed in either bedrock (equivalent to Unit 3) or a sand and gravel aquifer (Unit 2). Both USGS wells to the south of the Site (U1184 and U1183 on **Figure 3-2**) are installed in the bedrock (**Attachment E**). The USGS wells identified to the north of the Site are installed in the sand and gravel aquifer (Unit 2; U12206 and U1203) and deeper bedrock (U1204 installed at 220 ft bgs).

Water well U1183 is in a residential neighborhood, according to Ulster County, New York property records, and the homes in this neighborhood are not on public water; therefore, these wells may be associated with providing drinking water to private residents. Following a public meeting in 2019, one private well owner (Mr. Shultis) provided analytical results for a private well around U1183. The analytical CVOCs concentrations were below the laboratory reporting limits. In addition, the laboratory reporting limits were in the acceptable range for evaluation. The exact location, depth, and hydrostratigraphic unit for this well is unknown.

Public supply wells identified in the Federal Database include two wells (both labeled NY0003382; **Figure 3-2**) to the north of the Site owed by Port Ewen Water Department. It is likely there is a single well, the exact location is unknown. According to the 2019 Annual Water Quality Report (Port Ewen Water District, 2020), all the water for the district comes from surface water provided by the Hudson River and groundwater is not used. According to the Port Ewen Water & Sewer Department, the wells were formerly part of the public water system. However, they have not been used since about 1963 when the wastewater treatment plant was built on the Hudson River, and the Hudson River became the sole source for public drinking water. The Port Ewen Water & Sewer Department has indicated that there are no plans to use these wells again.

To the south of the Site there is one public supply well (NY0021830; **Figure 3-2**) owned by the Hutterian Brethren Society. This well supplies water to 280 people. Based on information provided by NYSDEC, the community to the South (also known as the Bruderhof-Maple Ridge Community) has four wells that provide water to up to 380 people. All four deep wells are installed in bedrock with an average depth greater than 200 ft bgs. Periodic Department of Health-required testing of the wells has not reported any CVOCs at concentrations greater than the NYSDEC Class GA GQS (Chazen Companies, 2019). Chazen Companies (2019) also indicated that drawdown from these wells extends a considerable distance from the pumping wells; however, pump rates or drawdown distances were not provided (Chazen Companies, 2019).

Chazen Companies (2019) reports that the Bruderhof-Maple Ridge Community also operates a shallow bedrock well (referred to as the Pond Well) that is 60 ft deep with 16 ft of open bedrock borehole. This well provided water to an on-site pond. The Pond Well is located approximately 3,200 ft southwest of monitoring well MW-4A.

5.2 Wetlands Area

The Wetlands Complex is a wetland and successional forest area (**Figure 2-1**). This area is dominated by a common reedgrass (Phragmites australis) marsh on the eastern side of the railroad tracks that intersect the Site. The wetlands generally drain to the north to an unnamed tributary to Plantasie Creek and eventually to Rondout Creek. Near the downstream extent of the Site, hydrology in the wetlands has been altered by beaver activity. An open water area is located within the wetlands (SWMU 1); the open water area was used as a shooting pond during plant operations for underwater detonation of off-specification explosives and energetic process waste. Portions of the Wetlands Complex have the potential to support permanent aquatic communities. Perennial water is likely to exist north of the access road to the Site and can support benthic invertebrate communities and limited warm water fish communities. Fish and wildlife resources likely forage within the wetlands system. The hydrological connectivity of this area to downstream fish and wildlife resources such as Rondout Creek increases its habitat value. Limiting factors associated with the habitat value of the Wetlands Complex include the dominance of the invasive species Phragmites, which provides poor habitat for wildlife relative to wetlands with more diverse vegetative communities.

This area is a local discharge point for groundwater flow from the Active Plant area and the glacial drumlin to the east of the wetlands complex in both in the shallow and deep overburden deposits. As a result, groundwater from the Site does not migrate east of the wetlands.

6 Current Site Understanding and Data Gaps

Based on the review of available information, the following conceptual understanding is provided for the Site to assist in the identification of data gaps. The data gaps have been identified as key questions with regards to the nature, extent, fate, and transport of CVOCs at the Site. Ultimately collection of additional information to supplement the current Site understanding and fill these data gaps will be allow for selection of an appropriate remedial strategy.

A drawing depicting the CSM with identified data gaps is included as **Figure 6-1**. The following bullets describe our current understanding of the CSM based on the geology, hydrogeology, and the nature and extent of soil/groundwater contamination.

- Releases of CVOCs from the shell cleaning process occurred in the vicinity of the Shell Plant and are associated with the SWMUs in that area. Based on the concentrations detected in the glacial till groundwater, residual product or a localized area of fine-grained sediments acting as a source area may be present. The nature and extent of the release is not well known. (**Data Gap 1 – Nature and extent of source material originating from the former Shell Plant**).
- The current groundwater monitoring well network has detected concentrations of CVOCs above the NYSDEC Class GA GQS in the glacial till (Unit 1) in or near the shell house. CVOCs have not recently been detected above the NYSDEC Class GA GQS in downgradient Unit 1 wells or Unit 2 wells. The 1995 hydropunch investigation further delineated the shallow dissolved phase plume. However, given that the nature and extent of source areas is not well known and the hydropunch investigation did not vertically delineate the dissolved phase plume, the nature and extent of CVOCs in the overburden (Units 1 and 2) requires further definition. (**Data Gap 2 – Nature and extent of dissolved phase CVOCs in the overburden**).
- In the area of the former Shell Plant, there is a downward gradient between the glacial outwash (Unit 2) to the bedrock (Unit 3). These vertical gradients range from (-0.055 to -0.033 feet per feet) and are the same order of magnitude as the horizontal gradients in the glacial outwash (0.04 feet per feet) and bedrock aquifers (0.03 feet per feet). The glacial outwash around the former Shell Plant is a buried Kame deposit that is not laterally continuous. This deposit would limit the lateral migration of groundwater in the glacial outwash near the former Shell Plant. In addition, the dip of the bedrock and therefore the dip of the more transmissive bedding planes, is likely between 30 and 70 degrees. The strike and dip of the bedrock surface is likely to favor vertical movement into the bedrock down dip and horizontal movement in bedrock with strike. The extent and connection of the glacial outwash around the former Shell Plant are unknown. Major water-bearing fractures that intersect the glacial outwash and facilitate hydraulic connection between the units are unknown. (**Data Gap 3 - Fate and transport of the dissolved phase plume between glacial outwash and bedrock**).
- The nature of the bedrock groundwater flow is unknown. Groundwater flow in bedrock can be controlled by just a few isolated fractures that are very transmissive. Wells installed at similar depths may not be hydraulically connected to other wells or the suspected source areas. One likely flow path is along formation strike (projected to be near due north-south) and down dip (east). In addition, near horizontal fractures were observed at depth. The exact orientation and

connectiveness of the fracture zones are unknown. (**Data Gap 4 -Physical properties of bedrock related to fate and transport of CVOCs, including degree of fracturing/weathering, identification of hydraulically significant features, hydraulic properties, and interconnectivity of fractures**).

- Three bedrock wells have been installed in the vicinity of the former Shell Plant. Monitoring well MW-21R currently considered side-gradient of the former Shell Plant source area(s) has had low detections of CVOCS below the NYSDEC Class GA GQS. CVOCs have not been detected in well MW-20R currently considered upgradient of the former Shell Plant source area(s) or MW-22R currently considered downgradient of the former Shell Plant source area(s). However, fractures may limit the migration of groundwater in the direction of the measured gradient. Isolated fractures may transport CVOCs away from source areas in the vicinity of the former Shell Plant and may not intersect the existing groundwater well network. Given that the source areas are not well defined (**Data Gap 1**) and the groundwater flow dynamics in the bedrock are not well understood (**Data Gap 4**), the nature and extent of dissolved phase CVOCs in bedrock is unknown. (**Data Gap 5 – Nature and Extent of dissolved phase CVOCs in the bedrock aquifer)**.

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Attached Tables

Attached Figures (note that Figures 3-5 and 3-8 are in the text)

List of Attachments

Tables

TABLE 3-1
HYDROSTRATIGRAPHIC UNIT ASSIGNMENT
CONCEPTUAL SITE MODEL
HERCULES, INC. SITE
ULSTER COUNTY, NEW YORK

Well ID	Surface Elevation	TOC Elevation	Depth to Top of Screen/Open Hole		Depth to Bottom of Screen		Top of Lacustrine Silt and Clay (lsc)		Top of Soft Zone		Top of Till (t)		Top of Glacial Outwash (go)		Top of Austin Glen (Qag)		Hydrostatigraphic Unit
	feet amsl	feet amsl	ft bls	ft amsl	ft bls	ft amsl	ft bls	ft amsl	ft bls	ft amsl	ft bls	feet amsl	ft bls	ft amsl	ft bls	feet amsl	
HP-1 (28-29)	163.4	-	28	135.4	29	134.4	1	162.4	-	-	15	148.4	45	118.4	-	-	1
HP-1 (42-43)	163.4	-	42	121.4	43	120.4	1	162.4	-	-	15	148.4	45	118.4	-	-	1
HP-2 (26-29)	164.7	-	26	138.7	29	135.7	1	163.7	20.00	144.70	15	149.7	49	115.7	-	-	1
HP-3 (23-24)	164.4	-	23	141.4	24	140.4	2	162.4	36.00	128.40	20	144.4	-	-	-	-	1
HP-3 (43-44)	164.4	-	43	121.4	44	120.4	2	162.4	-	-	20	144.4	-	-	-	-	1
HP-4 (27.5-28.5)	164.6	-	27.5	137.1	28.5	136.1	1	163.6	20.00	144.60	20	144.6	-	-	-	-	1
HP-4 (42-43)	164.6	-	42	122.6	43	121.6	1	163.6	-	-	20	144.6	-	-	-	-	1
HP-5 (26-28)	161.1	-	26	138.6	28	136.6	1	160.1	20.00	141.10	16.7	144.4	-	-	-	-	1
HP-6 (23-24)	157.8	-	23	134.8	24	133.8	1	156.8	-	-	15	142.8	45	112.8	46.6	111.2	1
HP-7 (23-24)	157.8	-	23	134.8	24	133.8	1	161.7	25.00	137.70	15.7	142.1	45	112.8	-		1
HP-8 (23-24)	162.7	-	23	139.7	24	138.7	1	161.7	-	-	15	147.7	45	117.7	-		1
HP-8 (42-43)	162.7	-	42	120.7	43	119.7	1	163	-	-	15	147.7	45	117.7	-		1
HP-9 (22-23)	164	-	22	142	23	141	1	163	-	-	10.4	153.6	-	-	-		1
HP-10 (21-24)	156.8	-	21	135.8	24	132.8	1	155.8	-	-	15.3	141.5	-	-	37.5	119.3	1
HP-10A (32-34)	156.8	-	32	124.8	34	122.8	1	155.8	20.00	136.80	15.3	141.5	-	-	37.5	119.3	1
HP-10 (37-37.5)	156.8	-	37	119.8	37.5	119.3	1	155.8	-	-	15.3	141.5	-	-	37.5	119.3	1
HP-11 (21-24)	161.8	-	21	140.8	24	137.8	1	160.8	-	-	15	146.8	-	-	-		1
HP-12 (23-24)	158.9	-	23	135.9	24	134.9	1	157.9	-	-	11.2	147.7	-	-	-		1
HP-12 (42-43)	158.9	-	42	116.9	43	115.9	1	157.9	30.00	128.90	11.2	147.7	-	-	-		1
HP-13 (22-22.5)	163	-	22	141	22.5	140.5	5	158	-	-	15.4	147.6	-	-	-	-	1
HP-13 (43-44)	163	-	43	120	44	119	5	158	35.00	128.00	15.4	147.6	-	-	-	-	1
HP-14 (25)	163.4	-	25	138.4	-	-	1	162.4	-	-	15.5	147.9	-	-	-	-	1
HP-15 (28-29)	163.2	-	28	135.2	29	134.2	3	160.2	-	-	15.5	147.7	45	118.2	-	-	1
HP-15 (43-44)	163.2	-	43	120.2	44	119.2	3	160.2	35.00	128.20	15.5	147.7	45	118.2	-	-	1
HP-16 (23-24)	163	-	23	140	24	139	1	162	35.00	128.00	15.4	147.6	-	-	-	-	1
MW-1	225.00	227.40	9.5	215.50	34	191.00	0	225.00	-	-	0.5	224.50	-	-	2	223	3
MW-2A	168.00	170.70	14	154.00	24	144.00	5	168.00	-	-	20	148.00	25	143.00	-	-	1
MW-2B	169.80	171.70	17	152.80	27	142.80	1	169.80	-	-	15	154.80	25	144.80	32	137.8	2
MW-3	164.80	167.20	16	148.80	26	138.80	1	164.80	-	-	15	149.80	-	-	-	-	1
MW-4A	156.30	158.90	13.5	142.80	23.5	132.80	1	156.30	-	-	15	141.30	-	-	-	-	1
MW-4B	155.90	158.30	17	138.90	27	128.90	1	155.90	-	-	-	-	-	-	-	-	1
MW-5	190.90	193.10	24.5	166.40	34.5	156.40	1	190.90	-	-	16	174.90	-	-	-	-	1
MW-6	178.40	180.90	57	121.40	67	111.40	1	178.40	25	153.40	50	128.40	52	126.40	65	113.4	2
MW-7	170.50	172.80	33.5	137.00	43.5	127.00	1	170.50	15	155.50	36	134.50	-	-	45	125.5	1
MW-8	151.40	153.90	12	139.40	22	129.40	5	151.40	20	131.40	-	-	-	-	-	-	1
MW-9	146.00	148.00	9	137.00	19	127.00	0	146.00	-	-	-	-	-	-	20	126	1
MW-10	146.90	149.00	14	132.90	24	122.90	0	146.90	-	-	-	-	-	-	-	-	1

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	feet amsl	feet amsl	ft bls	ft amsl	ft bls	ft amsl	ft bls	ft amsl	ft bls	ft amsl	ft bls	feet amsl	ft bls	ft amsl	ft bls	feet amsl	
MW-11D	161.40	163.90	55	106.40	65	96.40	0	161.40	25	136.40	45	116.40	50	111.40	>67	<94	2
MW-11S	162.10	164.40	14	148.10	24	138.10	-	-	-	-	-	-	-	-	-	-	1
MW-12D	166.00	168.40	74	92.00	84	82	1	166.00	20.00	146.00	66	100.00	80	86.00	85.1	80.9	2
MW-12S	166.50	168.90	15	151.50	25	141.50	1	166.50	18.00	148.50	-	-	-	-	-	-	1
MW-13D	160.20	162.40	35	125.20	45	115.20	1	160.20	20.00	140.20	15	145.20	43.5	116.70	44	116.2	2
MW-13S	160.10	162.50	15	145.10	25	135.10	-	-	-	-	-	-	-	-	-	-	1
MW-14D	173.70	176.10	55	118.70	65	108.70	1	173.70	30.00	143.70	15	158.70	-	-	65	108.7	1
MW-14S	173.10	175.60	15	158.10	25	148.10	1	173.10	30.00	143.10	15	158.10	-	-	65	108.1	1
MW-15D	159.20	162.00	24	135.20	30	129.20	1	159.20	-	-	15.5	143.70	20	139.20	31	128.2	2
MW-15S	159.60	162.00	10	149.60	20	139.60	-	-	-	-	-	-	-	-	-	-	1
MW-16D	157.40	159.90	39	118.40	49	108.40	1	157.40	35.00	122.40	-	-	49	108.40	49.5	107.9	2
MW-16S	157.30	159.30	15	142.30	25	132.30	-	-	-	-	-	-	-	-	-	-	1
MW-17S	140.80	143.90	4	136.80	10	130.80	1	140.80	-	-	5	135.80	10	130.80	10.8	130	2
MW-18S	144.40	146.80	9	135.40	19	125.40	1	144.40	-	-	5	139.40	6	138.40	20.5	123.9	1
MW-19S	153.20	156.20	14	139.20	24	129.20	1	155.20	-	-	-	-	-	-	-	-	1
MW-20D	158.40	161.40	44	114.40	54	104.40	-	-	-	-	-	-	-	-	-	-	2
MW-20R	158.00	161.00	59	99.00	77	81.00	1	160.00	-	-	43	115.00	48	110.00	54	104	3
MW-21D	161.10	164.10	49	112.10	59	102.10	-	-	-	-	-	-	-	-	-	-	2
MW-21R	159.80	162.80	66	93.80	86	73.80	1	158.80	-	-	40	119.80	48.75	111.05	59.9	99.9	3
MW-22D	148.90	151.90	27	121.90	32	116.90	1	150.90	-	-	25	123.90	26	122.90	33	115.90	2
MW-22R	148.60	151.60	35	-	55	93.60	1	150.60	-	-	25	123.60	26	122.60	33	115.60	3
MW-23S	162.20	165.20	14	148.20	24	138.20	1	164.20	18.00	139.21	-	-	-	-	-	-	1
MW-24D	154.75	157.21	30	124.75	40	114.75	1	154.75	14.00	143.19	28	126.75	38	116.75	40	114.75	2
MW-24S	154.60	157.19	10	144.60	20	134.60	1	154.60	15.00	144.71	-	-	-	-	-	-	1
MW-25S	156.70	159.71	10	146.70	30	126.70	1	156.70	12.00	141.70	10	146.70	-	-	-	-	1
MW-26D	150.96	153.70	47	103.96	58	92.96	1	149.96	18.00	135.70	43	107.96	45	105.96	56	94.96	2
MW-26S	151.70	154.49	10	141.70	20	131.70	1	151.70	-	-	-	-	-	-	-	-	1

Notes:

amsl- Above Mean Sea Level

bls - below land surface

ft - feet

TOC- top of casing

"-" Not included

TABLE 3-2
HISTORICAL WATER LEVEL GAUGING
CONCEPTUAL SITE MODEL
HERCULES, INC. SITE
ULSTER COUNTY, NEW YORK

	Date	4/3/2012		4/4/2012		10/24/2012		10/25/2012		4/17/2013		4/18/2013		4/30/2014		10/23/2014		4/15/2015		10/24/2015		11/11/2015		4/26/2016		10/19/2016		4/24/2017		6/6/2018		12/11/2018		12/12/2018		5/30/2019	
Well ID	TOC Feet amsl	GWE (feet amsl)	DTW (feet)	GWE (feet amsl)	DTW (feet)	GWE (feet amsl)	DTW (feet)	GWE (feet amsl)	DTW (feet)	GWE (feet amsl)	DTW (feet)	GWE (feet amsl)	DTW (feet)	GWE (feet amsl)	DTW (feet)	GWE (feet amsl)	DTW (feet)	GWE (feet amsl)	DTW (feet)	GWE (feet amsl)	DTW (feet)	GWE (feet amsl)	DTW (feet)	GWE (feet amsl)	DTW (feet)	GWE (feet amsl)	DTW (feet)	GWE (feet amsl)	DTW (feet)	GWE (feet amsl)	DTW (feet)	GWE (feet amsl)	DTW (feet)	GWE (feet amsl)	DTW (feet)	GWE (feet amsl)	DTW (feet)
Deep Overburden																																					
MW-11D	163.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	161.77	2.13	--	--
MW-15D	162	155.98	6.02	--	--	155.55	6.45	--	--	--	--	155.83	6.17	156.25	5.75	154.28	7.72	155.4	6.6	--	--	155.1	6.9	155.38	6.62	152.27	9.73	156.3	5.7	155.41	6.59	157.03	4.97	--	--	156.06	5.94
MW-21D	164.1	150.38	13.72	--	--	149.65	14.45	--	--	149.57	14.53	--	--	150.91	13.19	147.72	16.38	149.75	14.35	--	--	148.33	15.77	150.2	13.9	--	--	149.67	14.43	149.9	14.2	151.07	13.03	--	--	150.78	13.32
MW-22D	151.9	--	--	144.2	7.7	143.81	8.09	--	--	--	--	147.35	4.55	144.52	7.38	143.09	8.81	144.55	7.35	--	--	143.57	8.33	144.06	7.84	141.65	10.25	144.45	7.45	143.91	7.99	144.53	7.37	--	--	144.44	7.46
MW-24D	157.21	153.66	3.55	--	--	--	--	153.43	3.78	153.63	3.58	--	--	153.91	3.3	152.18	5.03	153.83	3.38	--	--	153.06	4.15	153.03	4.18	149.99	7.22	153.61	3.6	152.83	4.38	153.61	3.6	--	--	153.36	3.85
MW-26D	153.7	146.69	7.01	--	--	--	--	146.05	7.65	146.88	6.82	--	--	147.07	6.63	145.37	8.33	147	6.7	--	--	146.16	7.54	146.39	7.31	143.92	9.78	146.95	6.75	146.19	7.51	147.87	5.83	--	--	146.79	6.91
MW-2B	171.7	162.2	9.5	--	--	--	--	--	--	--	--	161.88	9.82	163.4	8.3	155.64	16.06	163.8	7.9	159.25	12.45	157.64	14.06	159.7	12	154.42	17.28	163.11	8.59	160.1	11.6	--	--	--	--	162.53	9.17
Shallow Bedrock																																					
MW-1	227.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	206.81	20.59
MW-20R	161	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	156.27	4.73
MW-21R	162.8	148.8	14	--	--	148.1	14.7	--	--	149.19	13.61	--	--	149.61	13.19	147.21	15.59	149.56	13.24	--	--	147.83	14.97	148.72	14.08	146.15	16.65	149.66	13.14	149.2	13.6	150.18	12.62	--	--	149.83	12.97
MW-22R	151.6	--	--	143.9	7.7	143.49	8.11	--	--	--	--	144.05	7.55	144.27	7.33	142.76	8.84	144.23	7.37	--	--	143.24	8.36	143.72	7.88	141.3	10.3	144.16	7.44	143.55	8.05	144.22	7.38	--	--	144.12	7.48
Shallow Overburden																																					
MW-10	149	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	144.69	4.31	--	--
MW-15S	162	156.29	5.71	--	--	155.93	6.07	--	--	--	--	153.12	8.88	156.59	5.41	154.46	7.54	156.68	5.32	--	--	155.42	6.58	155.52	6.48	152.22	9.78	156.56	5.44	155.55	6.45	156.69	5.31	--	--	156.32	5.68
MW-16S	159.3	150.12	9.18	--	--	--	--	146.51	12.79	--	--	153.42	5.88	150.56	8.74	140.72	18.58	150.45	8.85	--	--	144.49	14.81	150.08	9.22	139.08	20.22	150.45	8.85	148.4	10.9	150.61	8.69	--	--	149.89	9.41
MW-24S	157.19	151.36	5.83	--	--	--	--	148.69	8.5	152.32	4.87	--	--	152.24	4.95	143.07	14.12	152.29	4.9	--	--	153.19	4	150.23	6.96	140.54	16.65	152.19	5	149.72	7.47	151.63	5.56	--	--	151.64	5.55
MW-25S	159.71	--	--	153.13	6.58	151.21	8.5	--	--	153.07	6.64	--	--	153.33	6.38	147.86	11.85	152.71	7	--	--	151.13	8.58	152.96	6.75	145.84	13.87	153.03	6.68	152.46	7.25	153.53	6.18	--	--	152.67	7.04
MW-26S	154.49	149.54	4.95	--	--	--	--	147.18	7.31	148.86	5.63	--	--	149.64	4.85	141.92	12.57	148.43	6.06	--	--	146.81	7.68	147.4	7.09	--	--	146.01	8.48	147.09	7.4	148.68	5.81	--	--	148.83	5.66
MW-3	167.2	159.15	8.05	--	--	160	7.2	--	--	159.77	7.43	--	--	159.55	7.65	157.78	9.42	159.58	7.62	--	--	158.8	8.4	158.74	8.46	154.85	12.35	159.63	7.57	158.52	8.68	159.65	7.55	--	--	159.24	7.96
MW-4B	158.3	153.59	4.71	--	--	153.04	5.26	--	--	--	--	--	--	--	--	151.04	7.26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	153.77	4.53
MW-4A	158.9	154.49	4.41	--	--	154.7	4.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	153.4	5.5	154.76	4.14	149.94	8.96	154.91	3.99	153.9	5	--	--	--	--	155.16	3.74

Notes:

amsl = above mean sea level

DTW = depth to water

GWE = groundwater elevation

TOC = top of casing

-- = not measured

TABLE 3-3
VERTICAL ELEVATION GRADIENT
HERCULES, INC. SITE
ULSTER COUNTY, NEW YORK

Monitoring Well	Hydrostratigraphic Unit	Top of Casing Elevation (ft amsl)	Top of Screen Elevation (ft amsl)	Bottom of Screen Elevation (ft amsl)	Screen Interval Midpoint (ft amsl)	October 4, 1995		September 28, 1999		April 1, 2012		October 1, 2012		April 1, 2013		April 1, 2014		October 1, 2014		April 1, 2015		November 1, 2015	
						GWE (ft amsl)	Vertical Gradient	GWE (ft amsl)	Vertical Gradient	GWE (ft amsl)	Vertical Gradient	GWE (ft amsl)	Vertical Gradient	GWE (ft amsl)	Vertical Gradient	GWE (ft amsl)	Vertical Gradient	GWE (ft amsl)	Vertical Gradient	GWE (ft amsl)	Vertical Gradient	GWE (ft amsl)	Vertical Gradient
MW-15S	Unit 1	162	149.60	139.6	144.6	153.80	0.03	154,44	0.01	155.98	0.03	155.93	-0.03	153.12	0.22	156.59	-0.03	154.46	0.00	156.68	-0.10	155.42	-0.03
MW-15D	Unit 1	162	135.20	129.2	132.2	154.20		154.61		156.29		155.55		155.83		156.25		154.28		155.40		155.10	
MW-24S	Unit 1	157.19	144.60	134.6	139.6	--	--	--	--	151.36	0.12	148.69	0.24	152.32	0.07	152.24	0.08	143.07	0.46	153.83	-0.08	153.06	0.01
MW-24D	Unit 1	157.21	124.75	114.8	119.8	--		--		153.66		153.43		153.63		153.91		152.18		152.29		153.19	
MW-2A	Unit 1	170.7	154.00	144.0	149.0	155.80	0.75	155	1.18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-2B	Unit 1	171.7	152.80	142.8	147.8	156.70		156.42		--		--		--		--		--		--		--	
MW-26S	Unit 1	154.49	141.70	131.7	136.7	--	--	--	-	149.54	-0.07	147.18	-0.03	148.86	-0.05	149.64	-0.07	141.92	0.09	148.43	-0.04	146.81	-0.02
MW-26D	Unit 2	153.7	103.96	93.0	98.5	--		--		146.69		146.05		146.88		147.07		145.37		147.00		146.16	
MW-11S	Unit 1	164.4	148.10	138.1	143.1	154.40	0.005	156.45	0.00240	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-11D	Unit 2	163.9	106.40	96.4	101.4	154.60		156.55		--		--		--		--		--		--		--	
MW-12S	Unit 1	168.9	151.50	141.5	146.5	160.40	-0.18	161.56	-0.15	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-12D	Unit 2	168.4	92.00	82.0	87.0	149.50		152.93		--		--		--		--		--		--		--	
MW-13S	Unit 1	162.5	145.10	135.1	140.1	153.50	-0.74	154.44	-0.46	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-13D	Unit 2	162.4	125.20	115.2	120.2	138.70		145.31		--		--		--		--		--		--		--	
MW-14S	Unit 1	175.6	158.10	148.1	153.1	167.70	-0.29	170.15	-0.09	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-14D	Unit 2	176.1	118.70	108.7	113.7	156.40		166.67		--		--		--		--		--		--		--	
MW-16S	Unit 1	159.3	142.30	132.3	137.3	137.20	0.03	140.02	-0.54	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-16D	Unit 2	159.9	118.40	108.4	113.4	138.00		127.12		--		--		--		--		--		--		--	
MW-20D	Unit 2	161.4	114.40	104.4	109.4	--	--	150.33	-0.06	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-20R	Unit 3	161	99.00	81.0	90.0	--		149.21		--		--		--		--		--		--		--	
MW-21D	Unit 2	164.1	112.10	102.1	107.1	--		146.81	-0.01	150.38	-0.07	149.65	-0.07	149.57	-0.02	150.91	-0.06	147.72	-0.02	149.75	-0.01	148.33	-0.02
MW-21R	Unit 3	162.8	93.80	73.8	83.8	--	--	146.52		148.80		148.10		149.19		149.61		147.21		149.56		147.83	
MW-22D	Unit 2	151.9	121.90	116.9	119.4	--		142.22	-0.02	144.20	-0.02	143.81	-0.02	147.35	-0.21	144.52	-0.02	143.09	-0.02	144.55	-0.02	143.57	-0.02
MW-22R	Unit 3	151.6	113.60	93.6	103.6	--	--	141.88		143.90		143.49		144.05		144.27		142.76		144.23		143.24	

Notes:
Negative values in the vertical gradient column denote a downward gradient.
"--" = vertical gradient not calculated
GWE = groundwater elevation
ft amsl = feet above mean sea level

TABLE 3-3
VERTICAL ELEVATION GRADIENT
HERCULES, INC. SITE
ULSTER COUNTY, NEW YORK

Monitoring Well	Hydrostratigraphic Unit	Top of Casing Elevation (ft amsl)	Top of Screen Elevation (ft amsl)	Bottom of Screen Elevation (ft amsl)	Screen Interval Midpoint (ft amsl)	April 1, 2016		October 1, 2016		April 1, 2017		June 1, 2018		December 1, 2018		May 1, 2019		June 23, 2020		Average Total Vertical Gradient
						GWE (ft amsl)	Vertical Gradient	GWE (ft amsl	Vertical Gradient	GWE (ft amsl)	Vertical Gradient	GWE (ft amsl)	Vertical Gradient	GWE (ft amsl)	Vertical Gradient	GWE (ft amsl)	Vertical Gradient	GWE (ft amsl)	Vertical Gradient	
MW-15S	Unit 1	162	149.60	139.6	144.6	155.52	-0.01	152.22	0.00	156.56	-0.02	155.55	-0.01	156.69	0.03	156.32	-0.02	154.48	-0.01	**0.004**
MW-15D	Unit 1	162	135.20	129.2	132.2	155.38		152.27		156.30		155.41		157.03		156.06		154.35		
MW-24S	Unit 1	157.19	144.60	134.6	139.6	153.03	-0.14	149.99	-0.48	153.61	-0.07	152.83	-0.16	153.61	-0.10	153.36	-0.09	146.77	0.25	**0.008**
MW-24D	Unit 1	157.21	124.75	114.8	119.8	150.23		140.54		152.19		149.72		151.63		151.64		151.80		
MW-2A	Unit 1	170.7	154.00	144.0	149.0	--	--	--	--	--	--	--	--	--	--	--	--	156.94	0.63	**0.853**
MW-2B	Unit 1	171.7	152.80	142.8	147.8	--		--		--		--		--		--		157.69		
MW-26S	Unit 1	154.49	141.70	131.7	136.7	147.40	-0.03	--	-	146.01	0.03	147.09	-0.02	148.68	-0.02	148.83	-0.05	145.12	0.01	**-0.021**
MW-26D	Unit 2	153.7	103.96	93.0	98.5	146.39		143.92		147.00		146.20		147.87		146.80		145.45		
MW-11S	Unit 1	164.4	148.10	138.1	143.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**0.004**
MW-11D	Unit 2	163.9	106.40	96.4	101.4	--		--		--		--		--		--		--		
MW-12S	Unit 1	168.9	151.50	141.5	146.5	--	--	--	--	--	--	--	--	--	--	--	--	162.50	-0.003	**-0.110**
MW-12D	Unit 2	168.4	92.00	82.0	87.0	--		--		--		--		--		--		162.35		
MW-13S	Unit 1	162.5	145.10	135.1	140.1	--	--	--	--	--	--	--	--	--	--	--	--	153.47	-0.37	**-0.523**
MW-13D	Unit 2	162.4	125.20	115.2	120.2	--		--		--		--		--		--		146.16		
MW-14S	Unit 1	175.6	158.10	148.1	153.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**-0.188**
MW-14D	Unit 2	176.1	118.70	108.7	113.7	--		--		--		--		--		--		--		
MW-16S	Unit 1	159.3	142.30	132.3	137.3	--	--	--	--	--	--	--	--	--	--	--	--	146.21	-0.77	**-0.426**
MW-16D	Unit 2	159.9	118.40	108.4	113.4	--		--		--		--		--		--		127.77		
MW-20D	Unit 2	161.4	114.40	104.4	109.4	--	--	--	--	--	--	--	--	--	--	--	--	155.82	-0.05	**-0.055**
MW-20R	Unit 3	161	99.00	81.0	90.0	--		--		--		--		--		--		154.80		
MW-21D	Unit 2	164.1	112.10	102.1	107.1	150.20	-0.06	--		149.67	-0.0004	149.90	-0.03	151.07	-0.04	150.78	-0.04	149.30	-0.02	**-0.033**
MW-21R	Unit 3	162.8	93.80	73.8	83.8	148.72		146.15	-	149.66		149.20		150.18		149.83		148.83		
MW-22D	Unit 2	151.9	121.90	116.9	119.4	144.06	-0.02	141.65	-0.02	144.45	-0.02	143.91	-0.02	144.53	-0.02	144.44	-0.02	143.16	-0.02	**-0.033**
MW-22R	Unit 3	151.6	113.60	93.6	103.6	143.72		141.30		144.16		143.55		144.22		144.12		142.83		

Notes:
Negative values in the vertical gradient column denote a downward gradient.
"--" = vertical gradient not calculated
GWE = groundwater elevation
ft amsl = feet above mean sea level

TABLE 3-4
CONVERTED K HISTORICAL VALUES
HERCULES, INC. SITE
ULSTER COUNTY, NEW YORK

Well Name	Date	Hydraulic Conductivity (cm/sec)	Hydraulic Conductivity (ft/day)	Hydrostratigraphic Unit	Notes
MW-13S	10/27/95	0.0000004	0.001	1	
MW- 2A	1989	0.0000034	0.0096	1	
MW- 4A	1989	0.0000034	0.0096	1	
MW-11S	10/26/95	0.0000046	0.013	1	
MW-16S	10/26/95	0.0000050	0.014	1	
MW-12S	10/27/95	0.0000074	0.021	1	
MW- 4B	10/27/95	0.000017	0.048	1	
MW-14S	10/30/95	0.000018	0.051	1	
MW-10	1989	0.000019	0.054	1	
MW- 9	1989	0.00003	0.09	1	
MW- 3	10/27/95	0.00005	0.1	1	
MW- 5	1989	0.0002	0.7	1	
MW- 2B	10/26/95	0.0003	0.7	1	
MW-15S	10/30/95	0.0007	2	1	Very soft clay across screen
MW- 8	10/27/95	0.0008	2	1	Very soft clay across screen
MW- 7	1989	0.0029	8.2	1	Very soft clay across screen
MW- 6	1989	0.0009	2	2	
MW-12D	10/26/95	0.0010	2.8	2	
MW-14D	10/30/95	0.0014	4.0	2	
MW-17S	10/30/95	0.0078	22	2	
MW-11D	10/27/95	0.0088	25	2	
MW-16D	10/26/95	0.0092	26	2	
MW-15D	10/30/95	0.0140	39.7	2	Angular Gravel and Sand
MW-13D	10/30/95	0.0190	53.9	2	
MW- 1	10/26/1995	0.0001	0.2	3	

Notes:
cm/sec = centimeters per second
ft/day = feet per day

TABLE 4-1
HISTORIC DETECTIONS OF VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER: 2011-2019
HERCULES, INC. SITE
ULSTER COUNTY, NEW YORK

	Analyte	Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl chloride	Toluene	trans-1,3-Dichloropropene	Trichloro-fluoromethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethylene	1,2,4-Trichlorobenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane (EDB)
	Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
	NYSDEC CLASS GA GW STANDARD	5	5	5	5	2	5	0.4	5	5	5	1	5	5	5	0.04	NS
MW-3	4/14/2011	< 500	**41,000**	**480 J**	< 500	< 500	< 500	< 500	< 500	**28,000**	< 500	< 500	**140 J**	**37,000**	< 500	< 500	< 500
	10/11/2011	**77 J**	**24,000**	**340**	< 250	< 250	< 250	< 250	< 250	**19,000**	< 250	< 250	**130 J**	**22,000**	< 250	< 250	< 250
	4/3/2012	< 500	**37,000**	**720**	< 500	< 500	< 500	< 500	< 500	**22,000**	< 500	< 500	**160 J**	**29,000**	< 500	< 500	< 500
	10/24/2012	< 500	**23,000**	**400 J**	< 500	< 500	< 500	< 500	< 500	**15,000**	< 500	< 500	< 500	**23,000**	< 500	< 500	< 500
	4/17/2013	< 500	**30,000**	**420 J**	< 500	< 500	< 500	< 500	< 500	**18,000**	< 500	< 500	< 500	**17,000**	< 500	< 500	< 500
	10/24/2013	< 500	**31,000**	**540**	< 500	< 500	< 500	< 500	< 500	**17,000**	< 500	< 500	< 500	**19,000**	< 500	< 500	< 500
	4/30/2014	< 500	**36,000**	**700**	< 500	< 500	< 500	< 500	< 500	**17,000**	< 500	< 500	**140 J**	**20,000**	< 500	< 500	< 500
	10/23/2014	**130 J**	**33,000**	**890**	< 500	< 500	< 500	< 500	< 500	**15,000**	< 500	< 500	< 500	**27,000**	< 2,500	< 2,500	< 500
	4/15/2015	< 500	**30,000**	**610**	< 500	< 500	< 500	< 500	< 500	**13,000**	< 500	< 500	< 500	**23,000**	< 2,500	< 2,500	< 500
	11/11/2015	< 500	**28,000**	**660**	< 500	< 500	< 500	< 500	< 500	**11,000**	< 500	< 500	< 500	**23,000**	< 2,500	< 2,500	< 500
	4/26/2016	< 250	**28,000**	**750**	< 250	< 250	< 250	< 250	< 250	**12,000**	< 250	< 250	< 250	**28,000**	< 1,300	< 1,300	< 250
	10/19/2016	< 250	**42,000**	**1,100**	< 250	< 250	< 250	< 250	< 250	**15,000**	< 250	< 250	**160 J**	**29,000**	< 1,300	< 1,300	< 250
	4/24/2017	< 250	**31,000**	**670**	< 250	< 250	< 250	< 250	< 250	**9,800**	< 250	< 250	< 250	**23,000**	< 1,300	< 1,300	< 250
	11/7/2017	< 250	**17,000**	**590**	< 250	< 250	< 250	< 250	< 250	**6,800**	< 250	< 250	< 250	**16,000**	< 1,300	< 1,300	< 250
	6/5/2018	< 250	**42,000**	**1,100**	< 250	< 250	< 250	< 250	< 250	**12,000**	< 250*	< 250	**150 J**	**31,000**	< 1,300*	< 1,300	< 250
	12/11/2018	< 100	**25,000**	**670**	< 100	< 100	< 100	< 100	< 100	**7,900**	< 100	< 100	**110**	**20,000**	< 500	< 500	< 100
	5/30/2019	< 250	**28,000**	**770**	< 250	< 250	< 250	< 250	< 250	**8,900**	< 250	< 250	**130 J**	**25,000**	< 1,300	< 1,300	< 250
	10/17/2019	< 250	**27,000**	**960**	< 250	< 250	< 250	< 250	< 250	**7,000**	< 250	< 250	**98 J**	**19,000**	< 1,300	< 1,300	< 250
MW-4A	4/14/2011	< 5,000	**520,000**	< 5,000	< 5,000	< 5,000	< 5,000	< 5,000	< 5,000	< 5,000	< 5,000	< 5,000	< 5,000	< 5,000	< 5,000	< 5,000	< 5,000
	10/11/2011	< 500	**26,000**	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500
	4/3/2012	< 1,300	**97,000**	< 1,300	< 1,300*	< 1,300	< 1,300	< 1,300	< 1,300	< 1,300	< 1,300	< 1,300	< 1,300*	< 1,300	< 1,300	< 1,300	< 1,300
	10/24/2012	< 2,000	**250,000**	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000
	10/24/2013	< 2,000	**360,000**	**650 J**	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000
	10/23/2014	< 2,000	**230,000**	**33,000**	**440 J**	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 10,000	< 10,000	< 2,000
	4/15/2015	< 1,000	**83,000**	**9,800**	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 5,000	< 5,000	< 1,000
	11/11/2015	< 1,000	**140,000**	**92,000**	**800 J**	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 5,000	< 5,000	< 1,000
	4/26/2016	< 1,000	**270,000**	**110,000**	**1,100**	**3,700**	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 5,000	< 5,000	< 1,000
	10/19/2016	< 2,000	**310,000**	**99,000**	**1,500 J**	**4,900**	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	**1,700 J**	< 10,000	< 10,000	< 2,000
	4/24/2017	< 2,000	**240,000**	**68,000**	**780 J**	**3,300**	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 10,000	< 10,000	< 2,000
	11/7/2017	< 2,000	**340,000**	**150,000**	**1,600 J**	**4,700**	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 10,000	< 10,000	< 2,000
	6/5/2018	< 1,000	**260,000**	**72,000**	**730 J**	**1,400**	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000*	< 1,000	< 1,000	< 1,000	< 5,000*	< 5,000	< 1,000
	5/30/2019	< 2,000	**370,000**	**98,000**	**1,000 J**	**2,300**	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 10,000	< 10,000	< 2,000
	10/17/2019	< 100	**170,000 H**	**79,000 H**	**910**	**1,700**	< 100	< 100	< 100	< 100	< 100	< 100	< 100	**92 J**	< 500	< 500	< 100
MW-4B	4/14/2011	< 500	**43,000**	**220 J**	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500
	4/3/2012	< 500	**35,000**	**370 J**	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500
	10/24/2012	< 500	**7,300**	**150 J**	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500
	10/23/2014	< 500	**65,000**	**530**	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 2,500	< 2,500	< 500
	5/30/2019	< 500	**32,000**	**350 J**	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 2,500	< 2,500	< 500
	10/17/2019	< 500	**45,000**	**530**	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 2,500	< 2,500	< 500
MW-21D	4/14/2011	< 1	0.46 J	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	0.19 J	< 1	< 1	< 1
	10/11/2011	< 1.0	0.20 J	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	4/3/2012	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	10/24/2012	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	4/17/2013	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	10/24/2013	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	4/30/2014	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	10/23/2014	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	4/15/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0

TABLE 4-1
HISTORIC DETECTIONS OF VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER: 2011-2019
HERCULES, INC. SITE
ULSTER COUNTY, NEW YORK

	Analyte	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloropropane	1,3-Dichlorobenzene	1,4-Dichlorobenzene	Chloroform	2-Butanone (MEK)	2-Hexanone	Acetone	Cyclohexane	Benzene	Bromo-dichloromethane	Bromoform	Bromomethane	Carbon disulfide	Carbon tetrachloride	Chlorobenzene
	Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
	NYSDEC CLASS GA GW STANDARD	NS	0.6	1	3	3	7	50	50	50	NS	1	50	50	5	NS	5	5
MW-3	4/14/2011	< 500	**150 J**	< 500	< 500	< 500	< 500	< 5,000	< 5,000	< 12,000	< 500	< 500	< 500	< 500	< 500	< 1,000	< 500	< 500
	10/11/2011	< 250	**94 J**	< 250	< 250	< 250	< 250	< 2,500	< 2,500	< 6,300	< 250	< 250	< 250	< 250	< 250	< 500	< 250	< 250
	4/3/2012	< 500	**130 J**	< 500	< 500	< 500	< 500	< 5,000	< 5,000	< 13,000	< 500	< 500	< 500	< 500	< 500	< 1,000	< 500	< 500
	10/24/2012	< 500	< 500	< 500	< 500	< 500	< 500	< 5,000	< 5,000	< 13,000	< 500	< 500	< 500	< 500	< 500	< 1,000	< 500	< 500
	4/17/2013	< 500	**110 J**	< 500	< 500	< 500	< 500	< 5,000	< 5,000	< 13,000	< 500	< 500	< 500	< 500	< 500	< 1,000	< 500	< 500
	10/24/2013	< 500	< 500	< 500	< 500	< 500	< 500	< 5,000	< 5,000	< 13,000	< 500	< 500	< 500	< 500	< 2,500	< 1,000	< 500	< 500
	4/30/2014	< 500	**140 J**	< 500	< 500	< 500	**190 BJ**	< 5,000	< 5,000	< 13,000	< 500	< 500	< 500	< 500	< 2,500	< 1,000	< 500	< 500
	10/23/2014	< 500	**220 J**	< 500	< 500	< 500	< 500	< 5,000	< 5,000	< 5,000	< 500	< 500	< 500	< 500	< 2,500	< 1,000	< 500	< 500
	4/15/2015	< 500	< 500	< 500	< 500	< 500	< 500	< 5,000	< 5,000	< 5,000	< 500	< 500	< 500	< 500	< 2,500	< 1,000	< 500	< 500
	11/11/2015	< 500	< 500	< 500	< 500	< 500	< 500	< 5,000	< 5,000	< 5,000	< 500	< 500	< 500	< 500	< 2,500	< 1,000	< 500	< 500
	4/26/2016	< 250	< 250	< 250	< 250	< 250	< 250	< 2,500	< 2,500	< 2,500	< 250	< 250	< 250	< 250	< 1,300	< 500	< 250	< 250
	10/19/2016	< 250	**180 J**	< 250	< 250	< 250	< 250	< 2,500	< 2,500	< 2,500	< 250	< 250	< 250	< 250	< 1,300	< 500	< 250	< 250
	4/24/2017	< 250	< 250	< 250	< 250	< 250	< 250	< 2,500	< 2,500	< 2,500	< 250	< 250	< 250	< 250	< 1,300	< 500	< 250	< 250
	11/7/2017	< 250	< 250	< 250	< 250	< 250	< 250	< 2,500	< 2,500	< 2,500	< 250	< 250	< 250	< 250	< 1,300	< 500	< 250	< 250
	6/5/2018	< 250	**150 J**	< 250	< 250	< 250	< 250	< 2,500*	< 2,500	< 2,500	< 250	< 250	< 250	< 250	< 1,300	< 500	< 250	< 250
	12/11/2018	< 100	**100**	< 100	< 100	< 100	< 100	< 1,000	< 1,000	< 1,000	< 100	< 100	< 100	< 100	< 500	< 200	< 100	< 100
	5/30/2019	< 250	< 250	< 250	< 250	< 250	< 250	< 2,500	< 2,500	< 2,500	< 250	< 250	< 250	< 250	< 1,300*	< 500	< 250	< 250
	10/17/2019	< 250	**130 J**	< 250	< 250	< 250	< 250	< 2,500	< 2,500	< 2,500	< 250	< 250	< 250	< 250	< 1,300*	< 500	< 250	< 250
MW-4A	4/14/2011	< 5,000	< 5,000	< 5,000	< 5,000	< 5,000	< 5,000	< 50,000	< 50,000	< 12,0000	< 5,000	< 5,000	< 5,000	< 5,000	< 5,000	< 10,000	< 5,000	< 5,000
	10/11/2011	< 500	< 500	< 500	< 500	< 500	**160 J**	< 5,000	< 5,000	< 13,000	< 500	< 500	< 500	< 500	< 500	< 1,000	< 500	< 500
	4/3/2012	< 1,300	< 1,300	< 1,300	< 1,300	< 1,300	< 1,300	< 13,000	< 13,000	< 31000	< 1,300	< 1,300	< 1,300	< 1,300	< 1,300	< 2,500	< 1,300	< 1,300
	10/24/2012	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 20,000	< 20,000	< 50,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 4000	< 2,000	< 2,000
	10/24/2013	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 20,000	< 20,000	< 50,000	< 2,000	< 2,000	< 2,000	< 2,000	< 10,000	< 4000	< 2,000	< 2,000
	10/23/2014	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 20,000	< 20,000	< 20,000	< 2,000	< 2,000	< 2,000	< 2,000	< 10,000	< 4000	< 2,000	< 2,000
	4/15/2015	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 10,000	< 10,000	< 10,000	470 J	< 1,000	< 1,000	< 1,000F	< 5,000	< 2,000	< 1,000	< 1,000
	11/11/2015	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 10,000	< 10,000	< 10,000	< 1,000	**610 J**	< 1,000	< 1,000	< 5,000	< 2,000	< 1,000	< 1,000
	4/26/2016	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 10,000	< 10,000	< 10,000	< 1,000	< 1,000	< 1,000	< 1,000	< 5,000	< 2,000	< 1,000	< 1,000
	10/19/2016	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 20,000	< 20,000	< 20,000	< 2,000	< 2,000	< 2,000	< 2,000	< 10,000	< 4000	< 2,000	< 2,000
	4/24/2017	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 20,000	< 20,000	< 20,000	< 2,000	< 2,000	< 2,000	< 2,000	< 10,000	< 4000	< 2,000	< 2,000
	11/7/2017	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 20,000	< 20,000	< 20,000	< 2,000	< 2,000	< 2,000	< 2,000	< 10,000	< 4000	< 2,000	< 2,000
	6/5/2018	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 10,000*	< 10,000	< 10,000	< 1,000	< 1,000	< 1,000	< 1,000	< 5,000	< 2,000	< 1,000	< 1,000
	5/30/2019	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 20,000	< 20,000	< 20,000	< 2,000	< 2,000	< 2,000	< 2,000	< 10,000*	< 4000	< 2,000	< 2,000
	10/17/2019	< 100	< 100	< 100	< 100	< 100	< 100	< 1,000	< 1,000	< 1,000	< 100	< 100	< 100	< 100	< 500	< 200	< 100	< 100
MW-4B	4/14/2011	< 500	< 500	< 500	< 500	< 500	< 500	< 5,000	< 5,000	< 12,000	< 500	< 500	< 500	< 500	< 500	< 1,000	< 500	< 500
	4/3/2012	< 500	< 500	< 500	< 500	< 500	< 500	< 5,000	< 5,000	< 13,000	< 500	< 500	< 500	< 500	< 500	< 1,000	< 500	< 500
	10/24/2012	< 500	< 500	< 500	< 500	< 500	< 500	< 5,000	< 5,000	< 13,000	< 500	< 500	< 500	< 500	< 500	< 1,000	< 500	< 500
	10/23/2014	< 500	< 500	< 500	< 500	< 500	< 500	**970 J**	< 5,000	< 5,000	< 500	< 500	< 500	< 500	< 2,500	< 1,000	< 500	< 500
	5/30/2019	< 500	< 500	< 500	< 500	< 500	< 500	< 5,000	< 5,000	< 5,000	< 500	< 500	< 500	< 500	< 2,500*	< 1,000	< 500	< 500
	10/17/2019	< 500	< 500	< 500	< 500	< 500	< 500	< 5,000	< 5,000	< 5,000	< 500	< 500	< 500	< 500	< 2,500*	< 1,000	< 500	< 500
MW-21D	4/14/2011	< 1	< 1	< 1	< 1	< 1	< 1	< 10	< 10	5.5 J	< 1	< 1	< 1	< 1	< 1	< 2	< 1	< 1
	10/11/2011	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 25	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0
	4/3/2012	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 25	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0
	10/24/2012	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 25	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0
	4/17/2013	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 25	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0
	10/24/2013	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 25	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	4/30/2014	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	0.25 BJ	< 10	< 10	< 25	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	10/23/2014	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	4/15/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0

TABLE 4-1
HISTORIC DETECTIONS OF VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER: 2011-2019
HERCULES, INC. SITE
ULSTER COUNTY, NEW YORK

Analyte		Chloromethane	cis-1,3-Dichloropropene	Dibromo-chloromethane	Dichloro-difluoromethane	Ethylbenzene	Freon 113	Isopropylbenzene	Methyl acetate	Methyl Isobutyl Ketone	Methylcyclohexane	Methyl-tertiary-butyl ether	Styrene	Xylene (Total)
Unit		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
NYSDEC CLASS GA GW STANDARD		NS	0.4	50	5	5	5	5	NS	NS	NS	NS	5	5
MW-3	4/14/2011	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500*	< 5,000	< 500	< 5,000	< 500	< 1,000
	10/11/2011	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 2,500	< 250	< 2,500	< 250	< 500
	4/3/2012	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 5,000	< 500	< 5,000	< 500	< 1,000
	10/24/2012	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 5,000	< 500	< 5,000	< 500	< 1,000
	4/17/2013	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 5,000	< 500	< 5,000	< 500	< 1,000
	10/24/2013	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 5,000	< 500	< 5,000	< 500	< 1,000
	4/30/2014	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 5,000	< 500	< 5,000	< 500	< 1,000
	10/23/2014	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 2,500	< 5,000	< 500	< 5,000	< 500	< 1,000
	4/15/2015	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 2,500	< 5,000	< 500	< 5,000	< 500	< 500
	11/11/2015	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 2,500	< 5,000	< 500	< 5,000	< 500	< 500
	4/26/2016	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 1,300	< 2,500	< 250	< 2,500	< 250	< 250
	10/19/2016	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 1,300	< 2,500	< 250	< 2,500	< 250	< 250
	4/24/2017	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 1,300	< 2,500	< 250	< 2,500	< 250	< 250
	11/7/2017	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 1,300	< 2,500	< 250	< 2,500	< 250	< 250
	6/5/2018	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 1,300	< 2,500	< 250	210 J	< 250	< 250
	12/11/2018	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 500	< 1,000	< 100	< 1,000	< 100	< 100
	5/30/2019	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 1,300	< 2,500	< 250	< 2,500	< 250	< 250
	10/17/2019	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 1,300	< 2,500	< 250*	< 2,500	< 250	< 250
MW-4A	4/14/2011	< 5,000	< 5,000	< 5,000	< 5,000	< 5,000	< 5,000	< 5,000	< 5,000*	< 50,000	< 5,000	< 50,000	< 5,000	< 10,000
	10/11/2011	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 5,000	< 500	< 5,000	< 500	< 1,000
	4/3/2012	< 1,300	< 1,300	< 1,300	< 1,300	< 1,300	< 1,300	< 1,300	< 1,300	< 13,000	< 1,300	< 13,000	< 1,300	< 2,500
	10/24/2012	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 20,000	< 2,000	< 20,000	< 2,000	< 4000
	10/24/2013	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 20,000	< 2,000	< 20,000	< 2,000	< 4000
	10/23/2014	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 10,000	< 20,000	< 2,000	< 20,000	< 2,000	< 4000
	4/15/2015	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 5,000	< 10,000	< 1,000	< 10,000	< 1,000	< 1,000
	11/11/2015	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 5,000	< 10,000	< 1,000	< 10,000	< 1,000	< 1,000
	4/26/2016	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 5,000	< 10,000	< 1,000	< 10,000	< 1,000	< 1,000
	10/19/2016	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 10,000	< 20,000	< 2,000	< 20,000	< 2,000	< 2,000
	4/24/2017	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 10,000	< 20,000	< 2,000	< 20,000	< 2,000	< 2,000
	11/7/2017	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 10,000	< 20,000	< 2,000	< 20,000	< 2,000	< 2,000
	6/5/2018	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 5,000	< 10,000	< 1,000	< 10,000	< 1,000	< 1,000
	5/30/2019	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 2,000	< 10,000	< 20,000	< 2,000	< 20,000	< 2,000	< 2,000
	10/17/2019	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 500	< 1,000	< 100	< 1,000	< 100	< 100
MW-4B	4/14/2011	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 5,000	< 500	< 5,000	< 500	< 1,000
	4/3/2012	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 5,000	< 500	< 5,000	< 500	< 1,000
	10/24/2012	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 5,000	< 500	< 5,000	< 500	< 1,000
	10/23/2014	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 2,500	< 5,000	< 500	< 5,000	< 500	< 1,000
	5/30/2019	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 2,500	< 5,000	< 500	< 5,000	< 500	< 500
	10/17/2019	< 500	< 500	< 500	< 500	< 500	< 500	< 500	< 2,500	< 5,000	< 500*	< 5,000	< 500	< 500
MW-21D	4/14/2011	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 10	< 1	< 10	< 1	< 2
	10/11/2011	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	4/3/2012	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	10/24/2012	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	4/17/2013	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	10/24/2013	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	4/30/2014	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	10/23/2014	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	4/15/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0

TABLE 4-1
HISTORIC DETECTIONS OF VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER: 2011-2019
HERCULES, INC. SITE
ULSTER COUNTY, NEW YORK

Analyte		Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl chloride	Toluene	trans-1,3-Dichloropropene	Trichloro-fluoromethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethylene	1,2,4-Trichlorobenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane (EDB)
Unit		**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
NYSDEC CLASS GA GW STANDARD		**5**	**5**	**5**	**5**	**2**	**5**	**0.4**	**5**	**5**	**5**	**1**	**5**	**5**	**5**	**0.04**	**NS**
MW-21D (cont'd.)	11/11/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	4/26/2016	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	10/19/2016	< 1.0F1	< 1.0	< 1.0	< 1.0	< 1.0F1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0F1	< 5.0	< 5.0	< 1.0
	4/24/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	11/7/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	6/5/2018	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0*	< 1.0	< 1.0	< 1.0	< 5.0*	< 5.0	< 1.0
	12/11/2018	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	5/30/2019	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	10/17/2019	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
MW-21R	4/14/2011	< 1	**5**	0.63 J	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
	10/11/2011	< 1.0	**6.1**	1.1	0.23 J	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	4/3/2012	< 1.0	2.3	0.59 J	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	10/24/2012	< 1.0	2.1	0.43 J	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	4/17/2013	< 1.0	1.1	0.21 J	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	10/24/2013	< 1.0	1.9	0.61 J	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	4/30/2014	< 1.0	0.96 J	0.41 J	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	10/23/2014	< 1.0	1.1	0.86 J	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	4/15/2015	< 1.0	0.79 J	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	11/11/2015	< 1.0	1.8	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	4/26/2016	< 1.0	1.5	0.50 J	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	10/19/2016	< 1.0	1.6	0.61 J	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	4/24/2017	< 1.0	3.7	0.75 J	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	11/7/2017	< 1.0	3.7	3.5	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	6/5/2018	< 1.0	3.6	2	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0*	< 1.0	< 1.0	< 1.0	< 5.0*	< 5.0	< 1.0
	12/11/2018	< 1.0	4.8	2.8	0.39 J	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	5/30/2019	< 1.0	3.4	1.8	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	10/17/2019	< 1.0	2.9	2.2	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
MW-22D	4/14/2011	< 1	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	0.2 J	< 1	< 1	< 1
	10/11/2011	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	4/4/2012	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	10/24/2012	< 1.0	0.14 J	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	10/23/2013	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	4/30/2014	< 1.0	0.27 J	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	10/23/2014	< 1.0	0.27 J	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	4/15/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	11/11/2015	< 1.0	**45**	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	**6.6**	< 1.0	< 1.0	< 1.0	**18**	< 5.0	< 5.0	< 1.0
	4/26/2016	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	10/19/2016	< 1.0	0.75 J	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	4/24/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	11/7/2017	< 1.0	0.62 J	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	6/5/2018	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0*	< 1.0	< 1.0	< 1.0	< 5.0*	< 5.0	< 1.0
	12/11/2018	< 1.0*	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	5/30/2019	< 1.0	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	10/17/2019	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
MW-22R	4/14/2011	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
	10/11/2011	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	4/4/2012	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

TABLE 4-1
HISTORIC DETECTIONS OF VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER: 2011-2019
HERCULES, INC. SITE
ULSTER COUNTY, NEW YORK

	Analyte	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloropropane	1,3-Dichlorobenzene	1,4-Dichlorobenzene	Chloroform	2-Butanone (MEK)	2-Hexanone	Acetone	Cyclohexane	Benzene	Bromo-dichloromethane	Bromoform	Bromomethane	Carbon disulfide	Carbon tetrachloride	Chlorobenzene
	Unit	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
	NYSDEC CLASS GA GW STANDARD	**NS**	**0.6**	**1**	**3**	**3**	**7**	**50**	**50**	**50**	**NS**	**1**	**50**	**50**	**5**	**NS**	**5**	**5**
MW-21D (cont'd.)	11/11/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	4/26/2016	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	10/19/2016	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10F1	< 10F1F2	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0F1	< 2.0F1	< 1.0	< 1.0
	4/24/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	11/7/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	6/5/2018	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10*	< 10	14	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	12/11/2018	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	5/30/2019	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	10/17/2019	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0*	< 2.0	< 1.0	< 1.0
MW-21R	4/14/2011	< 1	< 1	< 1	< 1	< 1	< 1	< 10	< 10	< 25	< 1	< 1	< 1	< 1	< 1	< 2	< 1	< 1
	10/11/2011	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 25	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0
	4/3/2012	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 25	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0
	10/24/2012	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 25	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0
	4/17/2013	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 25	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0
	10/24/2013	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 25	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	4/30/2014	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	8.5 J	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	10/23/2014	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	4/15/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	11/11/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	4/26/2016	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	10/19/2016	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	4/24/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	11/7/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	6/5/2018	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10*	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	12/11/2018	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	8.9 J	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	5/30/2019	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10*	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	10/17/2019	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0*	< 2.0	< 1.0	< 1.0
MW-22D	4/14/2011	< 1	< 1	< 1	< 1	< 1	< 1	< 10	< 10	< 25	< 1	< 1	< 1	< 1	< 1	< 2	< 1	< 1
	10/11/2011	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 25	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0
	4/4/2012	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 25	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0
	10/24/2012	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 25	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0
	10/23/2013	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 25	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	4/30/2014	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	0.27 BJ	< 10	< 10	< 25	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	10/23/2014	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	4/15/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	11/11/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	4/26/2016	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	10/19/2016	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	4/24/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	11/7/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	6/5/2018	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10*	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	12/11/2018	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0*	< 2.0	< 1.0	< 1.0
	5/30/2019	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	10/17/2019	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0*	< 2.0	< 1.0	< 1.0
MW-22R	4/14/2011	< 1	< 1	< 1	< 1	< 1	< 1	< 10	< 10	< 25	< 1	< 1	< 1	< 1	< 1	< 2	< 1	< 1
	10/11/2011	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 25	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0
	4/4/2012	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 25	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0

TABLE 4-1
HISTORIC DETECTIONS OF VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER: 2011-2019
HERCULES, INC. SITE
ULSTER COUNTY, NEW YORK

	Analyte	**Chloromethane**	**cis-1,3-Dichloropropene**	**Dibromo-chloromethane**	**Dichloro-difluoromethane**	**Ethylbenzene**	**Freon 113**	**Isopropylbenzene**	**Methyl acetate**	**Methyl Isobutyl Ketone**	**Methylcyclohexane**	**Methyl-tertiary-butyl ether**	**Styrene**	**Xylene (Total)**
	Unit	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
	NYSDEC CLASS GA GW STANDARD	**NS**	**0.4**	**50**	**5**	**5**	**5**	**5**	**NS**	**NS**	**NS**	**NS**	**5**	**5**
MW-21D (cont'd.)	11/11/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	4/26/2016	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	10/19/2016	< 1.0F1	< 1.0	< 1.0	< 1.0F1	< 1.0	< 1.0	< 1.0	< 5.0F1	< 10	< 1.0	< 10	< 1.0	< 1.0
	4/24/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	11/7/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	6/5/2018	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	12/11/2018	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	5/30/2019	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	10/17/2019	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
MW-21R	4/14/2011	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 10	< 1	< 10	< 1	< 2
	10/11/2011	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	4/3/2012	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	10/24/2012	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	4/17/2013	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	10/24/2013	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	4/30/2014	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	10/23/2014	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	4/15/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	11/11/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	4/26/2016	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	10/19/2016	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	4/24/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	11/7/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	6/5/2018	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	12/11/2018	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	5/30/2019	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	10/17/2019	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
MW-22D	4/14/2011	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 10	< 1	< 10	< 1	< 2
	10/11/2011	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	4/4/2012	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	10/24/2012	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	10/23/2013	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	4/30/2014	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	10/23/2014	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	4/15/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	11/11/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	4/26/2016	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	10/19/2016	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	4/24/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	11/7/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	6/5/2018	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	12/11/2018	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	5/30/2019	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	10/17/2019	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
MW-22R	4/14/2011	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 10	< 1	< 10	< 1	< 2
	10/11/2011	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	4/4/2012	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0

TABLE 4-1
HISTORIC DETECTIONS OF VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER: 2011-2019
HERCULES, INC. SITE
ULSTER COUNTY, NEW YORK

	Analyte	**Tetrachloroethene**	**Trichloroethene**	**cis-1,2-Dichloroethene**	**trans-1,2-Dichloroethene**	**Vinyl chloride**	**Toluene**	**trans-1,3-Dichloropropene**	**Trichloro-fluoromethane**	**1,1,1-Trichloroethane**	**1,1,2,2-Tetrachloroethane**	**1,1,2-Trichloroethane**	**1,1-Dichloroethane**	**1,1-Dichloroethylene**	**1,2,4-Trichlorobenzene**	**1,2-Dibromo-3-chloropropane**	**1,2-Dibromoethane (EDB)**
	Unit	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
	NYSDEC CLASS GA GW STANDARD	**5**	**5**	**5**	**5**	**2**	**5**	**0.4**	**5**	**5**	**5**	**1**	**5**	**5**	**5**	**0.04**	**NS**
MW-22R (cont'd.)	10/24/2012	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	10/23/2013	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	4/30/2014	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	10/23/2014	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	4/15/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	11/11/2015	< 1.0	**23**	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	3.3	< 1.0	< 1.0	< 1.0	**9.5**	< 5.0	< 5.0	< 1.0
	4/26/2016	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	10/19/2016	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	4/24/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	4/24/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	11/7/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	11/7/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	6/5/2018	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0F1	< 1.0	< 1.0	< 1.0*F1	< 1.0F1	< 1.0	< 1.0	< 5.0*F1F2	< 5.0F1F2	< 1.0F1
	12/12/2018	< 1.0*	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	12/12/2018	< 1.0*	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	5/30/2019	< 1.0F2	< 1.0F2	< 1.0	< 1.0	< 1.0F1F2	< 1.0F2	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0F2	< 1.0	< 1.0	< 5.0F1F2	< 5.0F2	< 1.0
	10/17/2019	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
MW-25S	4/14/2011	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
	10/11/2011	< 1.0	0.67 J	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	4/4/2012	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	10/24/2012	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	4/17/2013	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	10/23/2013	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	4/30/2014	< 1.0	0.16 J	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	10/23/2014	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	4/15/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	11/11/2015	< 1.0	**39**	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	3.7	< 1.0	< 1.0	< 1.0	**9.7**	< 5.0	< 5.0	< 1.0
	4/26/2016	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	10/19/2016	< 1.0	0.75 J	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	4/24/2017	< 1.0	**5.9**	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.3	< 1.0	< 1.0	< 1.0	1.9	< 5.0	< 5.0	< 1.0
	8/16/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	11/7/2017	< 1.0	< 1.0	0.89 J	0.44 J	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	6/5/2018	< 1.0	2.6	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0*	< 1.0	< 1.0	< 1.0	< 5.0*	< 5.0	< 1.0
	12/12/2018	< 1.0*	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	5/30/2019	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0
	10/17/2019	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 5.0	< 1.0

TABLE 4-1
HISTORIC DETECTIONS OF VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER: 2011-2019
HERCULES, INC. SITE
ULSTER COUNTY, NEW YORK

	Analyte	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloropropane	1,3-Dichlorobenzene	1,4-Dichlorobenzene	Chloroform	2-Butanone (MEK)	2-Hexanone	Acetone	Cyclohexane	Benzene	Bromo-dichloromethane	Bromoform	Bromomethane	Carbon disulfide	Carbon tetrachloride	Chlorobenzene
	Unit	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
	NYSDEC CLASS GA GW STANDARD	**NS**	**0.6**	**1**	**3**	**3**	**7**	**50**	**50**	**50**	**NS**	**1**	**50**	**50**	**5**	**NS**	**5**	**5**
MW-22R (cont'd.)	10/24/2012	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 25	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0
	10/23/2013	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 25	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	4/30/2014	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	0.20 BJ	< 10	< 10	< 25	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	10/23/2014	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	4/15/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	11/11/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	4/26/2016	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	10/19/2016	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	4/24/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10F1	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	4/24/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	11/7/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	11/7/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10*	< 10*	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	6/5/2018	< 1.0F1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10*F1	< 10F1	< 10F1	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0F2	< 2.0	< 1.0	< 1.0
	12/12/2018	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0*	< 2.0	< 1.0	< 1.0
	12/12/2018	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0*F2	< 2.0	< 1.0	< 1.0
	5/30/2019	< 1.0F2	< 1.0	< 1.0F2	< 1.0F2	< 1.0F2	< 1.0F1	< 10*	< 10F2	< 10	< 1.0	< 1.0	< 1.0F2	< 1.0F2	3.0 JB	< 2.0	< 1.0F1	< 1.0
	10/17/2019	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0*	< 2.0	< 1.0	< 1.0
MW-25S	4/14/2011	< 1	< 1	< 1	< 1	< 1	< 1	< 10	< 10	< 25	< 1	< 1	< 1	< 1	< 1	< 2	< 1	< 1
	10/11/2011	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 25	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0
	4/4/2012	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 25	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0
	10/24/2012	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 25	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0
	4/17/2013	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 25	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0
	10/23/2013	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 25	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	4/30/2014	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	0.28 BJ	< 10	< 10	< 25	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	10/23/2014	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	4/15/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	11/11/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	4/26/2016	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	10/19/2016	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	4/24/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	8/16/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	11/7/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10*	< 10*	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	6/5/2018	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10*	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 2.0	< 1.0	< 1.0
	12/12/2018	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0*	< 2.0	< 1.0	< 1.0
	5/30/2019	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10*	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	2.8 JB	< 2.0	< 1.0	< 1.0
	10/17/2019	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 10	< 10	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0*	< 2.0	< 1.0	< 1.0

TABLE 4-1
HISTORIC DETECTIONS OF VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER: 2011-2019
HERCULES, INC. SITE
ULSTER COUNTY, NEW YORK

	Analyte	Chloromethane	cis-1,3-Dichloropropene	Dibromo-chloromethane	Dichloro-difluoromethane	Ethylbenzene	Freon 113	Isopropylbenzene	Methyl acetate	Methyl Isobutyl Ketone	Methylcyclohexane	Methyl-tertiary-butyl ether	Styrene	Xylene (Total)
	Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
	NYSDEC CLASS GA GW STANDARD	NS	0.4	50	5	5	5	5	NS	NS	NS	NS	5	5
MW-22R (cont'd.)	10/24/2012	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	10/23/2013	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	4/30/2014	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	10/23/2014	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	4/15/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	11/11/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	4/26/2016	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	10/19/2016	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	4/24/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	4/24/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	11/7/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	11/7/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10*	< 1.0	< 10	< 1.0	< 1.0
	6/5/2018	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10F1	< 1.0	< 10F1	< 1.0	< 1.0
	12/12/2018	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	12/12/2018	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	5/30/2019	< 1.0	< 1.0F2	< 1.0F2	< 1.0F1	< 1.0	< 1.0	< 1.0	< 5.0	< 10F2	< 1.0F2	< 10	< 1.0	< 1.0
	10/17/2019	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0*	< 10	< 1.0	< 1.0
MW-25S	4/14/2011	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 10	< 1	< 10	< 1	< 2
	10/11/2011	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	4/4/2012	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	10/24/2012	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	4/17/2013	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	10/23/2013	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	4/30/2014	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	10/23/2014	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 2.0
	4/15/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	11/11/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	4/26/2016	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	10/19/2016	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	4/24/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	8/16/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	11/7/2017	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10*	< 1.0	< 10	< 1.0	< 1.0
	6/5/2018	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	12/12/2018	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	5/30/2019	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0
	10/17/2019	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 5.0	< 10	< 1.0	< 10	< 1.0	< 1.0

TABLE 4-1
HISTORIC DETECTIONS OF VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER: 2011-2019
HERCULES, INC. SITE
ULSTER COUNTY, NEW YORK

Notes:

µg/L = micrograms per liter

Analytes not detected are <u>not</u> included on this table.

< - Indicates the analyte was analyzed for but not detected at the noted reporting limit.

J - The result is less than the reporting limit (RL) but greater or equal to the method detection limit (MDL) and the concentration is an approximate value.

B - Compound was found in the blank sample.

H - Sample was prepped or analyzed beyond the specified holding time.

* - RPD of the LCS and LCSD exceeds the control limits.

F1 - MS and/or MSD Recovery is outside acceptable limits.

F2 - MS/MSD RPD exceeds control limits.

Shaded/bold exceeds New York Department of Environmental Conservation (NYSDEC) Class GA Groundwater (GW) Standards

LCS = laboratory control sample

LCSD = laboratory control sample duplicate

MS = matrix spike

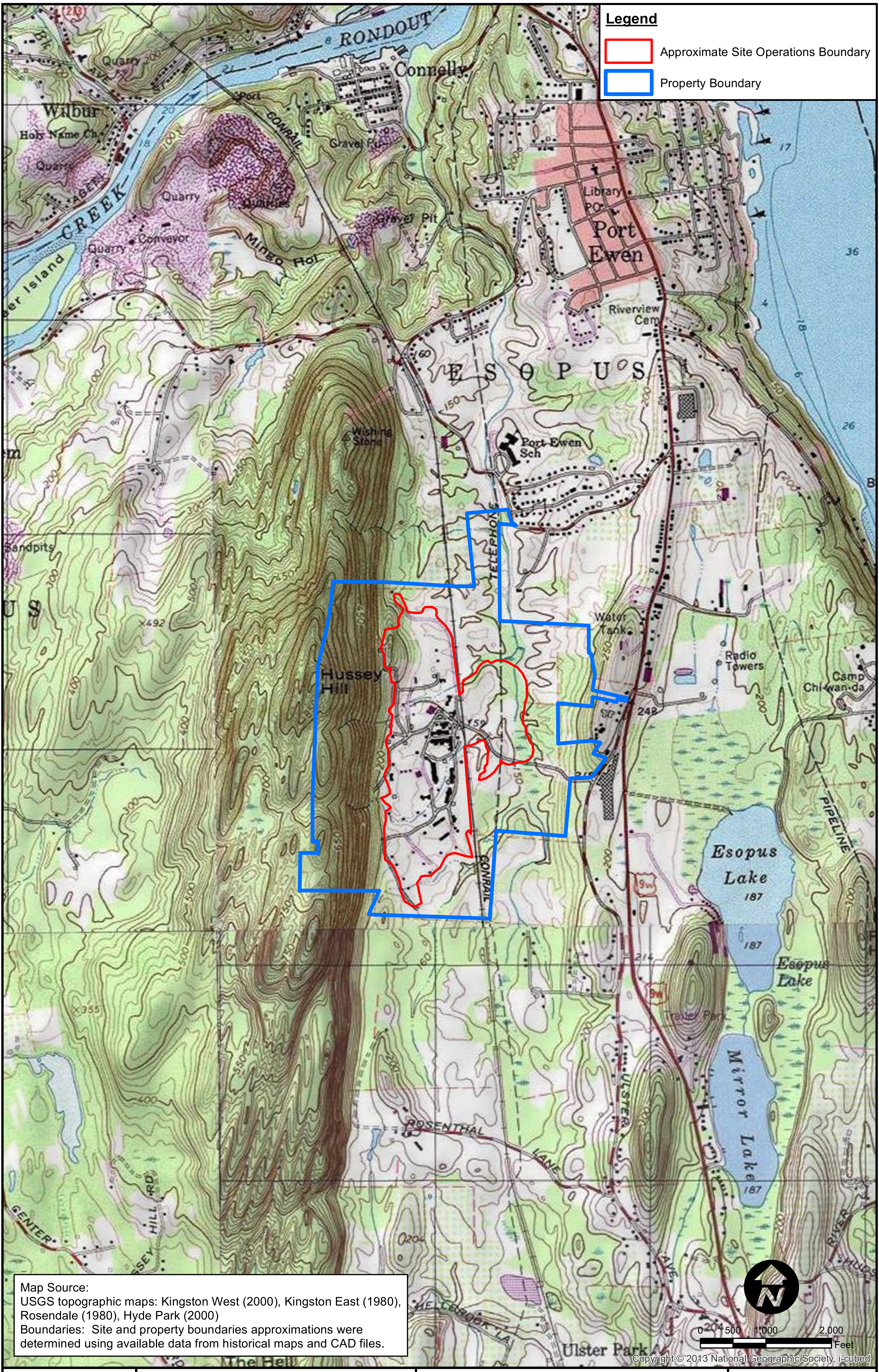
MSD = matrix spike duplicate

Figures

Legend

🟥 Approximate Site Operations Boundary

🟦 Property Boundary



Map Source:
USGS topographic maps: Kingston West (2000), Kingston East (1980), Rosendale (1980), Hyde Park (2000)
Boundaries: Site and property boundaries approximations were determined using available data from historical maps and CAD files.

J:\EHS_GIS\C00363_AshlandPortEwen\01_ANALYSIS\20190605_PublicOutreachPosters\11x17_Figures\Figure 1-1 - Site Location Map.mxd

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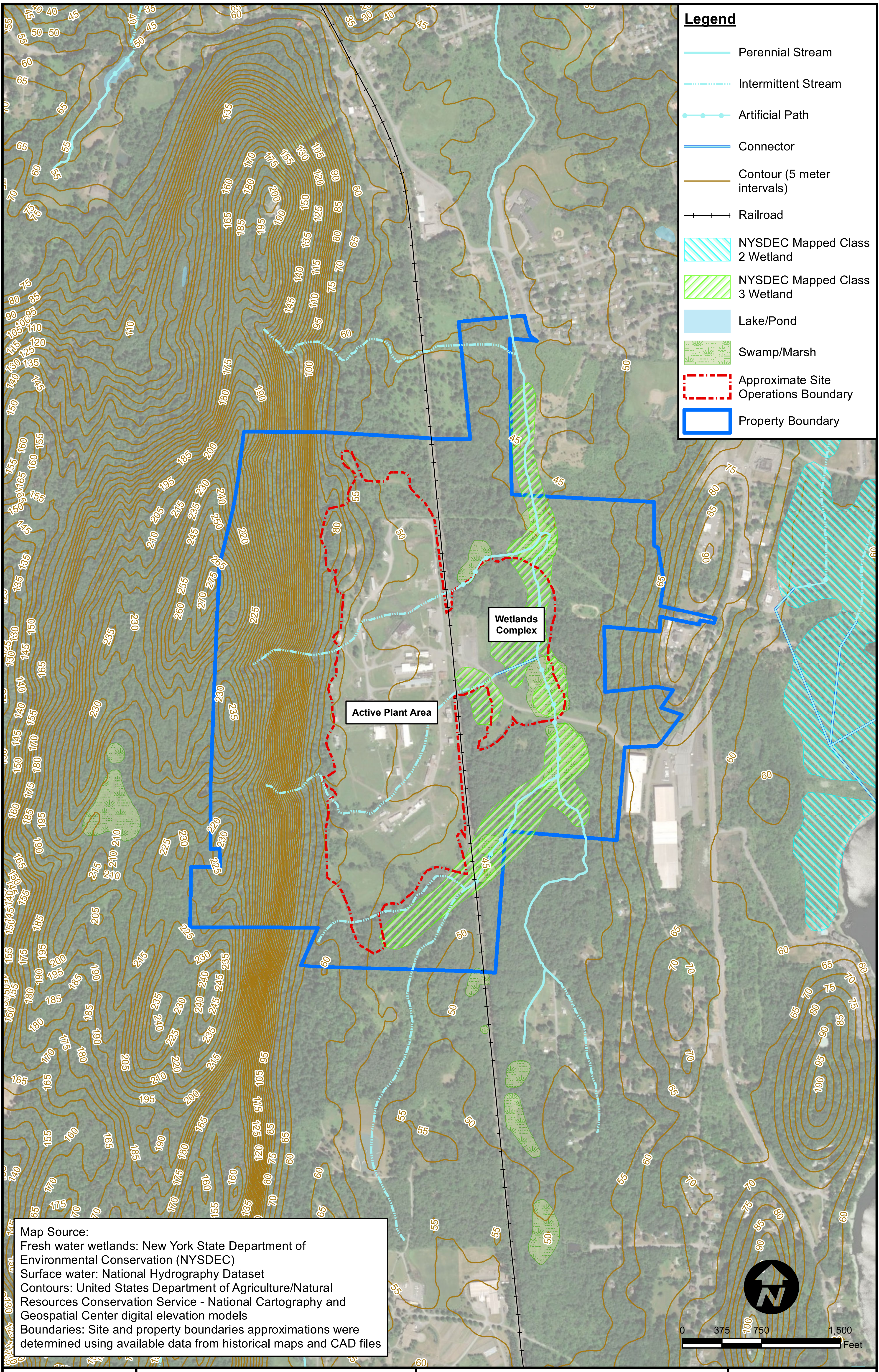
Reviewed By: K. VanLandingham

EHS Support

HERCULES INC. SITE
ULSTER COUNTY, NEW YORK
REGISTRY NO. 356001

SITE LOCATION MAP

FIGURE 1-1



Map Source:
Fresh water wetlands: New York State Department of Environmental Conservation (NYSDEC)
Surface water: National Hydrography Dataset
Contours: United States Department of Agriculture/Natural Resources Conservation Service - National Cartography and Geospatial Center digital elevation models
Boundaries: Site and property boundaries approximations were determined using available data from historical maps and CAD files

J:\EHSS_GIS\C00363_AshlandPortEwen\01_ANALYSIS\20190605_PublicOutreachPosters\11x17_Figures\Figure 2-1 - Site Setting.mxd

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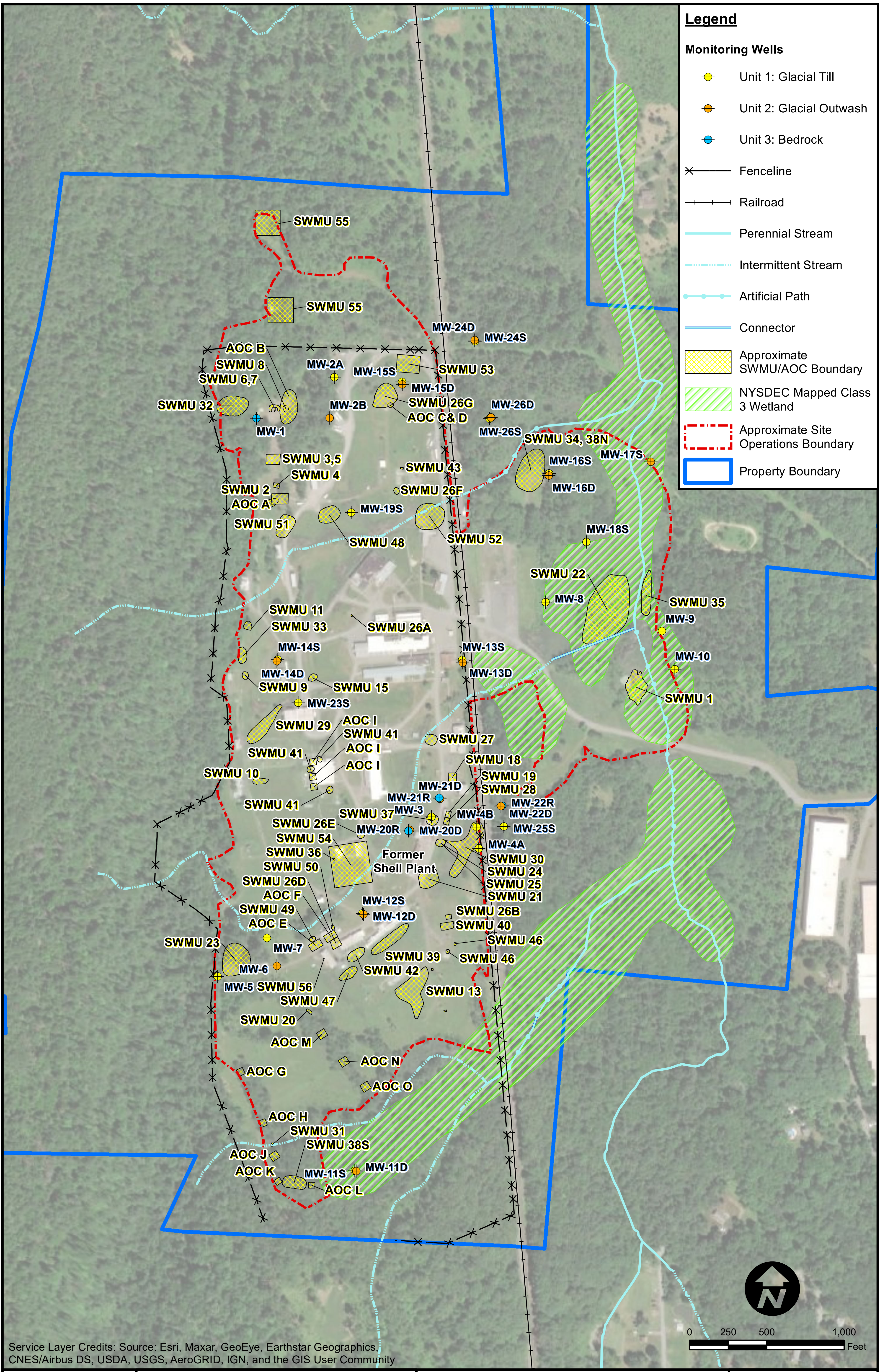
EHS Support	HERCULES INC. SITE ULSTER COUNTY, NEW YORK REGISTRY NO. 356001	SITE SETTING	FIGURE 2-1



Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

J:\EHSS_GIS\C00363_AshlandPortEwen\01_ANALYSIS\20190605_PublicOutreachPosters\11x17_Figures\Figure 2-2 - Site Layout.mxd

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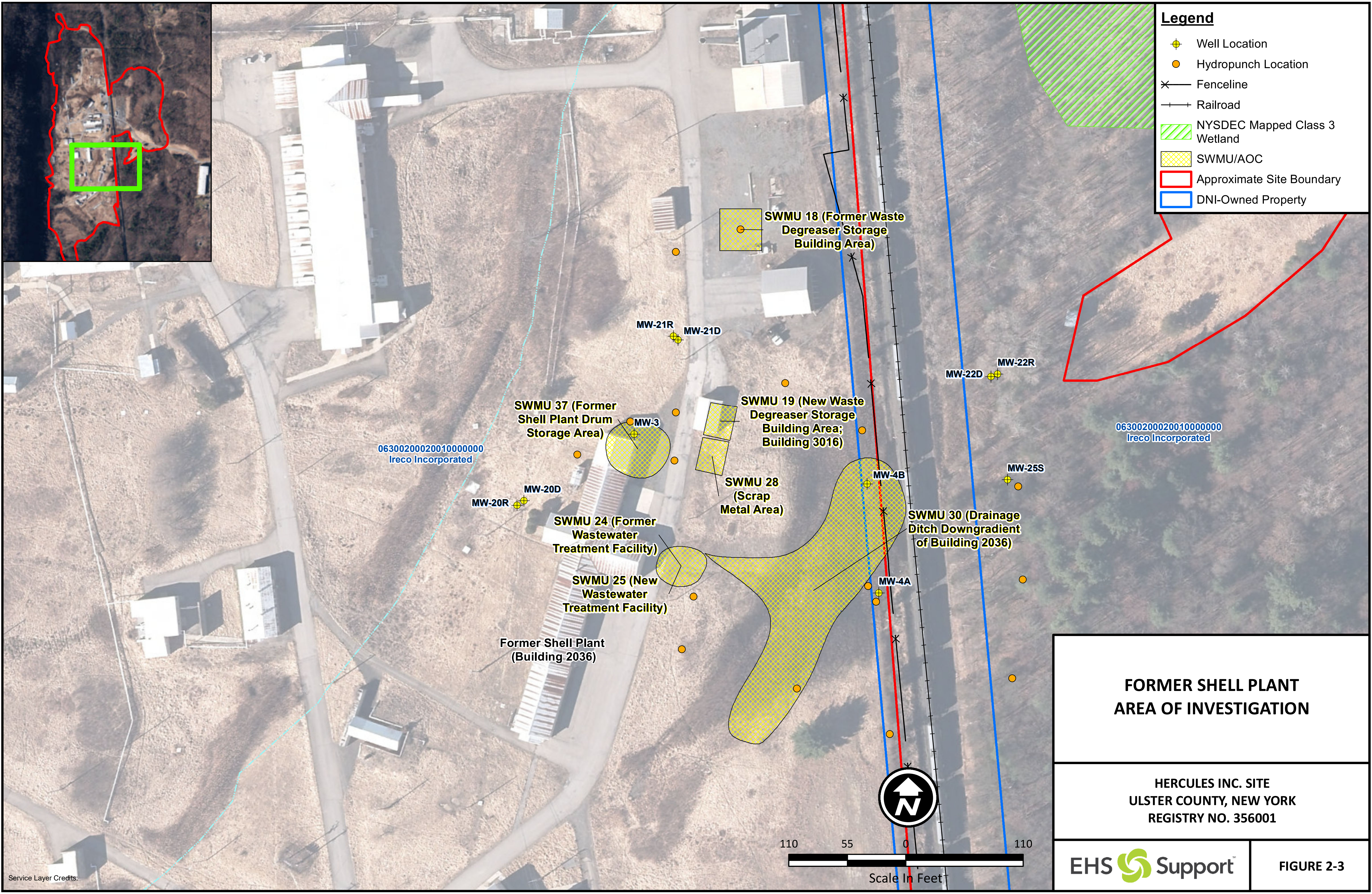
EHS Support	HERCULES INC. SITE ULSTER COUNTY, NEW YORK REGISTRY NO. 356001	SITE LAYOUT	FIGURE 2-2



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FORMER SHELL PLANT AREA OF INVESTIGATION

HERCULES INC. SITE
ULSTER COUNTY, NEW YORK
REGISTRY NO. 356001

EHS Support

FIGURE 2-3

J:\EHSS_GIS\C00363_AshlandPortEwen\01_ANALYSIS\20200305_CSM_Figures\Shell_Plant.mxd

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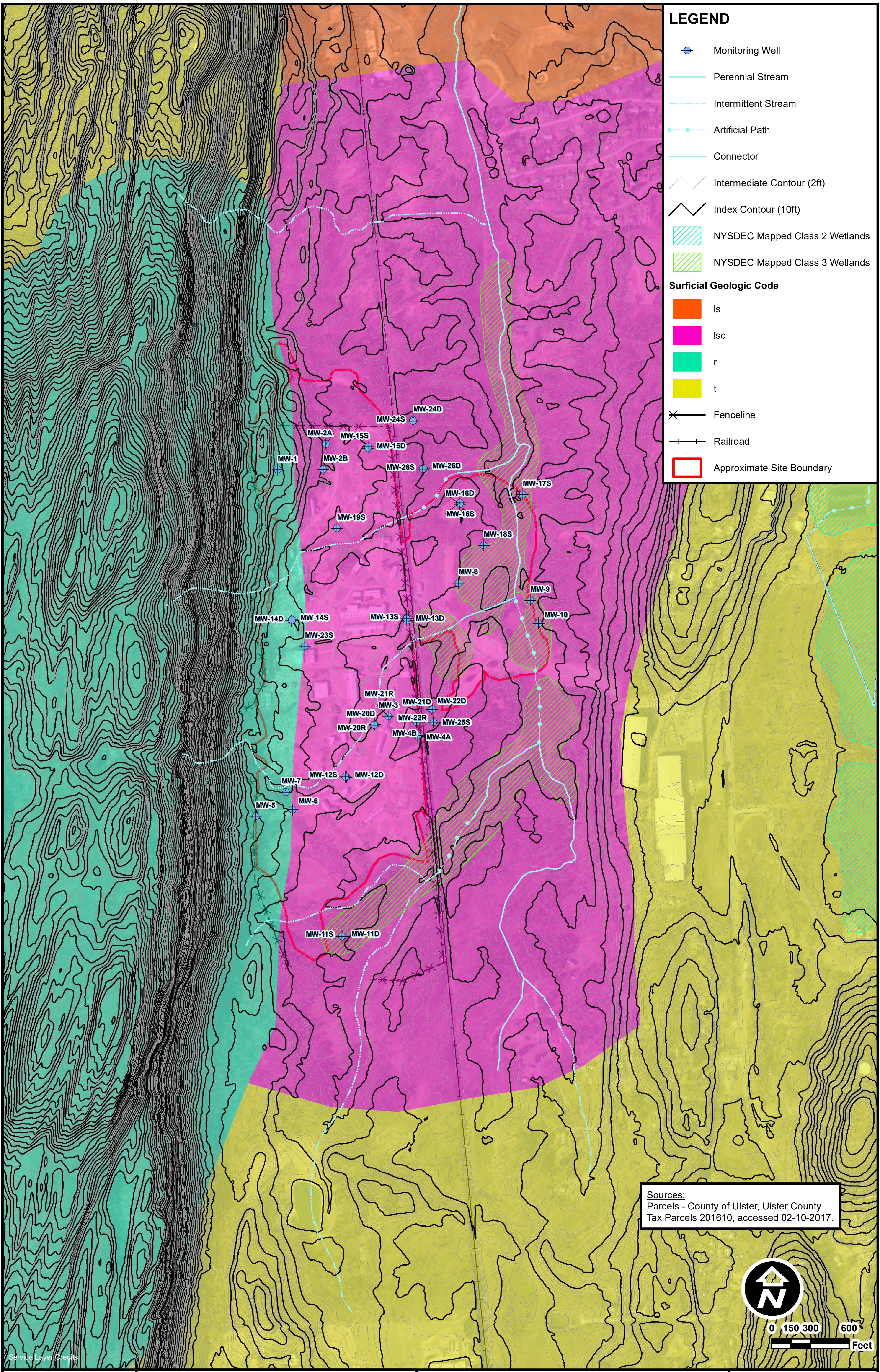

J:\EHSS_GIS\C00363_AshlandPortEwen\01_ANALYSIS\20200305_CSM_Figures\FigureSeries.mxd

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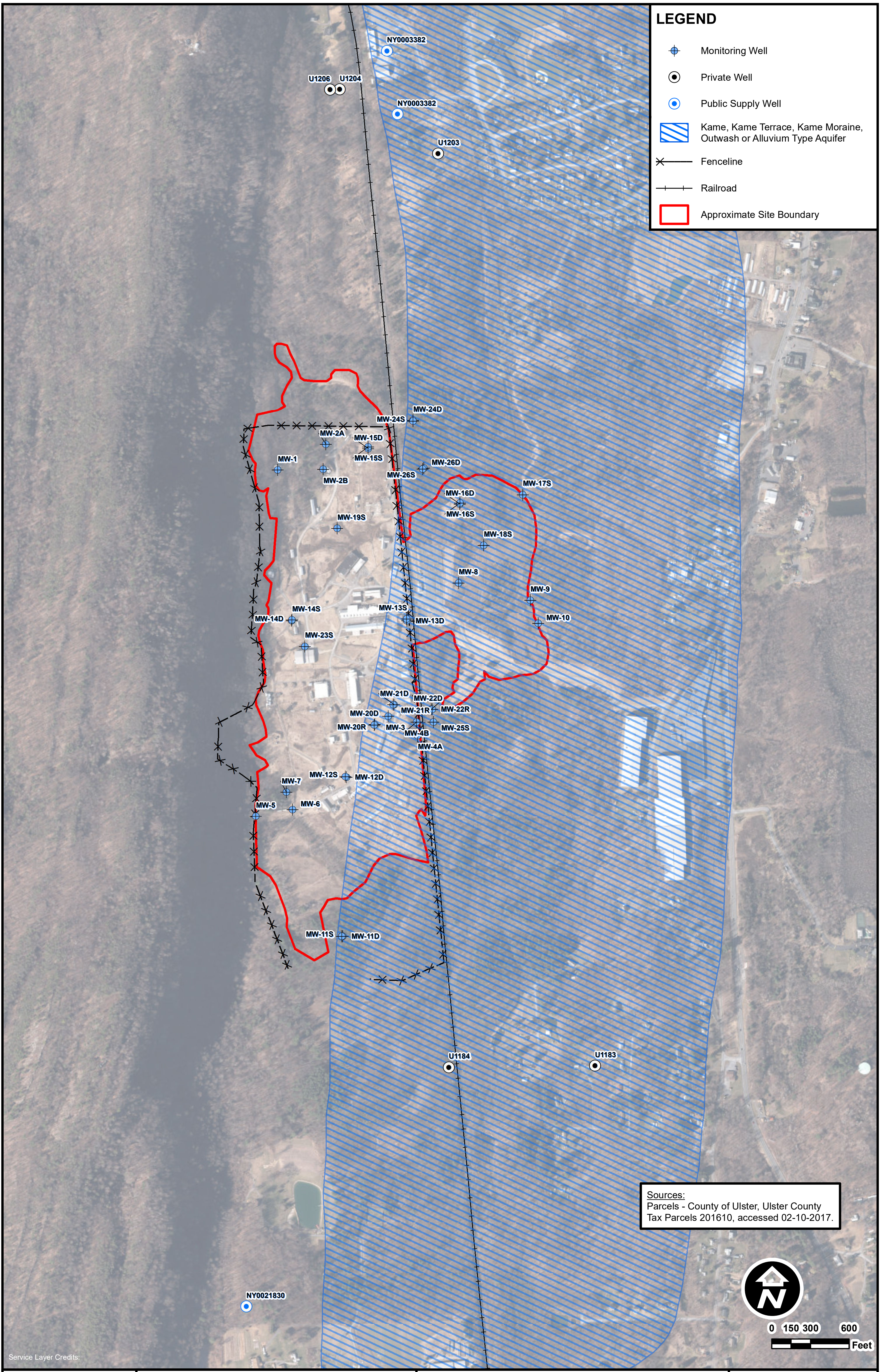
HERCULES INC. SITE
ULSTER COUNTY, NEW YORK
REGISTRY NO. 356001

SURFACE GEOLOGY MAP

FIGURE 3-1



Sources:
Parcels - County of Ulster, Ulster County Tax Parcels 201610, accessed 02-10-2017.

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HERCULES INC. SITE
ULSTER COUNTY, NEW YORK
REGISTRY NO. 356001

SURFACE HYDROGEOLOGY/RECEPTOR SURVEY

FIGURE 3-2

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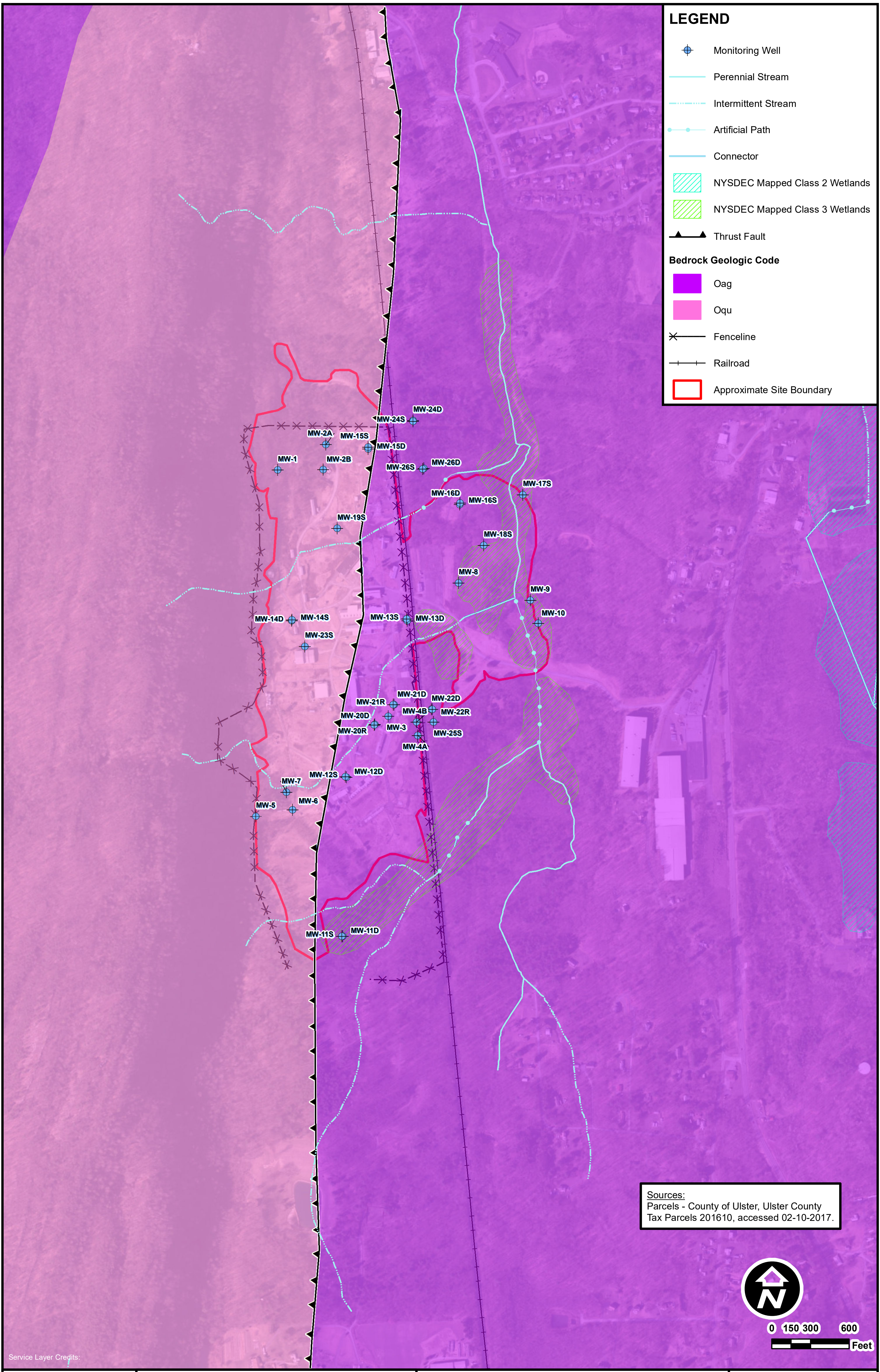

Sources:
Parcels - County of Ulster, Ulster County Tax Parcels 201610, accessed 02-10-2017.

J:\EHSS_GIS\C00363_AshlandPortEwen\01_ANALYSIS\20200305_CSM_Figures\FigureSeries.mxd

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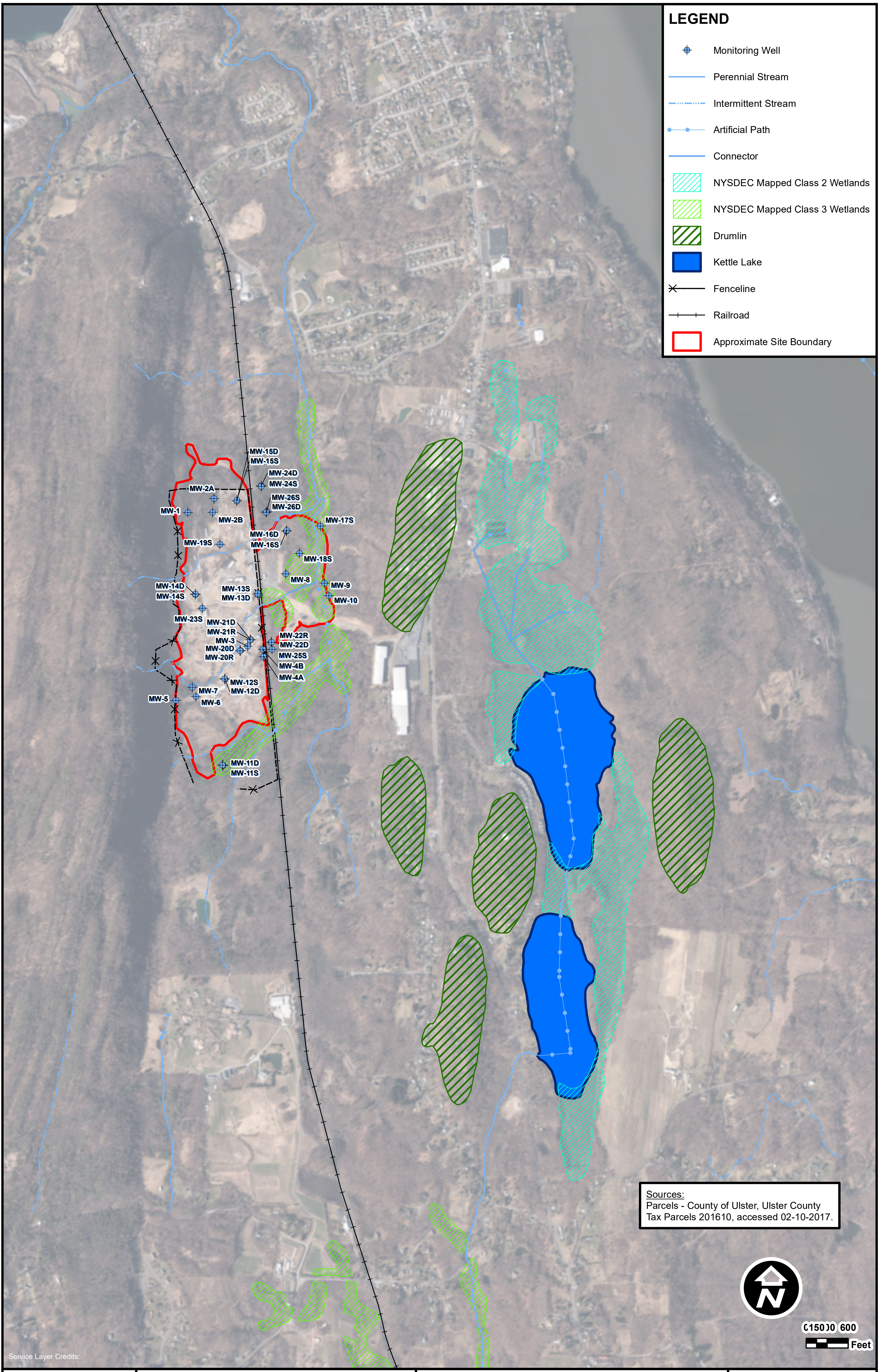
HERCULES INC. SITE
ULSTER COUNTY, NEW YORK
REGISTRY NO. 356001

BEDROCK GEOLOGY MAP

FIGURE 3-3



Sources:
Parcels - County of Ulster, Ulster County Tax Parcels 201610, accessed 02-10-2017.

J:\EHSS_GIS\C00363_AshlandPortEwen\01_ANALYSIS\20200305_CSM_Figures\FigureSeries.mxd

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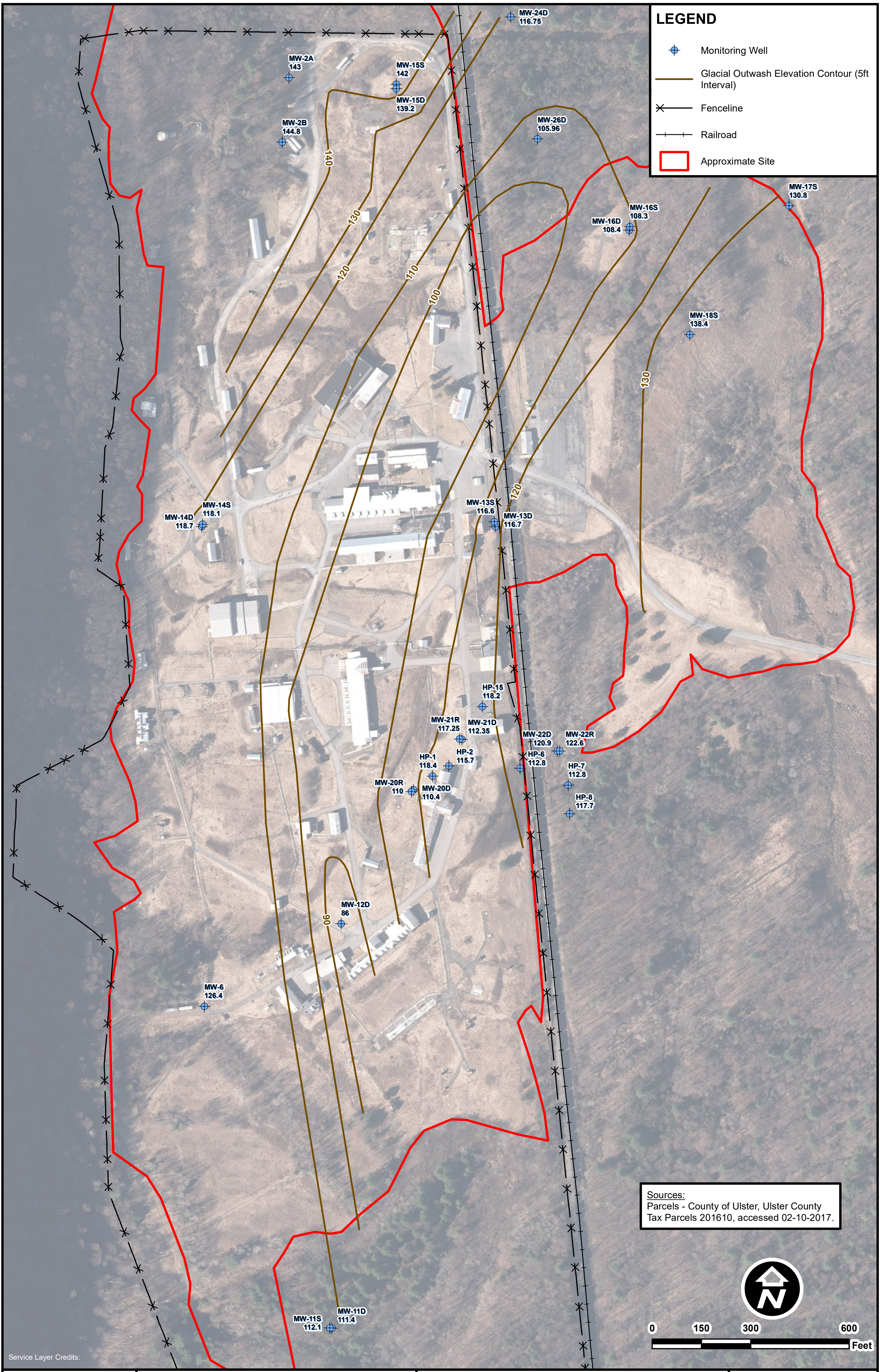
EHS Support	HERCULES INC. SITE ULSTER COUNTY, NEW YORK REGISTRY NO. 356001	SURFACE LANDFORMS	FIGURE 3-4



Sources:
Parcels - County of Ulster, Ulster County Tax Parcels 201610, accessed 02-10-2017.

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HERCULES INC. SITE
ULSTER COUNTY, NEW YORK
REGISTRY NO. 356001

GLACIAL OUTWASH ELEVATION

FIGURE 3-6

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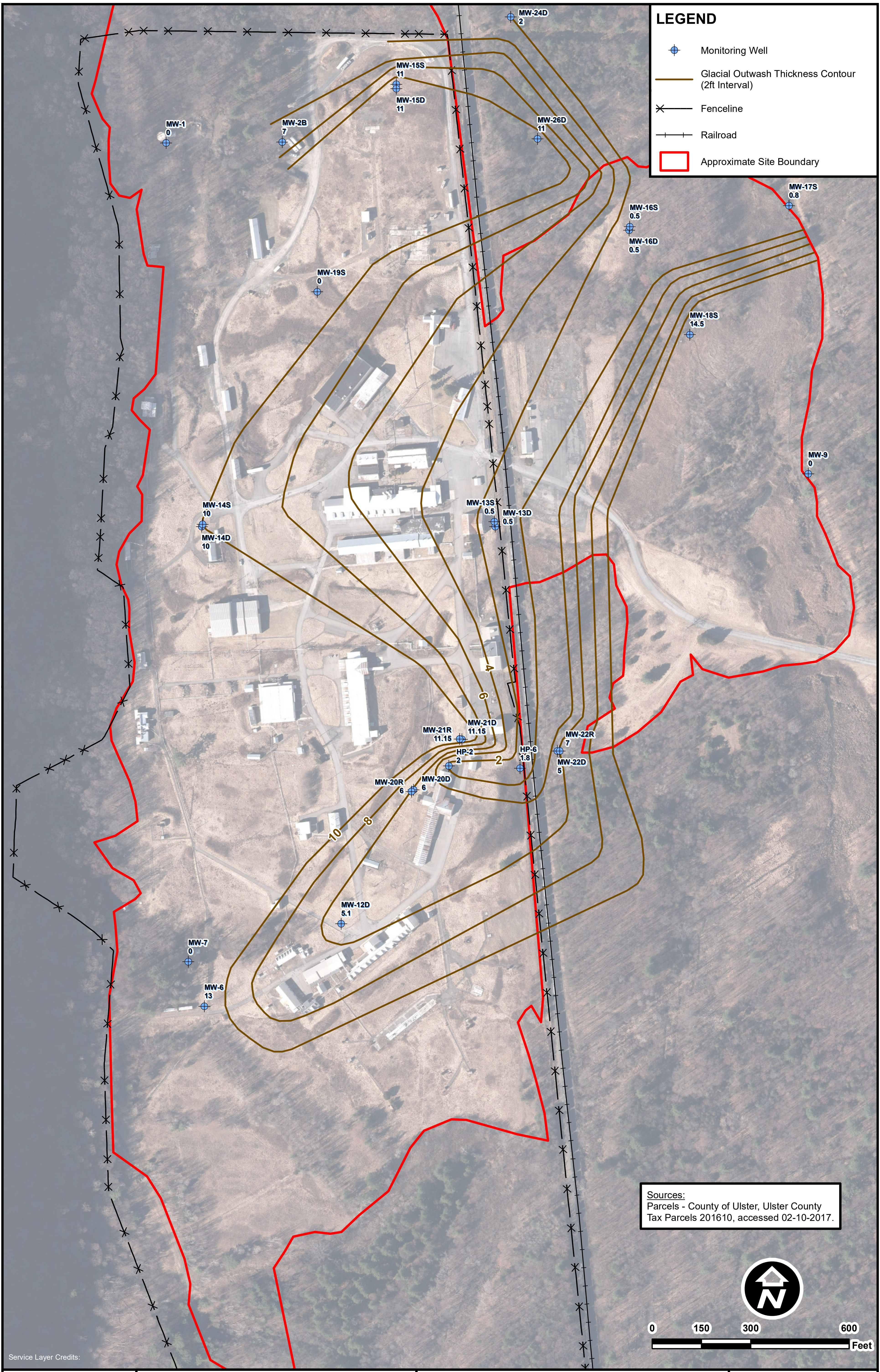

LEGEND

- ⌖ Monitoring Well
- — Glacial Outwash Thickness Contour (2ft Interval)
- ✕ Fenceline
- ┼ Railroad
- ▭ Approximate Site Boundary

Sources:
Parcels - County of Ulster, Ulster County Tax Parcels 201610, accessed 02-10-2017.

Service Layer Credits:

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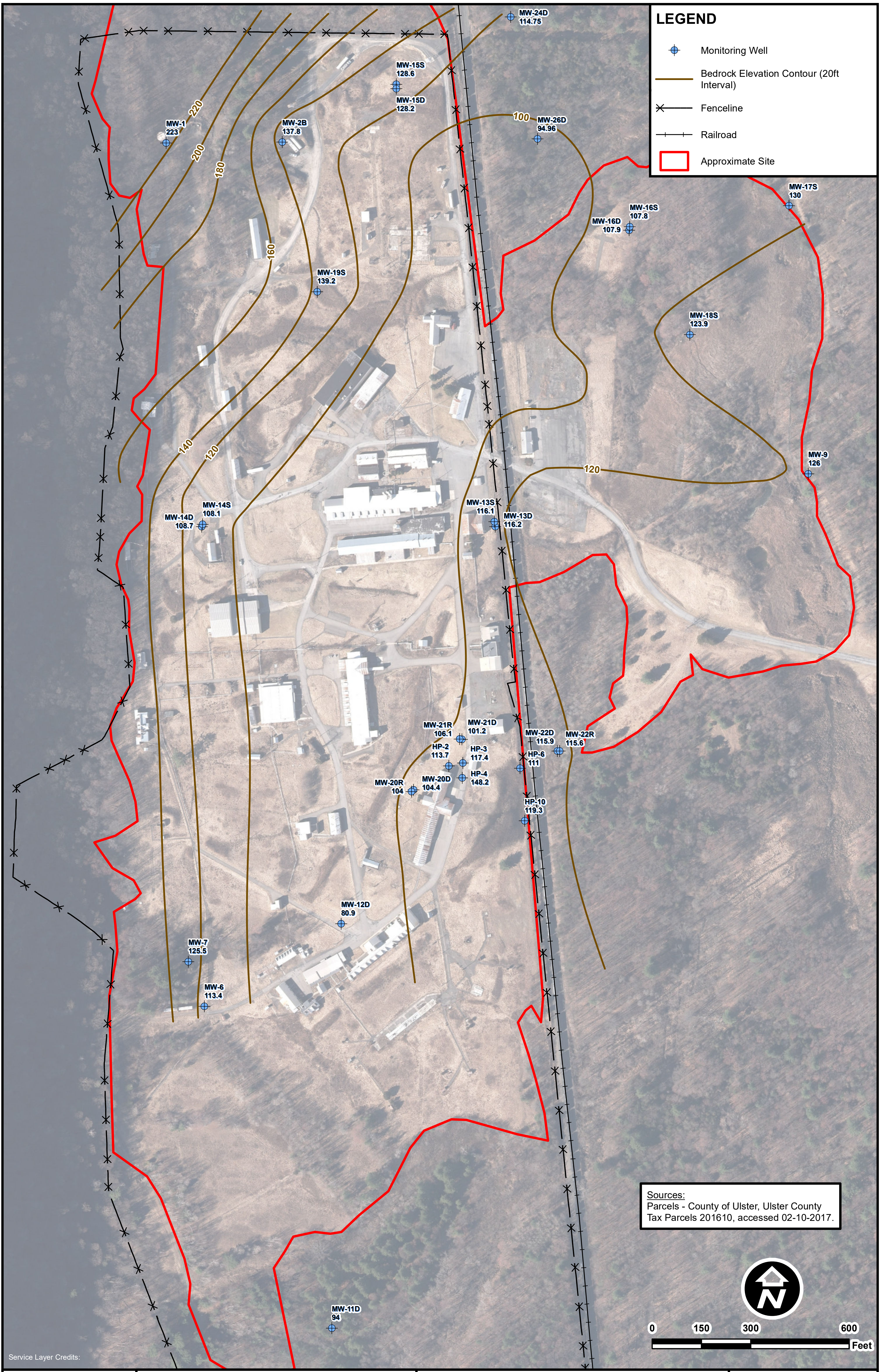
HERCULES INC. SITE
ULSTER COUNTY, NEW YORK
REGISTRY NO. 356001

GLACIAL OUTWASH THICKNESS CONTOURS

FIGURE 3-7



Sources:
Parcels - County of Ulster, Ulster County Tax Parcels 201610, accessed 02-10-2017.

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HERCULES INC. SITE
ULSTER COUNTY, NEW YORK
REGISTRY NO. 356001

BEDROCK ELEVATION

FIGURE 3-9

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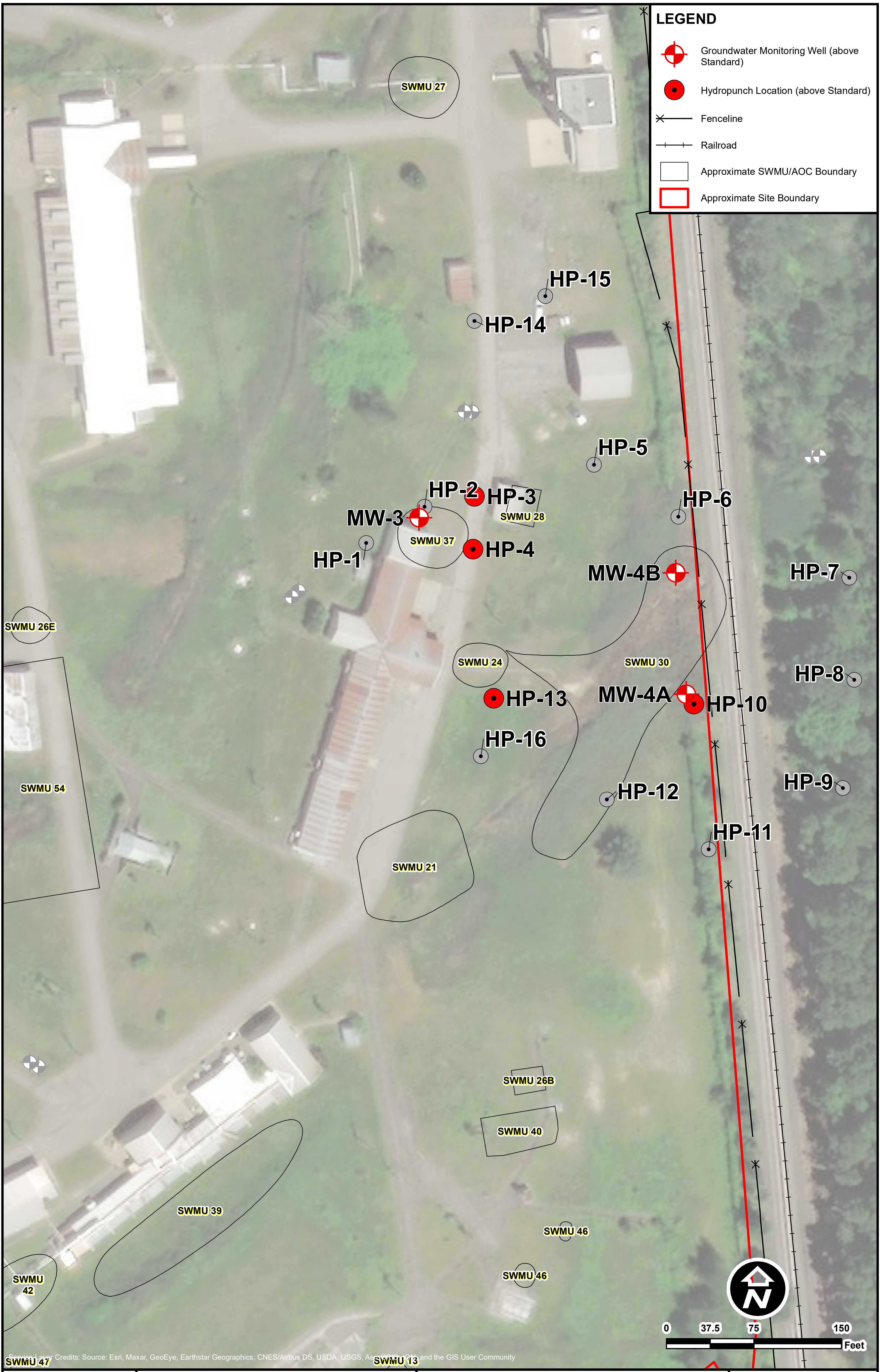

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

J:\EHSS_GIS\C00363_AshlandPortEwen\01_ANALYSIS\20201207_DataGapWP_Figures\Figure 4-1 Hydropunch Locations.mxd

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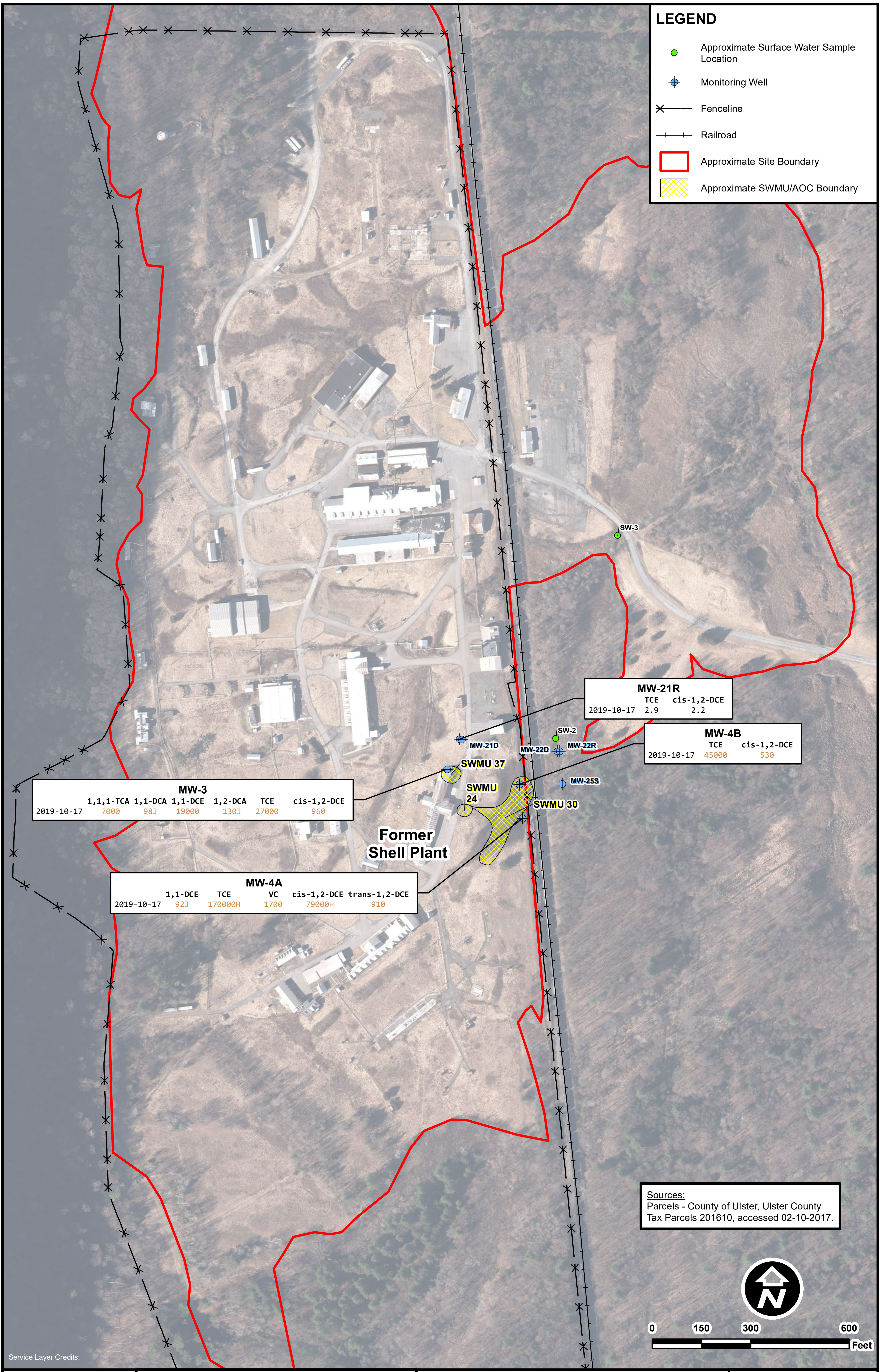
HERCULES INC. SITE
ULSTER COUNTY, NEW YORK
REGISTRY NO. 356001

HYDROPUNCH LOCATIONS

FIGURE 4-1



LEGEND

●	Approximate Surface Water Sample Location
⌖	Monitoring Well
✕	Fenceline
┼	Railroad
☐	Approximate Site Boundary
▨	Approximate SWMU/AOC Boundary

MW-21R

	TCE	cis-1,2-DCE
2019-10-17	2.9	2.2

MW-4B

	TCE	cis-1,2-DCE
2019-10-17	45000	530

MW-3

	1,1,1-TCA	1,1-DCA	1,1-DCE	1,2-DCA	TCE	cis-1,2-DCE
2019-10-17	7000	98J	19000	130J	27000	960

MW-4A

	1,1-DCE	TCE	VC	cis-1,2-DCE	trans-1,2-DCE
2019-10-17	92J	170000H	1700	79000H	910

Sources:
Parcels - County of Ulster, Ulster County Tax Parcels 201610, accessed 02-10-2017.

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HERCULES INC. SITE
ULSTER COUNTY, NEW YORK
REGISTRY NO. 356001

CVOC EXCEEDANCES OF
NYSDEC CLASS GA STANDARDS
IN GROUNDWATER

FIGURE 4-2

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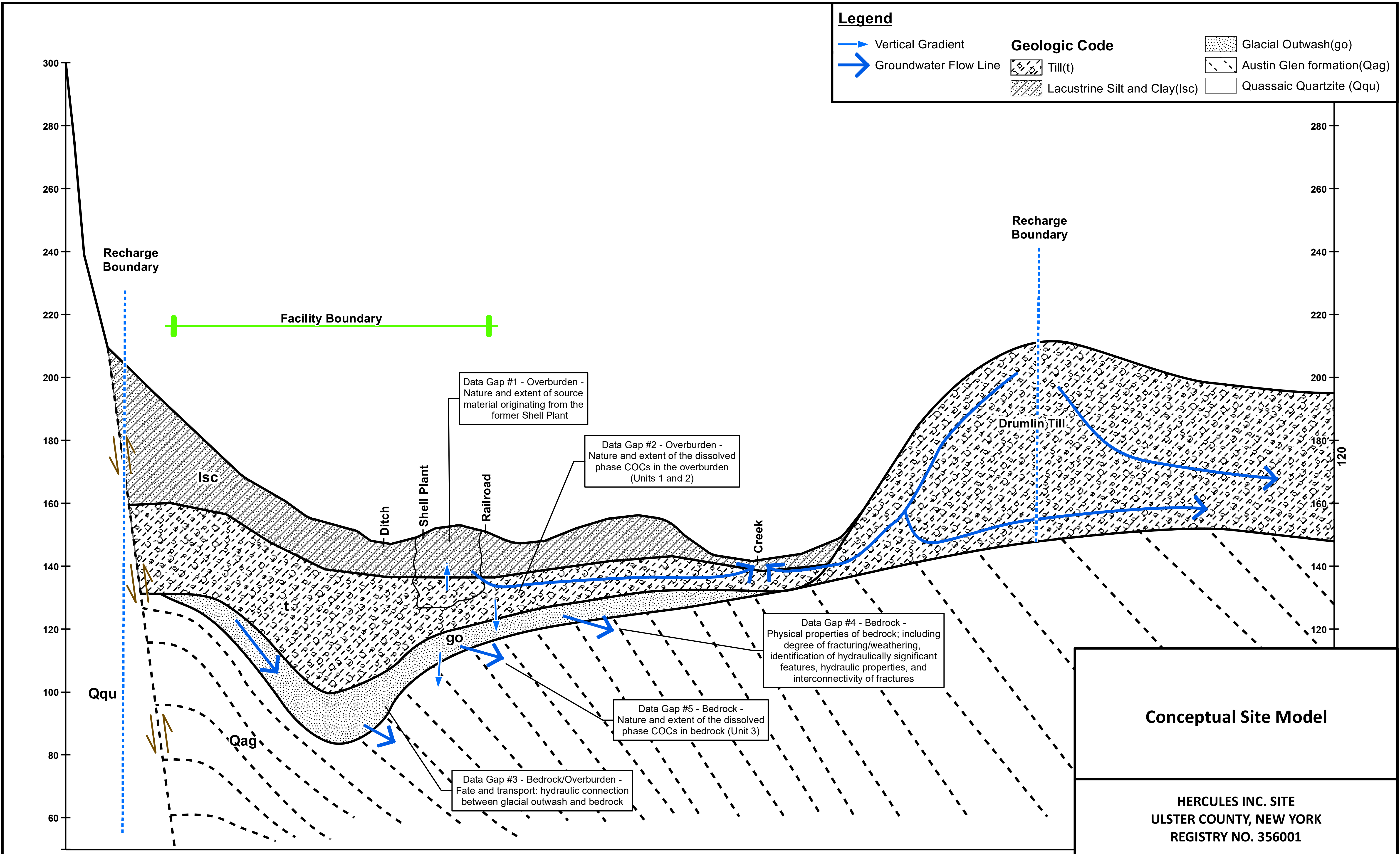

Data Gap #1 - Overburden - Nature and extent of source material originating from the former Shell Plant

Data Gap #2 - Overburden - Nature and extent of the dissolved phase COCs in the overburden (Units 1 and 2)

Data Gap #4 - Bedrock - Physical properties of bedrock; including degree of fracturing/weathering, identification of hydraulically significant features, hydraulic properties, and interconnectivity of fractures

Data Gap #5 - Bedrock - Nature and extent of the dissolved phase COCs in bedrock (Unit 3)

Data Gap #3 - Bedrock/Overburden - Fate and transport: hydraulic connection between glacial outwash and bedrock

Conceptual Site Model

HERCULES INC. SITE
ULSTER COUNTY, NEW YORK
REGISTRY NO. 356001

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Figure 6-1

Reviewed By: K. VanLandingham

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Attachment A Boring and Well Construction Logs

OVERBURDEN/BEDROCK WELL CONSTRUCTION SCHEMATIC

Site Hercules

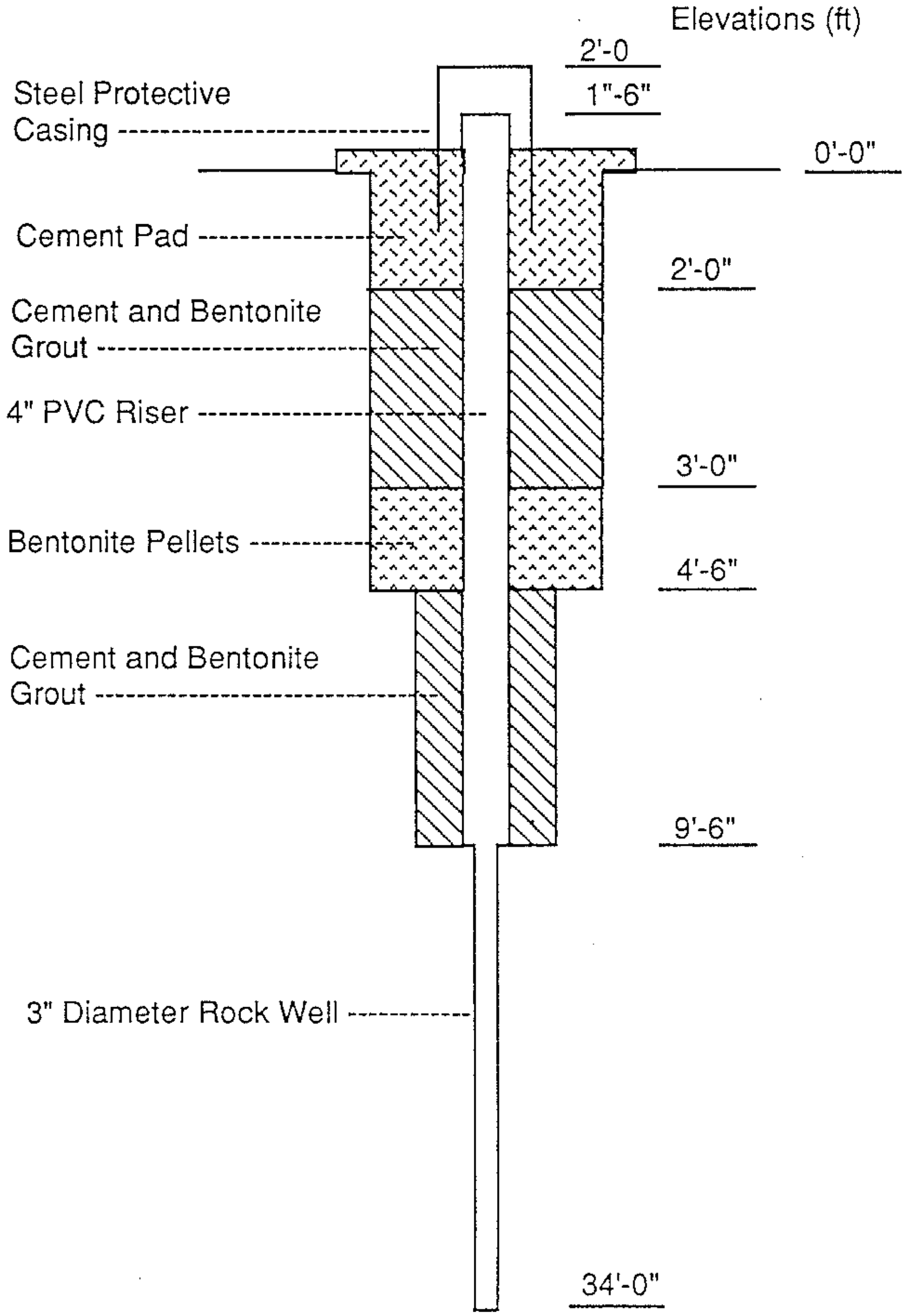
Well No. MW-1

Date Installed 2/24/89

Water Level from

Top of Casing 21'-6 1/2"

Date 3/22/89 Time 10:30 AM



Gibbs & Hill, Inc.

BORING LOG

Sheet 1 of 1

PROJECT: NYSDEC PROJECT NO. 5583 BORING NO. MW-1

Location: HERCULES Coord: Ground Elev:

Contractor: EMPIRE Date Started: 2/15/89 G.W.L. Hour: Date:

Inspector: J. SANGHVI Date Completed: G.W.L. Hour: Date:

Notes:

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows Casing Per Ft.	Blows Sampler 6"	Blows Sampler 6"	Recovery %	RQD %	HNu	Graphic Symbol	Description and Remarks
0		SS-1			4 52	4 100	14"		0	CL	Brown-gray, silt clay Shale fragments
5											
10											
15											BEDROCK
20											
25											
30											
35											
0											

I.D. Casing Wgt. Hammer on Casing

I.D. Spoon Wgt. Hammer on Spoon

Type Core Drill Drop Hammer on Casing

Core Dia. Drop Hammer on Spoon

Sample & Test Notations

Material Notations

Gibbs & Hill, Inc.

OVERBURDEN WELL CONSTRUCTION SCHEMATIC

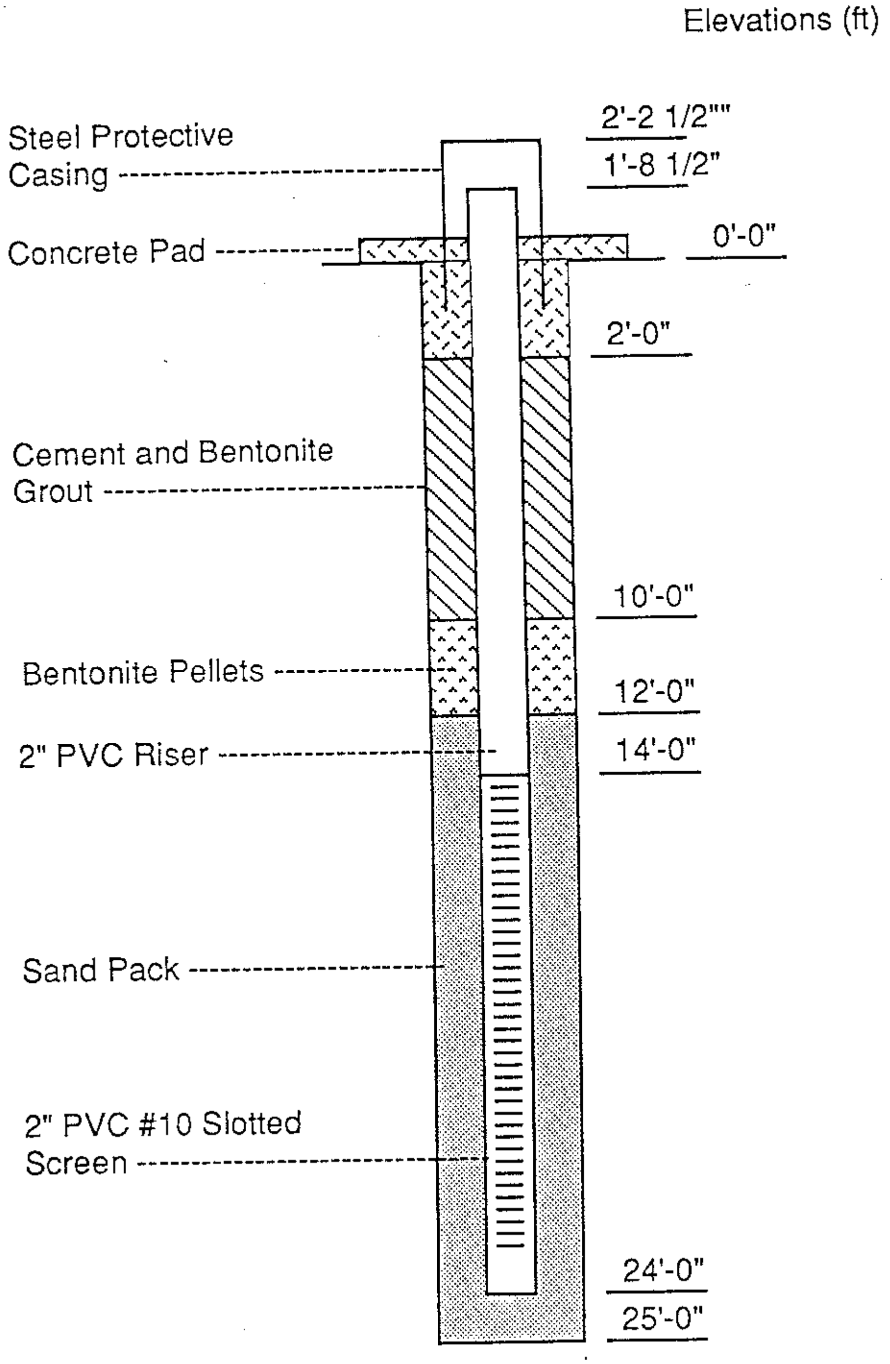
Site Hercules

Well No. MW-2A

Date Installed 2/21/89

Water Level from
Top of Casing 10'9 1/2"

Date 3/22/89 Time 11:15 AM



Gibbs & Hill, Inc.

BORING LOG

Sheet 1 of 1

PROJECT: NYSDEC Phase II PROJECT NO. 5583 BORING NO. MW-2A
Location: Hercules, Inc Coord: Ground Elev:
Contractor: Empire Date Started: 02/21/89 G.W.L. Hour: Date:
Inspector: Jayesh Sanghvi Date Completed: 02/2/89 G.W.L. Hour: Date:
Notes:

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows			Recovery %	[redacted] HNu	Drilling Rate Min./Ft.	Graphic Symbol	Description and Remarks
				Casing Per Ft.	Sampler 6"	6"					
0											
2											
5											
7		SS-1			9 16	15 20	14"	0		OL	Brown tanish orange clay some silt.
10											
12		SS-2			7 10	9 12	14"	.2		OL	Brown orange tanish clay Organics, grey wet Clay
15											
17		SS-3			2 3	3 4	11"	.1		OL	Mixture of brown and gray clay wet. Mostly gray. Low plasticity.
20											
22		SS-4			0 3	2 3	12"	0		CL	Gray clay low to medium plasticity Sandy and silty clay.
25											
27		SS-5			1 6	3 12	10"	.2		SM	silty sand, Sand silt mixtures.
0											
5											
0											

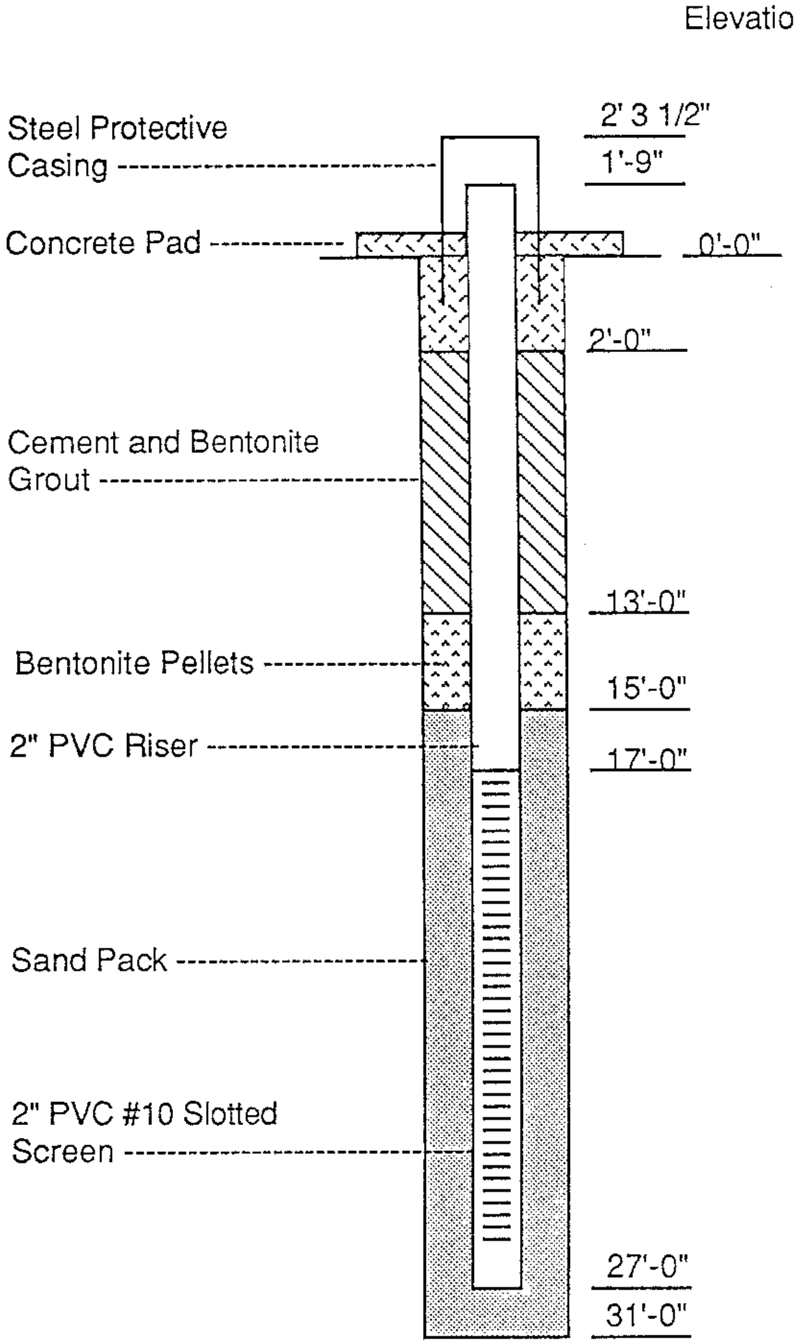
I.D. Casing	Wgt. Hammer on Casing	Material Notations
I.D. Spoon	Wgt. Hammer on Spoon	
Type Core Drill	Drop Hammer on Casing	
Core Dia.	Drop Hammer on Spoon	6001256
Sample & Test Notations		

Gibbs & Hill, Inc.

OVERBURDEN WELL CONSTRUCTION SCHEMATIC

Site Hercules
Well No. MW-2B
Date Installed 2/20/89

Water Level from
Top of Casing 12'-7 1/2"
Date 3/22/89 Time 12:10 PM



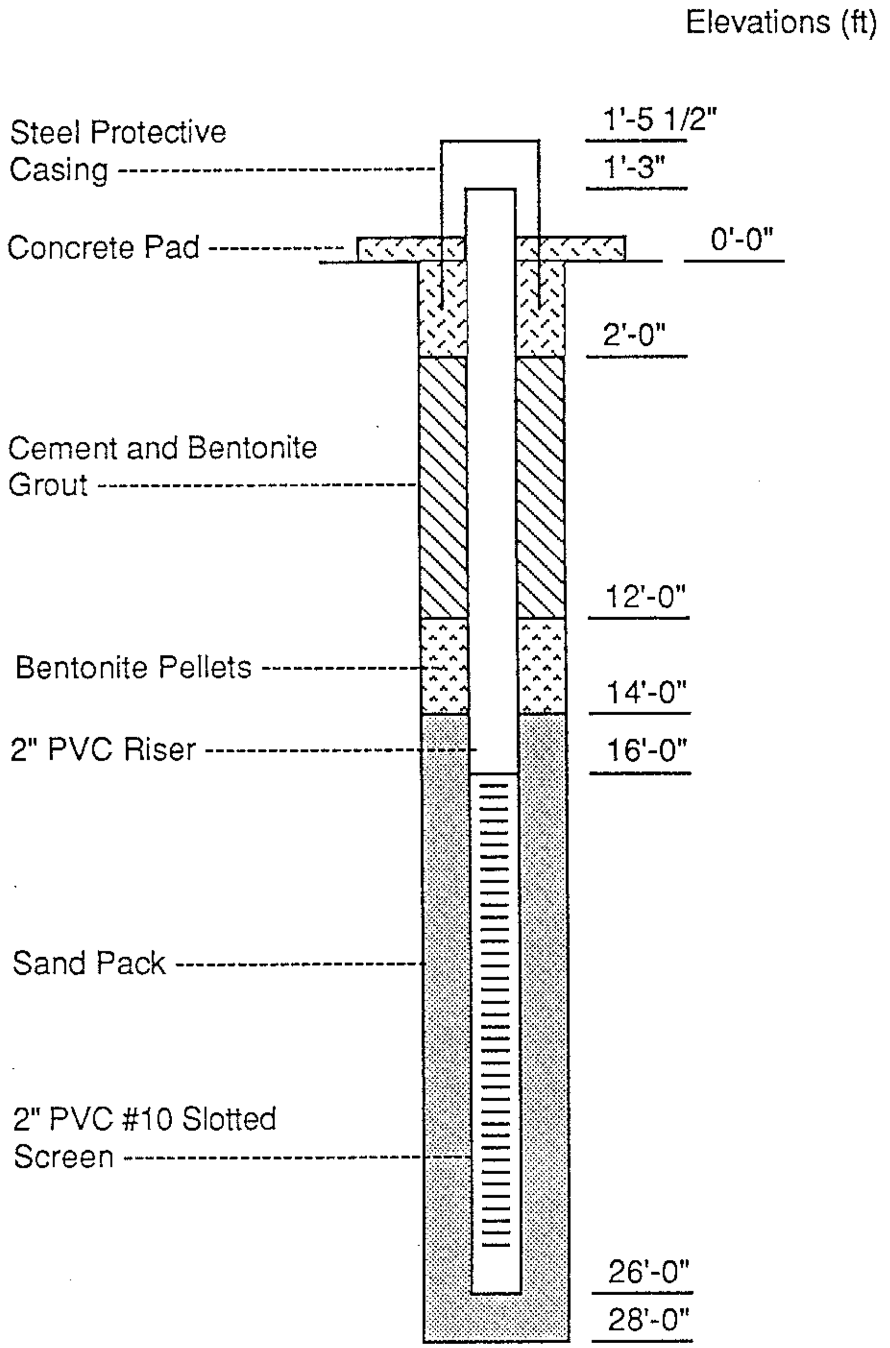
Gibbs & Hill, Inc.

B-13

OVERBURDEN WELL CONSTRUCTION SCHEMATIC

Site Hercules
Well No. MW-3
Date Installed 3/1/89

Water Level from Top of Casing 7'- 1 3/4"
Date 3/22/89 Time 1:30 PM



Gibbs & Hill, Inc.

BORING LOG

Sheet 1 of 1

PROJECT: NYSDEC Phase II PROJECT NO.

BORING NO. MW-2B

Location: Hercules, Inc Coord:

Ground Elev:

Contractor: Empire

Date Started: 02/17/89 G.W.L. Hour: Date:

Inspector: Jayesh Sanghvi/R. Capone

Date Completed: 02/20/89 G.W.L. Hour: Date:

Notes:

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows Casing Per Ft.	Blows Sampler 6"	Blows Sampler 6"	Recovery %	[redacted] HNu	Drilling Rate Min./Ft.	Graphic Symbol	Description and Remarks
0											
		SS-1	SS-1		6	4	6"	0		OL	Brown silty clay
2					4	2					
5											
		SS-2			4	9	14"	0		OL	Brown tonish orange clay some silt
7					13	15					
10											
		SS-3			4	10	14"	0		OL	Brown-orange tanish clay organics, gray wet-clay.
12					11	10					
15											
		SS-4			2	3	10"	0		OL	Grayish clay, graded into tanish brown wet silty clay
17					3	4					
20											
		SS-5			2	5	10"	0		SM	Brown silty sand some silt wet.
22					4	5					
25											
		SS-6			1	1	14"	0		GM	Brown tanish organics, some silt and sand wet.
27					3	4					
30											
		SS-7			19	47	10"	0		Bed-rock	Brown tanish gravel, some silt shale, Gray, grayish white shale.
32					57	90					
5											
0											

I.D. Casing	Wgt. Hammer on Casing	Material Notations
I.D. Spoon	Wgt. Hammer on Spoon	
Type Core Drill	Drop Hammer on Casing	
Core Dia.	Drop Hammer on Spoon	
Sample & Test Notations		

Gibbs & Hill, Inc.

BORING LOG

Sheet 1 of 1

PROJECT: NYSDEC Phase II PROJECT NO. 5583 BORING NO. MW-3
Location: Hercules Inc Coord: Ground Elev:
Contractor: Empire Date Started: 03/01/89 G.W.L. Hour: Date:
Inspector: Jayesh Sanghvi Date Completed: 03/01/89 G.W.L. Hour: Date:
Notes:

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows Casing Per Ft.	Blows Sampler 6"	Blows Sampler 6"	Recovery %	[redacted] HNU	Drilling Rate Min./Ft.	Graphic Symbol	Description and Remarks
0											
			SS-1		14	16	19"	0		OL	Brown silt and clay (Very Hard) frozen.
					12	14					
2											
5											
			SS-2		4	8	23"	0		OL	Brown orange tanish clay with low plasticity.
					11	12					
7											
10											
			SS-3		4	6	23"	0		OL	Brown clay little wet. some silt.
					8	11					
12											
15											
			SS-4		2	3	22"	0		CL	Gray clay with low to medium plasticity also brown clay
					3	4					
17											
20											
			SS-5		0	1	23"	0		CL	Mostly Gray clay with medium plasticity with mixture of brown silt and clay.
					2	2					
22											
5											
0											
5											
0											

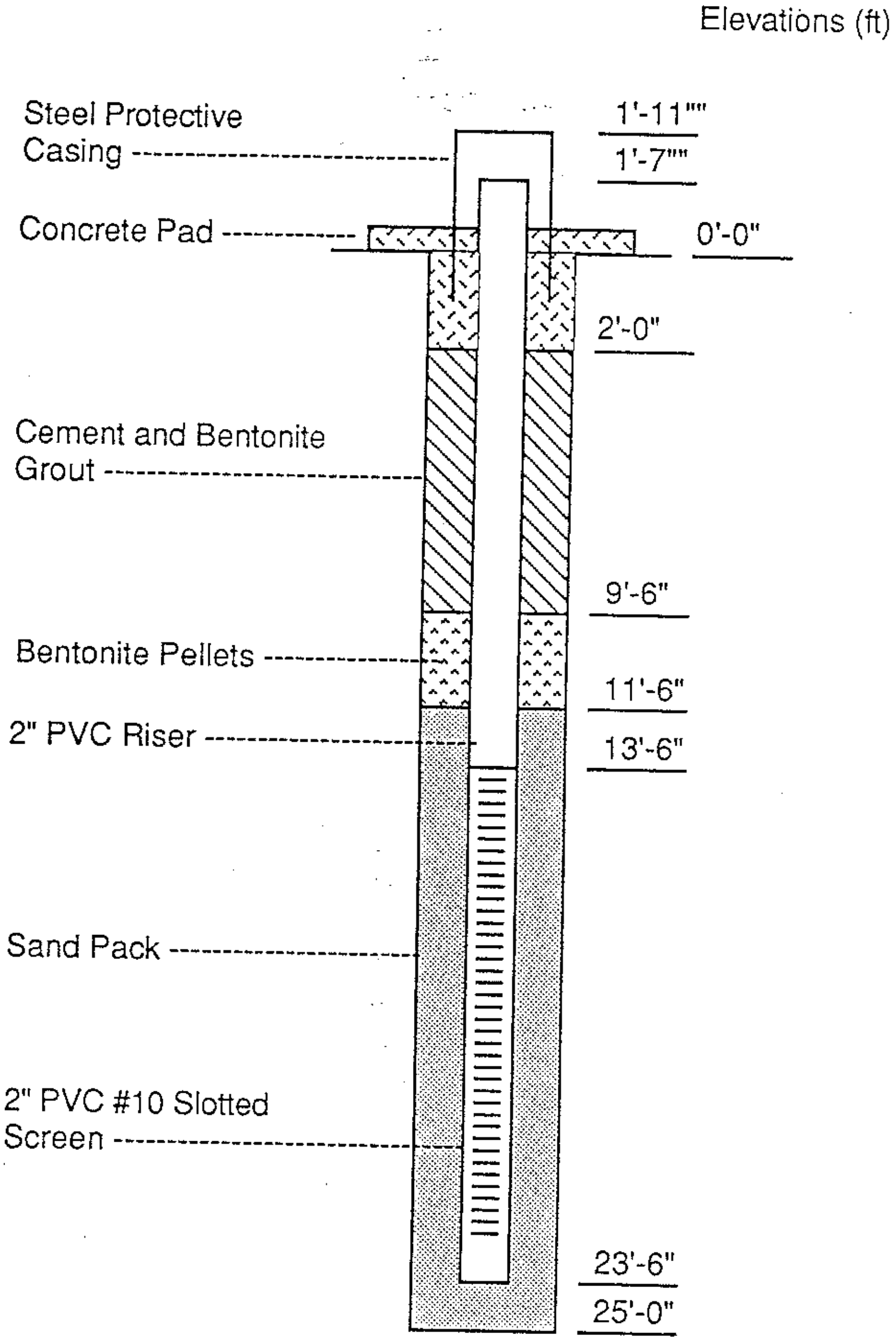
I.D. Casing	Wgt. Hammer on Casing	Material Notations
I.D. Spoon	Wgt. Hammer on Spoon	
Type Core Drill	Drop Hammer on Casing	
Core Dia.	Drop Hammer on Spoon	
Sample & Test Notations		

Gibbs & Hill, Inc.

OVERBURDEN WELL CONSTRUCTION SCHEMATIC

Site Hercules
Well No. MW-4A
Date Installed 2/27/89

Water Level from
Top of Casing 5'- 6 1/2"
Date 3/22/89 Time 2:00 PM



Gibbs & Hill, Inc.

BORING LOG

Sheet 1 of 1

PROJECT: NYSDEC Phase II PROJECT NO. BORING NO. MW-4A
Location: Hercules, Inc Coord: Ground Elev:
Contractor: Empire Date Started: 02/27/89 G.W.L. Hour: Date:
Inspector: J. Sanghvi Date Completed: 02/27/89 G.W.L. Hour: Date:
Notes:

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows Casing Per Ft.	Blows Sampler 6"	Blows Sampler 6"	Recovery	[redacted] HNu	Drilling Rate Min./Ft.	Graphic Symbol	Description and Remarks
0											
			SS-1		5	2	14"	0		OL	Mixture of silt and clay
2					2	4					Mostly brown silty clay.
5											
			SS-2		3	6	20"	0		OL	Mixture of silt and clay
7					8	10					Mostly brown clay with low plasticity.
10											
			SS-3		2	4	24"	0		OL	Silt and Clay Mostly brown
12					5	6					Clay (little wet).
15											
			SS-4		0	1	12"	0		CL	wet silt and clay Mostly clay
17					2	3					with some very fine sand.
											low to medium plasticity.
0											
5											
0											
5											
0											

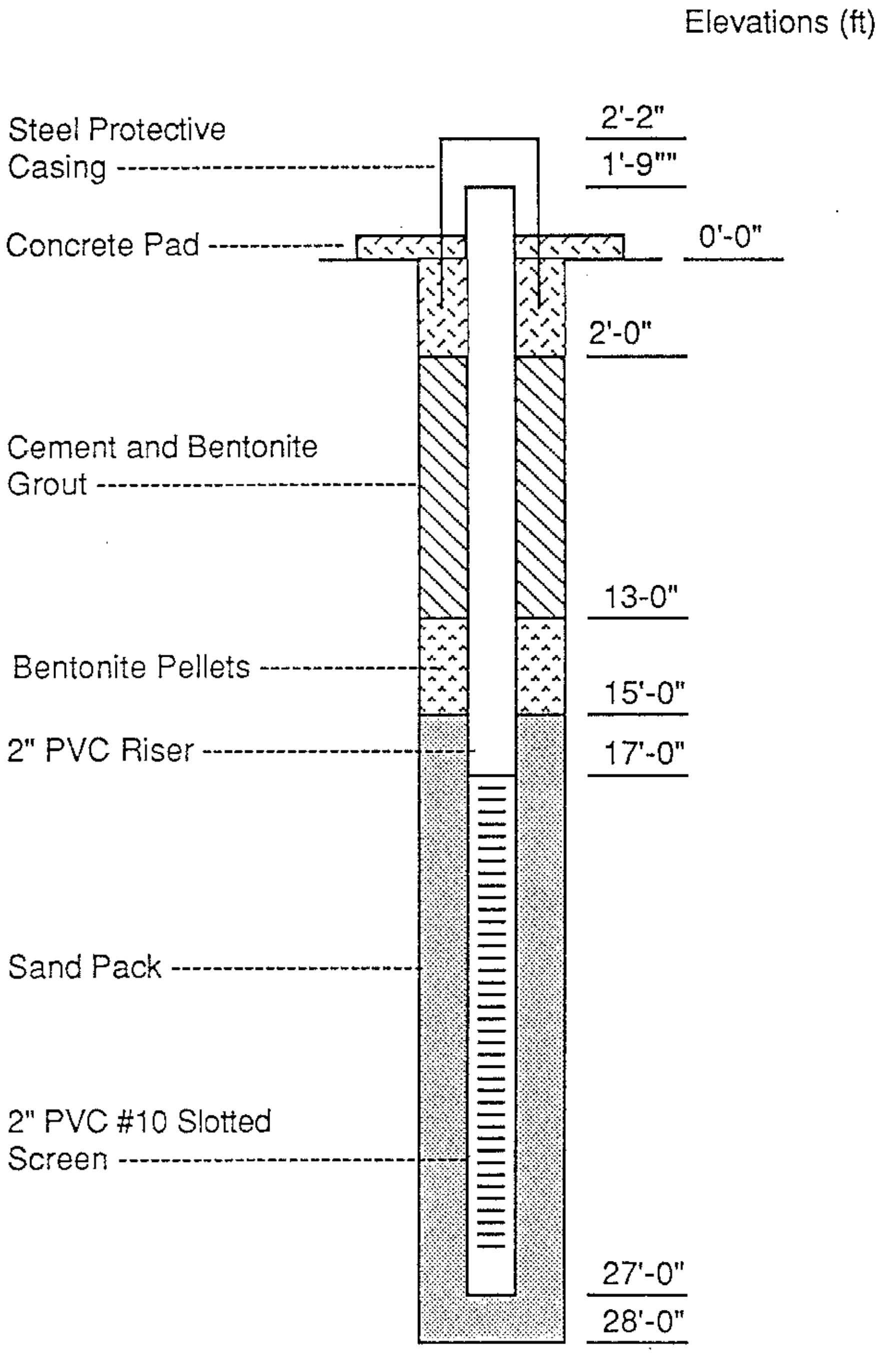
I.D. Casing	Wgt. Hammer on Casing	Material Notations
I.D. Spoon	Wgt. Hammer on Spoon	
Type Core Drill	Drop Hammer on Casing	
Core Dia.	Drop Hammer on Spoon	
Sample & Test Notations		

Gibbs & Hill, Inc.

OVERBURDEN WELL CONSTRUCTION SCHEMATIC

Site Hercules
Well No. MW-4B
Date Installed 2/28/89

Water Level from
Top of Casing 6'-5"
Date 3/22/89 Time 2:45 PM



Gibbs & Hill, Inc.

BORING LOG

Sheet 1 of 1

PROJECT: NYSDEC Phase II
PROJECT NO. 5583
BORING NO. MW-4B
Location: Hercules, Inc
Coord:
Ground Elev:
Contractor: Empire
Date Started: 02/28/89 G.W.L.
Hour:
Date:
Inspector: J. Sanghvi
Date Completed: 02/28/89 G.W.L.
Hour:
Date:
Notes:

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows Casing Per Ft.	Blows Sampler 6"	Blows Sampler 6"	Recovery %	RQD %	Drilling Rate Min./Ft.	Graphic Symbol	Description and Remarks
0											
		SS-1			8	4	14"			OL	Mixture of silt and clay
2					3	3					Mostly brown clay
5											
		SS-2			7	8	18"			OL	Mostly brown clay with
7					10	14					low plasticity and mixture of clay
10											
		SS-3			5	4	24"			OL	Mostly brown silty clay
12					5	6					very little wet.
15											
		SS-4			1	2	23"			CL	Brown wet clay with
17					2	1					low to medium plasticity.
20											
		SS-5			0	0	18"			CL	Mixture of brown and
22					1	2					gray clay wet. low to medium plasticity.
5											
0											
5											
0											

I.D. Casing	Wgt. Hammer on Casing	Material Notations
I.D. Spoon	Wgt. Hammer on Spoon	
Type Core Drill	Drop Hammer on Casing	
Core Dia.	Drop Hammer on Spoon	
Sample & Test Notations		

6001260

Gibbs & Hill, Inc.

BORING LOG

Sheet 1 of 1

PROJECT: Hercules

PROJECT NO.

BORING NO. MW-5

Location: Port Ewen, NY

Coord:

Ground Elev:

Contractor: Empire Drilling

Date Started: 3/14/89

G.W.L.

Hour:

Date:

Inspector: Mik. Valentino

Date Completed: 3/14/89

G.W.L.

Hour:

Date:

Notes:

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows			Recovery %	~~RQD %~~ HNU	Drilling Rate Min./Ft.	Graphic Symbol	Description and Remarks
				Casing Per Ft.	Sampler 6"	6"					
0		S1			8 4	6 3	18"	0		SM	Brown dry silty medium sand
5		S2			4 11	7 12	20"	0		ML	Brown dry clayey silt - two moist 1" clay seams present
10		S3			5 6	5 5	18"	0		ML	Brown moist clayey silt some gray silt in nose piece
15		S4			2 3	3 5	15"	0		CL	gray very moist silty clay becoming more silty toward bottom - some gravel is present at bottom
20		S5			2 4	2 4	12"	0		ML	gray wet clayey silt turning more clayey with some medium sand at bottom.
25		S6			3 3	3 3				CL	gray wet silty clay some pebbles at bottom
30					7 7	6 7				ML	gray wet clayey silt some very fine sand present
35					100/.2						refusal
0											

I.D. Casing

Wgt. Hammer on Casing

I.D. Spoon

Wgt. Hammer on Spoon

Type Core Drill

Drop Hammer on Casing

Core Dia.

Drop Hammer on Spoon

Sample & Test Notations

Material Notations

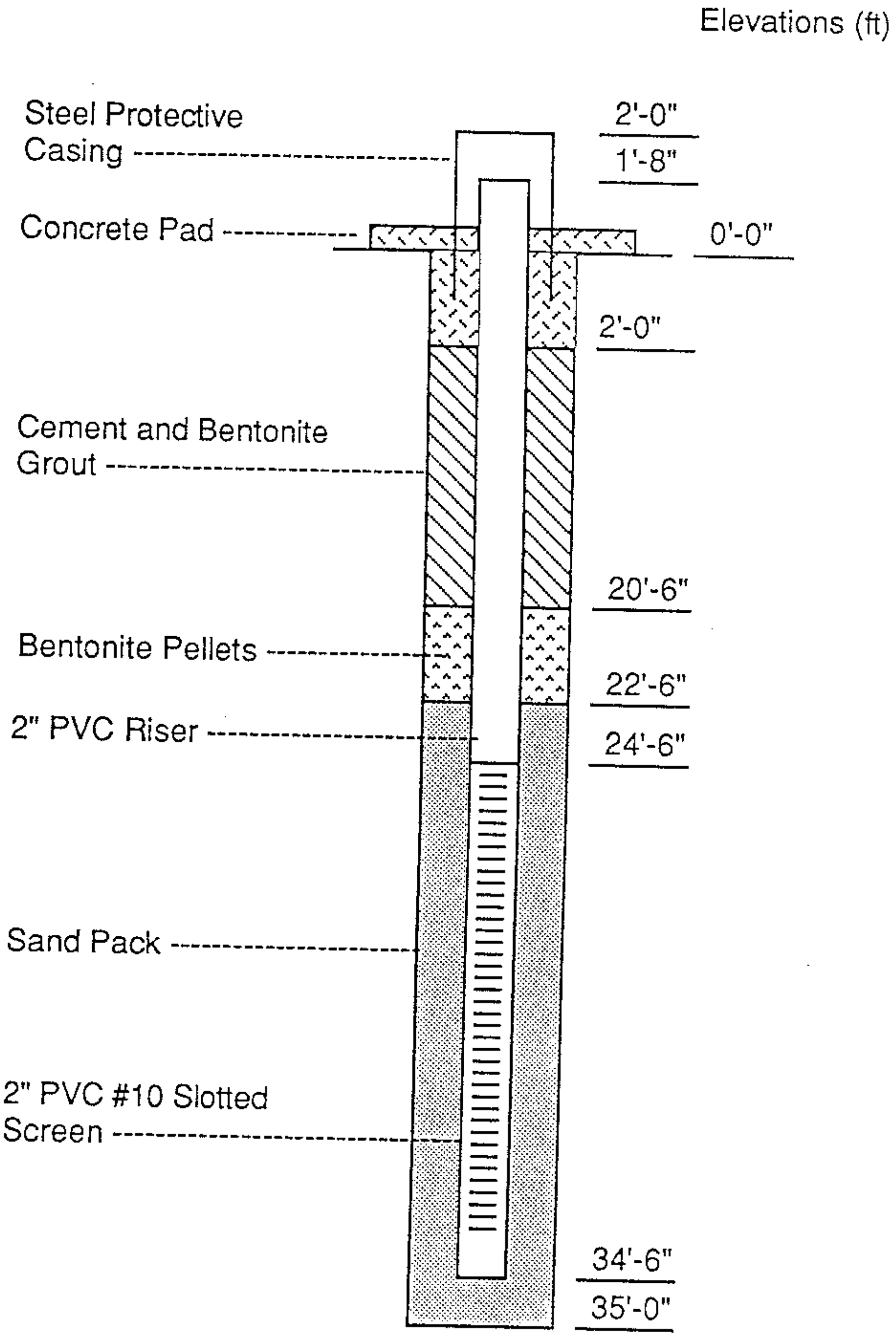
6001261

Gibbs & Hill, Inc.

OVERBURDEN WELL CONSTRUCTION SCHEMATIC

Site Hercules
Well No. MW-5
Date Installed 3/15/89

Water Level from
Top of Casing 19'- 9 1/2"
Date 3/23/89 Time 10:00 AM

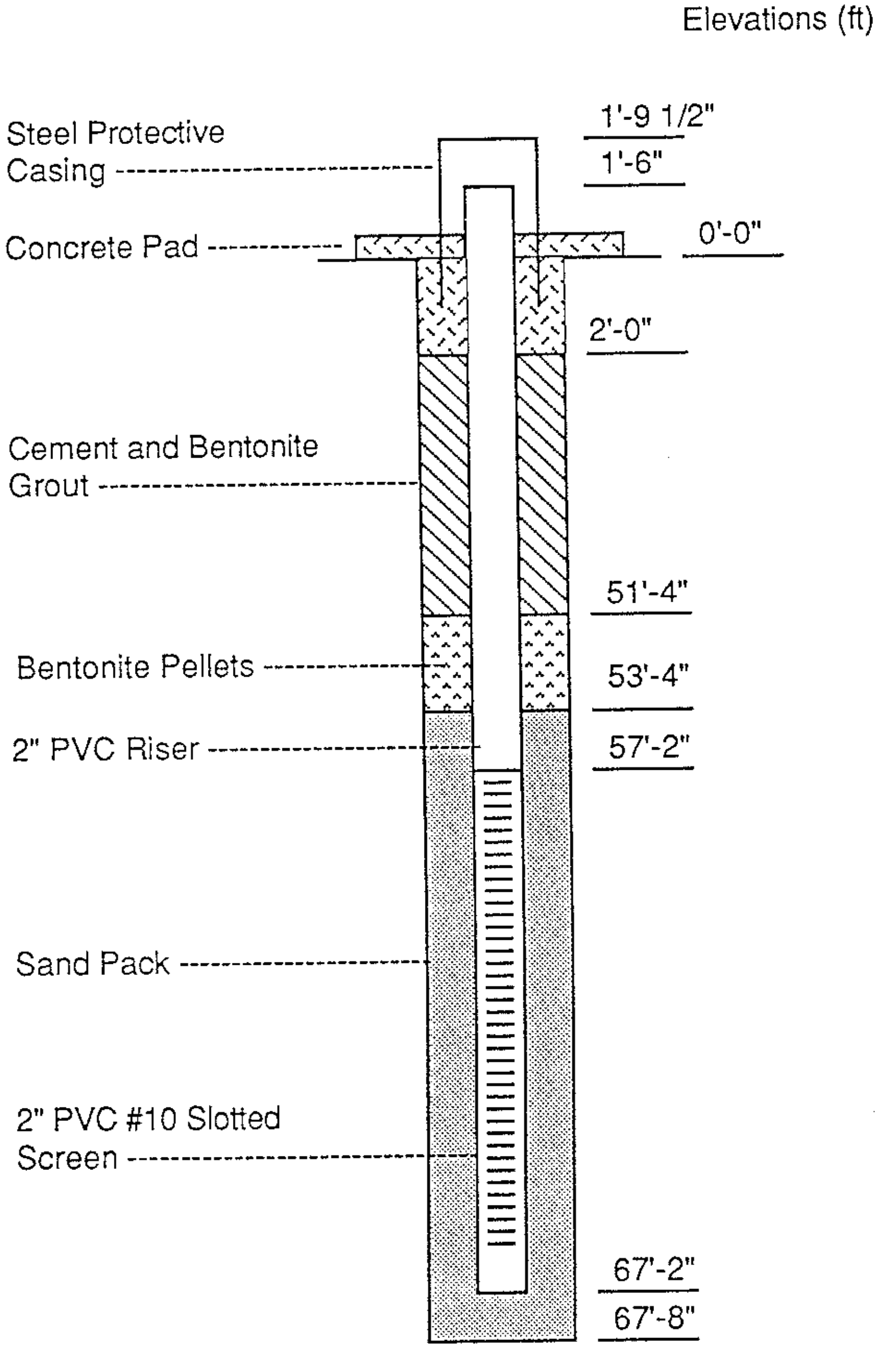


Gibbs & Hill, Inc.

OVERBURDEN WELL CONSTRUCTION SCHEMATIC

Site Hercules
Well No. MW-6
Date Installed 3/10/89

Water Level from
Top of Casing 14'-5"
Date 3/23/89 Time 11:00 A M



Gibbs & Hill, Inc.

BORING LOG

Sheet 1 of 2

PROJECT: Hercules PROJECT NO. 5583-09 BORING NO. MW-6

Location: Port Ewen, NY Coord: Ground Elev:

Contractor: Empire Drilling Date Started: 3/8/89 G.W.L. Hour: Date:

Inspector: Mike Valentino Date Completed: 3/13/89 G.W.L. Hour: Date:

Notes: HNU

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows: Casing Per Ft.	Blows: Sampler 6"	Blows: Sampler 6"	Recovery %	RQD %	Drilling Rate Min./Ft.	Graphic Symbol	Description and Remarks
0		S1			16 5	7 6	18"	0		OL	Brown Sandy Clayey silt with organics
5		S2			7 19	17 20	16"	0		ML	Brown clayey dry silt
10		S3			7 18	15 22	18"	0		ML	Brown clayey dry silt
15		S4			4 13	7 9	18"	0		ML	Brown clayey moist silt
20		S5			1 2	2 2	20"	0		CL	Gray cohesive wet silty clay
25		S6			WOH 1	WOH 2	20"	0		CL	Gray cohesive wet silty clay
30		S7			WOR WOR	WOR WOH	24"	0		CL	Gray cohesive wet silty clay
35		S8			WOR WOR	WOR WOH	24"	0		CL	Gray cohesive wet silty clay
40											

I.D. Casing	Wgt. Hammer on Casing	Material Notations
I.D. Spoon	Wgt. Hammer on Spoon	
Type Core Drill	Drop Hammer on Casing	
Core Dia.	Drop Hammer on Spoon	6001262
Sample & Test Notations		

Gibbs & Hill, Inc

BORING LOG

Sheet 2 of 2

PROJECT: Hercules PROJECT NO. 5583-09 BORING NO. MW-6

Location: Port Ewen, NY Coord: Ground Elev:

Contractor: Empire Drilling Date Started: 3/9/89 G.W.L. Hour: Date:

Inspector: Mike Valentino Date Completed: 3/13 G.W.L. Hour: Date:

Notes:

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows Casing Per Ft.	Blows Sampler 6"	Blows Sampler 6"	Recovery %	~~RQD %~~ HNU	Drilling Rate Min./Ft.	Graphic Symbol	Description and Remarks
40		S9			WOR	WOR	24"	0		CL	Gray cohesive wet silty clay
					WOR	WOH					
45		S10			WOR	WOR	24"	0		CL	Gray cohesive wet silty clay
					WOR	WOH					
50		S11			WOR	WOR	24"	0		ML	Gray wet clayey silt some fine sands at bottom
					WOH	4					
55		S12			WOR	WOR	24"	0		ML	Gray sandy clayey silt with some fine sand seams
					WOH	WOH					
60		S13			9	11	20"	0		SM	Gray clayey silty medium sands with gravel size fractured shale at bottom.
					27	28					
65											BOH
0											
5											
0											

I.D. Casing Wgt. Hammer on Casing

I.D. Spoon Wgt. Hammer on Spoon

Type Core Drill Drop Hammer on Casing

Core Dia. Drop Hammer on Spoon

Sample & Test Notations

Material Notations

Gibbs & Hill, Inc.

OVERBURDEN WELL CONSTRUCTION SCHEMATIC

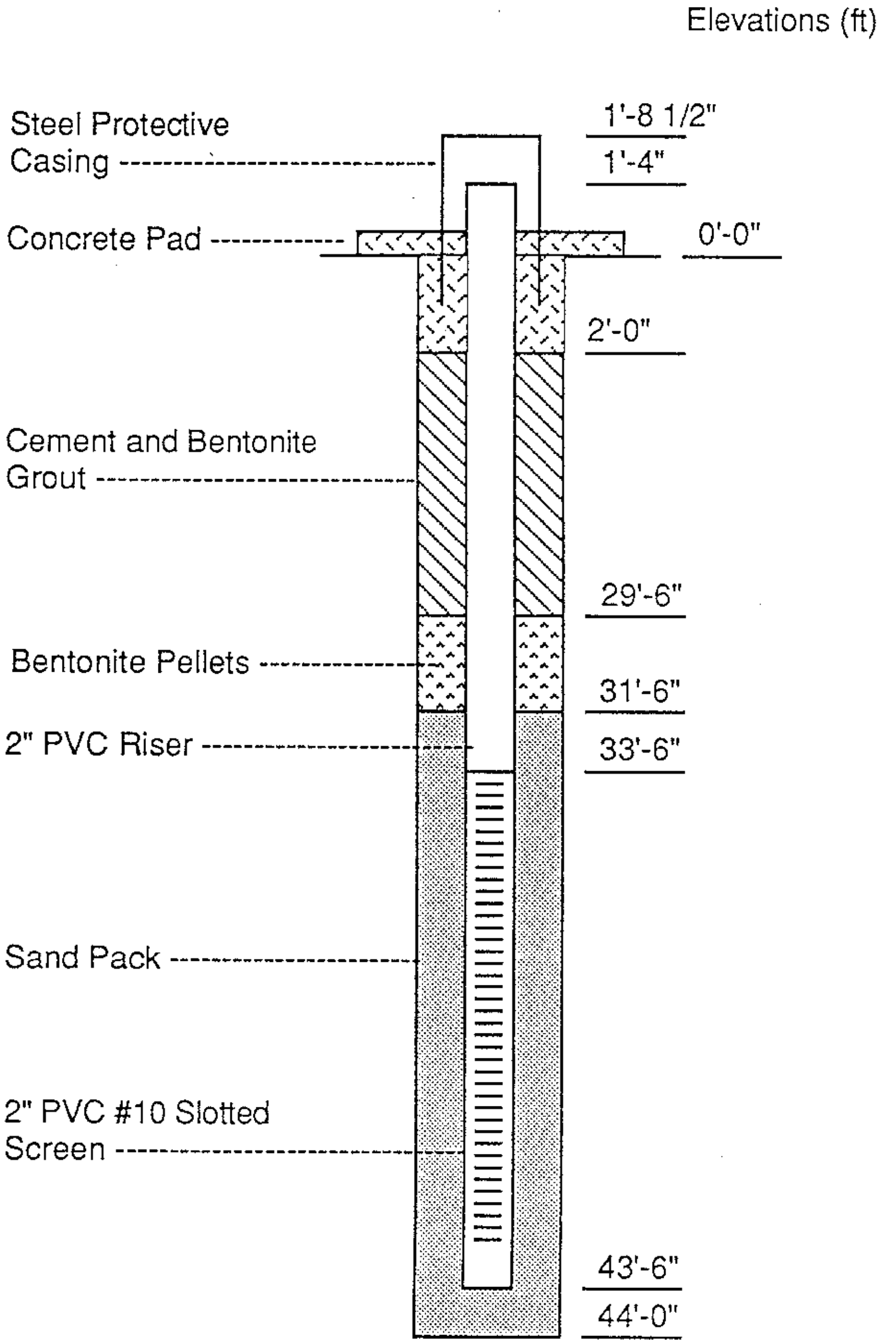
Site Hercules

Well No. MW-7

Date Installed 3/17/89

Water Level from Top of Casing 9'-7 1/4"

Date 3/23/89 Time 11:30 AM



Gibbs & Hill, Inc.

Sheet 1 of 2

BORING LOG

PROJECT: Hercules	PROJECT NO. 5583-09		BORING NO. MW-7
Location: Port Ewen, NY	Coord:		Ground Elev:
Contractor: Empire Drilling	Date Started: 3/16/89	G.W.L.	Hour:	Date:
Inspector: Mik Valentino	Date Completed: 3/17/89	G.W.L.	Hour:	Date:
Notes:			

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows			Recovery %	~~RQD %~~ HNU	Drilling Rate Min./Ft.	Graphic Symbol	Description and Remarks
				Casing	Sampler						
				Per Ft.	6"	6"					
0	SM	S1			2 6	9 5	18"	0		SM	Dry brown silty gravelly fine sand
5		S2			3 7	5 7	18"	0		ML	Dry brown clayey silt
10		S3			3 4	4 5	22"	0		ML	Moist brown clayey silt becoming grayer toward bottom
15		S4			WOH 1	WOH 2	22"	0		CL	wet gray silty clay
20		S5			WOR WOH	WOH WOH	24"	0		CL	wet gray silty clay
25		S6			WOH 2	WOH 2	16"	0		CL	wet gray silty clay
30		S7			WOH 2	WOH 3	24"	0		CL	Wet gray silty clay
35		S8			WOR WOH	WOH 1	24"	0		CL	wet gray silty clay some gravel at bottom
40											

I.D. Casing	Wgt. Hammer on Casing	Material Notations
I.D. Spoon	Wgt. Hammer on Spoon	
Type Core Drill	Drop Hammer on Casing	
Core Dia.	Drop Hammer on Spoon	
Sample & Test Notations		

6001264

Gibbs & Hill, In

BORING LOG

Sheet 2 of 2

PROJECT: Hercules
PROJECT NO. 5583-09
BORING NO. GW-7
Location: Port Ewen, NY
Coord:
Ground Elev:
Contractor: Empire Drilling
Date Started: 3/16/89
G.W.L.
Hour:
Date:
Inspector: Mik Valentino
Date Completed: 3/17/89
G.W.L.
Hour:
Date:
Notes:

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows Casing Per Ft.	Blows Sampler 6"	Blows Sampler 6"	Recovery %	RQD %	Drilling Rate Min./Ft.	Graphic Symbol	Description and Remarks
40		S9			WOR	5	12"	0		GM	wet dark shale fragments in a gray clayey silty matrix
					7	5					
5					100/.3						Refusal at 45' BOH
0											
5											
0											
5											
0											
5											
0											

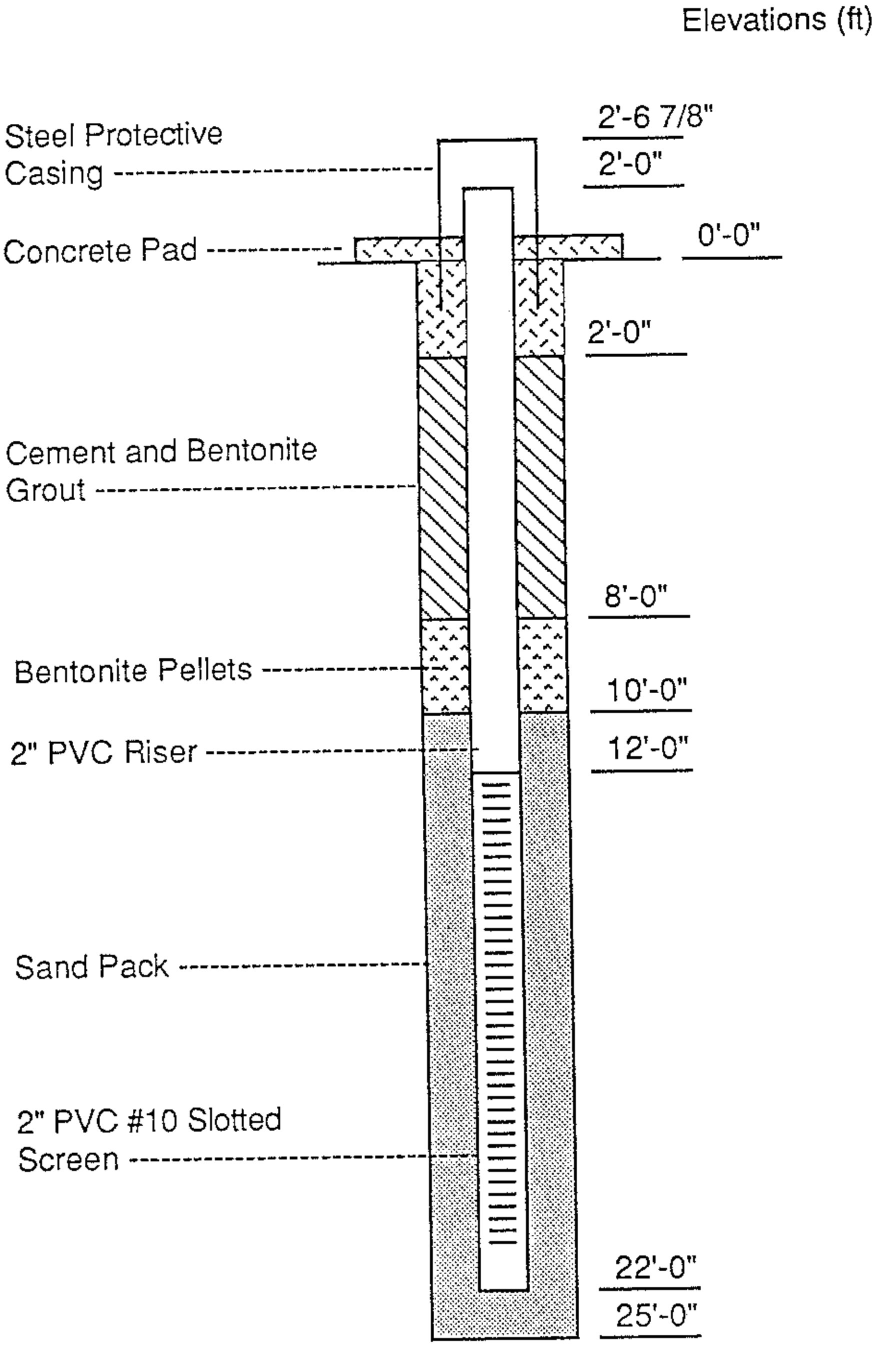
I.D. Casing
Wgt. Hammer on Casing
Material Notations
I.D. Spoon
Wgt. Hammer on Spoon
Type Core Drill
Drop Hammer on Casing
Core Dia.
Drop Hammer on Spoon
Sample & Test Notations

Gibbs & Hill, Inc.

OVERBURDEN WELL CONSTRUCTION SCHEMATIC

Site Hercules
Well No. MW-8
Date Installed 3/8/89

Water Level from
Top of Casing 8'-5 1/4"
Date 3/23/89 Time 1:00 PM



Gibbs & Hill, Inc.

Sheet 1 of 1

BORING LOG

PROJECT: Hercules
PROJECT NO. 5583-09
BORING NO. MW-8
Location: Port Ewen, N.Y.
Coord:
Ground Elev:
Contractor: Empire Drilling
Date Started: 3/8/89
G.W.L.
Hour:
Date:
Inspector: Mike Valentino
Date Completed: 3/8/89
G.W.L.
Hour:
Date:
Notes:

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows Casing Per Ft.	Blows Sampler 6"	Blows Sampler 6"	Recovery %	~~RQD %~~ HNU	Drilling Rate Min./Ft.	Graphic Symbol	Description and Remarks
0											No Sample
5					4	5	12"	0		ML	yellowish brown moist clayey-silt.
					6	8					
0					6	6	12"	0		ML	yellowish brown more moist clayey silt
					7	8					
5					2	2	10"	0		ML	Gray wet clayey silt
					1	2					
0					0	0	2"	0		ML	Gray saturated clayey silt
					0	1					
5											BOH - 25 ft
0											
5											
0											

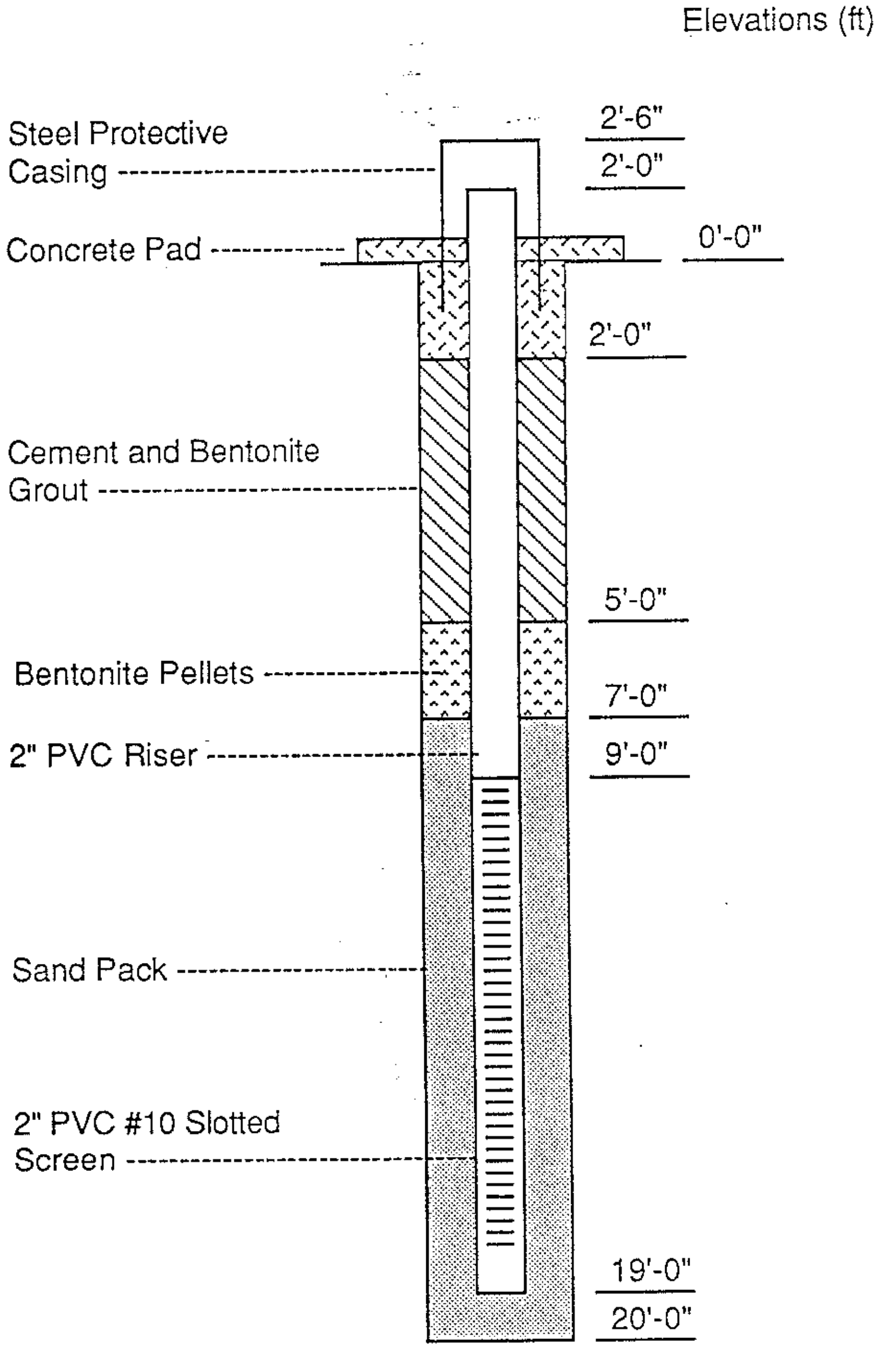
I.D. Casing
Wgt. Hammer on Casing
Material Notations
I.D. Spoon
Wgt. Hammer on Spoon
Type Core Drill
Drop Hammer on Casing
Core Dia.
Drop Hammer on Spoon
Sample & Test Notations

Gibbs & Hill, Inc

OVERBURDEN WELL CONSTRUCTION SCHEMATIC

Site Hercules
Well No. MW-9
Date Installed 3/7/89

Water Level from
Top of Casing 2'- 7 1/2"
Date 3/23/89 Time 2:00 PM



Gibbs & Hill, Inc.

BORING LOG

B Sheet 1 of 1

PROJECT: Hercules PROJECT NO. 5583-09 BORING NO. MW-9
Location: Port Ewen, NY Coord: Ground Elev:
Contractor: Empire Drilling Date Started: 3/7/89 G.W.L. 3'6.5. Hour: 2:30P Date: 3/7
Inspector: Mik Valentino Date Completed: 3/7/89 G.W.L. 4'5"72 Hour: 9:10A Date: 3/9
Notes:

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows Casing Per Ft.	Blows Sampler 6"	Blows Sampler 6"	Recovery %	~~RQD %~~ HNU	Drilling Rate Min./Ft.	Graphic Symbol	Description and Remarks
0					20 10	13 10	12"	0		ML	Dry brown clayey silt - 1st 3" frozen
5					3 4	7 7	18"	0		ML	Dry brown clayey silt becoming moist toward bottom of core
0					2 3	3 4	20"	0		ML	Moist brown clayey silt changing to gray clayey silt at 11'8"
5					0 2	0 2	12"	0		ML	wet. gray clayey silt
0					17 29	18 47	12"	0		GM	weathered black shale in a silty matrix
5											
0											
5											
0											

I.D. Casing	Wgt. Hammer on Casing	Material Notations
I.D. Spoon	Wgt. Hammer on Spoon	
Type Core Drill	Drop Hammer on Casing	
Core Dia.	Drop Hammer on Spoon	6001267
Sample & Test Notations		

Gibbs & Hill, Inc.

OVERBURDEN WELL CONSTRUCTION SCHEMATIC

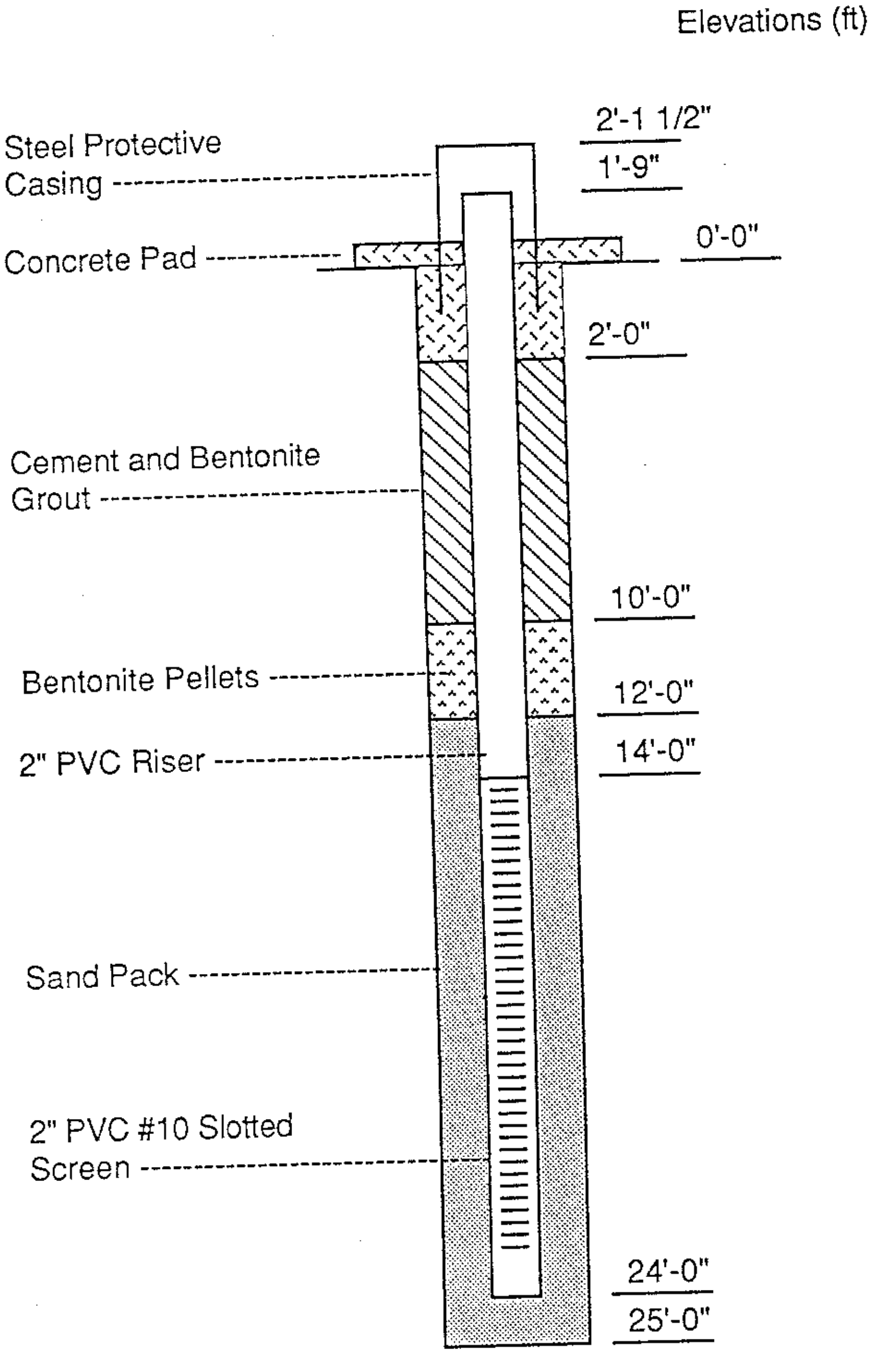
Site Hercules

Well No. MW-10

Date Installed 3/6/89

Water Level from Top of Casing 3'-9"

Date 3/23/89 Time 2:45 PM



Gibbs & Hill, Inc.

Sheet 1 of 1

BORING LOG

PROJECT: Hercules PROJECT NO. 5583-09 BORING NO. MW-10

Location: Port Ewen, N.Y. Coord: Ground Elev:

Contractor: Empire Drilling Date Started: 3/6/89 G.W.L. 5'(TOC) Hour: 1:20P Date: 3/7/8

Inspector: Mike Valentino Date Completed: 3/7/89 G.W.L. Hour: Date:

Notes:

Depth Ft.	Elev. Ft.	Sample Type & No.	Test Type & No.	Blows Casing Per Ft.	Blows Sampler 6"	Blows Sampler 6"	Recovery %	~~RQD %~~ HNU	Drilling Rate Min./Ft.	Graphic Symbol	Description and Remarks
0					3 6	3 7	20"	0		ML	Brown. dry-moist clayey silt - top 3" frozen
5					5 8	6 9	23"	0		ML	Clayey brown moist silt.
0					1 2	2 3	24"	0		ML	Clayey brown moist silt changing to gray wet clayey silt at 11½'
5					2 2	4 2	18"	0		ML	wetter gray clayey silt
0					0 2	1 3	18"	0		ML	saturated gray clayey silt.
5											BOH ↑
0											
5											
0											

I.D. Casing Wgt. Hammer on Casing

I.D. Spoon Wgt. Hammer on Spoon

Type Core Drill Drop Hammer on Casing

Core Dia. Drop Hammer on Spoon

Sample

Material Notations

6001268

Gibbs & Hill, Inc.

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location:
MW-11S

Page 1 of 1

Project: *Groundwater Investigation*	Project No.:	Start Date: *07/31/95*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*	*9596.03*	Finish Date: *07/31/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*PVC, Sch. 40*	*PVC, 0.010" Screen*
Diameter (ID):	*2 inch*	*2 inch*
Coupling:	*Flush-Threaded*	*Flush-Threaded*

WELL DEVELOPMENT

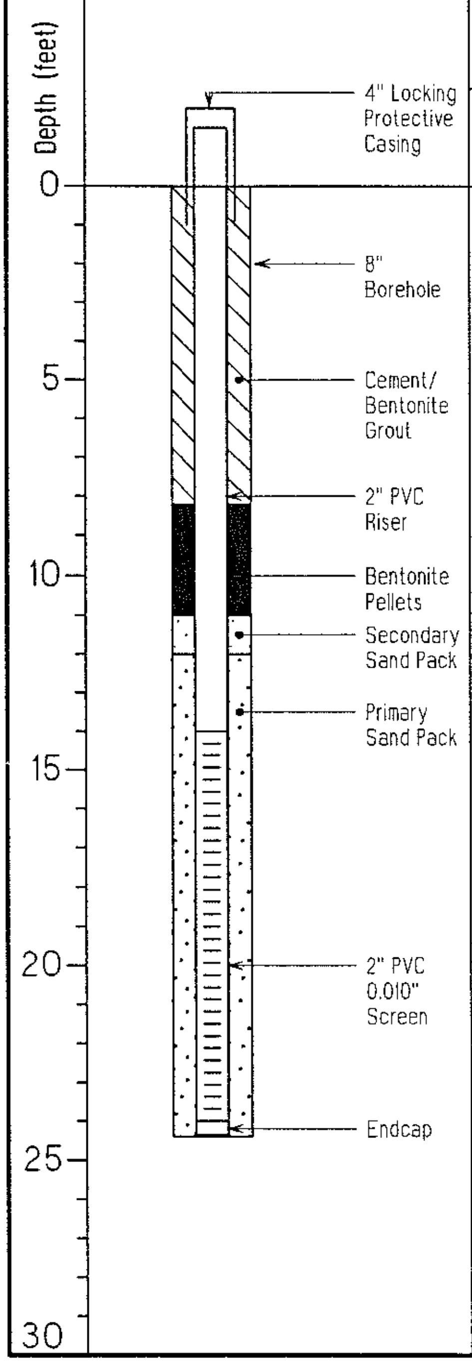
Method: *Surge Block/Bailer*
Duration: *0.5 hours*
Gals. Purged: *14 gallons*
Slug Test: *3.6 x 10^{-6}* (cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: *162.1*
TWC: *164.4*
TPC: *164.6*
North: *683,792.33*
East: *593,680.59*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	soil: Samp. No. rock: Run No.	SAMPLE DATA: Blows/ 6 in. Hydraul. Cond. cm/sec	Rec. (ft.)	USCS RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0							*See MW-11D for sample description.*	
24.4							End of Boring @ 24.4 feet.	



ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-11D

Page 1 of 2

Project: *Groundwater Investigation*

Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*

Project No.: *9596.03*

Start Date: *07/26/95*

Finish Date: *07/28/95*

DRILLING DATA

Inspector: *Laurie Scheuing*

Contractor: *B. Bosworth/Empire Soils Investigation Inc.*

Equipment: *CME 850*

Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*PVC, Sch. 40*	*PVC, 0.010" Screen*
Diameter (ID):	*2 inch*	*2 inch*
Coupling:	*Flush-Threaded*	*Flush-Threaded*

WELL DEVELOPMENT

Method: *Surge Block/Dual Line Air*

Duration: *4.4 hours*

Gals. Purged: *125 gallons*

Slug Test: *8.8×10^{-3}* (cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: *161.4*

TWC: *163.9*

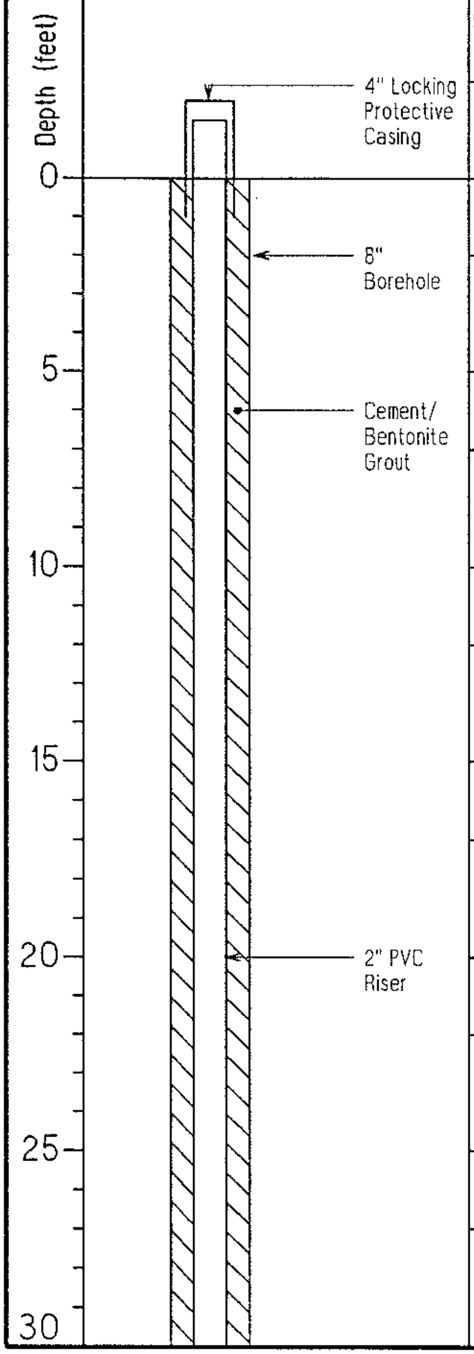
TPC: *164.0*

North: *683,789.62*

East: *593,686.64*

Geophysical Log: ☐ yes ☒ no

Comments:



Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
S-1	2-5-8-11	1.6'	CL	0	LACUSTRINE DEPOSITS Brown CLAY & SILT, trace f Sand, with roots in top 0.2', damp to dry	
S-2	2-7-8-15	1.8'	CH	0	@ 5.0' brown Silty CLAY, little f Sand, damp to wet	
S-3	5-6-6-9	2.0'	CH	0		
S-4	2-2-2-2	2.0'	CH	0	@ 15.0' gray Silty CLAY, trace f Sand, saturated	
S-5	2-1-1-2	1.9'	CH	0		
S-6	WOH/24"	1.8'	CH	0		

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: MW-11D *Page 2 of 2*

Project: *Groundwater Investigation*

Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*

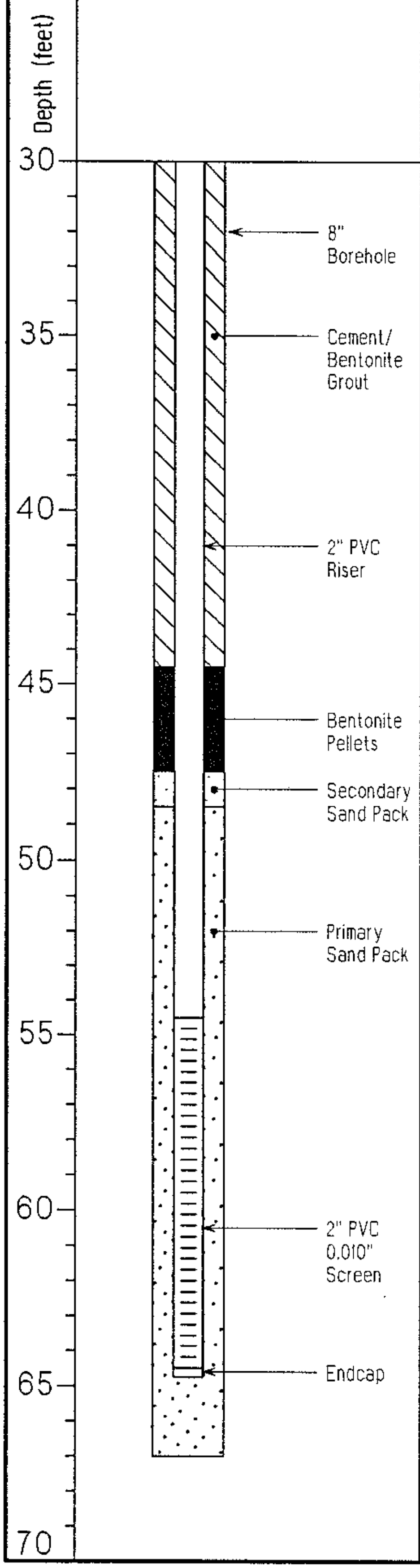
Project No.: *9596.03*

Start Date: *07/26/95*

Finish Date: *07/28/95*

(CONTINUATION)

WELL CONSTRUCTION



soil: SAMPLE DATA						
Samp. No.	Blows/ 6 in.	Rec. (ft.)	USCS	PID (ppm)		
rock: Run No.	Hydraul. Cond. cm/sec	Rec. (ft.)	RQD		VISUAL CLASSIFICATION	REMARKS
S-7	WOR/12"-WOH/12"	1.6'	CH	0		
S-8	WOH/24"	1.7'	CH	0	@ 35.0' gray Silty CLAY, little to trace f Sand	
S-9	WOR/18"-WOH/6"	1.6'	CH	0		
S-10	WOR-5-10-7	0.4'	SC	0	@ 45.0' gray cmf SAND, some Clay & Silt, little fm Gravel	
S-11	12-12-8-12	0.6'	GM	0	@ 50.0' gray GRAVEL and cmf SAND, little Clay & Silt	
S-12	9-12-11-13	1.3'	GM	0	@ 55.0' gray mf GRAVEL, some fmc Sand, trace (-) Clayey Silt	
S-13	36-51-35-30	2.0'	GP	0	@ 60.0' gray cmf SAND and fmc GRAVEL, trace Clayey Silt	
S-14	13-63-104-74	1.6'	GP	0		
					End of Boring at 67.0 feet.	

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: **MW-12S**

Page 1 of 1

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *05/18/95*
Finish Date: *05/18/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 55*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split Spoon	NA	NA
Diameter:	2 inch	NA	NA
Other:	140 lb./30 in.	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	PVC, Sch. 40	PVC, 0.010" Screen
Diameter (ID):	2 inch	2 inch
Coupling:	Flush-Threaded	Flush-Threaded

WELL DEVELOPMENT

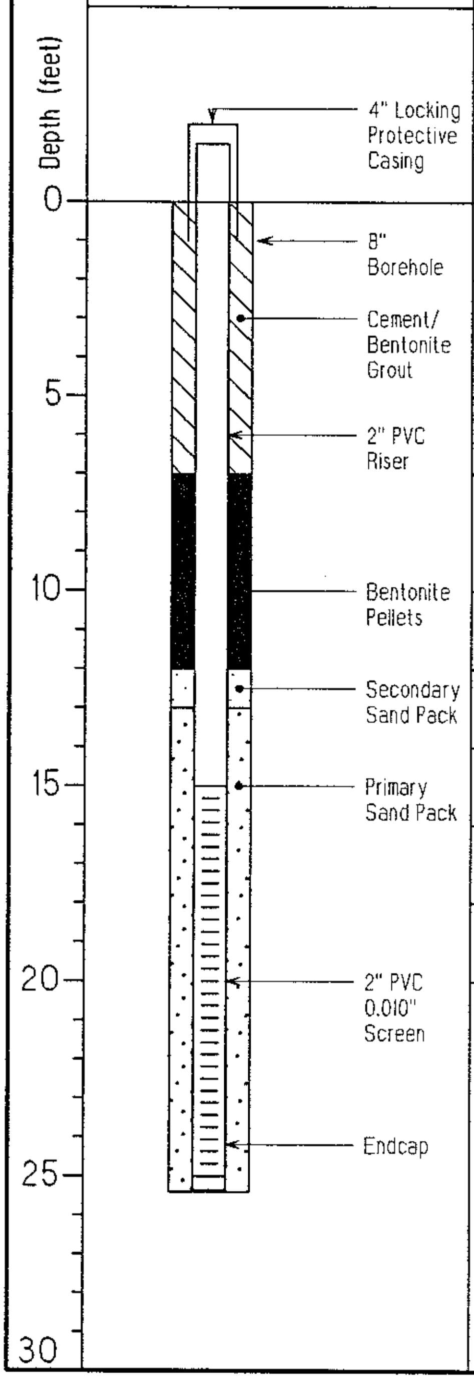
Method: *Surge Block/Bailer*
Duration: *0.5 hours*
Gals. Purged: *27 gallons*
Slug Test: *7.4×10^{-6}* (cm/sec)

SURVEY DATA

DATUM: NGVD/NYS Plane
Grade: *166.5*
TWC: *168.9*
TPC: *169.0*
North: *685,004.95*
East: *593,902.75*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA

soil / rock

Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)
S-1	12-12-15-14	1.1'	SM CH	0
S-2	6-8-10-13	1.6'	CH	0
S-3	2-4-5-6	1.9'	CH	0
S-4	7-5-7-7	1.4'	CH	0
S-5	2-1-2-3	1.9'	CH	0
S-6	3-2-3-3	1.7'	CH	0
S-7	WOH-1-2-3	1.5'	CH	0

VISUAL CLASSIFICATION

REMARKS

LACUSTRINE DEPOSITS

Brown fm SAND, some Clayey Silt, little (-) f Gravel, dry

@ 0.5' brown Silty CLAY, trace f Sand, dense, dry to wet

@ 12.9' grading to gray Silty CLAY, trace f Sand, saturated

@ 14.0' gray CLAY

End of Boring at 25.0 feet.

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location:
MW-12D

Page 1 of 3

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *05/15/95*
Finish Date: *05/17/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 55*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*PVC, Sch. 40*	*PVC, 0.010" Screen*
Diameter (ID):	*2 inch*	*2 inch*
Coupling:	*Flush-Threaded*	*Flush-Threaded*

WELL DEVELOPMENT

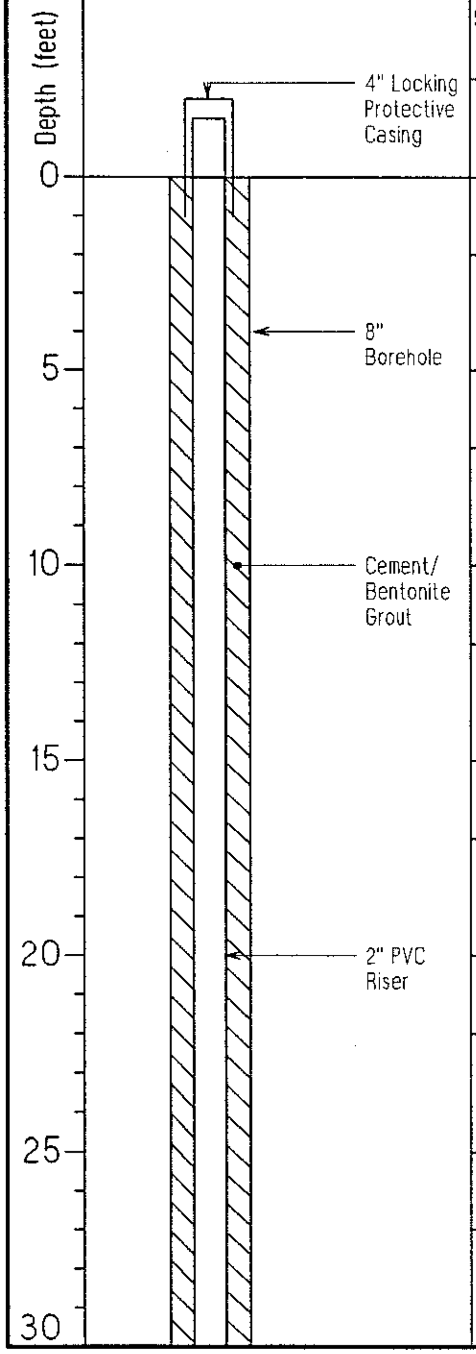
Method: *Surge Block/Bailer/Dual Line Air*
Duration: *4 hours*
Gals. Purged: *285 gallons*
Slug Test: *9.9×10^{-4}* (cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: *166.0*
TWC: *168.4*
TPC: *168.6*
North: *685,000.73*
East: *593,908.21*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA

Samp. No.	Blows/ 6 in.	Rec. (ft.)	USCS	PID (ppm)
Run No.	Hydraul. Cond. cm/sec	Rec. (ft.)	RQD	
S-1	12-9-10-8	1.2'	GC CH	0
S-2	4-7-8-8	1.0'	CH	0
S-3	4-5-4-7	0.8'	CH	0
S-4	3-2-2-2	0.2'	CH	0
S-5	WOR-1-2-1	1.6'	CH	0
S-6	1-1-1-1	2.0'	CH	0

VISUAL CLASSIFICATION

0.5

FILL

Gray fm GRAVEL and medium-brown Silty CLAY, dry

LACUSTRINE DEPOSITS

Medium-brown Silty CLAY, trace f Sand, dry to wet

@ 10.0' brown Silty CLAY, little fm Sand, trace f angular Gravel, wet

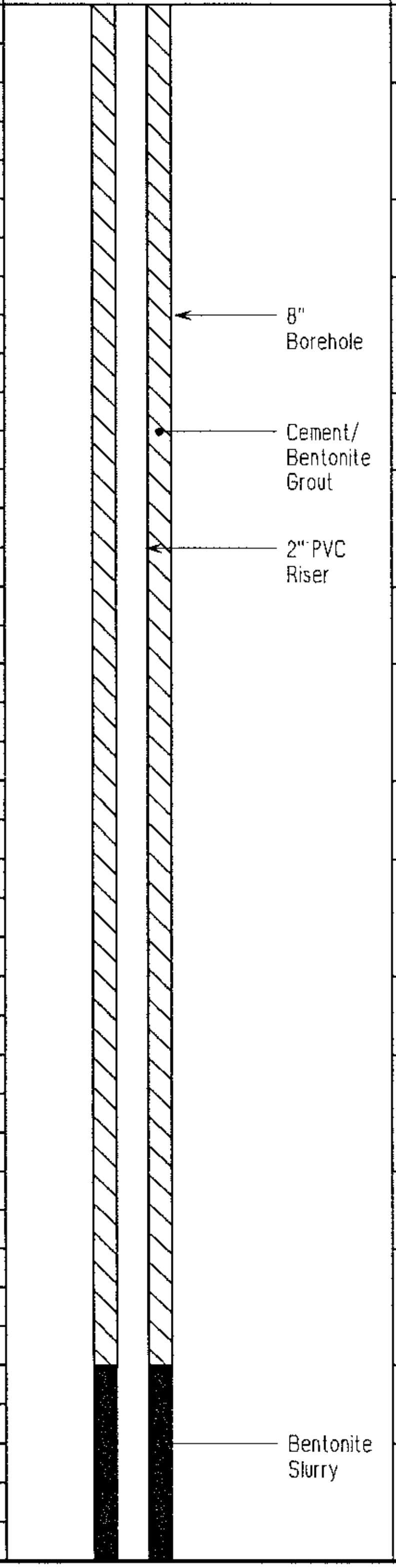
@ 15.0' gray Silty CLAY, trace f Sand, wet

@ 20.0' gray CLAY, saturated

REMARKS

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: MW-12D *Page 2 of 3*
Project: *Groundwater Investigation* Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*	Project No.: *9596.03*	Start Date: *05/15/95* Finish Date: *05/17/95*

WELL CONSTRUCTION

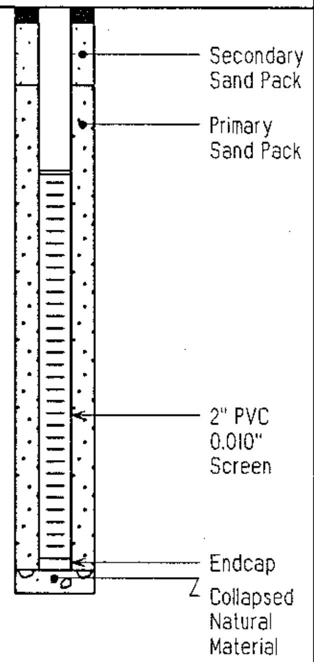


(CONTINUATION)

Depth (feet)	soil: Samp. No. rock: Run No.	soil: Blows/ 6 in. rock: Hydraul. Cond. cm/sec	Rec. (ft.)	soil: USCS rock: RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30	S-7	1-1-1-1	2.0'	CH	0		
35	S-8	WOR/18"-2	2.0'	CH	0		
40	S-9	WOH/24"	1.4'	CH	0		
45	S-10	WOR/18"-4	2.0'	CH	0	@ 46.5' gray CLAY, trace (–) f Sand	
50	S-11	WOR/12"-WOH-1	1.8'	CH	0		
55	S-12	WOR/12"-2-3	2.0'	CH	0	@ 55.0' gray CLAY	
60	S-13	WOR/18"-3	2.0'	CH	0		
65	S-14	WOR/12"-3-2	2.0'	CH	0	@ 66.8' gray CLAY, trace (–) fm angular Gravel, trace (–) f Sand	
70							

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: MW-12D *Page 3 of 3*
Project: *Groundwater Investigation* Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*	Project No.: *9596.03*	Start Date: *05/15/95* Finish Date: *05/17/95*

WELL CONSTRUCTION



soil / rock — SAMPLE DATA

(CONTINUATION)

Depth (feet)	Samp. No. Run No.	Blows/ 6 in. Hydraul. Cond. cm/sec	Rec. (ft.) Rec. (ft.)	USCS RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
70	S-15	2-3-3-8	1.3'	GC	0	@ 70.0' gray Silty CLAY, little fm grading to some fmc angular Gravel, trace f Sand	
75	S-16	5-3-4-6	0.5'	GC	0		
80	S-17	18-15-8-12	1.4'	SM GC	0	@ 80.0' gray cmf SAND, trace Clayey Silt @ 81.0' gray Silty CLAY and mf GRAVEL, some cf Sand	
85	S-18	100/1"	0.1'	GC	0	Bedrock @ 85.1 feet. End of Boring at 85.1 feet.	
90							
95							
100							
105							
110							

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: MW-13S Page 1 of 1

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *05/31/95*
Finish Date: *05/31/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 55*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*PVC, Sch. 40*	*PVC, 0.010" Screen*
Diameter (ID):	*2 inch*	*2 inch*
Coupling:	*Flush-Threaded*	*Flush-Threaded*

WELL DEVELOPMENT

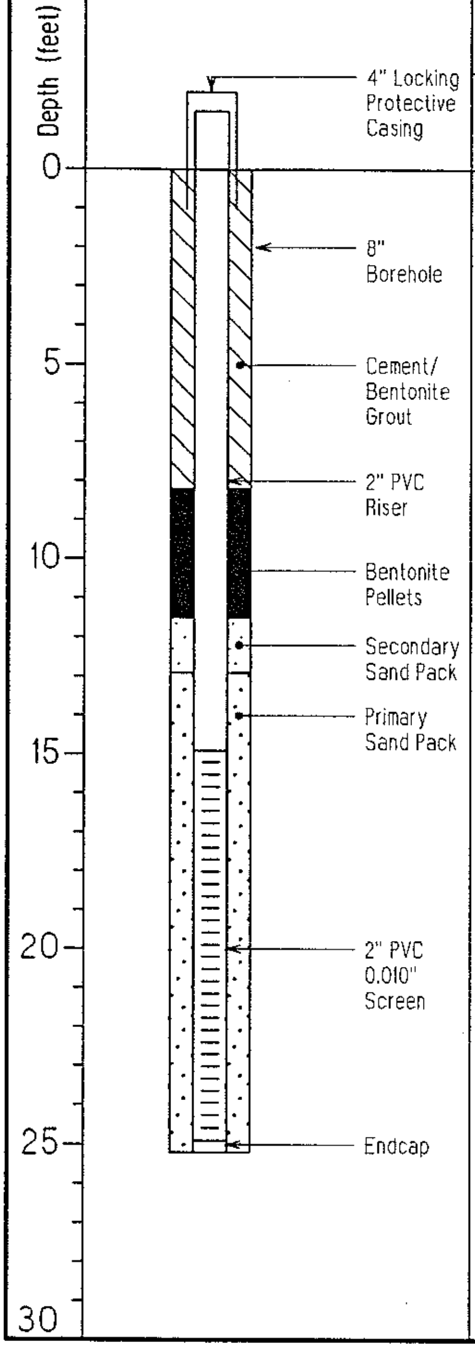
Method: *Surge Block/Bailer*
Duration: *0.75 hours*
Gals. Purged: *33 gallons*
Slug Test: 4.3×10^{-7} (cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: *160.1*
TWC: *162.5*
TPC: *162.6*
North: *686,130.09*
East: *594,562.13*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



soil: Samp. No. rock: Run No.	SAMPLE DATA: Blows/ 6 in. Hydraul. Cond. cm/sec	Rec. (ft.) Rec. (ft.)	USCS RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
					See MW-13D for sample description.	
					End of Boring @ 25.2 feet.	

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location:
MW-13D

Page 1 of 2

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *05/26/95*
Finish Date: *05/31/95*

DRILLING DATA

Inspector: *L. Scheuing/D. Gawronski*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 55*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*PVC, Sch. 40*	*PVC, 0.010" Screen*
Diameter (ID):	*2 inch*	*2 inch*
Coupling:	*Flush-Threaded*	*Flush-Threaded*

WELL DEVELOPMENT

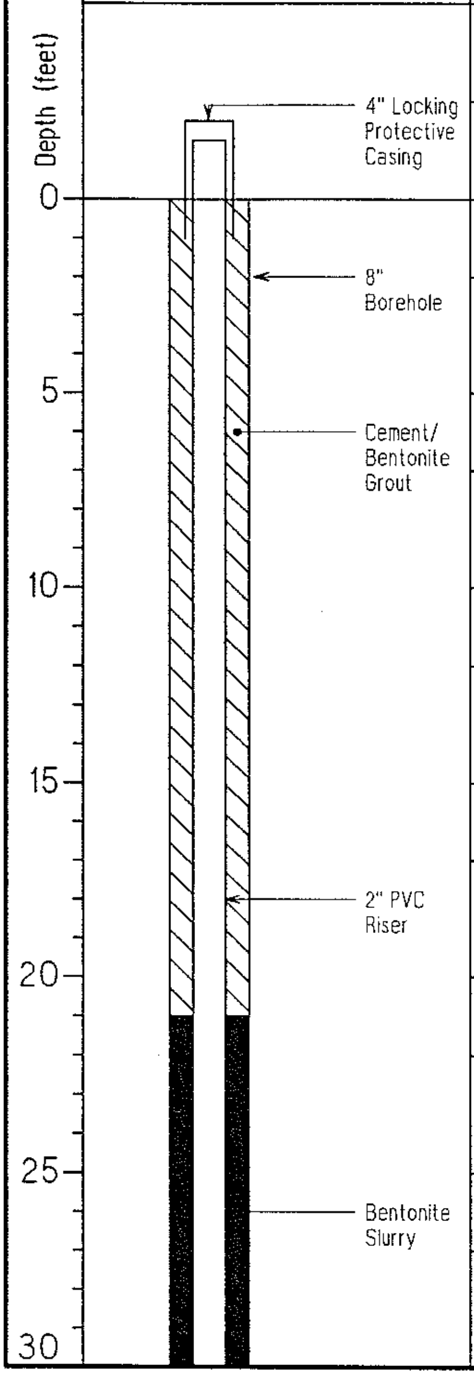
Method: *Surge Block/Dual Line Air*
Duration: *2.6 hours*
Gals. Purged: *205 gallons*
Slug Test: 1.9×10^{-2} (cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: *160.2*
TWC: *162.4*
TPC: *162.6*
North: *686,123.89*
East: *594,562.05*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA

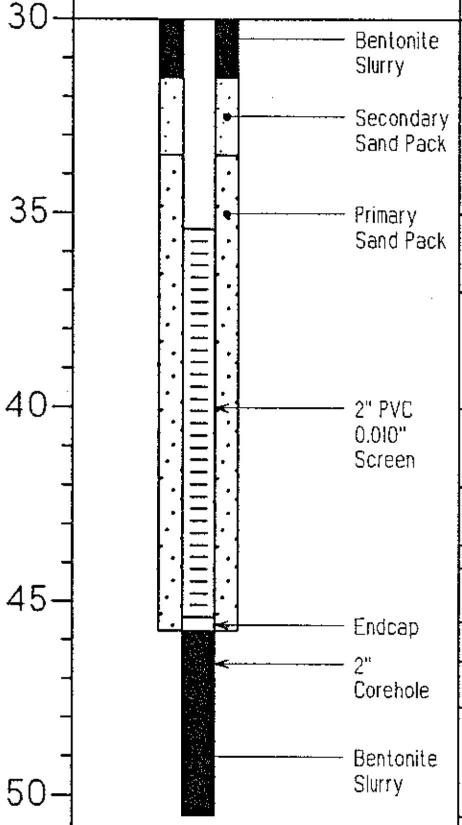
soil Samp. No.	Blows/ 6 in.	Rec. (ft.)	USCS	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
rock Run No.	Hydraul. Cond. cm/sec	Rec. (ft.)	RQD			
S-1	15-8-6-8	1.1'	SW CH	0.1	FILL Dark gray mf SAND, with cinders, wet 0.9 LACUSTRINE DEPOSITS Brown Silty CLAY, trace f Sand, wet to moist	
S-2	3-4-5-6	1.6'	CH	0		
S-3	3-4-5-6	2.0'	CH	0	@ 10.0' brown Silty CLAY, little f Sand, trace to no f Gravel, moist	
S-4	1-2-2-2	1.9'	CH	0	@ 15.3' grading to gray Silty CLAY, trace to little f Sand, saturated	
S-5	WOR-1-1-2	2.0'	CH	0		
S-6	WOH/18"-2	2.0'	CH	0		

ECKENFELDER INC. | Subsurface Boring Log | Well Name/Location: **MW-13D**

Page 2 of 2

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *05/26/95*
Finish Date: *05/31/95*

WELL CONSTRUCTION



SAMPLE DATA

(CONTINUATION)

soil: Samp. No. / rock: Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
S-7	WOR/12"-2-1	2.0'	CH	0		
S-8	WOH/18"-1	2.0'	CH	0	@ 35.0' gray CLAY, with few f Sand partings	
S-9	WOH-4-4-10	0.4'	CH	0	@ 40.0' gray Silty CLAY, little f Sand	
S-10	100/1"	0.1'	SM	0	@ 43.5' gray f SAND and Clayey SILT , some f Gravel 43.6 BEDROCK	
R-1	NM	0.5'	40%	NM	Gray & black interbedded SHALE, with quartz & calcite mineralization	
R-2	NM	1.2'	60%	NM		
R-3	NM	2.8'	70%	NM		

End of Boring at 50.5 feet.

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: MW-14S *Page 1 of 2*

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *05/18/95*
Finish Date: *05/25/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 55*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*PVC, Sch. 40*	*PVC, 0.010" Screen*
Diameter (ID):	*2 inch*	*2 inch*
Coupling:	*Flush-Threaded*	*Flush-Threaded*

WELL DEVELOPMENT

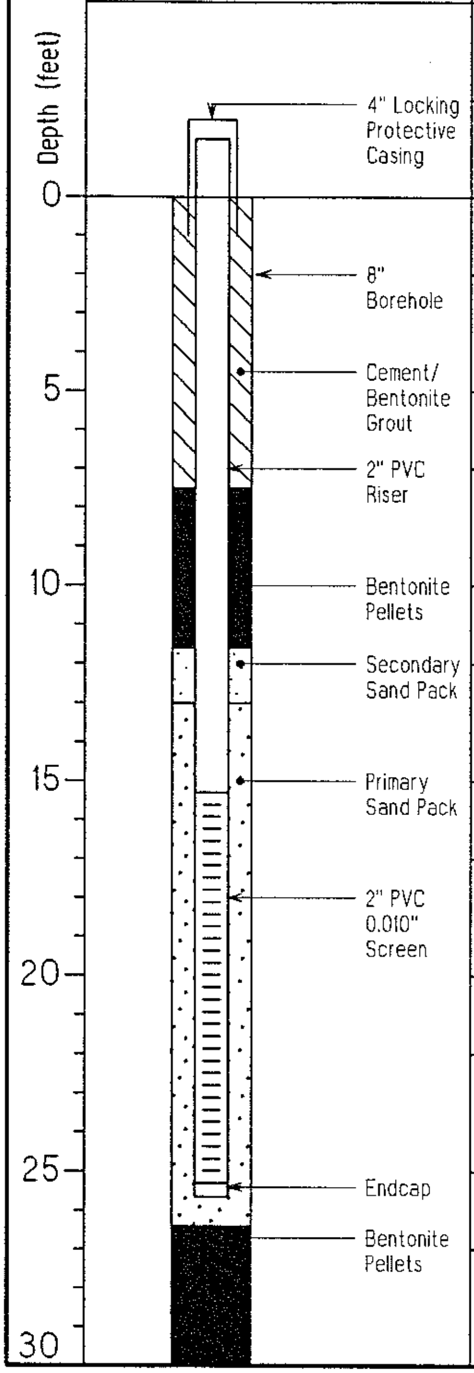
Method: *Surge Block/Bailer*
Duration: *0.75 hours*
Gals. Purged: *27 gallons*
Slug Test: *1.8 x* 10^{-5} (cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: *173.1*
TWC: *175.6*
TPC: *175.8*
North: *686,268.37*
East: *593,685.26*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA (soil / rock)

Samp. No.	Blows/ 6 in.	Rec. (ft.)	USCS	PID (ppm)
Run No.	Hydraul. Cond. cm/sec	Rec. (ft.)	RQD	
S-1	4-7-8-15	1.3'	CH	0
S-2	35-15-10-16	0.9'	CH	0
S-3	14-7-7-8	1.4'	CH	0
S-4	5-2-2-2	1.5'	CH	0
S-5	1-1-2-3	1.4'	CH	0
S-6	2-1-0-2	2.0'	CH	0

VISUAL CLASSIFICATION | **REMARKS**

LACUSTRINE DEPOSITS

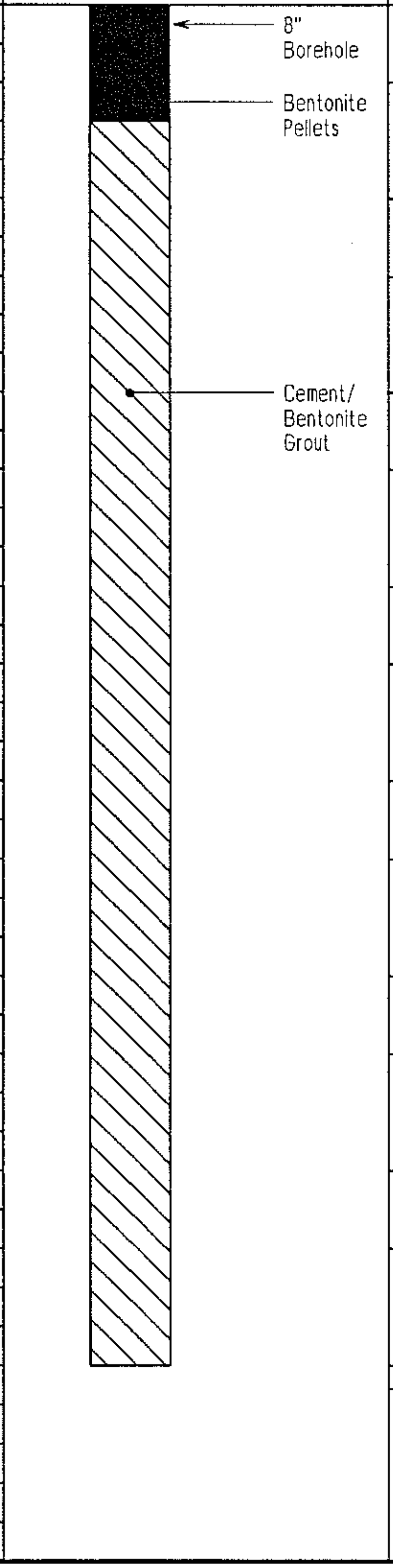
Brown Silty CLAY, little to no f Gravel, trace (-) mf to f Sand, with roots, dry to moist

@ 15.0' gray Silty CLAY, trace f Sand, saturated

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: MW-14S *Page 2 of 2*
Project: *Groundwater Investigation* Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*	Project No.: *9596.03*	Start Date: *05/18/95* Finish Date: *05/25/95*

(CONTINUATION)

WELL CONSTRUCTION



Depth (feet)	Samp. No.	Blows/ 6 in.	Rec. (ft.)	USCS	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
	Run No.	Hydraul. Cond. cm/sec	Rec. (ft.)	RQD			
30	S-7	WOR-2-1-2	1.5'	CH	0		
35	S-8	3-1-2-2	1.5'	CH	0	@ 35.0' gray Silty CLAY, trace f Gravel @ 36.0' gray CLAY	
40	S-9	WOR/18"-2	2.0'	CH	0	@ 40.6' gray CLAY, trace f Sand	
45	S-10	WOR/24"	1.6'	CH	0		
50	S-11	WOR/18"-1	1.5'	CH	0		
55	S-12	WOR-1-3-4	1.8'	CH	0	@ 55.0' gray CLAY, trace f Sand, trace (-) to no f Gravel	
60	S-13	WOR/18"-3	2.0'	CH	0		
65	S-14	100/0"	NR	NA	NA	Bedrock @ 65.0 feet. End of Boring at 65.0 feet.	
70							

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: MW-14D *Page 1 of 2*

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *05/18/95*
Finish Date: *05/25/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 55*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*PVC, Sch. 40*	*PVC, 0.010" Screen*
Diameter (ID):	*2 inch*	*2 inch*
Coupling:	*Flush-Threaded*	*Flush-Threaded*

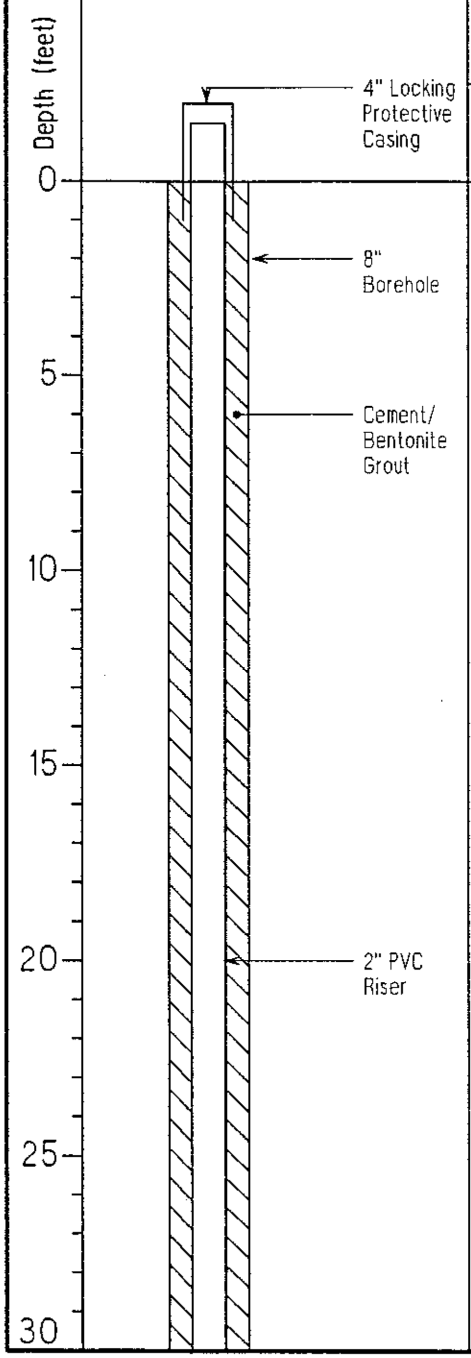
WELL DEVELOPMENT

Method: *Surge Block/Dual Line Air*
Duration: *4 hours*
Gals. Purged: *170 gallons*
Slug Test: *1.4×10^{-3}* (cm/sec)

SURVEY DATA

DATUM: NGVD/NYS Plane
Grade: *173.7*
TWC: *176.1*
TPC: *176.4*
North: *686,262.84*
East: *593,680.99*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	soil: Samp. No. rock: Run No.	SAMPLE DATA: Blows/ 6 in. Hydraul. Cond. cm/sec	Rec. (ft.) Rec. (ft.)	USCS RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0–30							*See MW-14S for sample descriptions.*	

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: **MW-14D**

Page 2 of 2

Project: *Groundwater Investigation*

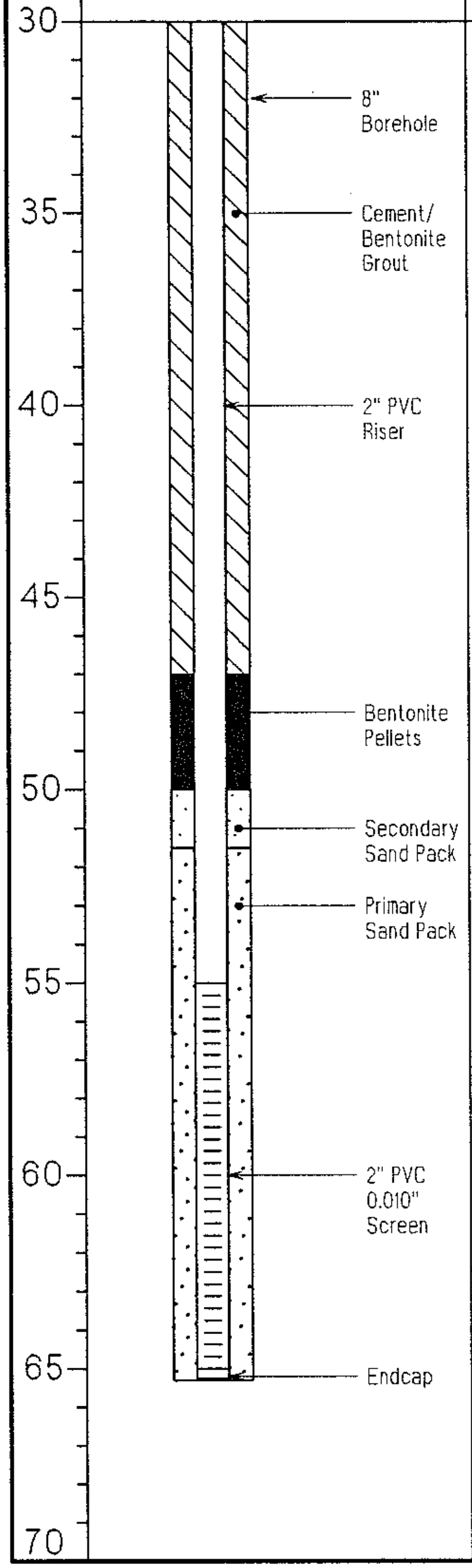
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*

Project No.: *9596.03*

Start Date: *05/18/95*

Finish Date: *05/25/95*

(CONTINUATION)



soil: Samp. No.	soil: Blows/ 6 in.	soil: Rec. (ft.)	soil: USCS	soil: PID (ppm)	VISUAL CLASSIFICATION	REMARKS
rock: Run No.	rock: Hydraul. Cond. cm/sec	rock: Rec. (ft.)	rock: RQD			
					End of Boring @ 65.3 feet.	

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-15S

Page 1 of 1

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *07/25/95*
Finish Date: *07/25/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*PVC, Sch. 40*	*PVC, 0.010" Screen*
Diameter (ID):	*2 inch*	*2 inch*
Coupling:	*Flush-Threaded*	*Flush-Threaded*

WELL DEVELOPMENT

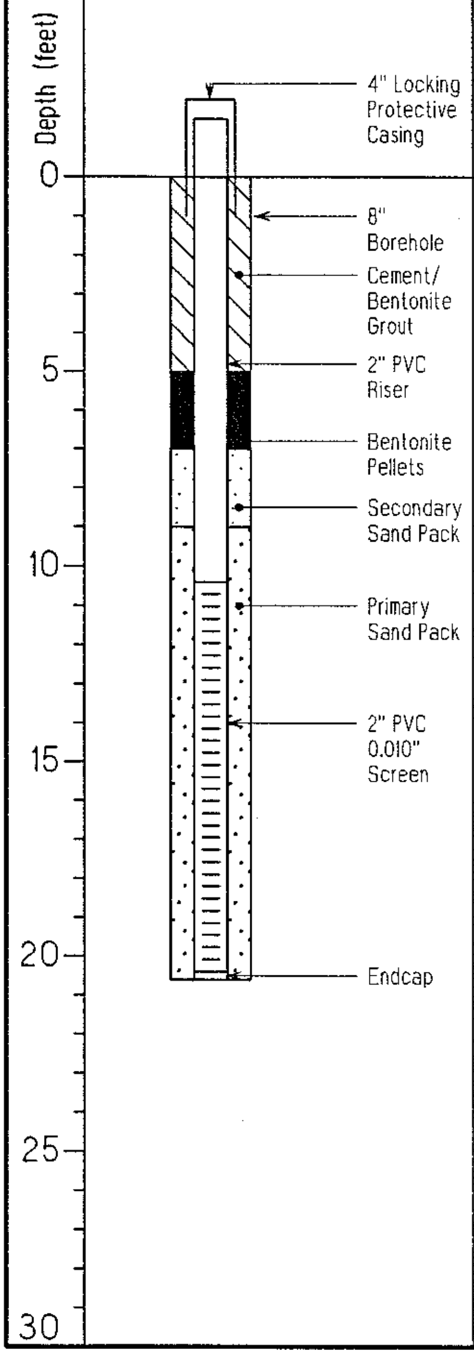
Method: *Surge Block/Bailer*
Duration: *0.5 hours*
Gals. Purged: *20 gallons*
Slug Test: *6.9×10^4* (cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: *159.6*
TWC: *162.0*
TPC: *162.2*
North: *687,490.56*
East: *594,477.68*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	soil: Samp. No. / rock: Run No.	SAMPLE DATA: Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.) / Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0							*See MW-15D for sample description.*	
20.6							End of Boring @ 20.6 feet.	



ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location:
MW-15D

Page 1 of 2

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *07/19/95*
Finish Date: *07/24/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*PVC, Sch. 40*	*PVC, 0.010" Screen*
Diameter (ID):	*2 inch*	*2 inch*
Coupling:	*Flush-Threaded*	*Flush-Threaded*

WELL DEVELOPMENT

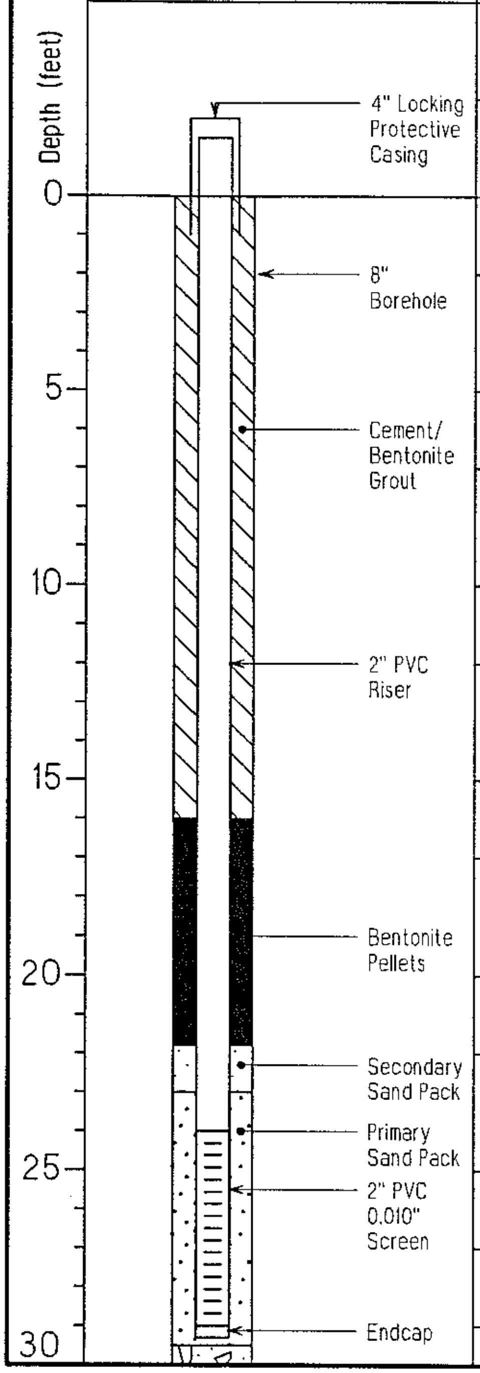
Method: *Surge Block/Dual Line Air*
Duration: *1.5 hours*
Gals. Purged: *45 gallons*
Slug Test: *1.4×10^{-2}* (cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: *159.2*
TWC: *162.0*
TPC: *161.6*
North: *687,485.21*
East: *594,477.51*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA

soil: Samp. No. rock: Run No.	Blows/ 6 in. Hydraul. Cond. cm/sec	Rec. (ft.)	USCS RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
S-1	2-2-4-4	1.5'	CH	0	LACUSTRINE DEPOSITS Brown Silty CLAY, trace to little f Sand, with roots, dry to wet	
S-2	4-5-6-8	1.6'	CH	0		
S-3	3-3-3-5	1.2'	CH	0		
S-4	1-1-2-1	1.1'	CH	0	@ 15.5' gray Silty CLAY, little f Sand, saturated	
S-5	4-5-7-14	0.2'	GP	0	@ 20.0' gray angular mf GRAVEL, some fmc Sand, no to little Clay & Silt	
S-6	23-29-18-15	0.2'	GP	0		
S-7	84-100/1"	0.1'	GP	0	@ 29.0' gray angular GRAVEL and cmf SAND	

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-15D

Page 2 of 2

Project: *Groundwater Investigation*

Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*

Project No.: *9596.03*

Start Date: *07/19/95*

Finish Date: *07/24/95*

(CONTINUATION)

Depth (feet)	WELL CONSTRUCTION	soil: Samp. No. / rock: Run No.	SAMPLE DATA: Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30	 Collapsed Natural Material	S-7	84-100/1"	0.1'	GP	0	Bedrock @ 31.0 feet. End of Boring at 31.0 feet.	
35								
40								
45								
50								
55								
60								
65								
70								

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location:
MW-16S

Page 1 of 1

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *07/10/95*
Finish Date: *07/11/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*PVC, Sch. 40*	*PVC, 0.010" Screen*
Diameter (ID):	*2 inch*	*2 inch*
Coupling:	*Flush-Threaded*	*Flush-Threaded*

WELL DEVELOPMENT

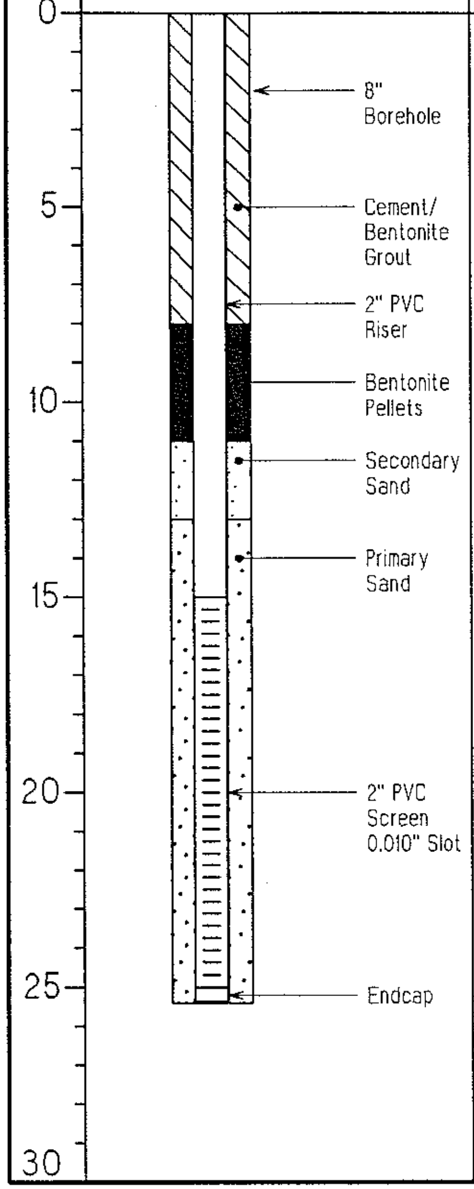
Method: *Surge Block/Bailer*
Duration: *0.5 hours*
Gals. Purged: *10.5 gallons*
Slug Test: 5.0×10^{-6} (cm/sec)

SURVEY DATA

DATUM: NGVD/NYS Plane
Grade: *157.3*
TWC: *159.3*
TPC: *159.5*
North: *686,949.23*
East: *595,108.94*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	soil rock	SAMPLE DATA			
		Samp. No.	Blows/ 6 in.	Rec. (ft.)	USCS	PID (ppm)
		Run No.	Hydraul. Cond. cm/sec	Rec. (ft.)	RQD	



VISUAL CLASSIFICATION	REMARKS
See MW-16D for sample description.	
End of Boring @ 25.4 feet.	

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location:
MW-16D

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *07/06/95*
Finish Date: *07/11/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*PVC, Sch. 40*	*PVC, 0.010" Screen*
Diameter (ID):	*2 inch*	*2 inch*
Coupling:	*Flush-Threaded*	*Flush-Threaded*

WELL DEVELOPMENT

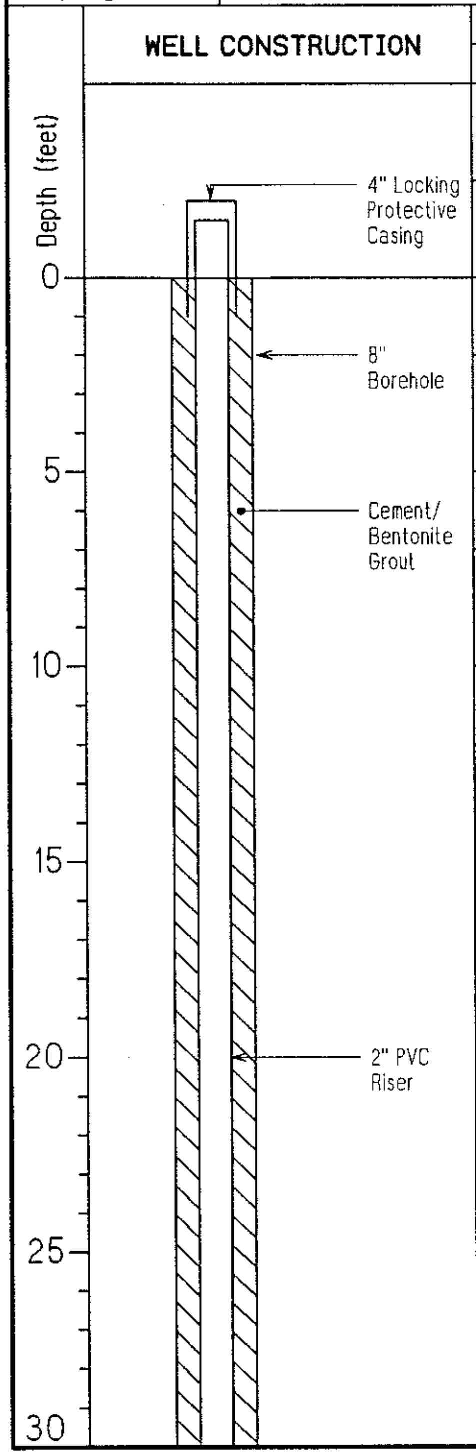
Method: *Surge Block/Dual Line Air/Bailer*
Duration: *2 hours*
Gals. Purged: *48 gallons*
Slug Test: *9.2 x 10^{-3}*
(cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: *157.4*
TWC: *159.9*
TPC: *160.1*
North: *686,942.93*
East: *595,107.68*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA

Samp. No. Run No.	Blows/ 6 in. Hydraul. Cond. cm/sec	Rec. (ft.) Rec. (ft.)	USCS RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
S-1	3-6-7-9	1.0'	SW CH	0.2	LACUSTRINE DEPOSITS Black f SAND, with roots, dry @ 0.2' brown, Silty CLAY, trace f Sand, dry to moist	
S-2	3-7-5-9	1.6'	CH	0		
S-3	7-8-7-7	NR	CH	0		
S-4	3-4-4-3	1.1'	CH	0	@ 15.0' gray Silty CLAY, little to trace f Sand, saturated	
S-5	2-3-3-3	0.8'	CH	0		
S-6	1-3-1-2	2.0'	CH	0		

ECKENFELDER INC. | Subsurface Boring Log | Well Name/Location: MW-16D

Page 2 of 2

Project: *Groundwater Investigation*

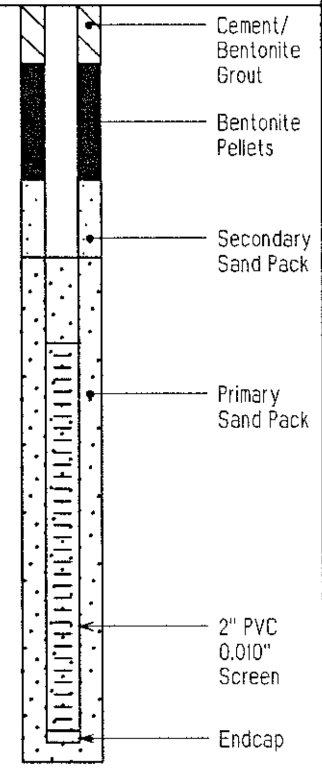
Project No.: *9596.03*

Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*

Start Date: *07/06/95*

Finish Date: *07/11/95*

WELL CONSTRUCTION



(CONTINUATION)

Depth (feet)	soil: Samp. No. rock: Run No.	Blows/ 6 in. Hydraul. Cond. cm/sec	Rec. (ft.) Rec. (ft.)	USCS RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30	S-7	1-2-2-2	1.6'	CH	0		
35	S-8	WOR/6"-WOH/18"	2.0'	CH	0		
40	S-9	WOH/24"	2.0'	CH	0	@ 40.0' gray CLAY	
45	S-10	WOR-3-5-8	0.1'	CH	0		
	S-11	40-100/1"	0.5'	SC	0	@ 49.0' gray fm SAND, some Silty CLAY, with gray Limestone or Shale fragments Bedrock @ 49.5 feet. End of Boring at 49.5 feet.	
50							
55							
60							
65							
70							

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-17S

Page 1 of 1

Project: *Groundwater Investigation*

Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*

Project No.: *9596.03*

Start Date: *10/03/95*

Finish Date: *10/03/95*

DRILLING DATA

Inspector: *Laurie Scheuing*

Contractor: *R. Heffernen/Empire Soils Investigation Inc.*

Equipment: *CME 850*

Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*PVC, Sch. 40*	*PVC, 0.010" Screen*
Diameter (ID):	*2 inch*	*2 inch*
Coupling:	*Flush-Threaded*	*Flush-Threaded*

WELL DEVELOPMENT

Method: *Surge Block/Bailer*

Duration: *0.75 hours*

Gals. Purged: *20 gallons*

Slug Test: *7.8×10^{-3}* (cm/sec)

SURVEY DATA

DATUM: NGVD/NYS Plane

Grade: *140.8*

TWC: *143.9*

TPC: *144.0*

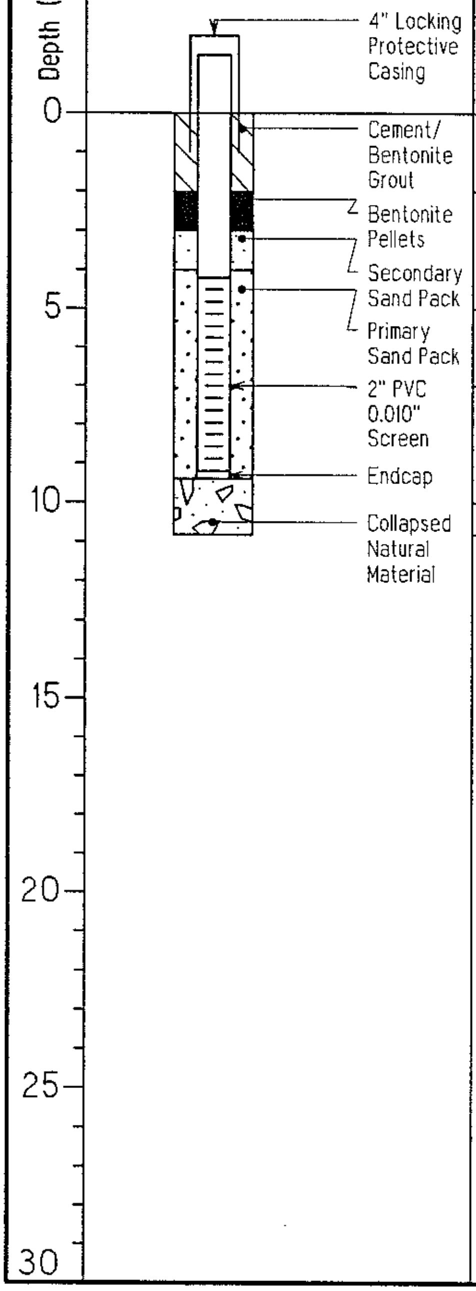
North: *686,934.03*

East: *595,603.13*

Geophysical Log: ☐ yes ☒ no

Comments:

WELL CONSTRUCTION



SAMPLE DATA

Samp. No. (soil) / Run No. (rock)	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)
S-1	2-3- 1-3	1.1'	CL	NM
S-2	19-20- 18-18	1.5'	SM	NM
S-3	38-100/3"	0.8'	GP	NM

VISUAL CLASSIFICATION

LACUSTRINE DEPOSITS

Brown Clayey SILT, trace f Gravel, with reed fragments, moist

@ 0.5' grading to gray CLAY & SILT, moist

@ 5.0' brown fmc SAND and Clayey SILT, some fm Gravel, wet

@ 10.0' gray fmc GRAVEL, little f Sand, saturated

Bedrock @ 10.8 feet.

End of Boring at 10.8 feet.

REMARKS

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: **MW-18S**

Page 1 of 1

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *07/18/95*
Finish Date: *07/19/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split Spoon	NA	NA
Diameter:	2 inch	NA	NA
Other:	140 lb./30 in.	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	PVC, Sch. 40	PVC, 0.010" Screen
Diameter (ID):	2 inch	2 inch
Coupling:	Flush-Threaded	Flush-Threaded

WELL DEVELOPMENT

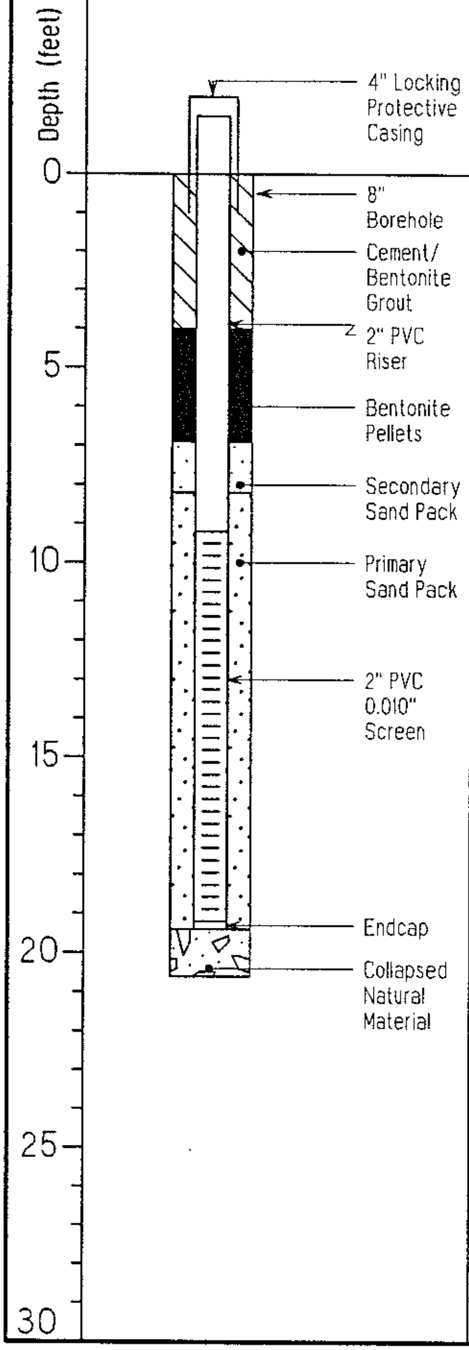
Method: *Surge Block/Dual Line Air*
Duration: *2 hours*
Gals. Purged: *30 gallons*
Slug Test: *8.3×10^{-4}* (cm/sec)

SURVEY DATA DATUM: NGVD/NYS Plane

Grade: *144.4*
TWC: *146.8*
TPC: *147.0*
North: *686,601.13*
East: *595,237.84*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA

Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0	S-1	1-1-2-4	1.1'	MH	0	LACUSTRINE DEPOSITS Brown SILT & CLAY, little f Sand, moist	
5	S-2	1-10-11-9	1.3'	SM GP	0	@ 5.0' brown f SAND, some to no Silt & Clay, damp @ 5.6' grading to gray mf GRAVEL and cmf SAND, little Clayey Silt, damp	
10	S-3	34-100/1"	0.4'	GP	0		
15	S-4	17-63-38-37	1.2'	GP	0	@ 15.0' gray mf GRAVEL and cmf SAND, trace to little Clayey Silt, saturated	
20	S-5	45-100/0"	0.3'	GP	0	Bedrock @ 20.5 feet. End of Boring at 20.5 feet.	

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-19S

Page 1 of 1

Project: *RFI*
Project No.: *0192.02*
Client: *DYNO Nobel, Port Ewen, NY*
Start Date: *09/16/97*
Finish Date: *09/16/97*

DRILLING DATA

Inspector: *E.R.Limbrick*
Contractor: *Maxim Technologies, Inc., C.Dinovo*
Equipment: *Acker Soil Max*
Method: *4 1/4" HAS*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split Spoon	NA	NA
Diameter:	2 inch	NA	NA
Other:	140 lb/30 inch	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	Schd. 40 PVC	Schd. 40 pvc .010 slot
Diameter (ID):	2"	2"
Coupling:	Flush-threaded	Flush-threaded

WELL DEVELOPMENT

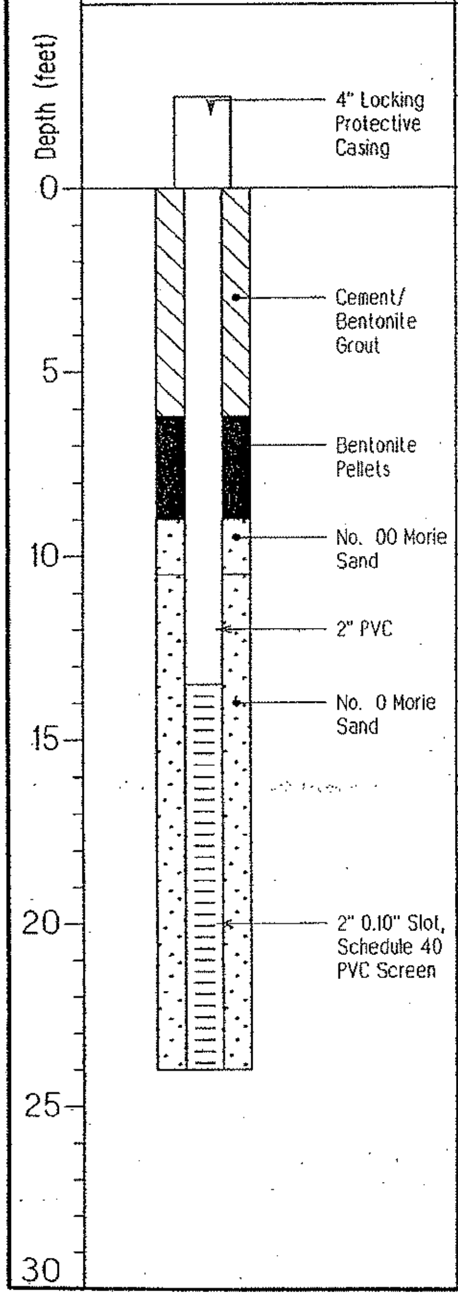
Method:
Duration:
Gals. Purged:
Slug Test: (cm/sec)

SURVEY DATA DATUM:

Grade:
TWC: *156.2*
TPC:
North: *686911.12*
East: *594141.46*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA

Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)
S-1	2-2-3-7	1.4'		
S-2	7-10-13-22	1.2'		
S-3	8-12-14-20	1.4'		
S-4	21-20-25-24	1.8'		
S-5	4-8-8-12	2.0'		
S-6	5-5-6-6	1.2'		
S-7	6-6-7-6	2.0'		
S-8	2-2-3-3	1.7'		
S-9	5-5-3-5	1.5'		
S-10	3-1-2-3	1.7'		
S-11	1-2-2-3	1.3'		
S-12	1-2-1-1	1.8'		

VISUAL CLASSIFICATION

LACUSTRINE DEPOSITS

Dark brown f SAND and silty CLAY

Dry Light-brown Silty CLAY, trace (-) f Sand, trace (-) to no c Sand

Slightly moist Silty CLAY tace (-) to no cf Sand

Moist brownish-gray Silty CLAY

Moist Gray Silty CLAY with brown mottling

Wet Gray Silty CLAY

24.0

End of Boring at 24.0 feet.

REMARKS

Water table @ 18'

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location:
MW-20D

Page 1 of 2

Project: *RFI*
Client: *DYNO Nobel, Port Ewen, NY*
Project No.: *0192.02*
Start Date: *09/12/97*
Finish Date: *09/15/97*

DRILLING DATA

Inspector: *E.R.Limbrick*
Contractor: *Maxim Technologies, Inc., C.Dinovo*
Equipment: *Acker Soil Max*
Method: *4 1/4" HAS*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb/30 inch*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*type 304 S.S*	*type 304 S.S. .010 slot*
Diameter (ID):	*2 inch ID*	*2"*
Coupling:	*Flush-threaded*	*Flush-threaded*

WELL DEVELOPMENT

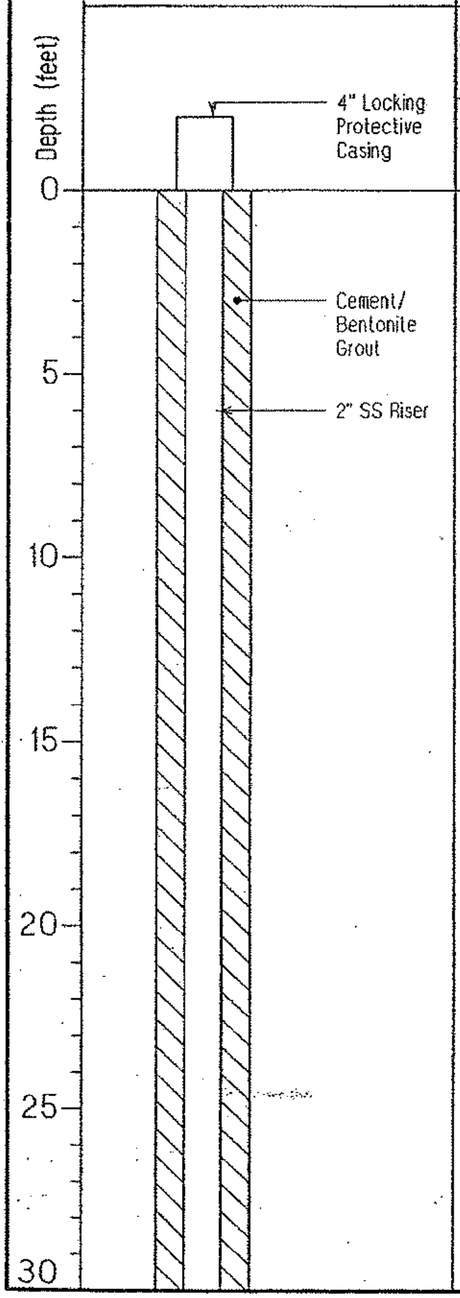
Method:
Duration:
Gals. Purged:
Slug Test: (cm/sec)

SURVEY DATA DATUM:

Grade:
TWC: *161.40*
TPC:
North: *685366.27*
East: *594189.91*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



soil / rock — SAMPLE DATA

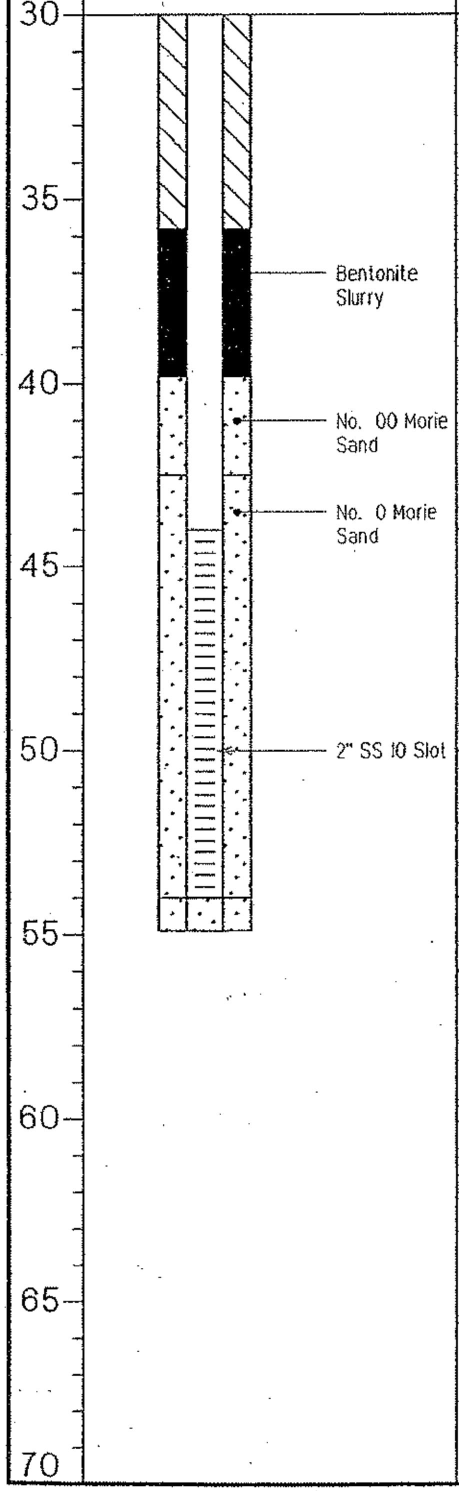
Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.) / Rec. (ft.)	USCS / RQD	HNU (ppm)

VISUAL CLASSIFICATION	REMARKS
For soil description between the 0-44'interval refer to the boring log MW-20R.	

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: MW-20D Page 2 of 2
Project: *RFI* Client: *DYNO Nobel, Port Ewen, NY*	Project No.: *0192.02*	Start Date: *09/12/97* Finish Date: *09/15/97*

WELL CONSTRUCTION

(CONTINUATION)



Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
					44 SAND & GRAVEL	
S-1	3-4-15-18	0.0'			Gray cm SAND, some (+) Silty CLAY, little (+) Gravel	
S-2	14-5-17-16	1.1'			c GRAVEL, lens of brown Silty CLAY	
S-3	13-31-18-22	0.5'				
S-4	58-24-29-32	0.9'			cm SAND and to trace c GRAVEL, trace (+) Silty CLAY	
S-5	28-37-38-41	1.8'			c GRAVEL, sone (+) cm SAND, trace silty CLAY	
S-6	76-100/4"	0.7'			Weathered Shale-- BEDROCK @ 54.0' 54.9	
					End of Boring at 54.9 feet.	

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: MW-21D Page 1 of 2

Project: *RFI* Client: *DYNO Nobel, Port Ewen, NY*	Project No.: *0192.02*	Start Date: *09/08/97* Finish Date: *09/09/97*

DRILLING DATA

Inspector: *E.R.Limbrick*
Contractor: *Maxim Technologies, Inc., C.Dinovo*
Equipment: *Acker Soil Max*
Method: *4 1/4" HAS*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*Type 304 S.S.*	*Type 304 S.S .010" slo*
Diameter (ID):	*2 inch ID*	*2"*
Coupling:	*Flush-threaded*	*Flush-threaded*

WELL DEVELOPMENT

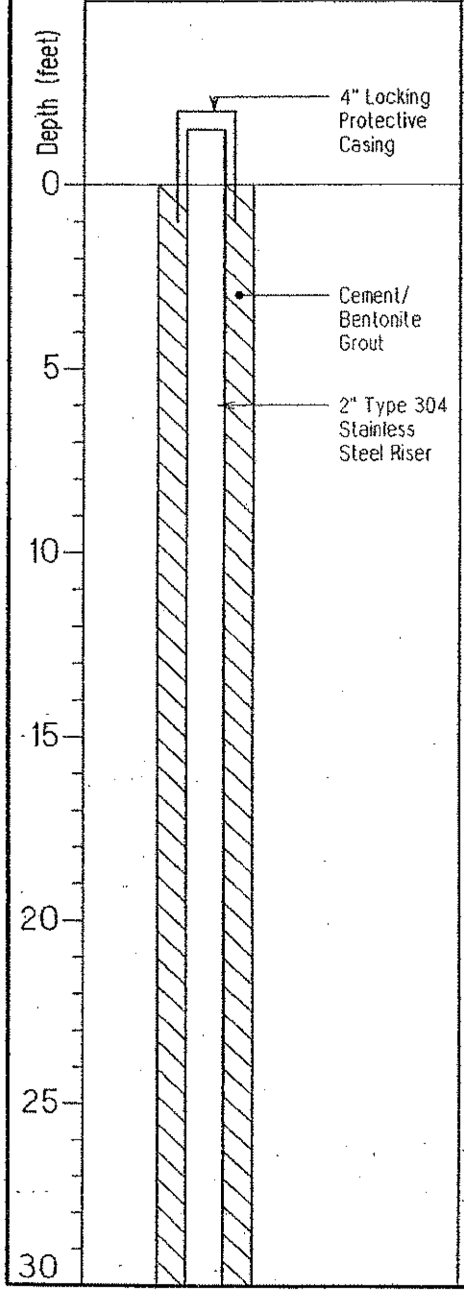
Method:
Duration:
Gals. Purged:
Slug Test: (cm/sec)

SURVEY DATA DATUM:

Grade:
TWC: *164.10*
TPC:
North: *685492.08*
East: *594355.78*

Geophysical Log: ☐ yes ☒ no
Comments:

Depth (feet)	WELL CONSTRUCTION	soil: Samp. No. / rock: Run No.	SAMPLE DATA: Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0							OVERBURDEN/LACUSTRINE DEPOSIT	
10							Refer to the MW-21R log for soil descriptions.	



ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-21D

Page 2 of 2

Project: *RFI*

Client: *DYNO Nobel, Port Ewen, NY*

Project No.: *0192.02*

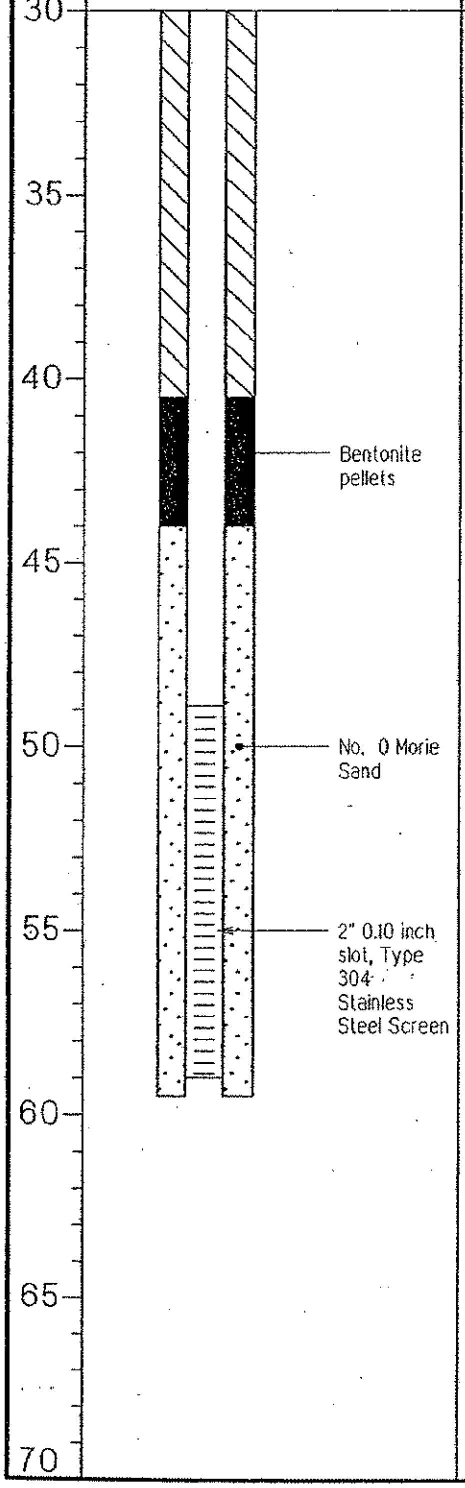
Start Date: *09/08/97*

Finish Date: *09/09/97*

WELL CONSTRUCTION	soil / rock	SAMPLE DATA				
	Samp. No.	Blows/ 6 in.	Rec. (ft.)	USCS	HNU (ppm)	
	Run No.	Hydraul. Cond. cm/sec	Rec. (ft.)	RQD		

(CONTINUATION)

VISUAL CLASSIFICATION | REMARKS



SAND & GRAVEL

BEDROCK-GRAY SHALE

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-22D

Page 1 of 2

Project: *RFI*	Project No.:	Start Date: *09/24/97*
Client: *DYNO Nobel, Port Ewen, NY*	*0192.02*	Finish Date: *09/24/97*

DRILLING DATA

Inspector: *E.R.Limbrick*
Contractor: *Maxim Technologies, Inc., C.Dinovo*
Equipment: *Acker Soil Max*
Method: *4 1/4" HAS*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb/30 inch*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*stainless steel*	*stainless steel*
Diameter (ID):	*2 inch ID*	*2 1/8*
Coupling:	*npt*	*npt*

WELL DEVELOPMENT

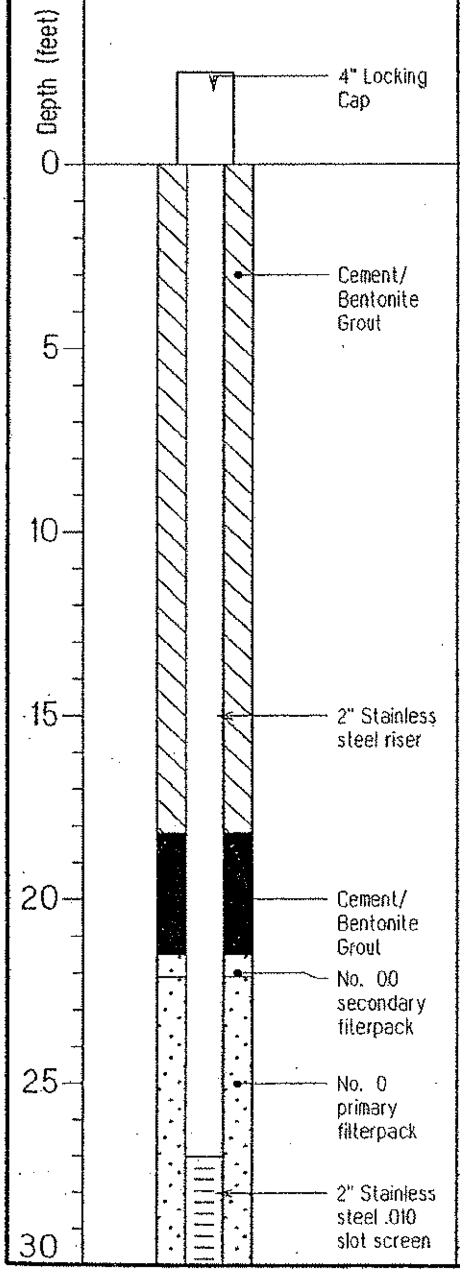
Method: *na*
Duration: *na*
Gals. Purged: *na*
Slug Test: *na*
(cm/sec)

SURVEY DATA
DATUM: na

Grade: *na*
TWC: *151.9*
TPC:
North: *685412.14*
East: *594639.41*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



soil / rock

SAMPLE DATA

Samp. No.	Blows/ 6 in.	Rec. (ft.)	USCS	HNU (ppm)
Run No.	Hydraul. Cond. cm/sec	Rec. (ft.)	RQD	
S-1	2-1-2-3			
S-2	5-7-11-13			

VISUAL CLASSIFICATION	REMARKS
OVERBURDEN?LACUSTRINE DEPOSIT	
For soil descriptions above and below the 27.5'-32.2' interval refer to the MW-22R log.	
Gray f GRAVEL, little silty clay and cmf sand.	
Gray cmf GRAVEL and cmf SAND.	

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-22D

Page 2 of 2

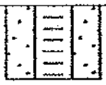
Project: *RFI*

Client: *DYNO Nobel, Port Ewen, NY*

Project No.: *0192.02*

Start Date: *09/24/97*

Finish Date: *09/24/97*

Depth (feet)	WELL CONSTRUCTION	soil: Samp. No. rock: Run No.	soil: Blows/ 6 in. rock: Hydraul. Cond. cm/sec	soil: Rec. (ft.) rock: Rec. (ft.)	soil: USCS rock: RQD	HNU (ppm)	(CONTINUATION) VISUAL CLASSIFICATION	REMARKS
30		S-2	5-7-11-13				Gray cm SAND, trace silty clay. 32.2	
		S-3	6-9-9-10				Refusal @ 32.2'.	
35								
40								
45								
50								
55								
60								
65								
70								

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-23S

Page 1 of 1

Project: *RFI*

Client: *DYNO Nobel, Port Ewen, NY*

Project No.: *0192.02*

Start Date: *09/16/97*

Finish Date: *09/16/97*

DRILLING DATA

Inspector: *E.R.Limbrick*

Contractor: *Maxim Technologies, Inc., C.Dinovo*

Equipment: *Acker Soil Max*

Method: *4 1/4" HAS*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb/30 inch*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*Type 304 S.S.*	*Type 304 S.S.*
Diameter (ID):	*2" ID*	*2" ID*
Coupling:	*Flush-threaded*	*Flush-threaded*

WELL DEVELOPMENT

Method:

Duration:

Gals. Purged:

Slug Test: (cm/sec)

SURVEY DATA DATUM:

Grade:

TWC: *165.2*

TPC:

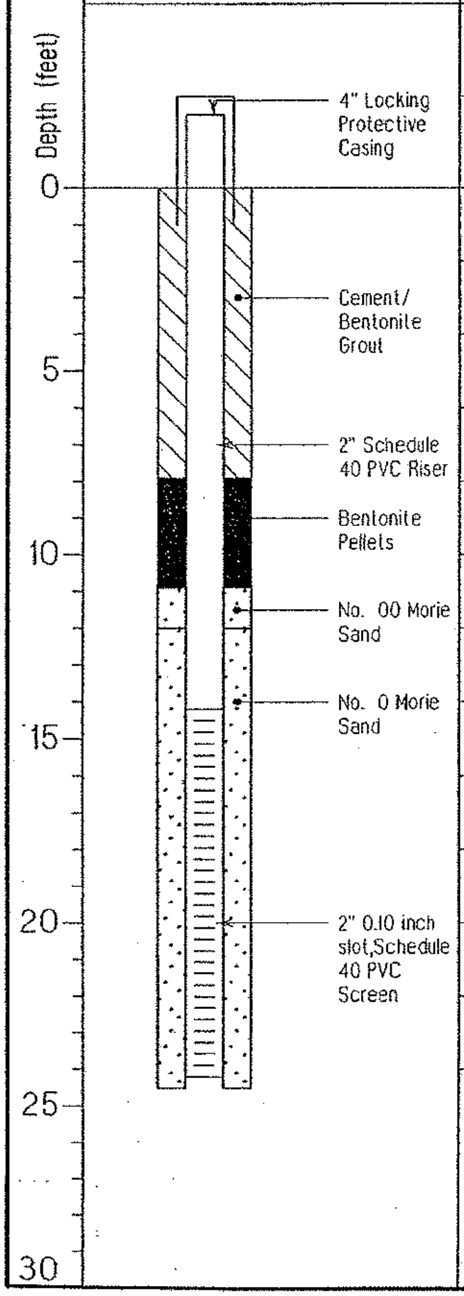
North: *686049.27*

East: *593751.85*

Geophysical Log: ☐ yes ☒ no

Comments:

WELL CONSTRUCTION



SAMPLE DATA

Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)
S-1	5-6-7-10	0.4'		0
S-2	5-6-5-7	1.1'		0
S-3	3-4-5-8	1.2'		0
S-4	8-11-14-15	0.8'		0
S-5	5-5-6-8	2.0'		0
S-6	3-3-3-2	1.2'		0
S-7	3-4-4-4	1.7'		0
S-8	2-2-2-1	1.0'		0
S-9	3-2-1-3	2.0'		0
S-10	WOR-WOR-WOH-WOH	2.0'		0
S-11	WOR-WOH 1-1	2.0'		0
S-12	1-1-2-1	2.0'		0

VISUAL CLASSIFICATION

Slightly moist Medium brown Silty CLAY, some roots present

Moist Brown Silty CLAY with brown mottling

Wet Brown Silty CLAY with brown mottling

Reddish-brown Silty CLAY with thin lenses of Gray SILT

Wet Gray to Greenish-gray Silty CLAY

Gray with lens of orange Silty CLAY

Saturated Gray and Reddish-Gray Silty CLAY

Saturated Gray Silty CLAY

End of Boring at 24.0 feet.

REMARKS

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-22R

Page 1 of 2

Project: RFI

Project No.: 0192.02

Client: DYNO Nobel, Port Ewen, NY

Start Date: 09/22/97

Finish Date: 09/22/97

DRILLING DATA

Inspector: E.R.Limbrick

Contractor: Maxim Technologies, Inc., C.Dinovo

Equipment: Acker Soil Max

Method: 6 1/4" HAS/5 7/8 Roller Bit/NX Core

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split Spoon/NX Core Barrel	NA	NX
Diameter:	2 inch	NA	3 inch
Other:	140 lb/30 inch	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	black steel	NA
Diameter (ID):	4 inch ID	2 1/8
Coupling:	NPT	

WELL DEVELOPMENT

Method:

Duration:

Gals. Purged:

Slug Test: (cm/sec)

SURVEY DATA DATUM:

Grade:

TWC: 151.6

TPC:

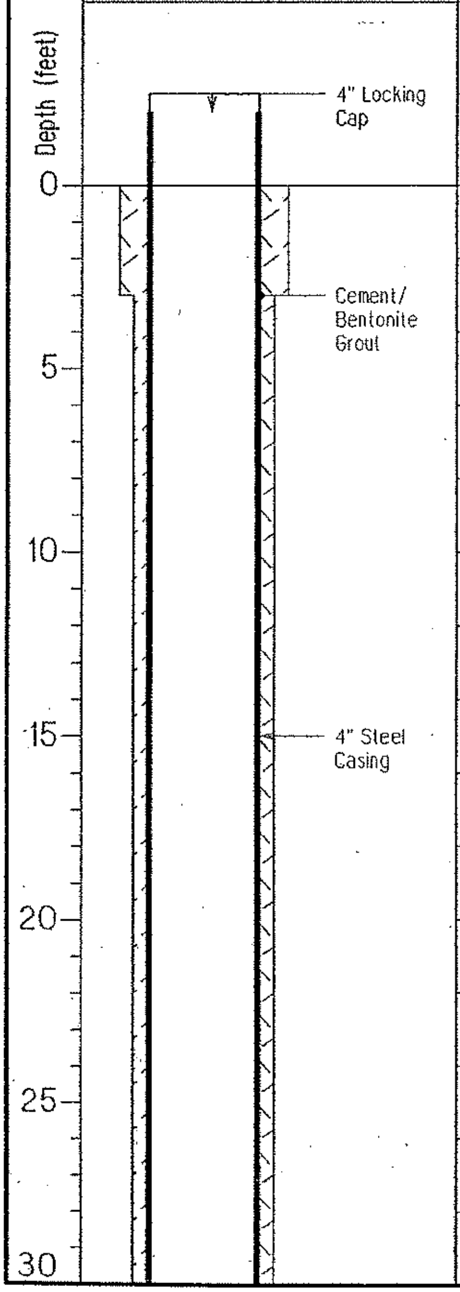
North: 685413.44

East: 594645.86

Geophysical Log: ☐ yes ☒ no

Comments:

WELL CONSTRUCTION



SAMPLE DATA

soil / rock

Samp. No.	Blows/ 6 in.	Rec. (ft.)	USCS	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
Run No.	Hydraul. Cond. cm/sec	Rec. (ft.)	RQD			
S-1	2-1-2-3	1.5'			OVERBURDEN/LACUSTRINE DEPOSITS Brown SILT/ SILT and CLAY, trace roots.	
S-2	5-7-11-13	1.2'			Brown SILT and CLAY, mottled.	
S-3	6-9-9-10	1.7'				
S-4	7-8-8-8	0.0				
S-5	4-2-3-2	1.5'			Brown Silty CLAY	
S-6	2-3-3-4	0.0'				
S-7	3-2-3-3	1.7'			@ 12.7' change to gray Silty CLAY. Saturated	Saturated @ 12.7 feet.
S-8	woh-woh 2-2	1.2'				
S-9	3-2-2-2	1.0'				
S-10	woh-woh woh-1	1.3'				
S-11	1-1-2-1	1.2'				
S-12	1-1-2-1	1.4'				
S-13	WOH-WOH 1-1	2.0'				
S-14	10-19 22-12	2.0'			Gray cmf SAND and gray Silty CLAY, some mf Gravel grading to cmf SAND.	
S-15	9-7-8-8	2.0'			@ 28.5 brown Silty CLAY and c GRAVEL, some silty clay.	

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-22R

Page 2 of 2

Project: *RFI*

Project No.: *0192.02*

Start Date: *09/22/97*

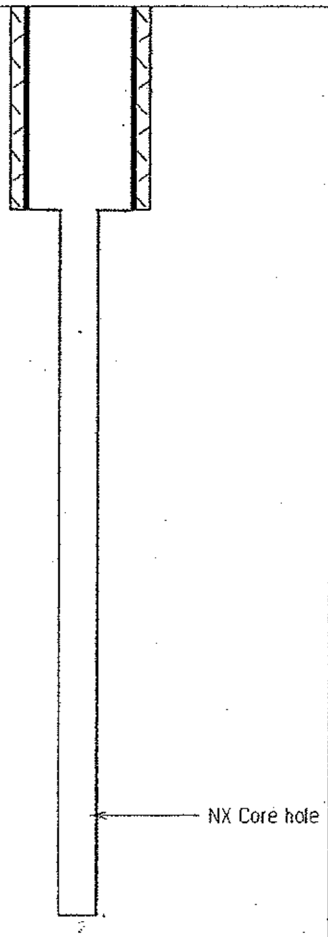
Client: *DYNO Nobel, Port Ewen, NY*

Finish Date: *09/22/97*

WELL CONSTRUCTION

Depth (feet)

30 35 40 45 50 55 60 65 70



SAMPLE DATA (soil / rock)

(CONTINUATION)

Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
S-16	13-32 15-10	0.6'			Gray cmf GRAVEL (weathered rock), some cmf Sand, some silty clay.	
S-17	58-100/4	1.1'			33 BEDROCK-GRAY SHALE	
S-18	100/4	0.1'				
			NA			
			55%			
			74%			
			33%			

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-21R

Page 1 of 3

Project: *RFI*
Project No.: *0192.02*
Client: *DYNO Nobel, Port Ewen, NY*
Start Date: *09/04/97*
Finish Date: *09/08/97*

DRILLING DATA

Inspector: *E.R.Limbrick*
Contractor: *Maxim Technologies, Inc., C.Dinovo.*
Equipment: *Acker Soil Max*
Method: *6 1/4" HAS/5 7/8 Roller Bit/NX Core*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon/NX Core Barrel*	*NA*	*NX*
Diameter:	*2 inch*	*NA*	*3 inch*
Other:	*140 lb/30 inch*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*black steel*	*NA*
Diameter (ID):	*4 inch ID*	*2 1/8*
Coupling:	*NPT*	

WELL DEVELOPMENT

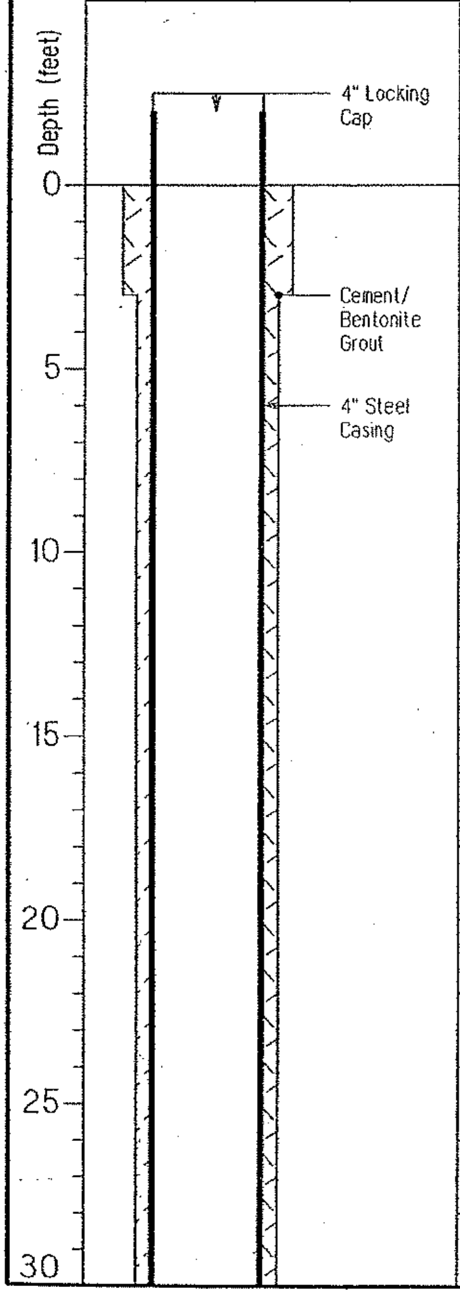
Method:
Duration:
Gals. Purged:
Slug Test: (cm/sec)

SURVEY DATA DATUM:

Grade:
TWC: *162.80*
TPC:
North: *685486.17*
East: *594352.10*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA (soil / rock)

Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)
S-1	7-7-9-13	1.7'		
S-2	14-23-21-23	1.6'		
S-3	4-10-11-18	1.5'		
S-4	10-11-11-12	1.2'		
S-5	4-5-6-9	1.5'		
S-6	4-4-8-8	1.4'		
S-7	9-8-11-11	1.5'		
S-8	3-5-5-6	1.7'		
S-9	6-6-6-5	2.0'		
S-10	1-1-1-3	1.3'		
S-11	1-1-3-4	1.2'		
S-12	4-4-5-5	0.0'		
S-13	WOH-WOH-3-4	1.2'		
S-14	3-4-4-5	2.0'		
S-15	WOH-1-1-2	0.8'		

VISUAL CLASSIFICATION

OVERBURDEN/LACUSTRINE DEPOSITS

Brown SILT, little f Sand

Slightly moist Brown SILT & CLAY

Moist Brown SILT & CLAY, some gray mottling, trace Gravel

@ 9.6' becoming more moist, Moist Brown SILT & CLAY, some gray mottling

Moist Brown to Reddish-brown CLAY & SILT

Moist Brown to Reddish-brown CLAY & SILT, few lens of f SAND

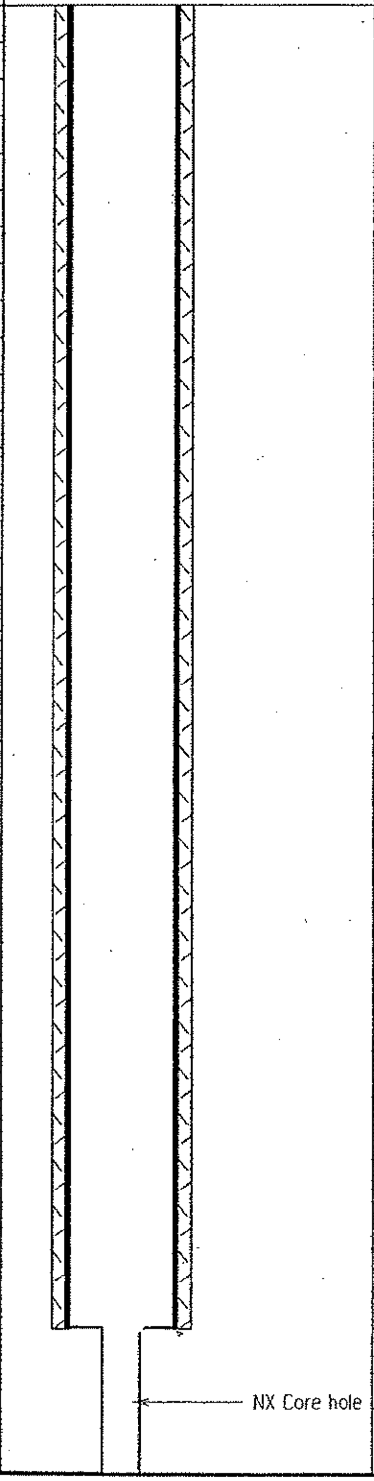
@ 18.5 Saturated
Wet, Gray CLAY & SILT to Silty CLAY with brown mottling
Gray Silty Clay

REMARKS

Saturated @ 18.5 feet.

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: MW–21R
Project: *RFI* Client: *DYNO Nobel, Port Ewen, NY*	Project No.: *0192.02*	Start Date: *09/04/97* Finish Date: *09/08/97*

WELL CONSTRUCTION



(CONTINUATION)

Depth (feet)	soil: Samp. No. rock: Run No.	Blows/ 6 in. Hydraul. Cond. cm/sec	Rec. (ft.)	USCS RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
30	S-16	2-3-2-2	0.9'				
	S-17	WOR-WOR-WOH-2	1.6'				
35	S-18	WOH-2-2-3	1.4'				
	S-19	WOH-2-2-3	2.0'				
	S-20	2-1-3-2	1.8'				
40	S-21	WOR-1-3-4	2.0'			Gray Silty Clay, trace (–) f Sand	
	S-22	3-4-3-4	2.0'				
45	S-23	WOR-WOR-2-3	2.0'			Gray Silty Clay	
	S-24	WOH-1-2-3	2.0'			Gray Silty Clay, little (–) f Sand 48.75	
	S-25	1-4-9-6	2.0'			SAND & GRAVEL	
50	S-26	4-5-7-8	0.8'			c SAND, and Silty CLAY, little Gravel	
	S-27	4-4-7-7	1.3'			cmf GRAVEL (chips of weathered Shale), some c Sand, some Silty Clay	
55	S-28	7-8-17-24	1.6'			Gray f SAND, trace (+) Gravel (chips of weathered Shale)	
	S-29	8-18-15-16	2.0'			Gray to black cmf Gravel (chips of weathered Shale), little c Sand, little silty Clay, grading to all c Gravel	
	S-30	18-14-24-56	1.4'			59.9	
60 65				100%		BEDROCK- GRAY SHALE *No core collected from 60.0' to 66.0'.*	No core collected from 60.0' to 66.0'
70	R-1		5.0'	83%		Gray Shale, few small fractures with no staining, dipping at a steep angle, from 67.3' to 69.5'.	

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-21R

Project: *RFI*
Client: *DYNO Nobel, Port Ewen, NY*
Project No.: *0192.02*
Start Date: *09/04/97*
Finish Date: *09/08/97*

(CONTINUATION)

Depth (feet)	WELL CONSTRUCTION	soil: Samp. No. / rock: Run No.	SAMPLE DATA: Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
70		R-1		5.0'				
		R-2		5.0'	83%		Gray Shale, few small fractures, some with calcite and brown staining, dipping at steep angle Steep angle Calcite vein from 73.4' to 73.6' Smaller Calcite veins from at 75.5' and 75.8'	
75		R-3		5.0'			Large fracture, steep angle, some calcite mineralization Horizontal fracture, in-filled with some clay Fractures from 77.3' to 79.5' no staining Small veins of Calcite from 79.0' to 81.6'	
80					87%			
		R-4		5.0'			Badly fractured zone, little mineralization	
85							Slightly angled fractues at 85.2' and 85.5' no staining	
86							End of Boring at 86.0 feet.	
90					96%			
95								
100								
105								
110								

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: MW-20R *Page 1 of 3*

Project: *RFI*
Client: *DYNO Nobel, Port Ewen, NY*
Project No.: *0192.02*
Start Date: *09/09/97*
Finish Date: *09/12/97*

DRILLING DATA

Inspector: *E.R.Limbrick*
Contractor: *Maxim Technologies, Inc., C.Dinovo*
Equipment: *Acker Soil Max*
Method: *6 1/4" HAS/5 7/8 Roller Bit/NX Core*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*S.S./NX Core Barrel*	*NA*	*NX*
Diameter:	*2 inch*	*NA*	*3 inch*
Other:	*140 lb/30 inch*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*black steel*	*NA*
Diameter (ID):	*4 inch ID*	*2 1/8*
Coupling:	*NPT*	

WELL DEVELOPMENT

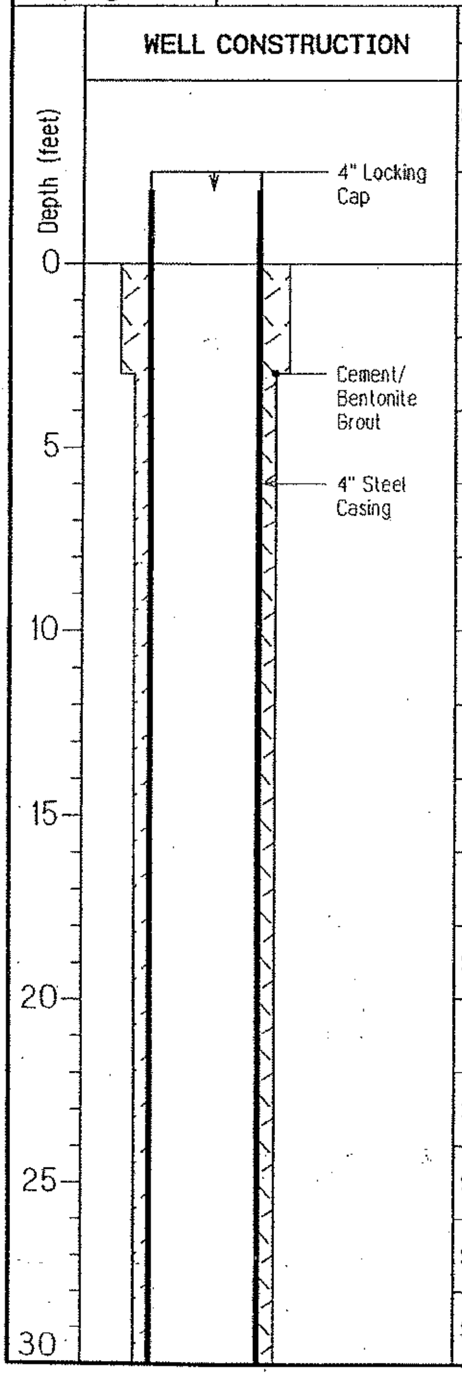
Method:
Duration:
Gals. Purged:
Slug Test: (cm/sec)

SURVEY DATA DATUM:

Grade:
TWC: *161.00*
TPC:
North: *685362.95*
East: *594182.84*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA

Samp. No.	Blows/ 6 in.	Rec. (ft.)	USCS	HNU (ppm)
Run No.	Hydraul. Cond. cm/sec	Rec. (ft.)	RQD	
S-1	5-7-9-10	1.7'		
S-2	11-11-12-13	1.5'		
S-3	7-11-12-13	2.0'		
S-4	11-12-12-16	2.0'		
S-5	7-7-8-11	2.0'		
S-6	3-5-6-8	1.6'		
S-7	8-8-9-8	1.7'		
S-8	3-3-4-4	1.4'		
S-9	5-5-5-6	1.8'		
S-10	1-1-2-3	1.1'		
S-11	WOR-WOH-2-2	0.6'		
S-12	2-2-2-2	1.6'		
S-13	WOH-2-1-2	1.1'		
S-14	2-2-3-2	2.0'		
S-15	WOR-WOH-1-2	1.2'		

VISUAL CLASSIFICATION

Slightly moist Brown SILT to Brown SILT & CLAY, few thin lens of c Sand, some red staining

Moist Brown Clayey SILT, some red mottling

@ 7.6' very moist dark Gray c SAND

Mottled Brown SILT & CLAY, lens of f Gray SAND, some dark staining

Reddish-brown with Gray mottling, SILT & CLAY , seams of f Gray Sand

@ 16.4 change to Gray Silty CLAY

@ 18.3 Saturated

Wet, Gray Silty CLAY with brown mottling

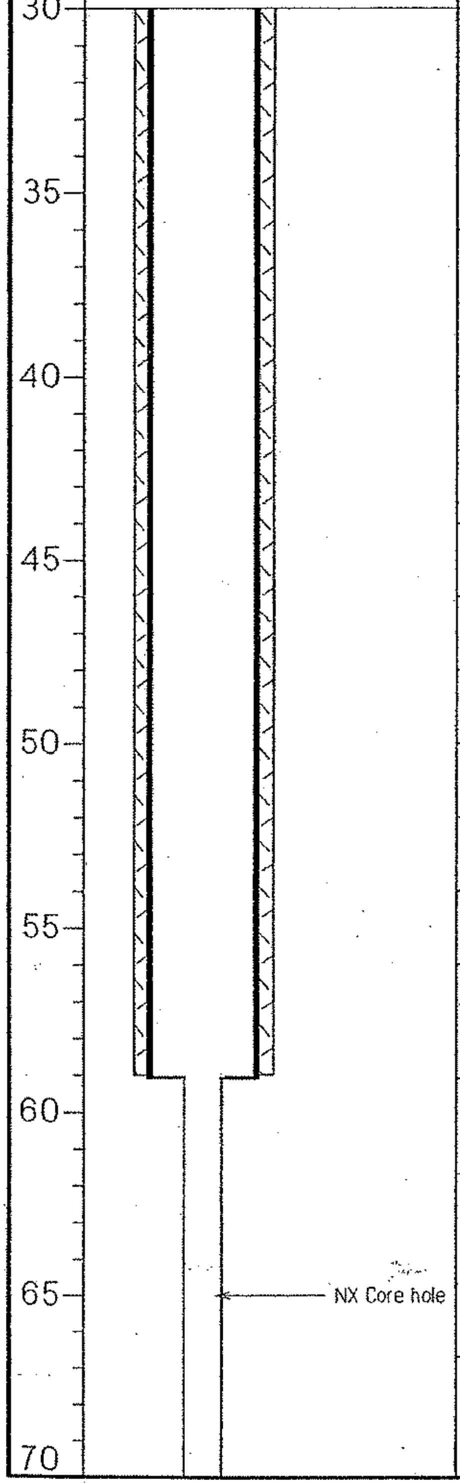
Gray Silty Clay

REMARKS

Saturated @ 18.3 feet.

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: MW-20R *Page 2 of 3*
Project: *RFI* Client: *DYNO Nobel, Port Ewen, NY*	Project No.: *0192.02*	Start Date: *09/09/97* Finish Date: *09/12/97*

WELL CONSTRUCTION



SAMPLE DATA *(CONTINUATION)*

soil Samp. No. / rock Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)
S-16	WOR-WOH-1-3	1.0'		
S-17	2-3-1-4	2.0'		
S-18	WOR-WOR-WOR-WOR	1.9'		
S-19	WOH-2-2-3	2.0'		
S-20	1-2-2-3	2.0'		
S-21	WOR-WOH-WOH-2	2.0'		
S-22	1-2-2-4	2.0'		
S-23	2-58-24-43	1.4'		
S-24	13-15 25-28	1.6'		
S-25	79-64-32-51	2.0'		
S-26	13-15-24-26	2.0'		
S-27	10-13-27-28	1.6'		
S-28	50/0"	0.0'		
R-1		1.8'	78%	
R-2		4.8'	56%	
R-3		4.8'	63%	

VISUAL CLASSIFICATION

Gray Silty CLAY and Orange-brown SILT

Gray Silty CLAY

Gray with Orange and Olive streaking and mottling, Silty CLAY

SAND & GRAVEL
c GRAVEL and Gray with olive mottling Silty CLAY, little cmf Sand

Orange-brown f SAND and CLAY & SILT

Olive-gray c GRAVEL, some silty CLAY, little cmf SAND

c GRAVEL,little c to cmf Sand, little gading to trace (+) Silty Clay

54.0

BEDROCK - GRAY SHALE
No core collected from 54.0' to 59.1'.

Gray Shale, some fractures with no staining, dipping from vertical, to steep, to horizontal from 60.0' to 61.3'.

Badly fractured from 61.1' to 61.3' d=61.7 Few fractures from 61.7' to 62.4', no staining
Few horizontal fractures some clay in-filling, and some calcite mineralization
Large horizontal fracture @ 64.7', heay calcite mineralization

Several small fractures from 64.9' to 65.8', trace to no staining
Fractures @ 67.5' and 67.6', some calcite mineralization
Badly fractured zone from 68.7' to 71.2', some calcite

REMARKS

No core collected from 54.0' to 59.1'

Formation taking a lot of water from 62.5' to 66.5'

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: MW-20R

Page 3 of 3

Project: *RFI*

Client: *DYNO Nobel, Port Ewen, NY*

Project No.: *0192.02*

Start Date: *09/09/97*

Finish Date: *09/12/97*

(CONTINUATION)

Depth (feet)	WELL CONSTRUCTION	soil: Samp. No. / rock: Run No.	SAMPLE DATA: Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
70		R-3		4.8'	63%			
75		R-4		4.5'	79%			
77							End of Boring at 77.0 feet.	
80								
85								
90								
95								
100								
105								
110								

110 Commerce Drive
Allendale, New Jersey 07401

Tel: (201) 574-4700
Fax: (201) 236-1607

www.brownandcaldwell.com

BROWN AND CALDWELL

December 30, 2002

23167.001

Mr. Paul Patel
NYSDEC
Bureau of Solid Waste & Corrective Action, 8th Floor
625 Broadway
Albany, New York 12233

Subject: DYNO Nobel, Inc. Facility
Port Ewen, New York

Dear Mr. Patel:

Enclosed for your records, please find completed well and boring logs for the new monitoring wells installed at the Dyno Facility in Port Ewen, New York. These wells were sampled as part of the semi-annual groundwater sampling event and the analytical results were forwarded to the Department on December 3, 2002. Groundwater samples collected from these newly installed wells do not indicate the presence of site related constituents above naturally occurring background levels (inorganics) or above the detection limits for volatile organic constituents.

Please do not hesitate to contact us with any questions you may have.

Sincerely,

Brown and Caldwell Associates

Timothy R. Roeper
Supervising Hydrogeologist

Elyse J. Apicello

Elyse J. Apicello
Assistant Hydrogeologist

Attachment
cc: Fred Jardinico (Dyno Nobel)
Dennis Amorose (Hercules)
Keith Gronwald (NYSDEC)

P:\^J\23167\L123002(Patel-DEC).doc
12/30/02

BROWN AND CALDWELL

BORING LOG

Well Name/Location: MW-24S

Project: *Off Site Well Installation*
Project No.: *23167.001*
Client: *Dyno Nobel*
Start Date: *8/28/02*
Finish Date: *8/28/02*

DRILLING DATA

Inspector: *Elyse J. Apicello*
Contractor: *SJB Services, Inc.*
Equipment: *CME 550X*
Method: *4.25" HSA*

SAMPLING METHODS

Sampler Type: *Split Spoon*	**Tube Type:** *NA*	**Core Type:** *NA*
Diameter: *2"*	**Diameter:** *NA*	**Diameter:** *NA*
Other: *NA*	**Other:** *NA*	**Other:** *NA*

WELL CONSTRUCTION

Riser Material: *PVC*	**Screen Material:** *PVC*
Diameter (ID): *2"*	**Diameter (ID):** *2"*
Coupling: *Flush-Threaded*	**Coupling:** *Flush-Threaded*

WELL DEVELOPMENT

Method: *Bailer*
Duration: *2 Hours*
Gals. Purged: *4*
Slug Test: *NA*

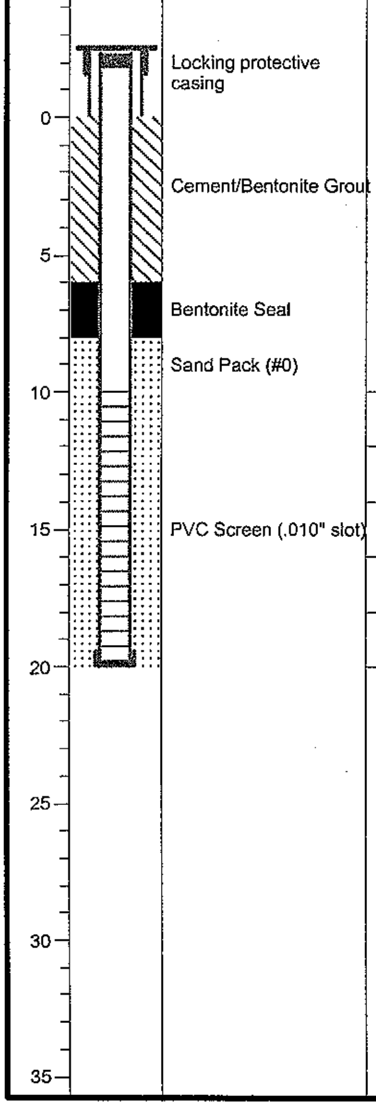
SURVEY DATA

Datum:
Grade: *154.60*
North: *687631.81*
TWC: *157.19*
East: *594854.61*
TPC:

SOIL / **ROCK** — **SAMPLE DATA**

Geophysical Log: ☐
Comments:

Depth (feet) — **WELL DETAIL**



Run No. / Samp. No	Hydraul. Cond. cm/sec / Blows/ 6 in.	Rec. (ft.) / Rec. (ft.)	RQD. / USCS	HNU (ppm) / HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
					OVERBURDEN	
1	4-4-4-4	1.0			Brown silty CLAY, moist	
2	3-5-6-4	1.0			Brown f SAND and silty CLAY, grading into grey silty CLAY in tip, wet	
3	wh-wh-1-1	2.0			Grey silty CLAY, saturated	
4	1-2-1-2	1.0			Grey silty CLAY, saturated	
5	2-1-1-2	1.0			Grey silty CLAY, saturated	
					End of Borehole	

BROWN AND CALDWELL

BORING LOG

Well Name/Location: MW-24D

Project: *Off Site Well Installation*
Client: *Dyno Nobel*
Project No.: *23167.001*
Start Date: *8/29/02*
Finish Date: *8/29/02*

DRILLING DATA

Inspector: *Elyse J. Apicello*
Contractor: *SJB Services, Inc.*
Equipment: *CME 550X*
Method: *4.25" HSA*

SAMPLING METHODS

Sampler Type: *Split Spoon*
Diameter: *2"*
Other: *NA*

Tube Type: *NA*
Diameter: *NA*
Other: *NA*

Core Type: *NA*
Diameter: *NA*
Other: *NA*

WELL CONSTRUCTION

Riser Material: *PVC*
Diameter (ID): *2"*
Coupling: *Flush-Threaded*

Screen Material: *PVC*
Diameter (ID): *2"*
Coupling: *Flush-Threaded*

WELL DEVELOPMENT

Method: *Grundfos*
Duration: *1 Hour*
Gals. Purged: *120*
Slug Test: *NA*

SURVEY DATA

Datum:
Grade: *154.75*
North: *687637.80*
TWC: *157.21*
East: *594853.24*
TPC:

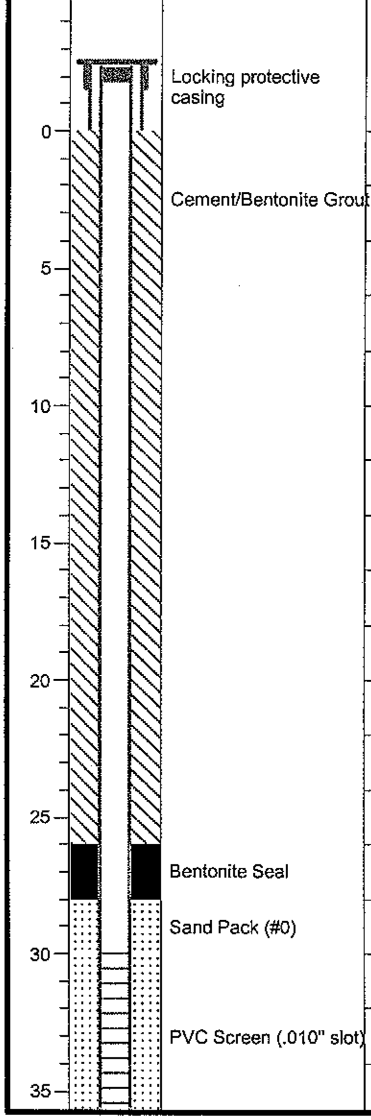
SOIL / **ROCK**

SAMPLE DATA

Geophysical Log: ☐
Comments:

Depth (feet)

WELL DETAIL



Run No.	Hydraul. Cond. cm/sec	Rec. (ft.)	RQD.	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
Samp. No	Blows/ 6 in.	Rec. (ft.)	USCS	HNU (ppm)		
1	5-6-7-6	2.0			**OVERBURDEN** Brown f SAND and SILT, trace organics	
2	6-7-8-9	2.0				
3	2-5-6-6	2.0			Brown clayey SILT and f SAND, moist	
4	5-7-6-6	1.0			Brown clayey SILT, trace f SAND, wet	
5	4-5-5-5	2.0			Grey/brown silty CLAY, some Clay, trace f Sand, wet	
6	3-4-4-4	2.0			Grey silty CLAY, trace f Sand, wet	
7	5-4-5-6	2.0			Grey/brown silty CLAY, wet	
8	wh-wh-wh-1	2.0			Grey silty CLAY, saturated	
9	1-1-wh-wh	2.0				
10	wh-wh-3-3	2.0				
11	wh-wh-wr-wr	1.0			Grey silty CLAY, saturated	
12	wh-3-3-3	2.0				
13	wh-wh-wh-wh	2.0				
14	wh-wh-1-1	2.0				
15	wr-wr-wh-wh	2.0			Grey silty CLAY, some f Gravel, saturated	
16	wh-wh-wh-wh	2.0			Grey CLAY and f GRAVEL	
17	10-6-6-10	2.0			Grey CLAY and fm GRAVEL, trace Silt, saturated	
		1.0				

BROWN AND CALDWELL

BORING LOG

Well Name/Location: MW-24D

Project: *Off Site Well Installation*
Client: *Dyno Nobel*
Project No.: *23167.001*
Start Date: *8/29/02*
Finish Date: *8/29/02*

DRILLING DATA

Inspector: *Elyse J. Apicello*
Contractor: *SJB Services, Inc.*
Equipment: *CME 550X*
Method: *4.25" HSA*

SAMPLING METHODS

Sampler Type: *Split Spoon*	**Tube Type:** *NA*	**Core Type:** *NA*
Diameter: *2"*	**Diameter:** *NA*	**Diameter:** *NA*
Other: *NA*	**Other:** *NA*	**Other:** *NA*

WELL CONSTRUCTION

Riser Material: *PVC*	**Screen Material:** *PVC*
Diameter (ID): *2"*	**Diameter (ID):** *2"*
Coupling: *Flush-Threaded*	**Coupling:** *Flush-Threaded*

WELL DEVELOPMENT

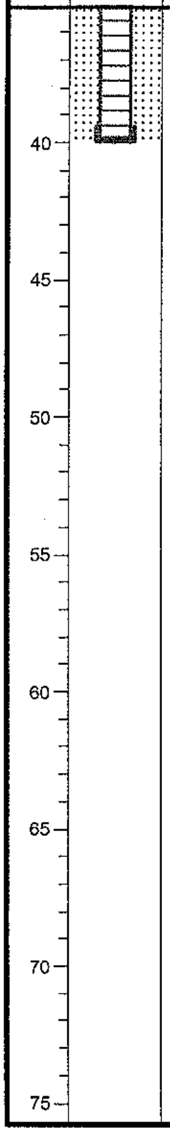
Method: *Grundfos*
Duration: *1 Hour*
Gals. Purged: *120*
Slug Test: *NA*

SURVEY DATA

Datum:
Grade: *154.75*
North: *687637.80*
TWC: *157.21*
East: *594853.24*
TPC:

SOIL / ROCK — **SAMPLE DATA**

Geophysical Log: ☐
Comments:



Run No. / Samp. No	Hydraul. Cond. cm/sec / Blows/ 6 in.	Rec. (ft.) / Rec. (ft.)	RQD. / USCS	HNU (ppm) / HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
18	4-5-5-3	1.0			Grey silty CLAY and fm GRAVEL, saturated	
19	8-11-10-8	2.0				
20	10-11-10-16	1.0			Grey silty CLAY and fm GRAVEL, trace Rock fragements, saturated	
					End of Borehole	

BROWN AND CALDWELL

BORING LOG

Well Name/Location: MW-25S

Project: *Off Site Well Installation*
Client: *Dyno Nobel*
Project No.: *23167.001*
Start Date: *8/26/02*
Finish Date: *8/26/02*

DRILLING DATA

Inspector: *Elyse J. Apicello*
Contractor: *SJB Services, Inc.*
Equipment: *CME 550X*
Method: *4.25" HSA*

SAMPLING METHODS

Sampler Type: *Split Spoon*
Diameter: *2"*
Other: *NA*

Tube Type: *NA*
Diameter: *NA*
Other: *NA*

Core Type: *NA*
Diameter: *NA*
Other: *NA*

WELL CONSTRUCTION

Riser Material: *PVC*
Diameter (ID): *2"*
Coupling: *Flush-Threaded*

Screen Material: *PVC*
Diameter (ID): *2"*
Coupling: *Flush-Threaded*

WELL DEVELOPMENT

Method: *Grundfos*
Duration: *1 Hour*
Gals. Purged: *30*
Slug Test: *NA*

SURVEY DATA

Datum:
Grade: *156.70*
North: *685314.40*
TWC: *159.71*
East: *594639.53*
TPC:

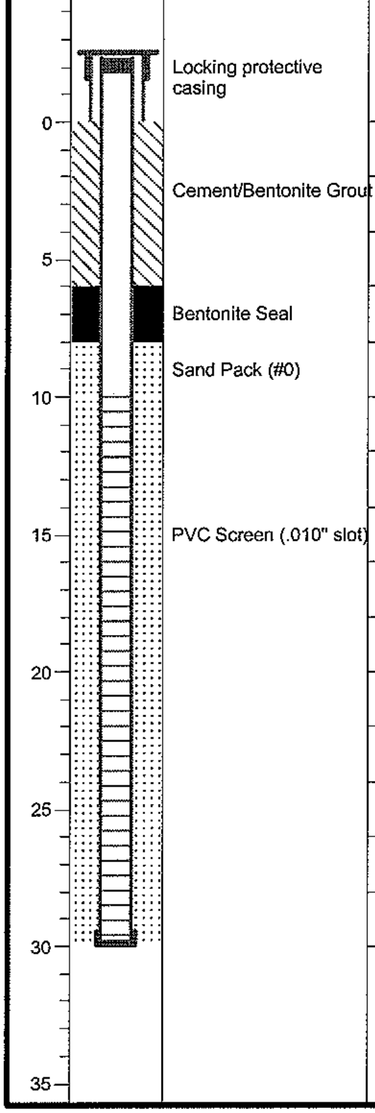
SOIL
ROCK

SAMPLE DATA

Geophysical Log: ☐
Comments:

Depth (feet)

WELL DETAIL



Run No.	Hydraul. Cond. cm/sec	Rec. (ft.)	RQD.	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
Samp. No	Blows/ 6 in.	Rec. (ft.)	USCS	HNU (ppm)		
1	3-4-6-6	1.5			**OVERBURDEN** Brown/tan fm SAND, some Silt, trace c Sand, dry	
2	7-9-11-11	2.0			Light brown f SAND and SILT, little clay, dry	
3	5-7-8-11	2.0			Brown/reddish CLAY and f SAND, little Silt, moist at tip	
4	11-9-9-8	2.0			Medium Brown CLAY, some Silt, moist	
5	3-4-4-4	2.0			Medium Brown silty CLAY, trace f Sand, wet	
6	4-4-5-2	2.0			Brown f SAND and silty CLAY, moist	
7	wh-wh-2-2	1.0				
8	wh-wh-1-2	2.0			Brown silty CLAY in top 2", grading into grey CLAY, some Silt, trace f Sand, saturated	
9	wh-1-2-2	1.0			Grey CLAY, trace Silt, saturated	
10	wh-wh-wh-1	1.5				
11	wh-wh-wh-wh	2.0			Grey CLAY, some silty Clay, saturated	
12	wh-2-3-3	2.0			Grey silty CLAY, saturated	
13	wr-1-1-1	2.0				
14	wh-wh-2-3	2.0				
15	wh-wh-wh-wh	2.0				
					End of Borehole	

BROWN AND CALDWELL | **BORING LOG** | **Well Name/Location: MW-26S**

Project: *Off Site Well Installation*
Client: *Dyno Nobel*
Project No.: *23167.001*
Start Date: *8/28/02*
Finish Date: *8/28/02*

DRILLING DATA

Inspector: *Elyse J. Apicello*
Contractor: *SJB Services, Inc.*
Equipment: *CME 550X*
Method: *4.25" HSA*

SAMPLING METHODS

Sampler Type: *Split Spoon*	**Tube Type:** *NA*	**Core Type:** *NA*
Diameter: *2"*	**Diameter:** *NA*	**Diameter:** *NA*
Other: *NA*	**Other:** *NA*	**Other:** *NA*

WELL CONSTRUCTION

Riser Material: *PVC*	**Screen Material:** *PVC*
Diameter (ID): *2"*	**Diameter (ID):** *2"*
Coupling: *Flush-Threaded*	**Coupling:** *Flush-Threaded*

WELL DEVELOPMENT

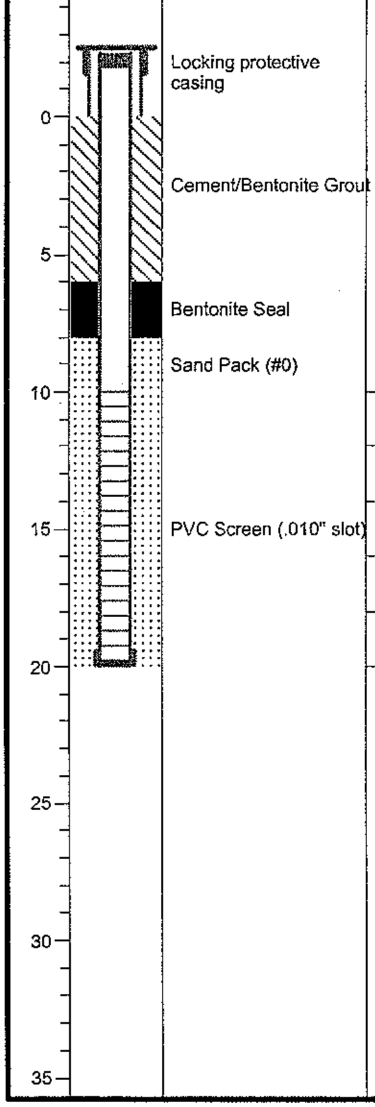
Method: *Bailer*
Duration: *2 Hours*
Gals. Purged: *3*
Slug Test: *NA*

SURVEY DATA

Datum:
Grade: *151.70* **North:** *687255.69*
TWC: *154.49* **East:** *594867.10*
TPC:

SOIL / **ROCK** — **SAMPLE DATA**

Geophysical Log: ☐
Comments:



Run No. / Samp. No	Hydraul. Cond. cm/sec / Blows/ 6 in.	Rec. (ft.) / Rec. (ft.)	RQD. / USCS	HNU (ppm) / HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
					OVERBURDEN	
1	3-4-4-4	2.0			Brownish/red f SAND and silty CLAY, moist	
2	2-4-5-6	2.0			Reddish brown silty CLAY, trace f Sand grading into grey Clay in the tip, moist	
3	2-1-2-2	1.5			Grey f SAND and silty CLAY, wet	
4	2-3-2-2	1.5			Grey CLAY, trace Silt, wet	
5	1-1-2-1	1.5			Grey silty CLAY, saturated	
					End of Borehole	

BROWN AND CALDWELL

BORING LOG

Well Name/Location: MW-26D

Project: *Off Site Well Installation*
Client: *Dyno Nobel*
Project No.: *23167.001*
Start Date: *8/27/02*
Finish Date: *8/27/02*

DRILLING DATA

Inspector: *Elyse J. Apicello*
Contractor: *SJB Services, Inc.*
Equipment: *CME 550X*
Method: *4.25" HSA*

SAMPLING METHODS

Sampler Type: *Split Spoon*	**Tube Type:** *NA*	**Core Type:** *NA*
Diameter: *2"*	**Diameter:** *NA*	**Diameter:** *NA*
Other: *NA*	**Other:** *NA*	**Other:** *NA*

WELL CONSTRUCTION

Riser Material: *PVC*	**Screen Material:** *PVC*
Diameter (ID): *2"*	**Diameter (ID):** *2"*
Coupling: *Flush-Threaded*	**Coupling:** *Flush-Threaded*

WELL DEVELOPMENT

Method: *Grundfos*
Duration: *1 Hour*
Gals. Purged: *85*
Slug Test: *NA*

SURVEY DATA

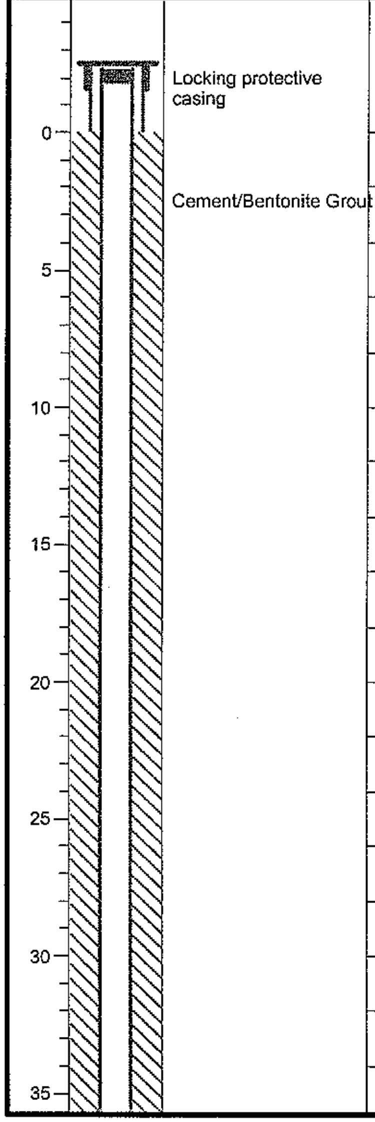
Datum:

Grade: *150.96*	**North:** *687260.02*
TWC: *153.70*	**East:** *594875.20*
TPC:	

SOIL / **ROCK** — **SAMPLE DATA**

Geophysical Log: ☐
Comments:

Depth (feet) — **WELL DETAIL**



Run No.	Hydraul. Cond. cm/sec	Rec. (ft.)	RQD.	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
Samp. No	**Blows/ 6 in.**	**Rec. (ft.)**	**USCS**	**HNU (ppm)**		
					OVERBURDEN	
1	2-3-5-9	2.0			Light brown fm SAND, some Silt, trace Clay, dry	
2	10-9-11-12	2.0			Light brown f SAND and clayey SILT, dry	
3	4-6-7-8	2.0			Brown f SAND and clayey SILT, dry	
4	5-5-5-6	2.0			Brown silty CLAY, some f Sand, moist	
5	3-3-5-5	2.0			Brown/grey silty Clay, trace f Sand, moist	
6	1-4-3-5	2.0				
7	4-6-5-5	2.0			Brown f SAND and CLAY, trace Silt, moist	
8	1-2-2-2	1.0			Brown/grey CLAY, trace Silt, wet	
9	1-3-2-3	1.5			Grey CLAY and SILT, some silty Clay, wet	
10	wh-wh-wh-wh	2.0			Grey CLAY, trace Silt, wet	
11	wh-wh-wh-1	2.0				
12	wh-wh-wh-wh	2.0				
13	wh-wh-wh-1	2.0				
14	wh-wh-2-2	2.0				
15	wh-wh-wh-wh	2.0				
16	wr-wh-wh-wh	2.0				
17	wh-wh-wh-wh	2.0				
		2.0				

BROWN AND CALDWELL

BORING LOG

Well Name/Location: MW-26D

Project: *Off Site Well Installation*
Client: *Dyno Nobel*
Project No.: *23167.001*
Start Date: *8/27/02*
Finish Date: *8/27/02*

DRILLING DATA

Inspector: *Elyse J. Apicello*
Contractor: *SJB Services, Inc.*
Equipment: *CME 550X*
Method: *4.25" HSA*

SAMPLING METHODS

Sampler Type: *Split Spoon*	**Tube Type:** *NA*	**Core Type:** *NA*
Diameter: *2"*	**Diameter:** *NA*	**Diameter:** *NA*
Other: *NA*	**Other:** *NA*	**Other:** *NA*

WELL CONSTRUCTION

Riser Material: *PVC*	**Screen Material:** *PVC*
Diameter (ID): *2"*	**Diameter (ID):** *2"*
Coupling: *Flush-Threaded*	**Coupling:** *Flush-Threaded*

WELL DEVELOPMENT

Method: *Grundfos*
Duration: *1 Hour*
Gals. Purged: *85*
Slug Test: *NA*

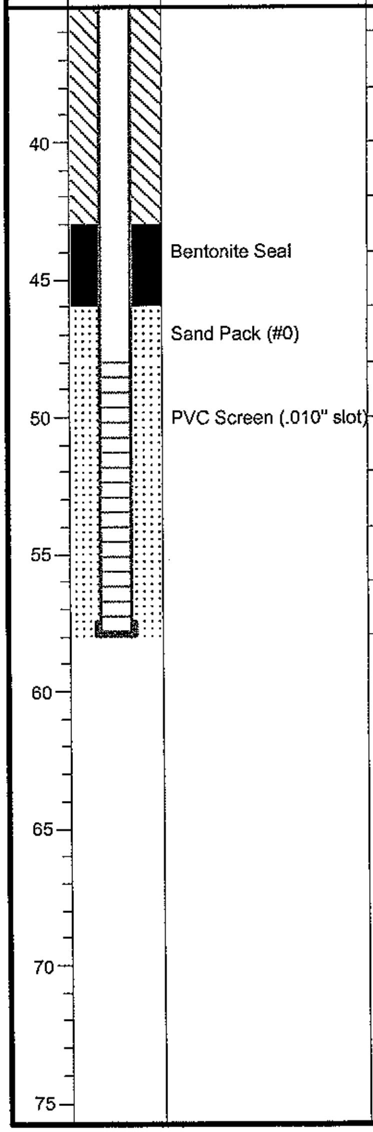
SURVEY DATA

Datum:

Grade: *150.96*	**North:** *687260.02*
TWC: *153.70*	**East:** *594875.20*
TPC:	

SOIL / **ROCK** — **SAMPLE DATA**

Geophysical Log: ☐
Comments:



Run No. / Samp. No	Hydraul. Cond. cm/sec / Blows/ 6 in.	Rec. (ft.) / Rec. (ft.)	RQD. / USCS	HNU (ppm) / HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
18	wr-wh-wh-wh	2.0				
19	wh-wh-1-1	2.0			Grey silty CLAY, saturated	
20	wr-wr-wh-wh	2.0				
21	wr-wh-wh-wh	2.0				
22	wr-wr-wh-wh	2.0			Grey CLAY, trace Silt, saturated	
23	wh-wh-wh-wh	2.0			Grey f SAND and silty CLAY, trace m Sand, saturated	
24	wh-2-3-4	2.0			Grey CLAY and SILT, trace f Sand, saturated	
25	wh-wh-wh-wh	2.0				
26	1-2-2-3	2.0			Grey silty CLAY, trace f Gravel, saturated	
28	4-6-7-8	1.5			Grey CLAY and f SAND, some c Sand, little fm Gravel, saturated	
30	11-15-20-30	2.0			Grey mc SAND, some fm Gravel, trace Silt, saturated	
31	27-28-38-49	2.0			Grey weathered bedrock (shale?) Grey fmc SAND and fm Gravel, some c Gravel, trace Silt, saturated	
					End of Borehole	

HYDROPUNCH® BORING LOGS

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location:
HP-1

Page 1 of 2

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/22/95*
Finish Date: *06/23/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

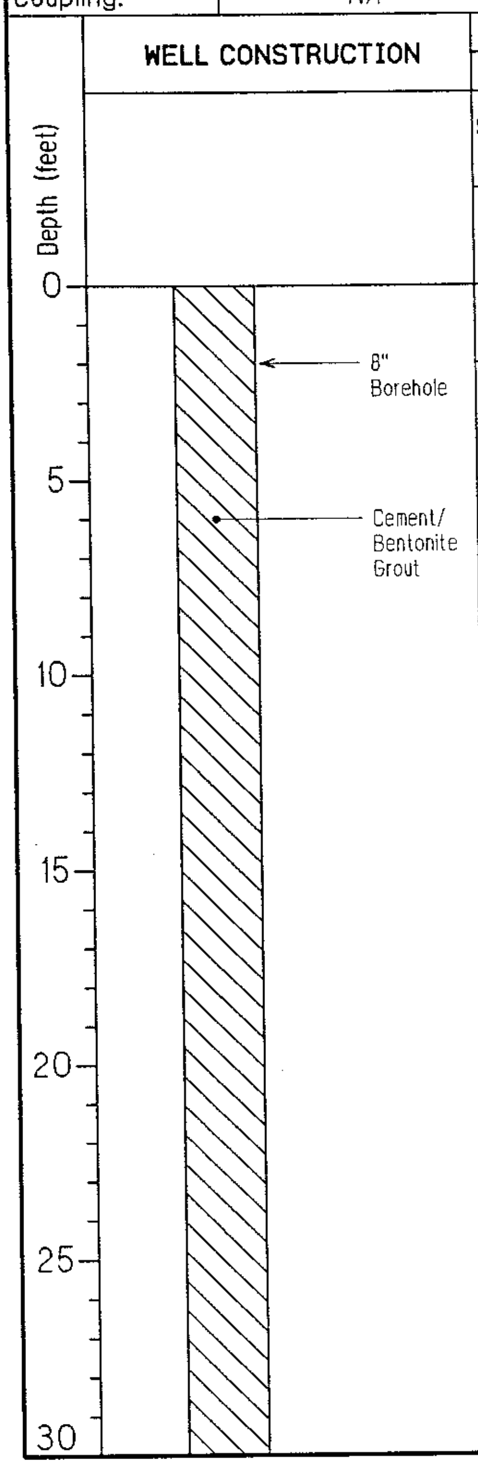
Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA*
(cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: *163.4*
TWC: *NA*
TPC: *NA*
North: *685,400.08*
East: *594,246.34*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA

Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)
S-1	6-8-8-8	1.4'	SM CH	0
S-2	6-7-7-9	1.5'	CH	0
S-3	6-5-5-8	1.8'	CH	34
S-4	6-3-3-4	2.0'	CH	144
S-5	3-1-2-2	2.0'	CH	0.4

VISUAL CLASSIFICATION

LACUSTRINE DEPOSITS

Light brown mf SAND, some Clayey Silt, with root hairs, dry

@ 0.2' grading to brown Silty CLAY, trace f Sand, moist to wet

@ 15.0' brown CLAY, trace f Sand, saturated

@ 16.9' changing to gray CLAY, trace f SAND

REMARKS

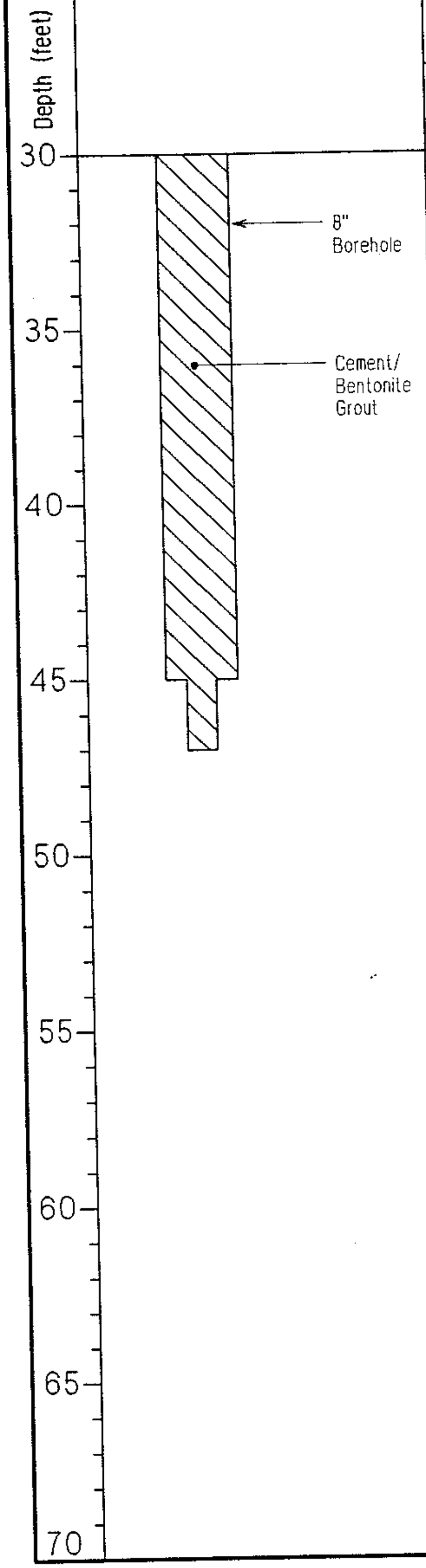
Borehole backfilled with cement/bentonite grout.

Hydropunch sample collected @ 28-29'

ECKENFELDER INC. | Subsurface Boring Log | Well Name/Location: HP-1 *Page 2 of 2*

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/22/95*
Finish Date: *06/23/95*

WELL CONSTRUCTION



(CONTINUATION)

soil: Samp. No. rock: Run No.	Blows/ 6 in. Hydraul. Cond. cm/sec	Rec. (ft.) Rec. (ft.)	USCS RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
S-6	2-1-2-1	0.9'	CH	0		
S-7	2-2-1-1	2.0'	CH	0		
						Hydropunch sample collected @ 42-43'
S-8	3-4-31-55	0.1'	GC	0	@ 45.0' gray mf GRAVEL and f SAND, some Silty Clay	
					End of Boring at 47.0 feet.	

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location:
HP-2

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/07/95*
Finish Date: *06/09/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 55*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split Spoon	NA	NA
Diameter:	2 inch	NA	NA
Other:	140 lb./30 in.	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	NA	NA
Diameter (ID):	NA	NA
Coupling:	NA	NA

WELL DEVELOPMENT

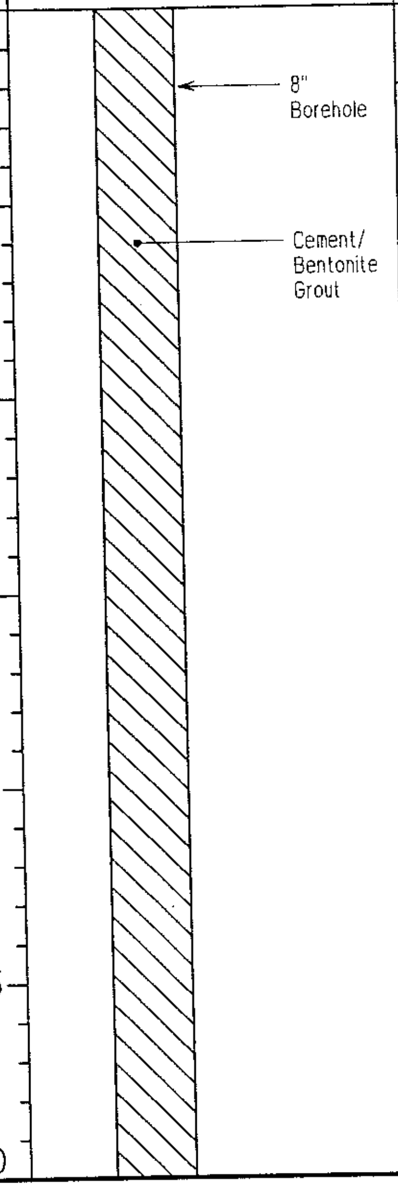
Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA*
(cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: *164.7*
TWC: *NA*
TPC: *NA*
North: *685,422.24*
East: *594,300.63*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



Depth (feet)	soil: Samp. No. rock: Run No.	Blows/ 6 in. Hydraul. Cond. cm/sec	Rec. (ft.) Rec. (ft.)	USCS RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0	S-1	5-6-7-7	1.3'	CH	0	LACUSTRINE DEPOSITS Brown CLAY & SILT, trace f Sand, with root hairs, dry to moist	Borehole backfilled with cement/bentonite grout.
5	S-2	4-6-7-9	1.4'	CH	0.2		
10	S-3	6-5-6-7	1.4'	CH	30		
15	S-4	2-1-2-2	1.8'	CH	1	@ 15.0' gray Silty CLAY, trace f Sand, saturated	
20	S-5	WOR-1-3-2	2.0'	CH	0		
25	S-6	WOR/12"-1/12"	NR	CH	NA		Hydropunch sample collected @ 26-29'
30							

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location:
HP−2

Page 2 of 2

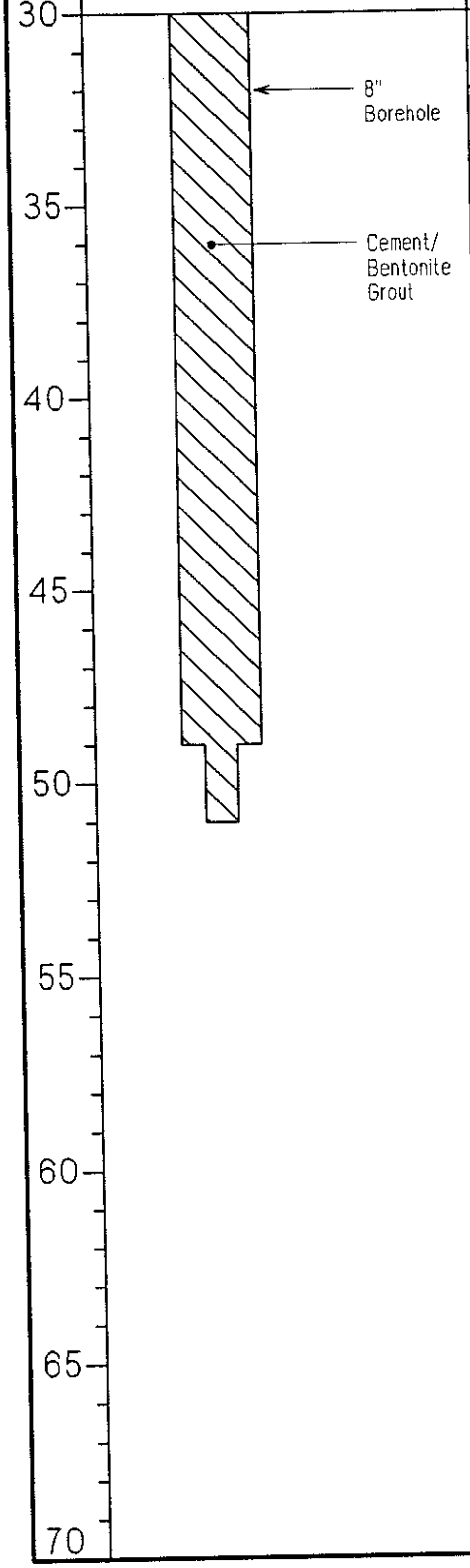
Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*

Project No.: *9596.03*

Start Date: *06/07/95*
Finish Date: *06/09/95*

(CONTINUATION)

WELL CONSTRUCTION



soil: Samp. No.	soil: Blows/ 6 in.	soil: Rec. (ft.)	soil: USCS	soil: PID (ppm)	VISUAL CLASSIFICATION	REMARKS
rock: Run No.	rock: Hydraul. Cond. cm/sec	rock: Rec. (ft.)	rock: RQD			
S-7	1-1- 1-2	2.0'	CH	0	@ 30.0' gray CLAY, trace f Sand	
S-8	WOR/24"	2.0'	CH	0	@ 35.0' gray Silty CLAY, little f Sand	
S-9	WOR/24"	NR	NA	NA		Hydropunch sample collected @ 46-49'
S-10	6-4- 24-17	0.7'	GC	0	@ 49.0' gray Silty CLAY, some angular fm Gravel, little cmf Sand	
					End of Boring at 51.0 feet.	

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-3

Page 1 of 2

Project: Groundwater Investigation

Client: Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.

Project No.: 9596.03

Start Date: 06/22/95

Finish Date: 07/07/95

DRILLING DATA

Inspector: Laurie Scheuing

Contractor: B. Bosworth/Empire Soils Investigation Inc.

Equipment: CME 850/Acker Soil Max

Method: 4 1/4" ID Hollow Stem Augers

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split Spoon	NA	NA
Diameter:	2 inch	NA	NA
Other:	140 lb./30 in.	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	NA	NA
Diameter (ID):	NA	NA
Coupling:	NA	NA

WELL DEVELOPMENT

Method: NA

Duration: NA

Gals. Purged: NA

Slug Test: NA (cm/sec)

SURVEY DATA

DATUM: NGVD/NYS Plane

Grade: 164.4

TWC: NA

TPC: NA

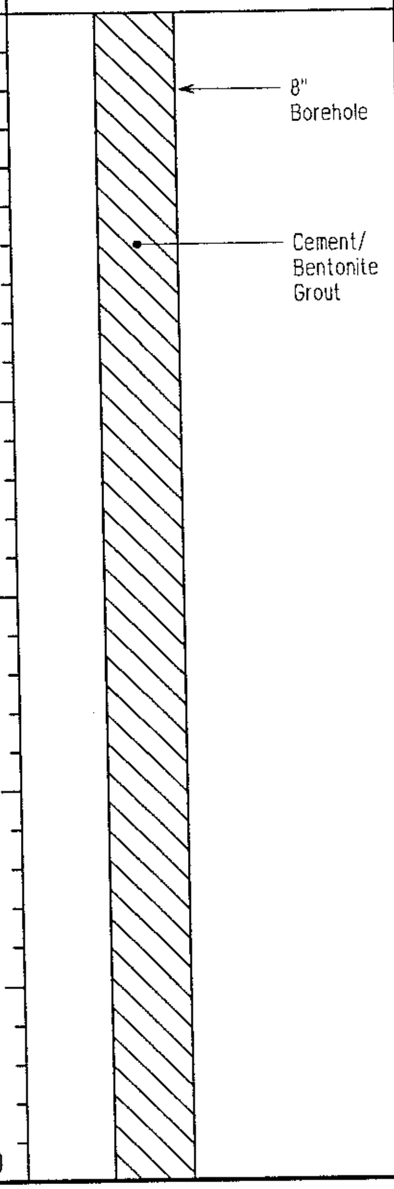
North: 685,424.48

East: 594,343.99

Geophysical Log: ☐ yes ☒ no

Comments:

WELL CONSTRUCTION



SAMPLE DATA

Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0	S-1	7-8-7-6	1.2'	SP CH	24	FILL (0.8) Light brown to black fmc SAND, little Clayey Silt, little f Gravel, with roots & cinders, dry to moist LACUSTRINE DEPOSITS Gray-black Silty CLAY, trace f Sand, damp	Borehole backfilled with cement/bentonite grout.
5	S-2	5-6-8-6	1.1'	CH	4.8	@ 5.0 brown & gray Silty CLAY, trace f Sand, moist to wet	
10	S-3	7-7-8-11	2.0'	CH	60		
15	S-4	3-4-3-5	2.0'	CH	12	@ 15.0' brown CLAY, trace (-) f Sand, saturated	
20	S-5	4-2-2-3	2.0	CH	0.2	@ 20.0' gray CLAY, trace (-) f Sand	Hydropunch sample collected @ 23-24'
25	S-6	4-3-4-5	1.2'	CH	1.2		
30							

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location:
HP-3

Page 2 of 2

Project: *Groundwater Investigation*

Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*

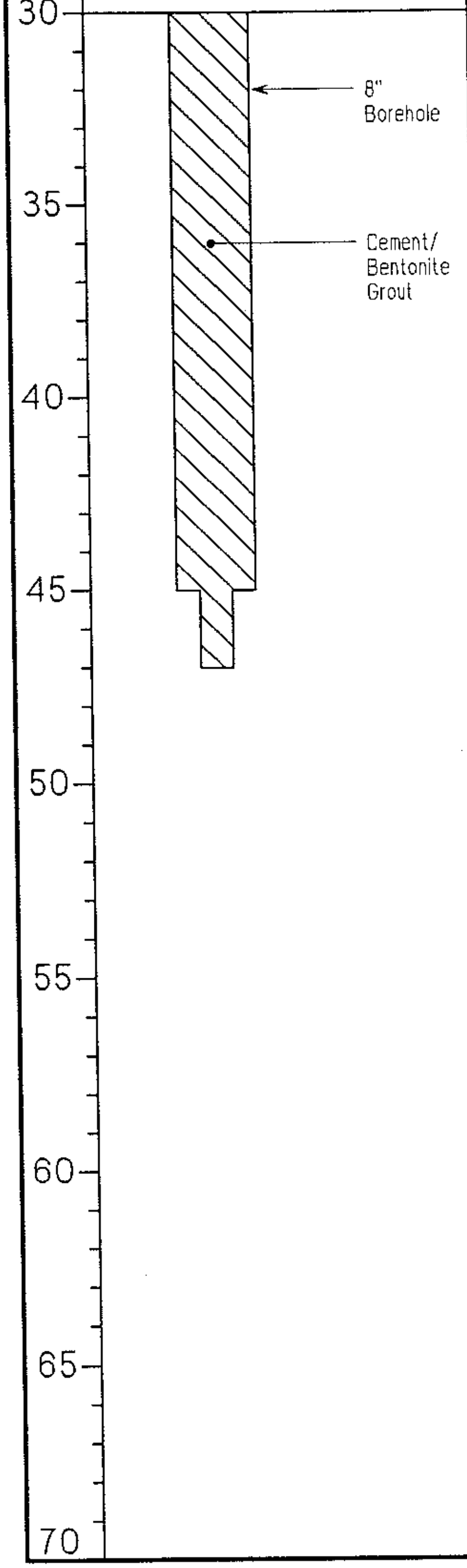
Project No.: *9596.03*

Start Date: *06/22/95*

Finish Date: *07/07/95*

(CONTINUATION)

WELL CONSTRUCTION



Depth (feet)	soil: Samp. No. rock: Run No.	Blows/ 6 in. Hydraul. Cond. cm/sec	Rec. (ft.) Rec. (ft.)	USCS RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30	S-7	3-4-4-4	1.2'	CH	0		
35						@ 35.0' gray CLAY, little f Sand	
35	S-8	WOH/24"	2.0'	CH	0		
43							Hydropunch sample collected @ 43-44'
45	S-9	5-5-4-3	2.0'	CH	0		
47						End of Boring at 47.0 feet.	

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-4

Page 1 of 2

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/21/95*
Finish Date: *06/21/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

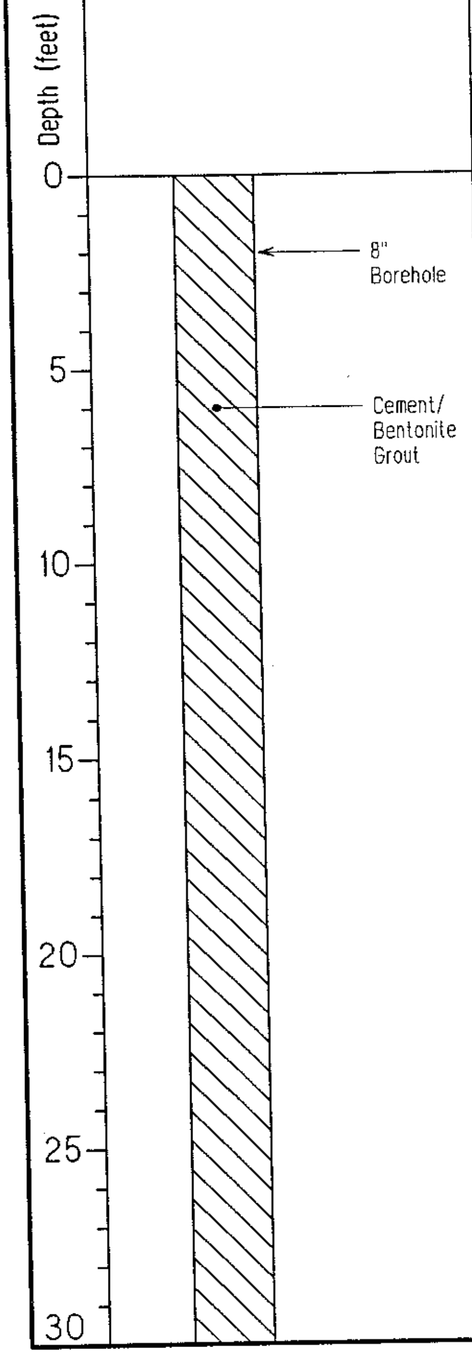
Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA*
(cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: *164.6*
TWC: *NA*
TPC: *NA*
North: *685,380.71*
East: *594,335.46*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA (soil / rock)

Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)
S-1	9-11-5-5	0.9'	GM	1.6
S-2	4-6-9-12	1.7'	CH	0.8
S-3	4-7-9-10	2.0'	CH	11.2
S-4	2-4-4-5	2.0'	CH	40
S-5	WOH/18"-3	2.0'	CH	19.6

VISUAL CLASSIFICATION

LACUSTRINE DEPOSITS

Gray mf GRAVEL, some fmc Sand, little Clay & Silt, dry to moist @ 0.7'

@ 5.0' brown Silty CLAY, trace f Sand, moist to wet

@ 16.4' changing to red-brown Silty CLAY, trace f Sand, saturated

@ 20.0' gray CLAY, trace (-) f Sand

REMARKS

Borehole backfilled with cement/bentonite grout.

Hydropunch sample collected @ 27.5-28.5'

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-4

Page 2 of 2

Project: *Groundwater Investigation*

Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*

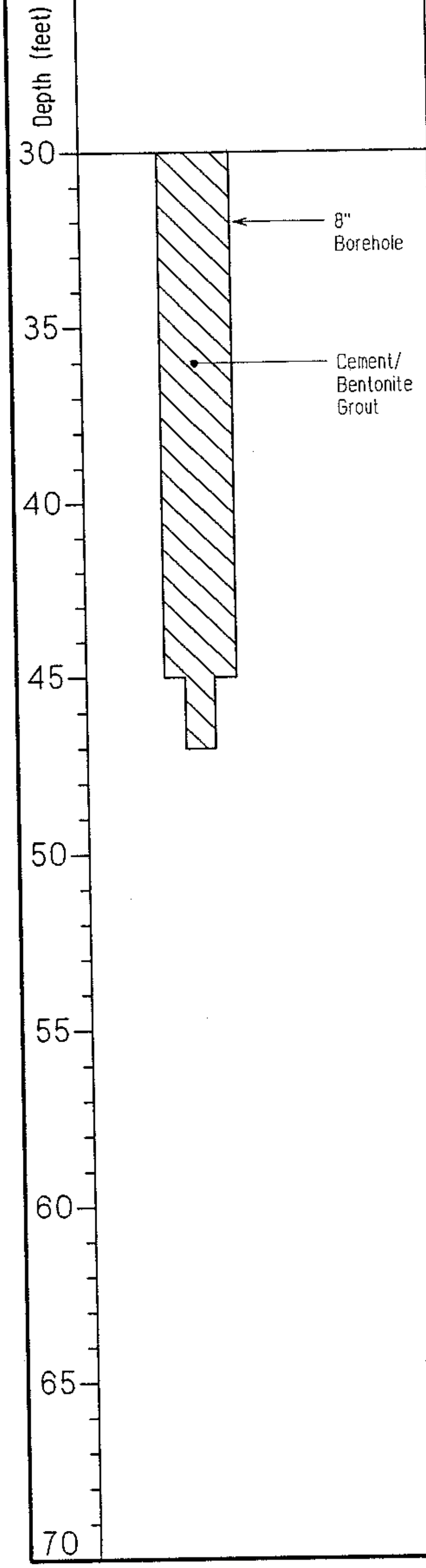
Project No.: *9596.03*

Start Date: *06/21/95*

Finish Date: *06/21/95*

(CONTINUATION)

WELL CONSTRUCTION



soil: Samp. No.	Blows/ 6 in.	Rec. (ft.)	USCS	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
rock: Run No.	Hydraul. Cond. cm/sec	Rec. (ft.)	RQD			
S-6	1-2- 1-1	1.2'	CH	0		
S-7	1-1- 1-1	NR	NA	NA		
						Hydropunch sample collected @ 42-43'
S-8	1-1- 4-5	NR	CH	NA		
					End of Boring at 47.0 feet.	

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: HP-5 Page 1 of 2

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/05/95*
Finish Date: *06/07/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 55*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

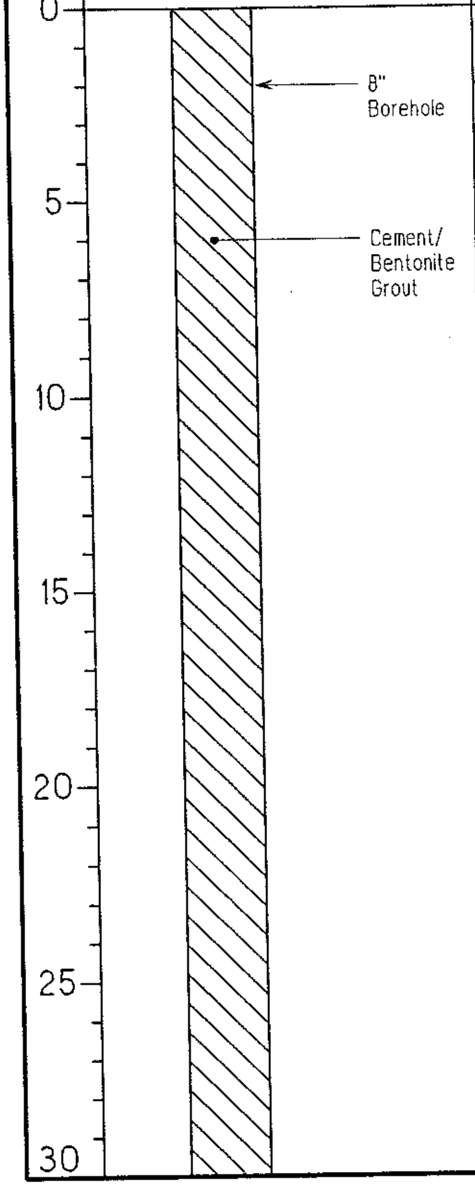
Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: *161.1*
TWC: *NA*
TPC: *NA*
North: *685,435.55*
East: *594,448.56*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION

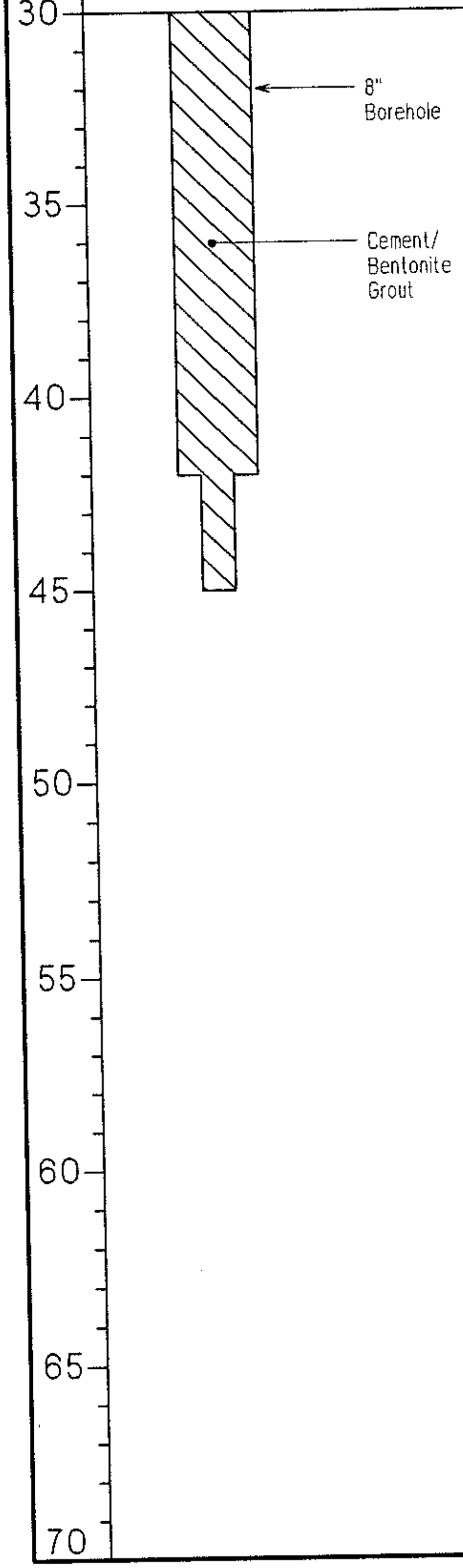


Depth (feet)	soil: Samp. No.	Blows/ 6 in.	Rec. (ft.)	USCS	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
	rock: Run No.	Hydraul. Cond. cm/sec	Rec. (ft.)	RQD			
0	S-1	4-3-5-7	0.9'	CL	0	LACUSTRINE DEPOSITS Brown SILT & CLAY, trace f Sand, dry	Borehole backfilled with cement/bentonite grout.
5	S-2	6-8-7-9	1.2'	CH	0	@ 5.0' brown Silty CLAY, trace f Sand, moist	
10	S-3	4-7-8-12	1.7'	CH	2		
15	S-4	3-4-3-3	2.0'	CH	0.6	@ 16.7' changing to gray Silty CLAY, trace f Sand, wet	
20	S-5	WOH/12"-2-3	2.0'	CH	0	@ 20.0' gray Silty CLAY, trace (-) f Sand, saturated	
25	S-6	1/24"	NR	NA	NA		Hydropunch sample collected @ 26-28'
30							

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: HP-5 *Page 2 of 2*
Project: *Groundwater Investigation* Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*	Project No.: *9596.03*	Start Date: *06/05/95* Finish Date: *06/07/95*

(CONTINUATION)

WELL CONSTRUCTION



SAMPLE DATA

Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30	S-7	1-1- 1-1	2.0'	CH	0.1	@ 30.0' gray CLAY, trace (-) f SAND	
35	S-8	WOR/12"- 1-3	2.0'	CH	0.1		
40	S-9	1-1- 1-1	NR	NA	NA		Hydropunch sample collected @ 42-45'
45						End of Boring at 45.0 feet.	

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: HP-6

Page 1 of 2

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/15/95*
Finish Date: *06/19/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split Spoon	NA	NA
Diameter:	2 inch	NA	NA
Other:	140 lb./30 in.	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	NA	NA
Diameter (ID):	NA	NA
Coupling:	NA	NA

WELL DEVELOPMENT

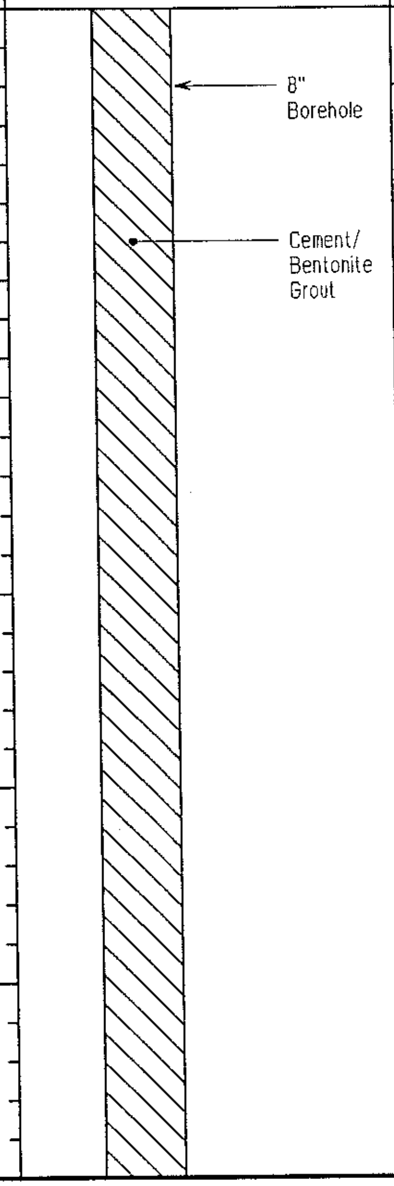
Method: NA
Duration: NA
Gals. Purged: NA
Slug Test: NA
(cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: 157.8
TWC: NA
TPC: NA
North: 685,379.73
East: 594,512.92

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA

soil / rock

Depth (feet)	Samp. No. Run No.	Blows/ 6 in. Hydraul. Cond. cm/sec	Rec. (ft.) Rec. (ft.)	USCS RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0						LACUSTRINE DEPOSITS	Borehole backfilled with cement/bentonite grout.
	S-1	3-4-3-4	1.4'	CL	0	Brown SILT & CLAY, little mf Sand, with reeds & roots, damp	
5	S-2	4-6-7-8	2.0'	CH	0	@ 5.0' brown Silty CLAY, trace f Sand, moist to wet	
10	S-3	3-5-7-7	2.0'	CH	0.1		
15	S-4	3-2-3-3	1.0'	CH	0	@ 15.0' gray Silty CLAY, trace f Sand, saturated	
20							
							Hydropunch sample collected @ 23-24'
25	S-5	2-4-4-3	1.5'	CH	0	@ 25.0' gray CLAY, trace (-) f Sand	
30							

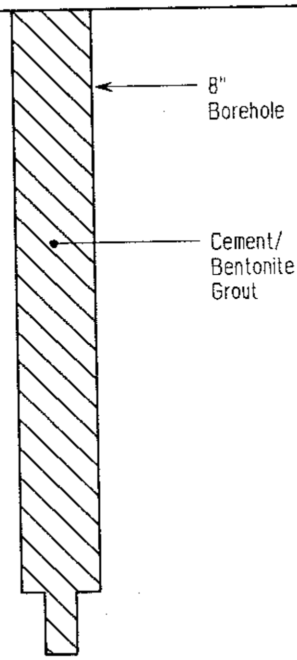
ECKENFELDER INC. | Subsurface Boring Log | Well Name/Location: HP-6

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/15/95*
Finish Date: *06/19/95*

WELL CONSTRUCTION

soil / rock — **SAMPLE DATA**

(CONTINUATION)



Depth (feet)	Samp. No.	Blows/ 6 in.	Rec. (ft.)	USCS	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
	Run No.	Hydraul. Cond. cm/sec	Rec. (ft.)	RQD			
30	S-6	1-1-3-3	1.0'	CH	0	@ 30.0' gray CLAY, little f Sand	
35	S-7	2-1/12"-1	2.0'	CH	0		
40							Hydropunch sample collected @ 41-44'
45	S-8	32-34-65-100/0.1"	1.3'	GC	0	@ 45.0' gray mf GRAVEL, some Silty Clay, some fmc Sand Bedrock @ 46.6 feet.	
						End of Boring at 46.6 feet.	
50							
55							
60							
65							
70							

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-7

Page 1 of 2

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *07/13/95*
Finish Date: *07/14/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

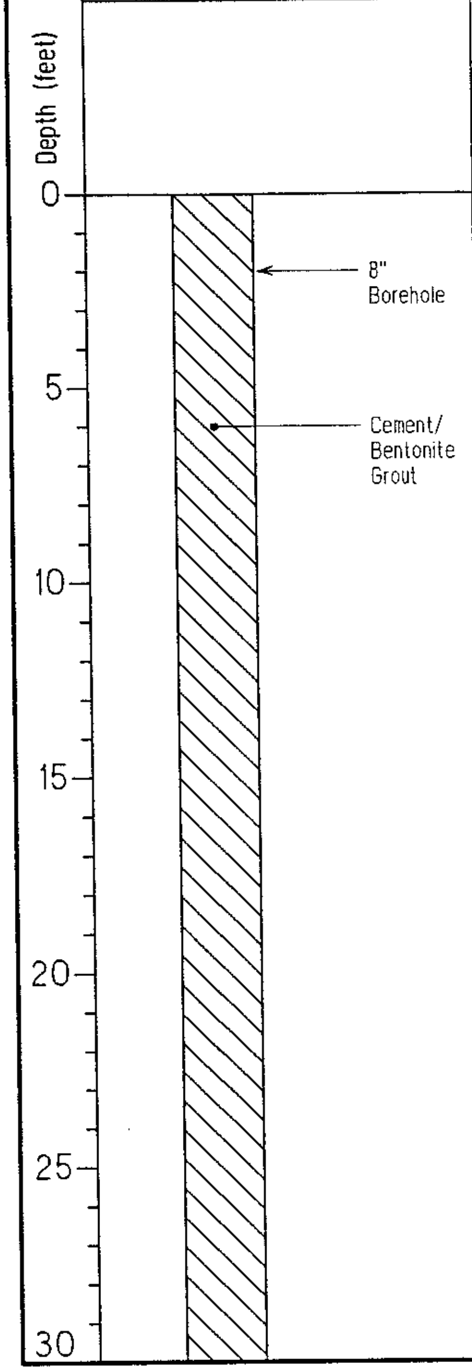
Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA*
(cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: *157.8*
TWC: *NA*
TPC: *NA*
North: *685,305.36*
East: *594,648.93*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA

Samp. No. (soil)	Blows/ 6 in.	Rec. (ft.)	USCS	PID (ppm)
Run No. (rock)	Hydraul. Cond. cm/sec	Rec. (ft.)	RQD	
S-1	3-5-9-10	2.0'	CH	0.2
S-2	5-5-5-8	2.0'	CH	0
S-3	4-6-5-6	NR	NA	NA
S-4	4-2-3-1	2.0'	CH	0
S-5	WOH/18"-2	1.2'	CH	0

VISUAL CLASSIFICATION

LACUSTRINE DEPOSITS

Brown Silty CLAY, trace f Sand, with roots, dry to wet

@ 15.7' grading to gray Silty CLAY, trace f Sand, saturated

REMARKS

Borehole backfilled with cement/bentonite grout.

Hydropunch sample collected @ 23-24'

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location:
HP-7

Page 2 of 2

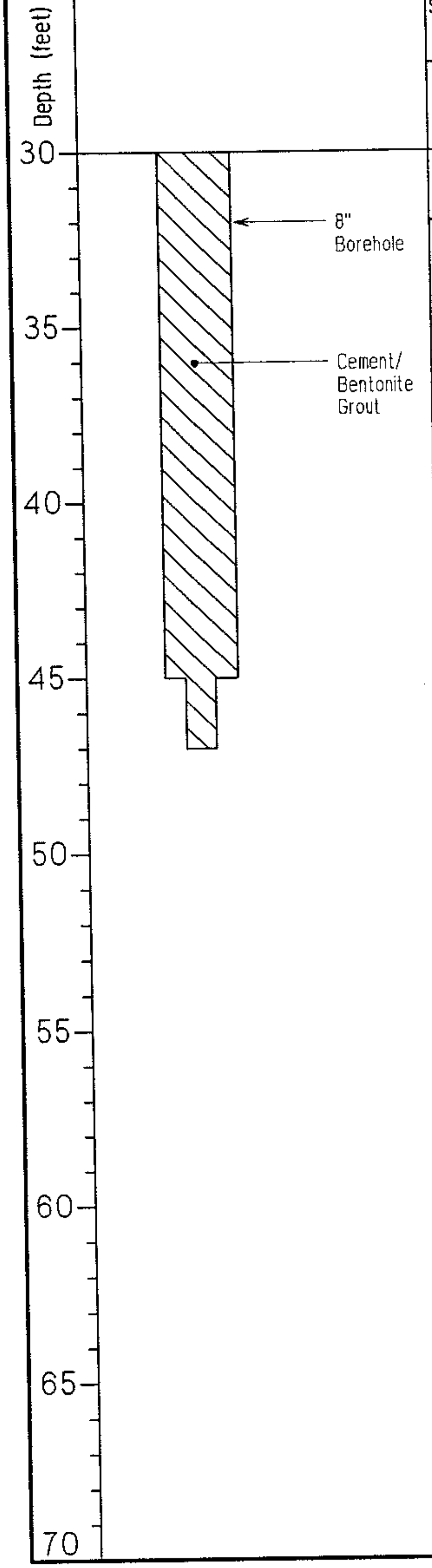
Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*

Project No.: *9596.03*

Start Date: *07/13/95*
Finish Date: *07/14/95*

(CONTINUATION)

WELL CONSTRUCTION



soil: Samp. No. rock: Run No.	Blows/ 6 in. Hydraul. Cond. cm/sec	Rec. (ft.)	USCS RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
S-6	1-1-1-2	1.8'	CH	0	@ 30.0' gray Silty CLAY, little (+) f Sand	
S-7	WOR/24"	1.8'	CH	0		
						Hydropunch sample collected @ 42-44'
S-8	16-14-42-38	1.1'	GP	0	@ 45.0' gray fmc GRAVEL, some cmf Sand, little Silt & Clay	
					End of Boring at 47.0 feet.	

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: **HP-8**

Page 1 of 2

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *07/12/95*
Finish Date: *07/15/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split Spoon	NA	NA
Diameter:	2 inch	NA	NA
Other:	140 lb./30 in.	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	NA	NA
Diameter (ID):	NA	NA
Coupling:	NA	NA

WELL DEVELOPMENT

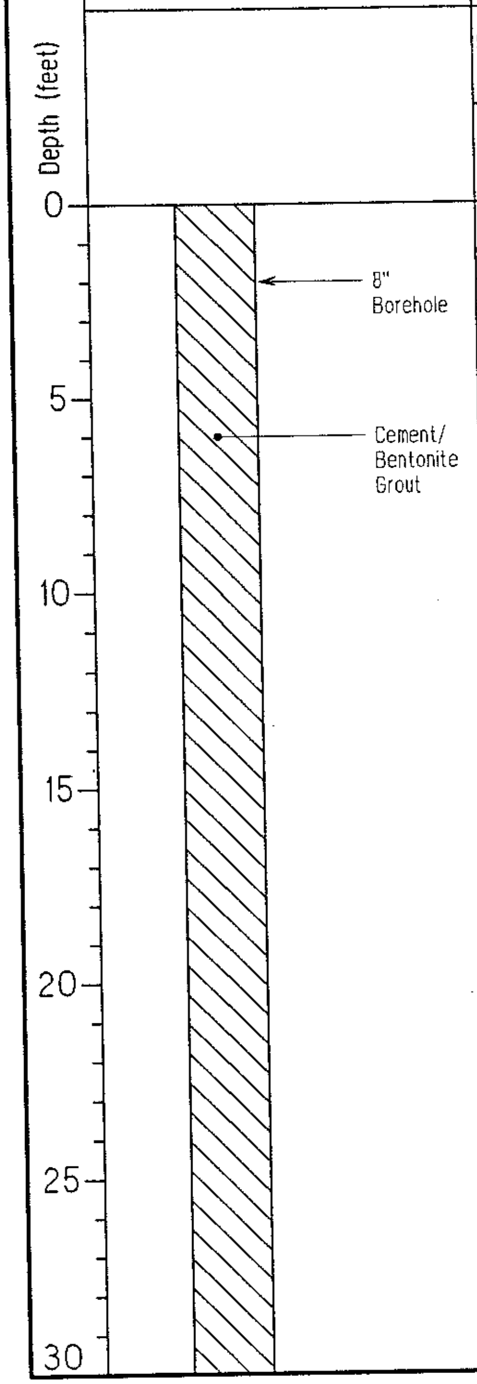
Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA*
(cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: *162.7*
TWC: *NA*
TPC: *NA*
North: *685,218.76*
East: *594,639.62*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA

soil rock					
Samp. No.	Blows/ 6 in.	Rec. (ft.)	USCS	PID (ppm)	Depth
Run No.	Hydraul. Cond. cm/sec	Rec. (ft.)	RQD		
S-1	2-4-6-10	1.5'	CH	0	0-2
S-2	6-8-11-11	2.0'	CH	0	5-7
S-3	7-5-8-11	2.0'	CH	0	10-12
S-4	6-5-4-5	1.3'	CH	0	15-17
S-5	2-2-2-4	1.5'	CH	0	25-27

VISUAL CLASSIFICATION

LACUSTRINE DEPOSITS

Dark brown to gray-brown Silty CLAY, trace f Sand, dry to wet

@ 15.0' gray Silty CLAY, trace f Sand, saturated

@ 25.0' gray Silty CLAY, little f Sand

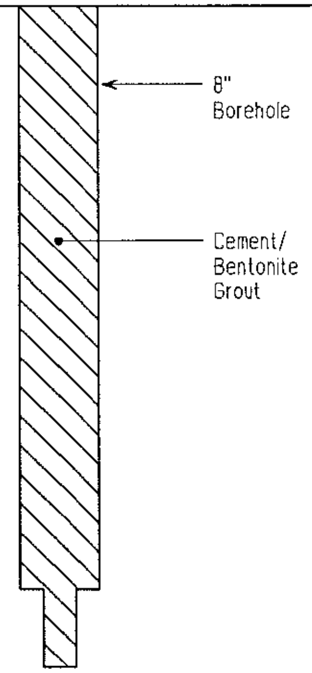
REMARKS

Borehole backfilled with cement/bentonite grout.

Hydropunch sample collected @ 23-24' plus DUP071395

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: HP-8 *Page 2 of 2*
Project: *Groundwater Investigation* Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*	Project No.: *9596.03*	Start Date: *07/12/95* Finish Date: *07/15/95*

WELL CONSTRUCTION



SAMPLE DATA (soil / rock)

(CONTINUATION)

Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.) / Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30	S-6	2-3-2-3	1.3'	CH	0	@ 30.0' gray Silty CLAY, some (–) f Sand	
35	S-7	1-2-1-1	1.5'	CH	0		
40							Hydropunch sample collected @ 42-43'
45	S-8	12-16-15-24	1.3'	SP	0	@ 45.0' gray cmf SAND, some fmc Gravel, little Silt & Clay	
						End of Boring at 47.0 feet.	
50							
55							
60							
65							
70							

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-9

Page 1 of 1

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *07/12/95*
Finish Date: *07/12/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

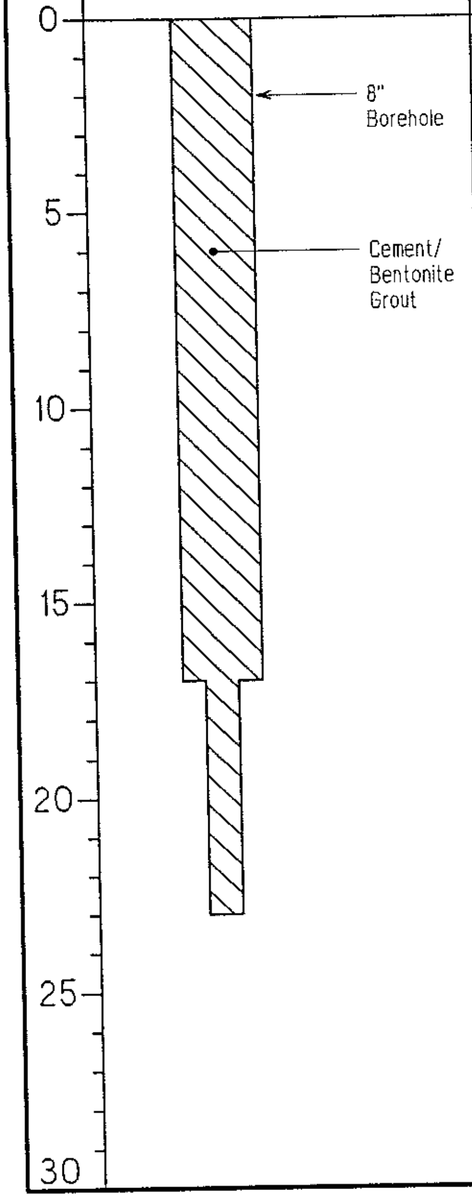
Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: *164.0*
TWC: *NA*
TPC: *NA*
North: *685,130.17*
East: *594,614.45*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA

soil Samp. No.	Blows/ 6 in.	Rec. (ft.)	USCS	PID (ppm)
rock Run No.	Hydraul. Cond. cm/sec	Rec. (ft.)	RQD	
S-1	2-5-9-12	1.5'	OL CH	0
S-2	8-7-8-10	1.7'	CH	0
S-3	6-5-4-4	1.8'	CH	0.2
S-4	7-7-6-6	0.9'	CH	0

VISUAL CLASSIFICATION

LACUSTRINE DEPOSITS

Dark brown SILT, some f Sand, with roots, needles & leaf litter, dry

@ 0.4' grading to brown Silty CLAY, trace to little f Sand, dry to moist

@ 10.4' changing to gray Silty CLAY, trace f Sand, wet to saturated

End of Boring at 23.0 feet.

REMARKS

Borehole backfilled with cement/bentonite grout.

Hydropunch sample collected @ 22-23'

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location:
HP-10

Page 1 of 2

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/02/95*
Finish Date: *06/08/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

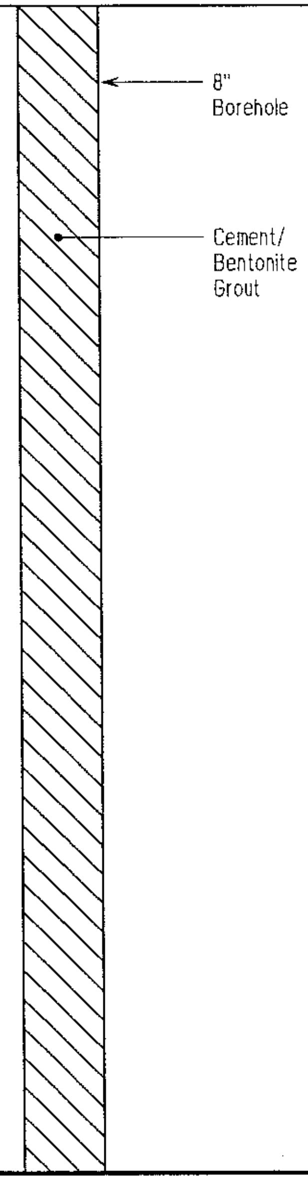
Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: *156.8*
TWC: *NA*
TPC: *NA*
North: *685,220.05*
East: *594,500.02*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0	S-1	1-3-3-4	1.6'	CH	2.6	LACUSTRINE DEPOSITS Brown CLAY & SILT, trace to (-) f Sand, moist to saturated	Borehole backfilled with cement/bentonite grout.
5	S-2	2-3-5-7	1.8'	CH	200		
10	S-3	4-4-4-6	2.0'	CH	250		
15	S-4	1-2-2-2-	2.0'	CH	400	@ 15.3' changing to gray CLAY, trace (-) f Sand, saturated	
20	S-5	WOH/24"	NR	NA	NA		Hydropunch sample collected @ 21-24', plus DUP060895
25	S-6	1/12"-1/12"	0.7'	CH	1		
30							

ECKENFELDER INC.

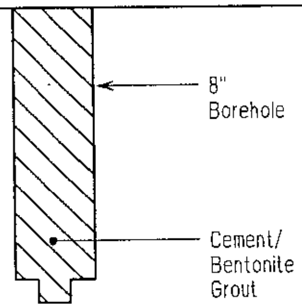
Subsurface Boring Log

Well Name/Location:
HP-10
Page 2 of 2

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/02/95*
Finish Date: *06/08/95*

(CONTINUATION)

WELL CONSTRUCTION



Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30	S-7	1-1- 1-2	2.0'	CH	0.4		Hydropunch sample, HP-10A, collected @ 32-34'
35	S-8	WOR/18"- 40	2.0'	CH	0.5	@ 36.6' grading to gray CLAY, some fm Sand	
	S-9	100/2"	NR	CH	NA	Bedrock @ 37.5 feet. 37.5	Hydropunch sample collected @ 37-37.5'
						End of Boring at 37.5 feet.	
40							
45							
50							
55							
60							
65							
70							

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-11

Page 1 of 2

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/09/95*
Finish Date: *06/12/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split Spoon	NA	NA
Diameter:	2 inch	NA	NA
Other:	140 lb./30 in.	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	NA	NA
Diameter (ID):	NA	NA
Coupling:	NA	NA

WELL DEVELOPMENT

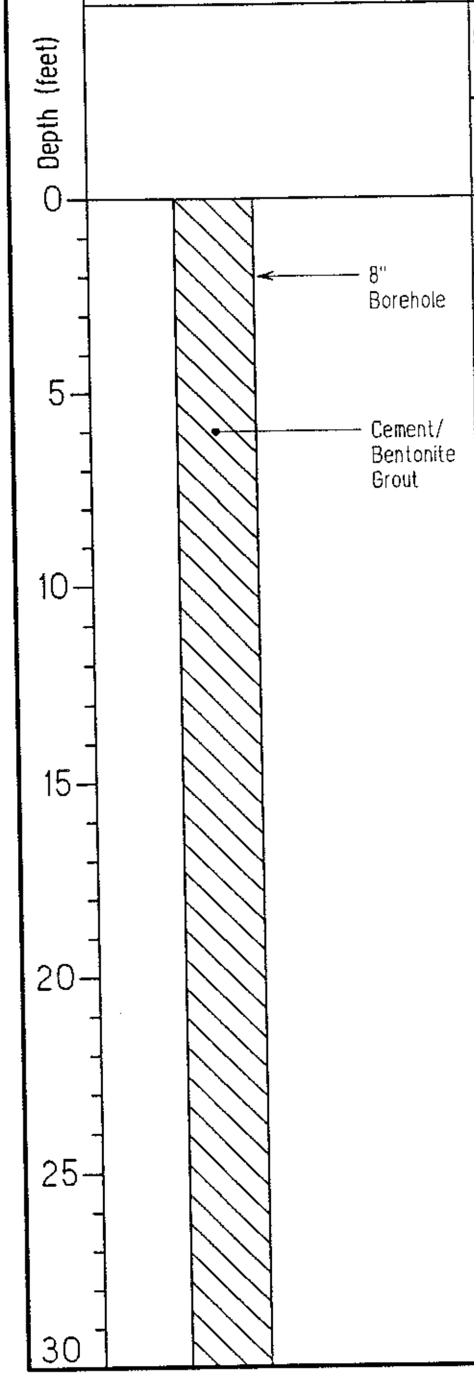
Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NGVD/NYS Plane

Grade: *161.8*
TWC: *NA*
TPC: *NA*
North: *685,096.79*
East: *594,493.05*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA (soil / rock)

Samp. No. / Run No.	Blows/6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)
S-1	2-8-9-9	1.2'	CH	0
S-2	6-4-7-10	1.6'	CH	0
S-3	6-4-5-5	1.8'	CH	0
S-4	6-4-3-2	1.5'	CH	0
S-5	5-3-1-2	1.4'	CH	0

VISUAL CLASSIFICATION

LACUSTRINE DEPOSITS

Brown Silty CLAY, trace f Sand, dry to moist

@ 15.0' gray Silty CLAY, trace (-) f Sand, wet to saturated

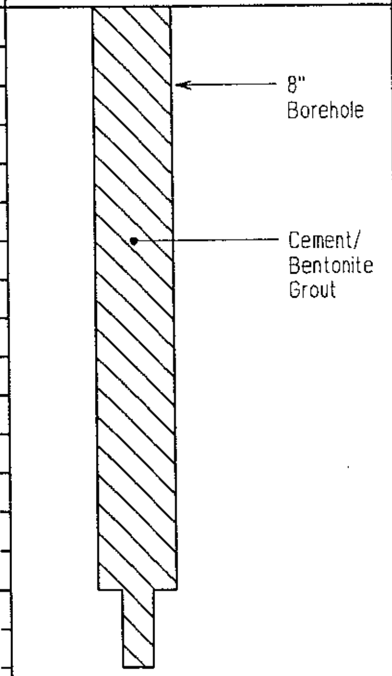
REMARKS

Borehole backfilled with cement/bentonite grout.

Hydropunch sample collected @ 21-24'

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: HP-11 *Page 2 of 2*
Project: *Groundwater Investigation* Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*	Project No.: *9596.03*	Start Date: *06/09/95* Finish Date: *06/12/95*

WELL CONSTRUCTION



SAMPLE DATA (soil / rock)

(CONTINUATION)

Depth (feet)	Samp. No.	Blows/ 6 in.	Rec. (ft.)	USCS	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
	Run No.	Hydraul. Cond. cm/sec	Rec. (ft.)	RQD			
30	S-6	4-3-2-1	NR	NA	NA		
35	S-7	3-2-1-1	1.7'	CH	0		
40							Hydropunch sample collected @ 41-43.5'
45	S-8	3-3-3-2	2.0'	CH	0		
						End of Boring at 47.0 feet.	
50							
55							
60							
65							
70							

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-12

Page 1 of 2

Project: *Groundwater Investigation*

Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*

Project No.: *9596.03*

Start Date: *06/12/95*

Finish Date: *06/28/95*

DRILLING DATA

Inspector: *Laurie Scheuing*

Contractor: *B. Bosworth/Empire Soils Investigation Inc.*

Equipment: *CME 850*

Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*

Duration: *NA*

Gals. Purged: *NA*

Slug Test: *NA* (cm/sec)

SURVEY DATA

DATUM: NGVD/NYS Plane

Grade: *158.9*

TWC: *NA*

TPC: *NA*

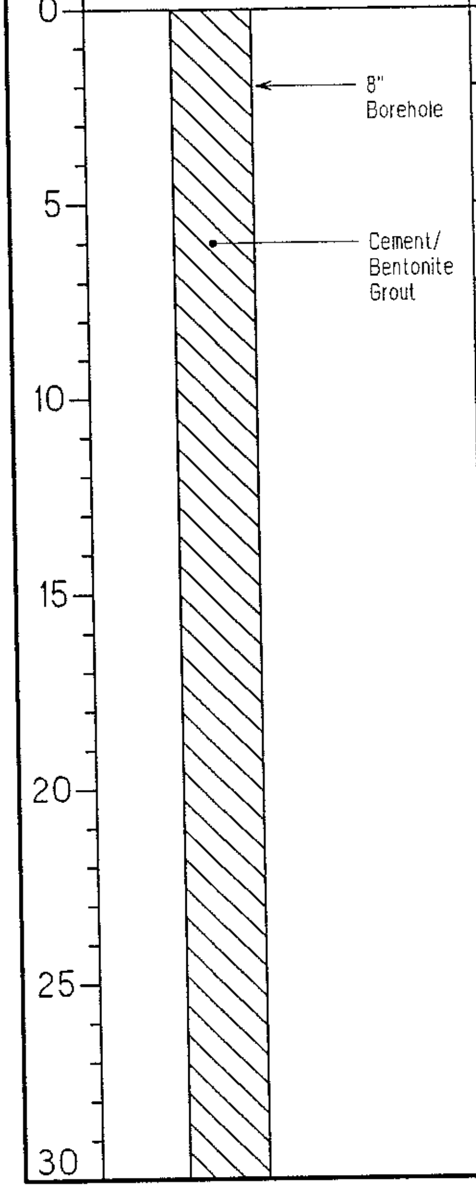
North: *685,152.73*

East: *594,414.82*

Geophysical Log: ☐ yes ☒ no

Comments:

WELL CONSTRUCTION

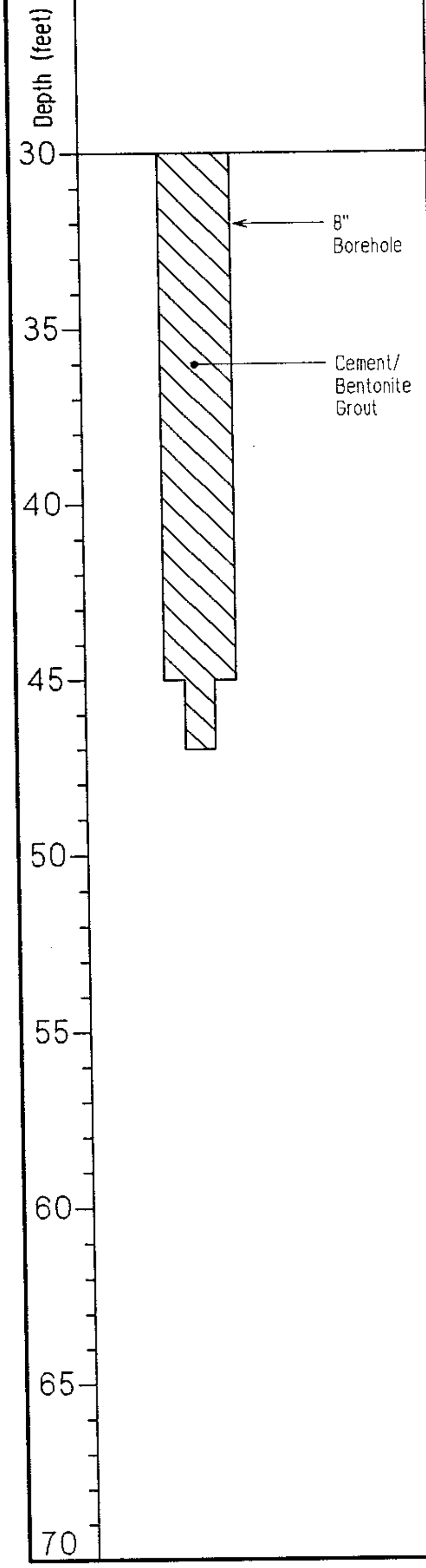


SAMPLE DATA

Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
S-1	2-4-4-5	1.7'	CH	0	LACUSTRINE DEPOSITS Brown Silty CLAY, trace f Sand, with roots & reeds, moist	Borehole backfilled with cement/bentonite grout.
S-2	3-6-7-8	1.9'	CH	0.8	@ 5.0' brown Silty CLAY, little f Sand, damp	
S-3	2-3-2-2	2.0'	CH	120	@ 11.2' grading to gray Silty CLAY, trace f Sand, moist to saturated	
S-4	1-1/12"-1	2.0'	CH	0.2	@ 15.0' gray CLAY, trace (-) f Sand	
						Hydropunch sample collected @ 23-24'
S-5	2-1-1-2	2.0'	CH	0		

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: HP-12 Page 2 of 2
Project: *Groundwater Investigation*	Project No.: *9596.03*	Start Date: *06/12/95*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*		Finish Date: *06/28/95*

WELL CONSTRUCTION



(CONTINUATION)

soil / rock SAMPLE DATA Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
S-6	WOR/6"-WOH/18"	0.8'	CH	0		
S-7	3-1-1-3	1.9'	CH	0	@ 36.0' gray CLAY, little to some f Sand	
						Hydropunch sample collected @ 42-43'
S-8	WOR/12"-1-2	2.0'	CH	0		
					End of Boring at 47.0 feet.	

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-13

Page 1 of 2

Project: Groundwater Investigation

Client: Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.

Project No.: 9596.03

Start Date: 06/14/95

Finish Date: 06/16/95

DRILLING DATA

Inspector: Laurie Scheuing

Contractor: B. Bosworth/Empire Soils Investigation Inc.

Equipment: CME 850

Method: 4 1/4" ID Hollow Stem Augers

SAMPLING METHODS

	Sampler	Tube	Core
Type:	Split Spoon	NA	NA
Diameter:	2 inch	NA	NA
Other:	140 lb./30 in.	NA	NA

WELL CONSTRUCTION

	Riser	Screen
Material:	NA	NA
Diameter (ID):	NA	NA
Coupling:	NA	NA

WELL DEVELOPMENT

Method: NA

Duration: NA

Gals. Purged: NA

Slug Test: NA (cm/sec)

SURVEY DATA DATUM: NGVD/NYS Plane

Grade: 163.0

TWC: NA

TPC: NA

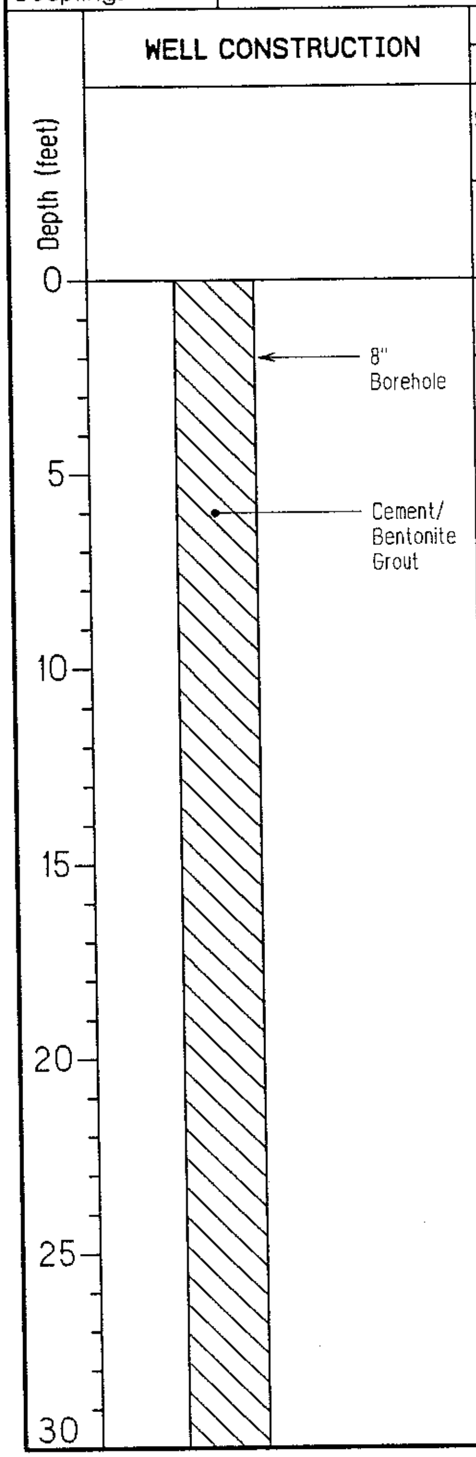
North: 685,252.57

East: 594,332.84

Geophysical Log: ☐ yes ☒ no

Comments:

WELL CONSTRUCTION



SAMPLE DATA

Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)
0–2	S-1	2-5-5-13	0.5'	CH	1.5
5–7	S-2	7-5-7-10	1.3'	CH	270
10–12	S-3	7-8-8-13	0.3'	CH	220
15–17	S-4	3-2-2-4	2.0'	CH	220
20–22	S-5	2-2-1-2	2.0'	CH	2
25–27	S-6	2-1-2-3	0.7'	CH	0.3

VISUAL CLASSIFICATION

FILL

Brown Silty CLAY, some mf Sand, with black cinders, saturated

LACUSTRINE DEPOSITS

Brown Silty CLAY, trace f Sand, moist

@ 15.4' grading to gray Silty CLAY, trace f Sand, wet to saturated

@ 20.0' gray CLAY, trace (–) f Sand

REMARKS

Borehole backfilled with cement/bentonite grout.

Hydropunch sample collected @ 22-22.5'

ECKENFELDER INC.

Subsurface Boring Log

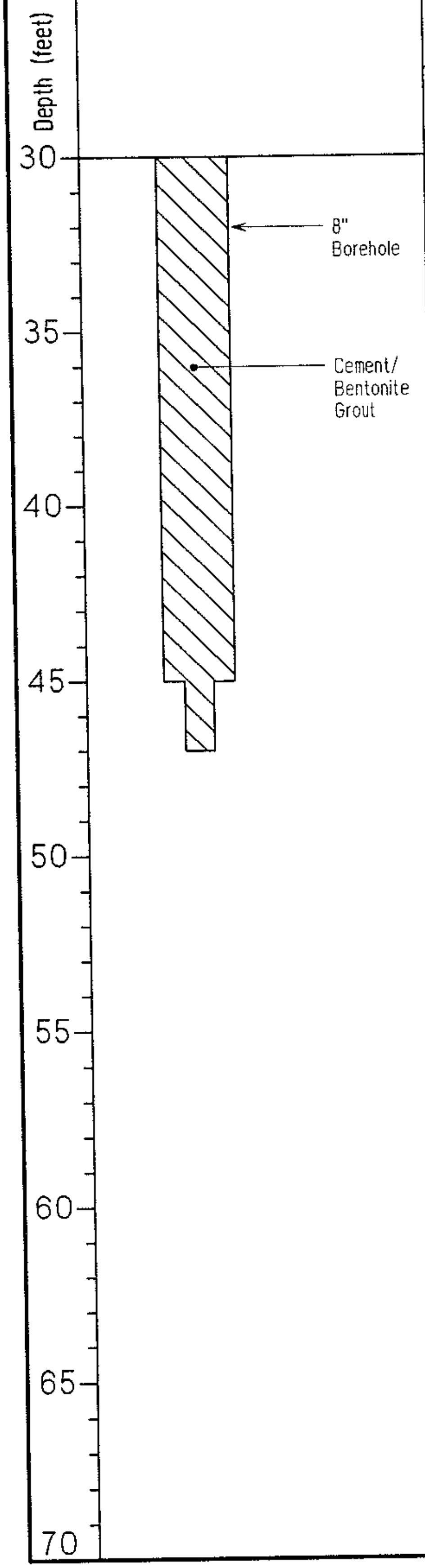
Well Name/Location:
HP-13

Page 2 of 2

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/14/95*
Finish Date: *06/16/95*

(CONTINUATION)

WELL CONSTRUCTION



SAMPLE DATA (soil / rock)

Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.) / Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30	S-7	3-3-1-2	1.6'	CH	0.2		
35	S-8	WOH/18"-1	2.0'	CH	0		
43							Hydropunch sample collected @ 43-44'
45	S-9	1/12"-1/12"	NR	NA	NA		
47						End of Boring at 47.0 feet.	

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: HP-14 Page 1 of 2

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/01/95*
Finish Date: *06/06/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850/CME 55*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

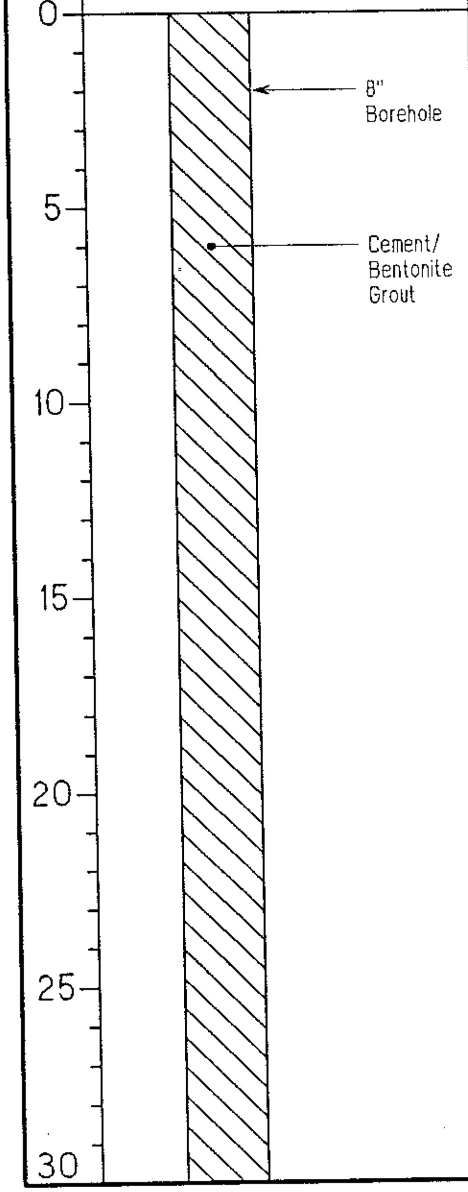
Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NGVD/NYS Plane

Grade: *163.4*
TWC: *NA*
TPC: *NA*
North: *685,571.49*
East: *594,367.79*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA

Samp. No.	Blows/ 6 in.	Rec. (ft.)	USCS	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
Run No.	Hydraul. Cond. cm/sec	Rec. (ft.)	RQD			
S-1	2-2-3-6	1.3'	CH	0	LACUSTRINE DEPOSITS Brown CLAY & SILT, trace f Sand, with root hairs, moist to wet	Borehole backfilled with cement/bentonite grout.
S-2	2-3-6-7	2.0'	CH	0.1		
S-3	3-4-5-8	2.0'	CH	1.1		
S-4	2-2-2-3	2.0'	CH	0	@ 15.5' grading to gray Silty CLAY, trace to no f Sand, moist to saturated	
S-5	WOH-1-1-2	1.6'	CH	0		
S-6	WOH/18"-2	0.2'	CH	0		Hydropunch sample collected @ 25'

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: HP-14

Page 2 of 2

Project: *Groundwater Investigation*

Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*

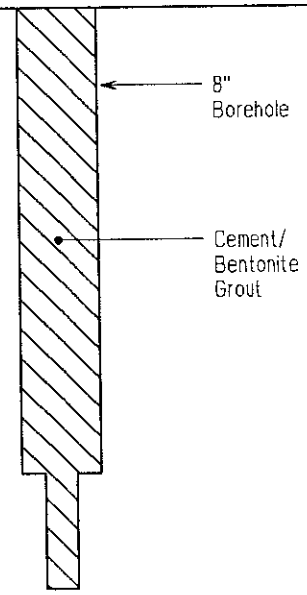
Project No.: *9596.03*

Start Date: *06/01/95*

Finish Date: *06/06/95*

(CONTINUATION)

WELL CONSTRUCTION



Depth (feet)	Samp. No. Run No.	Blows/ 6 in. Hydraul. Cond. cm/sec	Rec. (ft.) Rec. (ft.)	USCS RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30	S-7	WOH/18"-3	2.0'	CH	0		
35	S-8	WOR/24"	2.0'	CH	0		
40	S-9	WOR/24"	2.0'	CH	0		
							Hydropunch sample collected @ 42-45'
45						End of Boring at 45.0 feet.	
50							
55							
60							
65							
70							

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: HP-15 Page 1 of 2

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/28/95*
Finish Date: *06/29/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

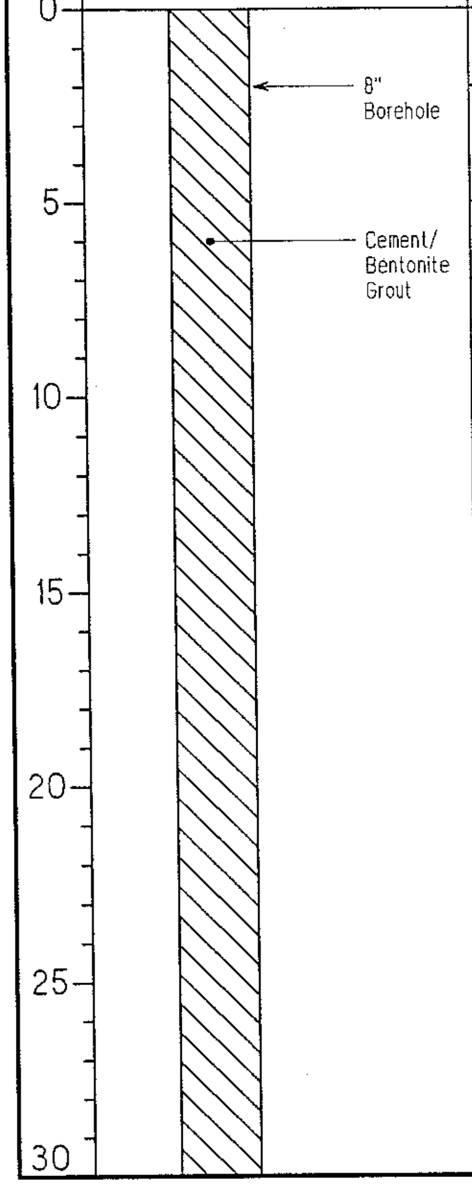
Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA*
(cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: *163.2*
TWC: *NA*
TPC: *NA*
North: *685,582.15*
East: *594,431.75*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



SAMPLE DATA (soil / rock)

Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)
S-1	15-21-12-14	1.5'	GW CH	0
S-2	7-6-7-9	1.4'	CH	0
S-3	6-5-7-8	1.5'	CH	0.4
S-4	4-3-2-3	1.5'	CH	NM
S-5	2-1-2-3	1.7'	CH	NM

VISUAL CLASSIFICATION

0.4

FILL

Gray GRAVEL and black cinders, dry

LACUSTRINE DEPOSITS

Brown Silty CLAY, trace f Sand, dry to wet

@ 10.0' brown Silty CLAY, little f Sand wet

@ 15.5' grading to gray CLAY, trace f Sand, wet to saturated

REMARKS

Borehole backfilled with cement/bentonite grout.

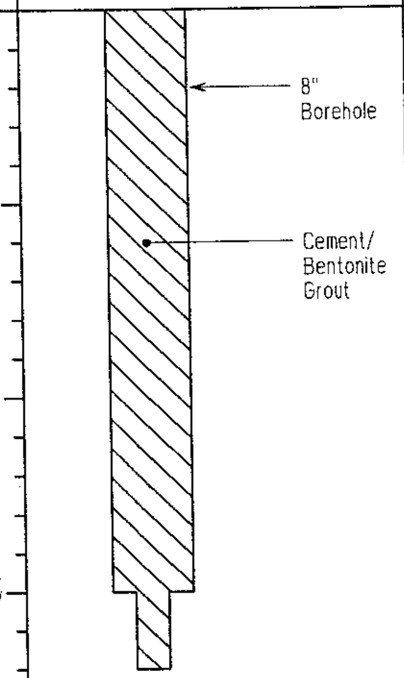
Hydropunch sample collected @ 28-29'

ECKENFELDER INC. | Subsurface Boring Log | Well Name/Location: **HP-15** | *Page 2 of 2*

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/28/95*
Finish Date: *06/29/95*

(CONTINUATION)

WELL CONSTRUCTION



SAMPLE DATA

Depth (feet)	soil: Samp. No. / rock: Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
30	S-6	2-2-1-1	1.5'	CH	0		
35	S-7	WOH/12"-1-2	NR	NA	NA		
40							
							Hydropunch sample collected @ 43-44'
45	S-8	WOH-2-1-4	1.6'	CH	0	@ 45.0' gray Silty CLAY and fmc SAND, trace f Gravel	
						End of Boring at 47.0 feet.	
50							
55							
60							
65							
70							

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: HP-16 *Page 1 of 2*

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/27/95*
Finish Date: *06/28/95*

DRILLING DATA

Inspector: *Laurie Scheuing*
Contractor: *B. Bosworth/Empire Soils Investigation Inc.*
Equipment: *CME 850*
Method: *4 1/4" ID Hollow Stem Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2 inch*	*NA*	*NA*
Other:	*140 lb./30 in.*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

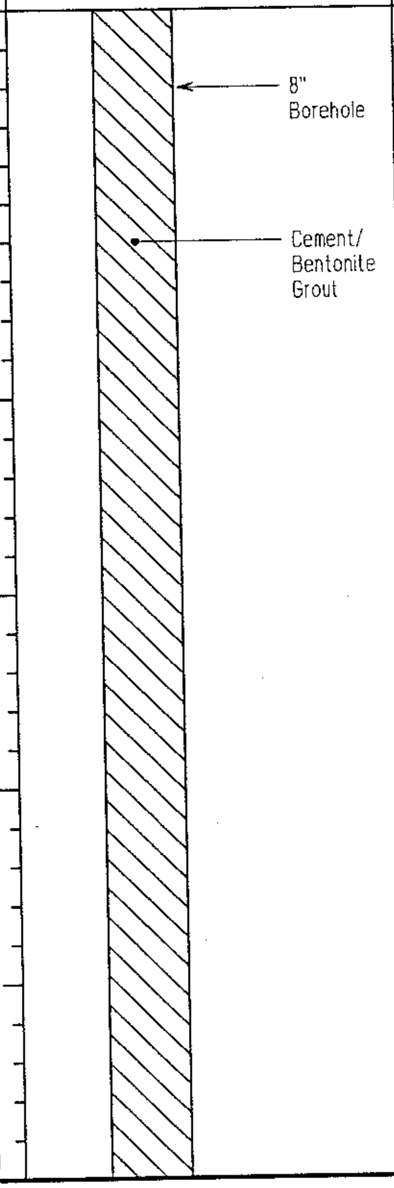
Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA
DATUM: NGVD/NYS Plane

Grade: *163.0*
TWC: *NA*
TPC: *NA*
North: *685,205.71*
East: *594,314.34*

Geophysical Log: ☐ yes ☒ no
Comments:

WELL CONSTRUCTION



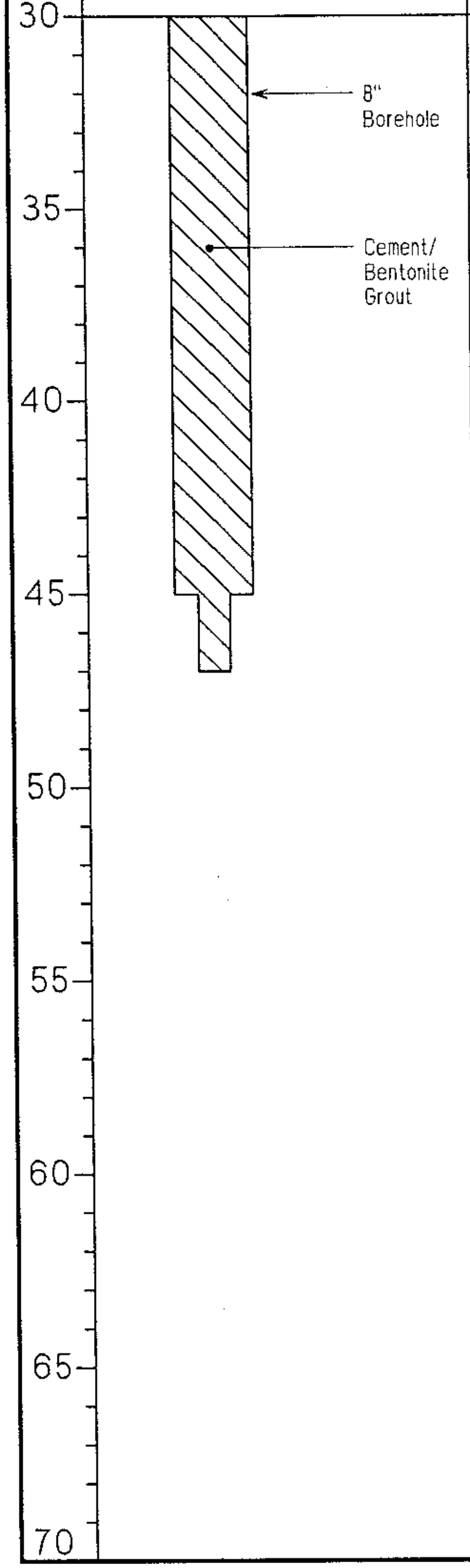
Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)	VISUAL CLASSIFICATION	REMARKS
0	S-1	4-3-2-2	0.2'	SP	0	LACUSTRINE DEPOSITS Brown & black cmf SAND, some fm Gravel, little Clay & Silt, with roots, dry	Borehole backfilled with cement/bentonite grout.
5	S-2	3-7-10-13	1.2'	CH	0	@ 5.0' brown Silty CLAY, trace f Sand, moist	
10	S-3	4-5-5-9	1.3'	CH	0		
15	S-4	4-3-2-2	1.5'	CH	0	@ 15.4' grading to gray CLAY, trace f Sand, saturated	
20							Hydropunch sample collected @ 23-24'
25	S-5	2-1-1-1	2.0'	CH	0		
30							

ECKENFELDER INC.	Subsurface Boring Log	Well Name/Location: HP-16 *Page 2 of 2*

Project: *Groundwater Investigation*
Client: *Hercules Inc./DYNO Nobel Inc. Port Ewen, N.Y.*
Project No.: *9596.03*
Start Date: *06/27/95*
Finish Date: *06/28/95*

(CONTINUATION)

WELL CONSTRUCTION

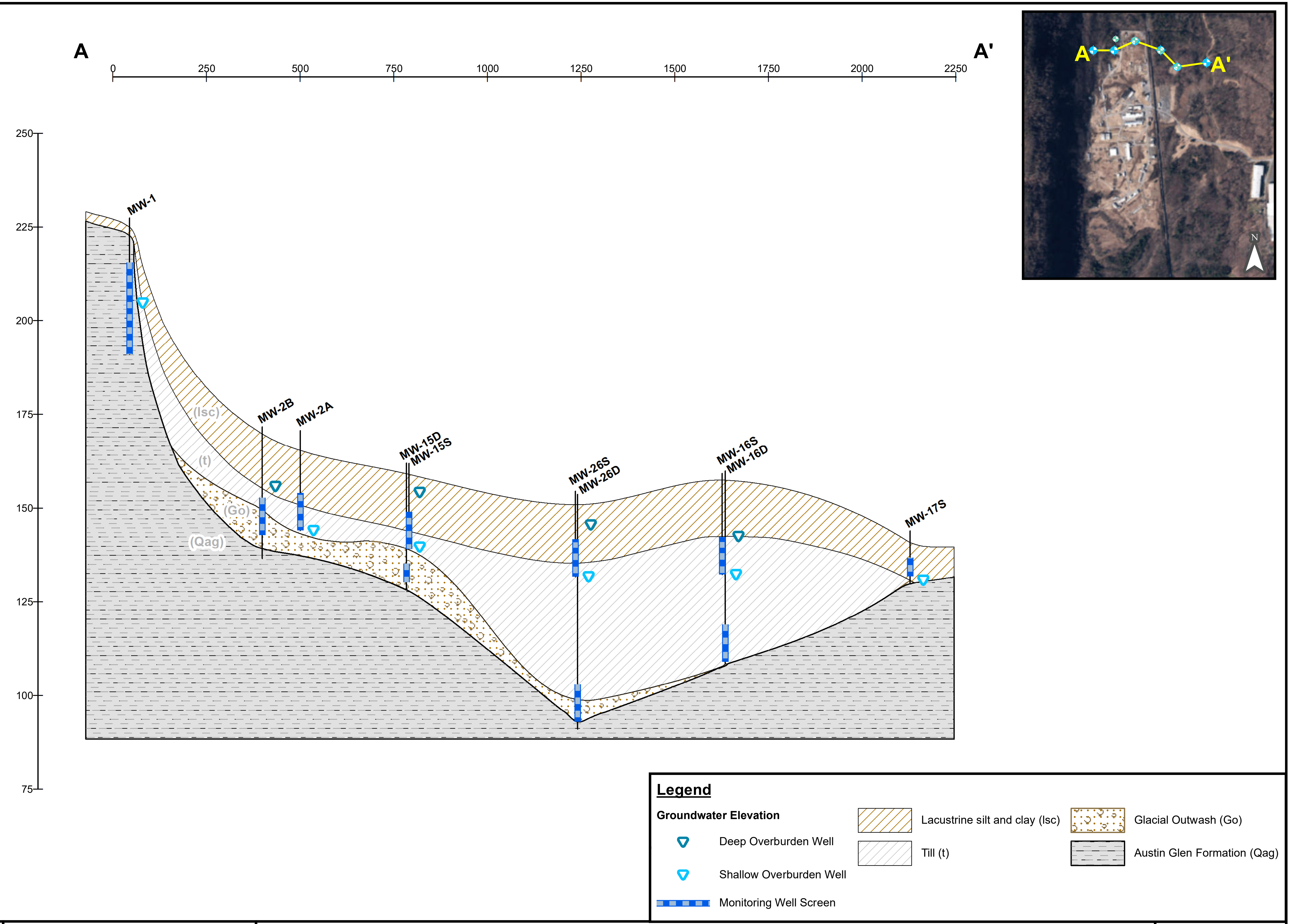


SAMPLE DATA (soil / rock)

Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	PID (ppm)
S-6	2/12"- 1-1	0.8'	CH	0
S-7	WOR/12"- WOH-2	2.0'	CH	0
S-8	WOH/24"	2.0'	CH	0

VISUAL CLASSIFICATION	REMARKS
	Hydropunch sample collected @ 43-44'
@ 45.0' gray CLAY, little f SAND	
End of Boring at 47.0 feet.	

Attachment B Cross Sections



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Reviewed By: K. VanLandingham

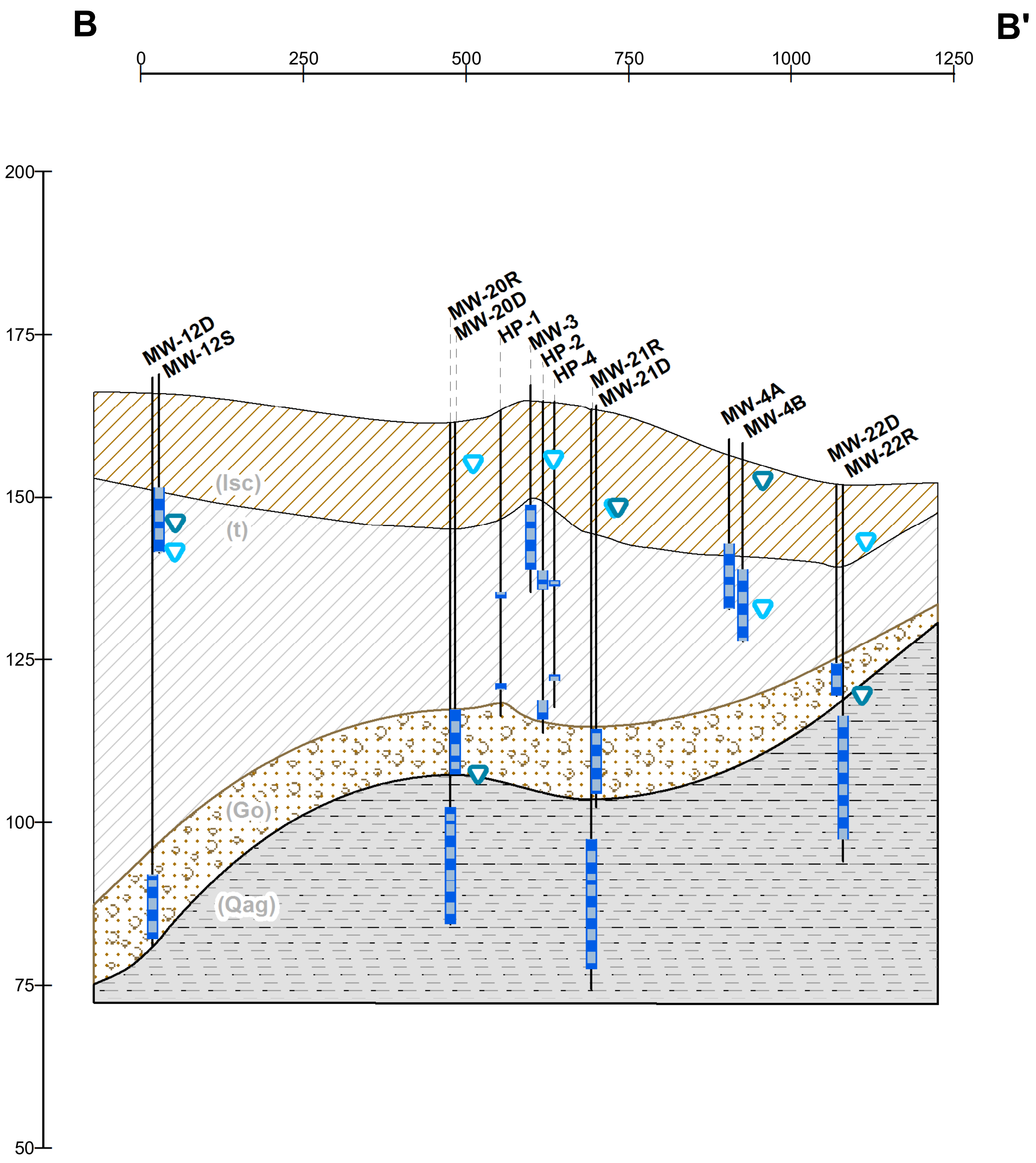
EHS Support

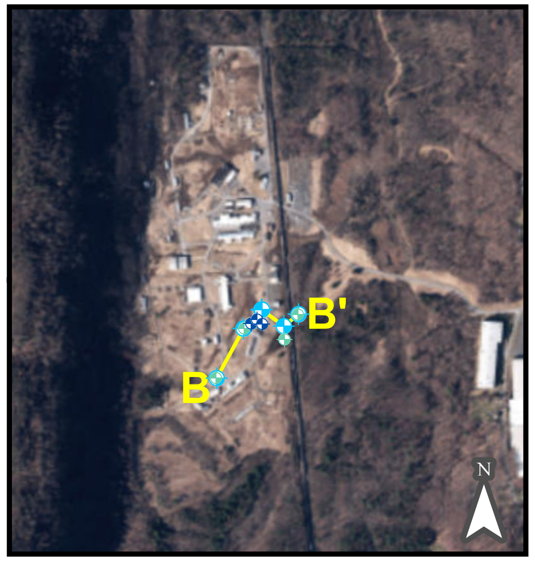
HERCULES INC. SITE,
ULSTER COUNTY, NEW YORK

Cross Section A - A'

HORIZONTAL SCALE: 1 in = 250 ft
VERTICAL SCALE: 1 in = 25 ft

FIGURE 1





Legend

Groundwater Elevation

- ▽ Deep Overburden Well
- ▽ Shallow Overburden Well
- ▬ Monitoring Well Screen

- ▨ Lacustrine silt and clay (lsc)
- ▨ Till (t)
- ▨ Glacial Outwash (Go)
- ▨ Austin Glen Formation (Qag)

EHS Support

HERCULES INC. SITE,
ULSTER COUNTY, NEW YORK

Cross Section B - B'

HORIZONTAL SCALE: 1 in = 250 ft
VERTICAL SCALE: 1 in = 25 ft

FIGURE 2

Reviewed By: K. VanLandingham

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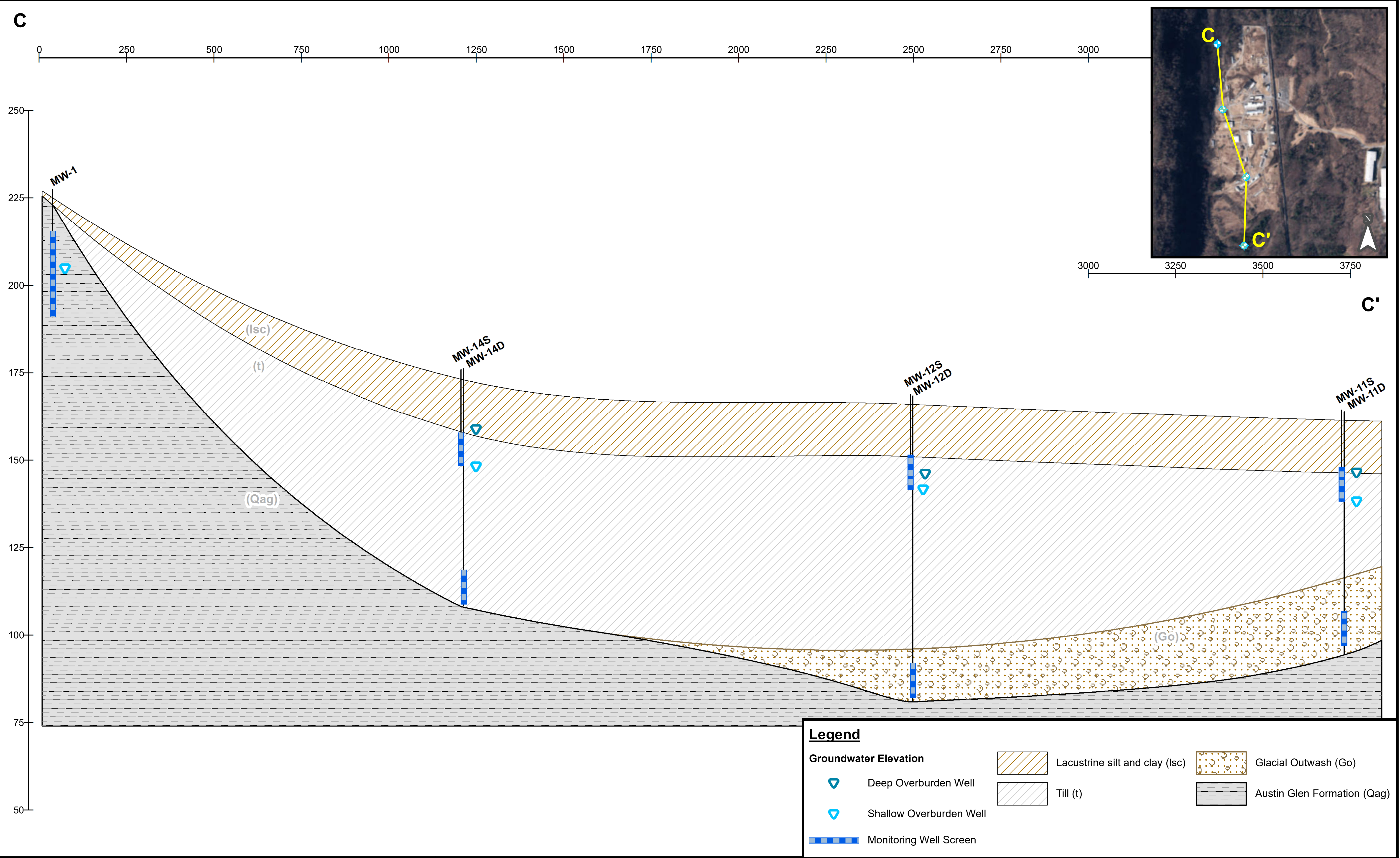

Legend

Groundwater Elevation

▽ Deep Overburden Well

▽ Shallow Overburden Well

▬ Monitoring Well Screen

▨ Lacustrine silt and clay (lsc)

▨ Till (t)

▨ Glacial Outwash (Go)

▨ Austin Glen Formation (Qag)

EHS Support

HERCULES INC. SITE,
ULSTER COUNTY, NEW YORK

Cross Section C - C'

HORIZONTAL SCALE: **1 in = 250 ft**
VERTICAL SCALE: **1 in = 25 ft**

FIGURE 3

Reviewed By: K. VanLandingham

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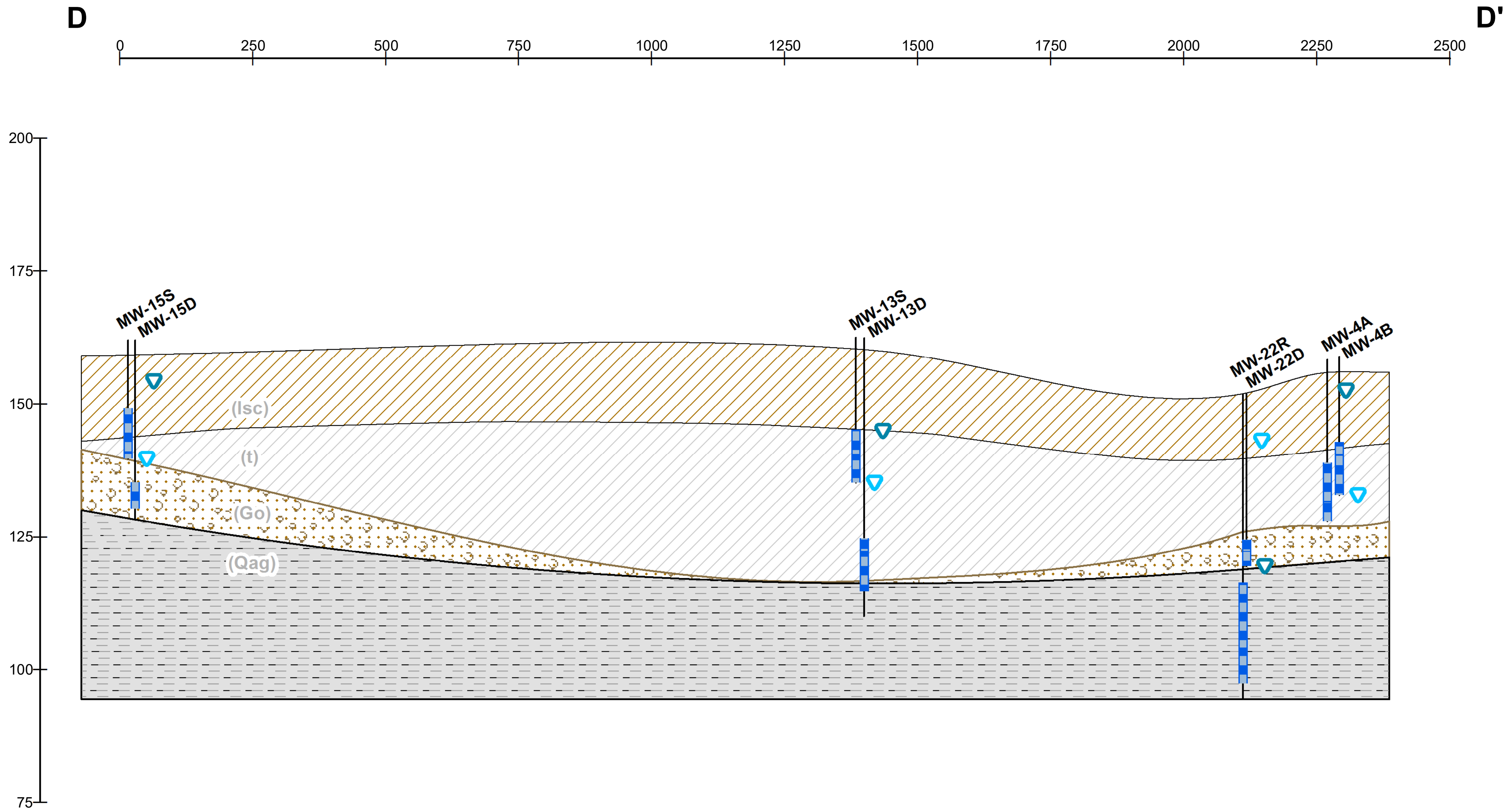

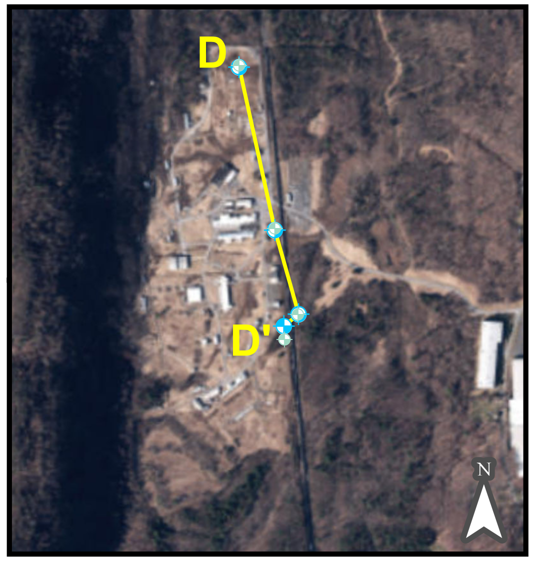

Legend

Groundwater Elevation

▽	Deep Overburden Well
▽	Shallow Overburden Well
▬	Monitoring Well Screen
▨	Lacustrine silt and clay (lsc)
▨	Till (t)
░	Glacial Outwash (Go)
▤	Austin Glen Formation (Qag)

EHS Support

HERCULES INC. SITE,
ULSTER COUNTY, NEW YORK

Cross Section D - D'

HORIZONTAL SCALE: 1 in = 250 ft
VERTICAL SCALE: 1 in = 25 ft

FIGURE 4

Reviewed By: K. VanLandingham

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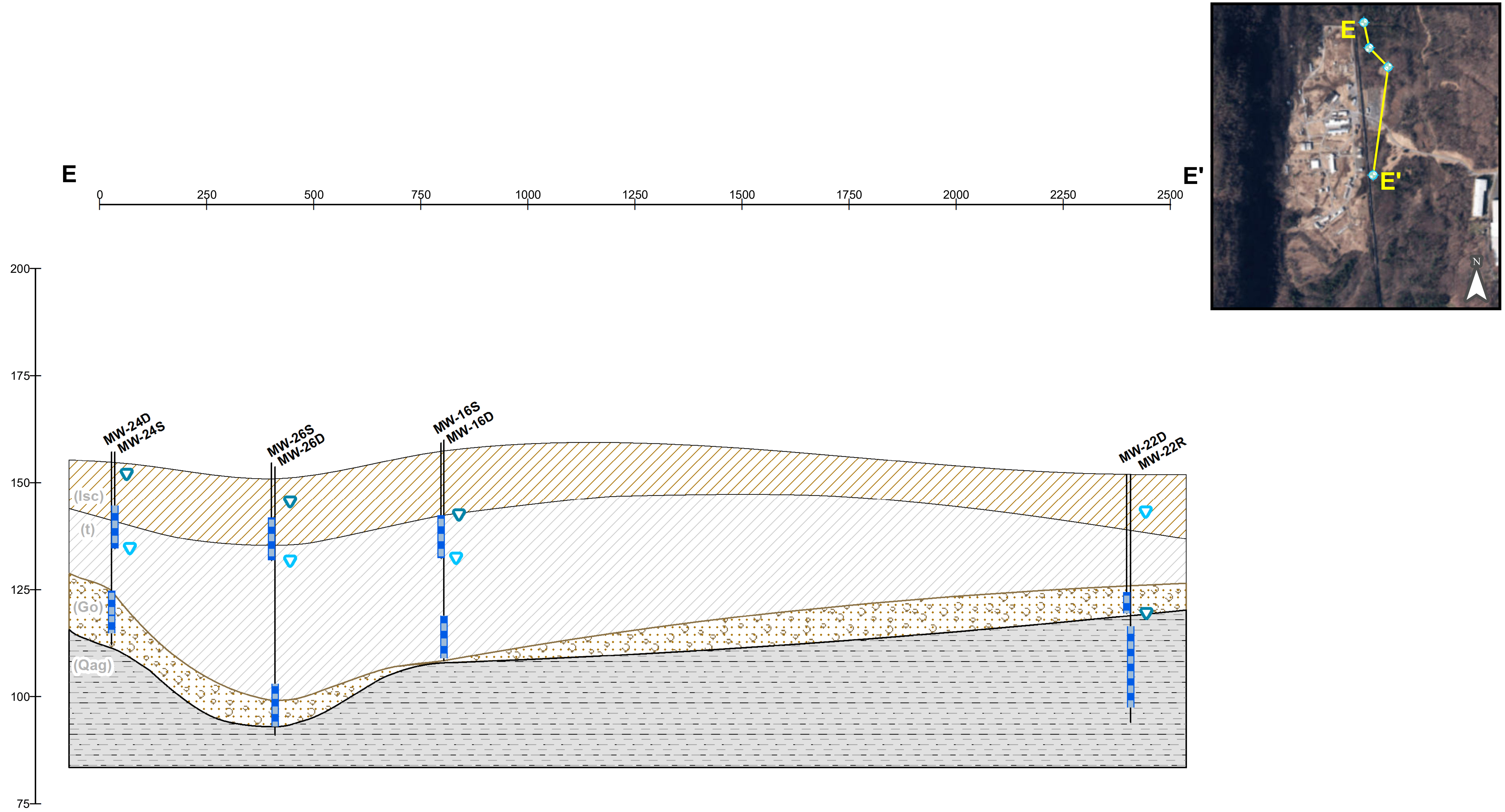

Legend

Groundwater Elevation

▽	Deep Overburden Well
▽	Shallow Overburden Well
▬	Monitoring Well Screen
▨	Lacustrine silt and clay (lsc)
▨	Till (t)
▨	Glacial Outwash (Go)
▨	Austin Glen Formation (Qag)

EHS Support

HERCULES INC. SITE,
ULSTER COUNTY, NEW YORK

Cross Section E - E'

HORIZONTAL SCALE: 1 in = 250 ft
VERTICAL SCALE: 1 in = 25 ft

FIGURE 5

Reviewed By: K. VanLandingham

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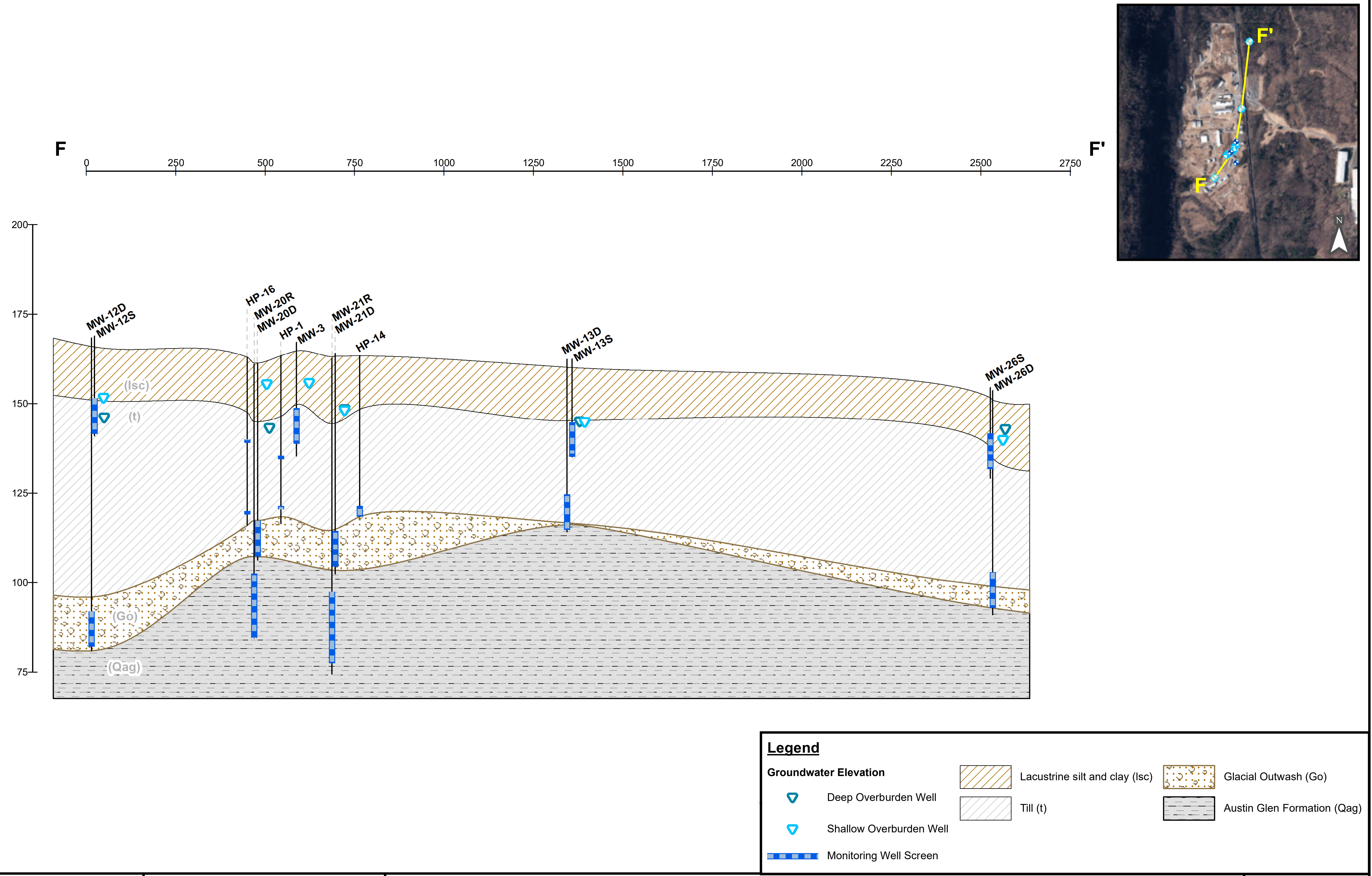

Reviewed By: K. VanLandingham

EHS Support

HERCULES INC. SITE,
ULSTER COUNTY, NEW YORK

Cross Section F - F'

HORIZONTAL SCALE: 1 in = 250 ft
VERTICAL SCALE: 1 in = 25 ft

FIGURE 6

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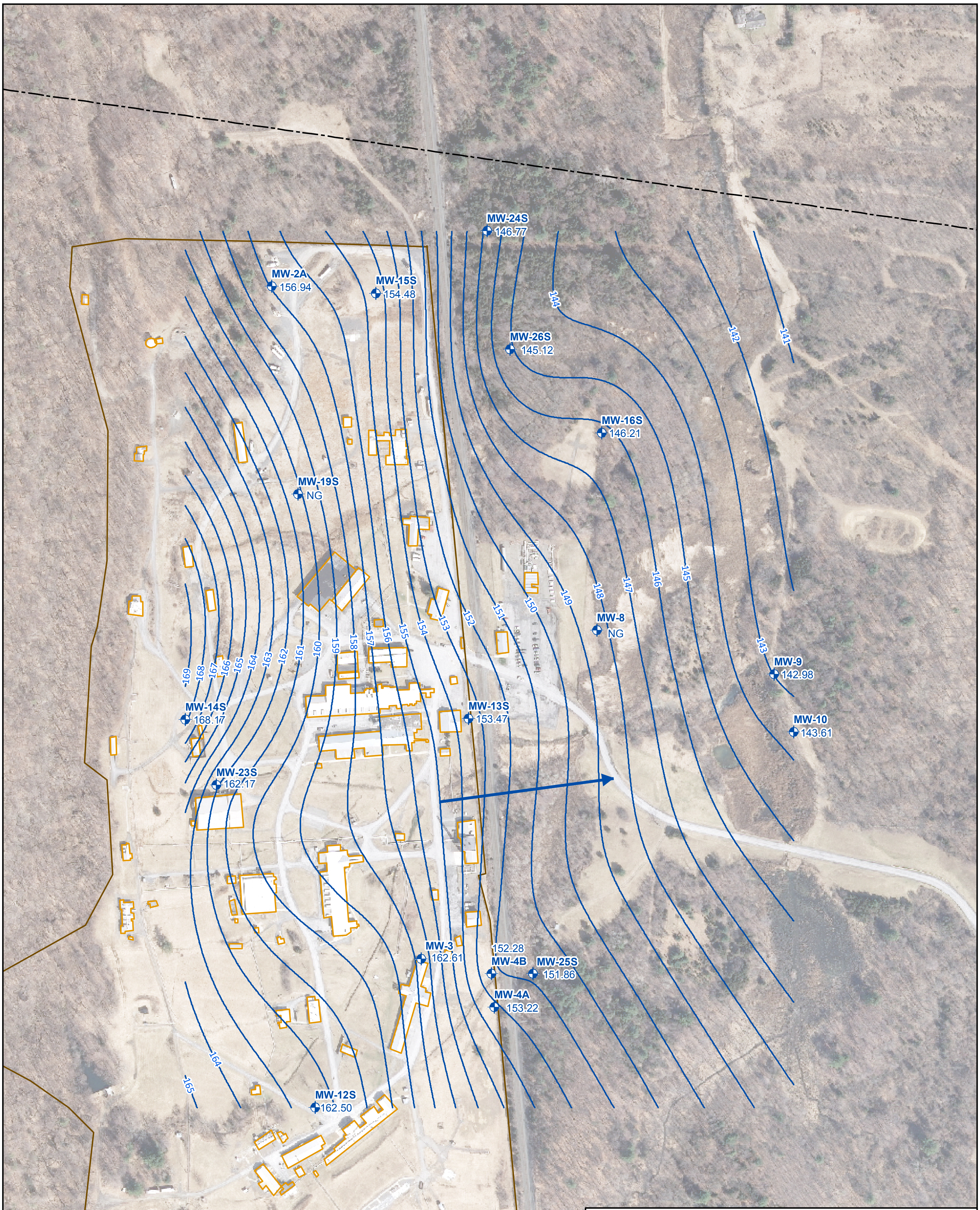
Attachment C 2020 Groundwater Elevation Contour Maps



Legend

- ⊕ Shallow Overburden Monitoring Well
- ➡ Groundwater Flow Direction
- — Groundwater Elevation Contours (ft amsl) Dashed where Inferred
- — Fence
- ▭ Buildings
- ⌐-·¬ Approximate Property Boundary

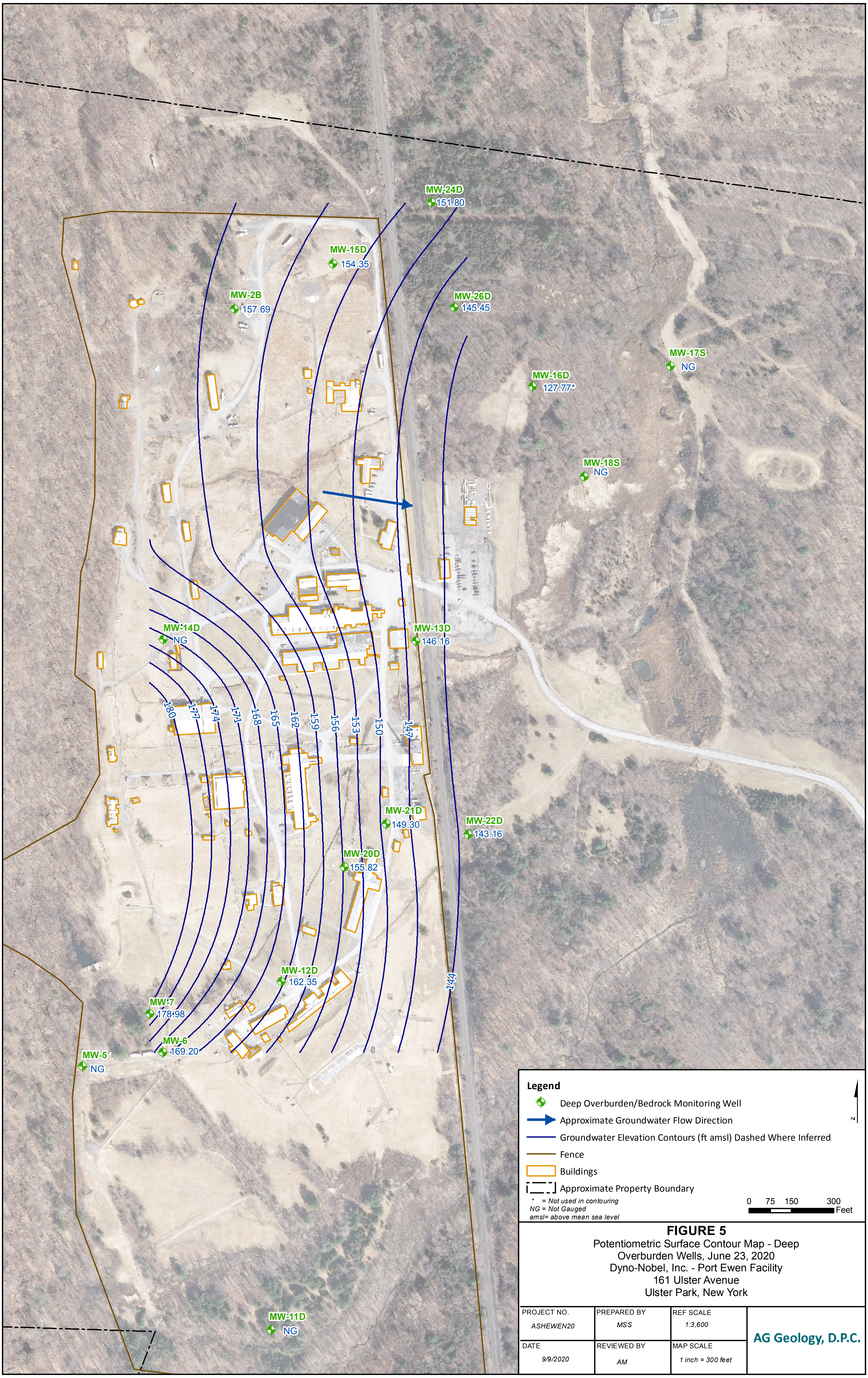
NG = Not Gauged
amsl= above mean sea level

0 75 150 300
Feet

FIGURE 4

Potentiometric Surface Contour Map - Shallow
Overburden Wells, June 23, 2020
Dyno-Nobel, Inc. - Port Ewen Facility
161 Ulster Avenue
Ulster Park, New York

PROJECT NO.	PREPARED BY	REF SCALE	
ASHEWEN20	MSS	1:3,600	AG Geology, D.P.C.
DATE	REVIEWED BY	MAP SCALE	
9/9/2020	AM	1 inch = 300 feet	



Legend

- Deep Overburden/Bedrock Monitoring Well
- Approximate Groundwater Flow Direction
- Groundwater Elevation Contours (ft amsl) Dashed Where Inferred
- Fence
- Buildings
- Approximate Property Boundary

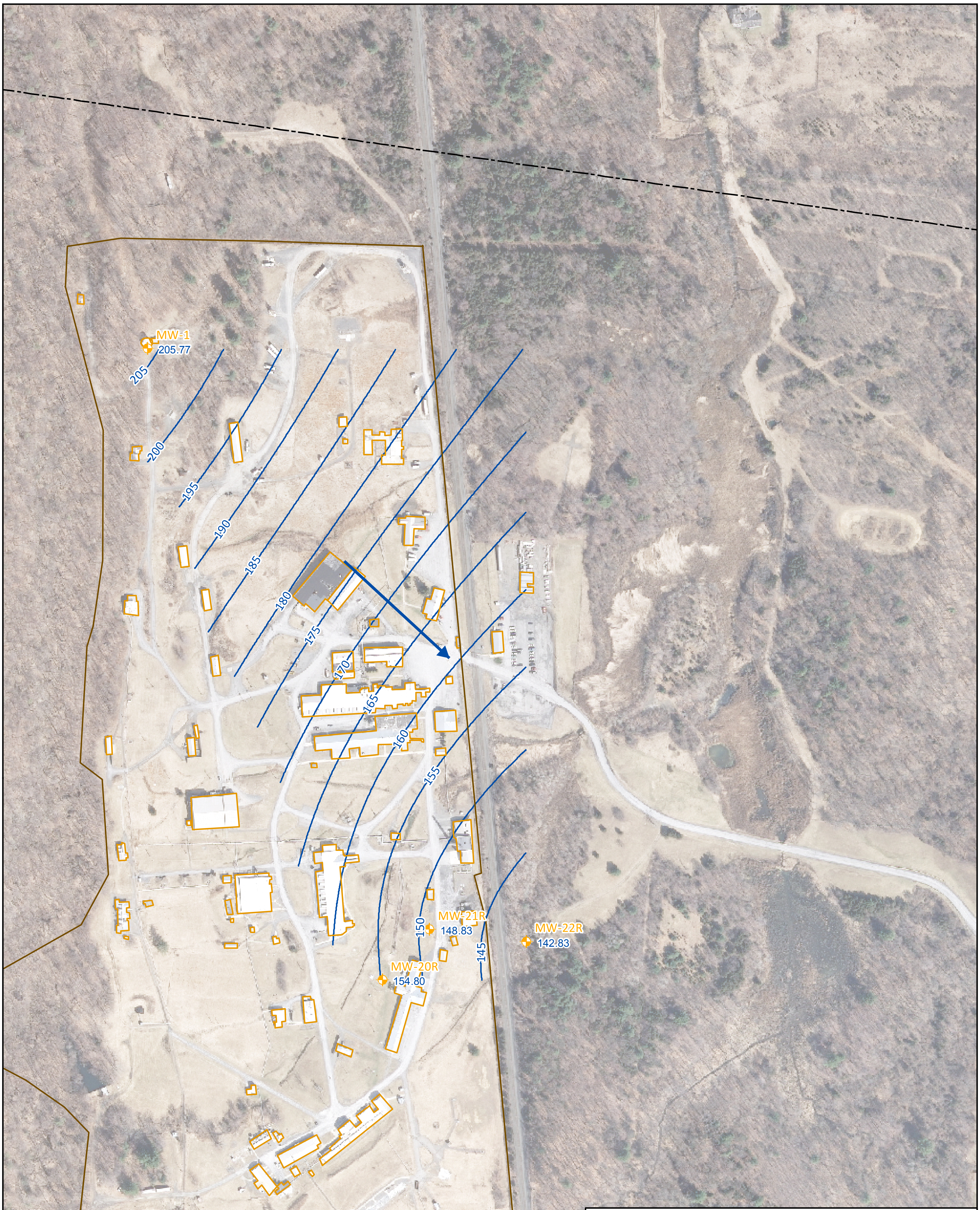
* = Not used in contouring
NG = Not Gauged
amsl= above mean sea level

0 75 150 300
Feet

FIGURE 5

Potentiometric Surface Contour Map - Deep
Overburden Wells, June 23, 2020
Dyno-Nobel, Inc. - Port Ewen Facility
161 Ulster Avenue
Ulster Park, New York

PROJECT NO. ASHEWEN20	PREPARED BY MSS	REF SCALE 1:3,600	AG Geology, D.P.C.
DATE 9/9/2020	REVIEWED BY AM	MAP SCALE 1 inch = 300 feet	



Legend

Bedrock Monitoring Well

Groundwater Elevation Contours (ft amsl) Dashed Where Inferred

Approximate Groundwater Flow Direction

Fence

Buildings

Approximate Property Boundary

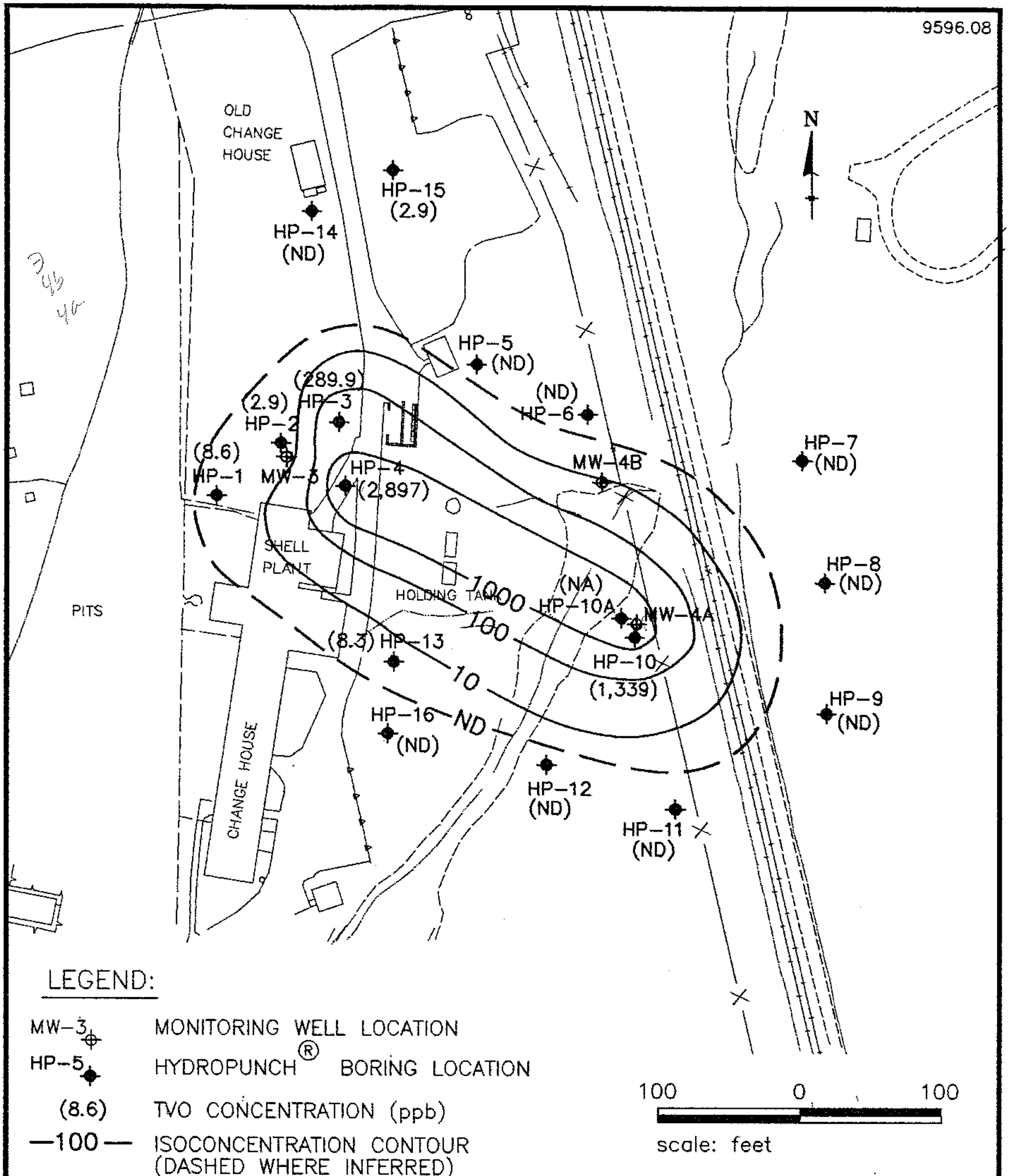
amsl- above mean sea level

FIGURE 6

Potentiometric Surface Contour Map - Bedrock Wells
Overburden Wells, June 23, 2020
Dyno-Nobel, Inc. - Port Ewen Facility
161 Ulster Avenue
Ulster Park, New York

PROJECT NO. *ASHEWEN20*	PREPARED BY *MSS*	REF SCALE *1:3,600*	**AG Geology, D.P.C.**
DATE *9/9/2020*	REVIEWED BY *AM*	MAP SCALE *1 inch = 300 feet*	

Attachment D Historic Groundwater Analytical Data



3
45
46

LEGEND:

MW-3 ⌖ MONITORING WELL LOCATION

HP-5 ◆ HYDROPUNCH® BORING LOCATION

(8.6) TVO CONCENTRATION (ppb)

—100— ISOCONCENTRATION CONTOUR (DASHED WHERE INFERRED) CONTOUR INTERVAL= LOGARITHMIC

--ND-- APPROXIMATE EXTENT OF TVO CONTAMINATION ASSOCIATED WITH SHELL PLANT

(NA) SAMPLE NOT ANALYZED

(ND) NOT DETECTED

FIGURE 3-2

ISOCONCENTRATION MAP OF TOTAL VOLATILE ORGANICS (TVO) IN GROUNDWATER-SHALLOW OVERBURDEN

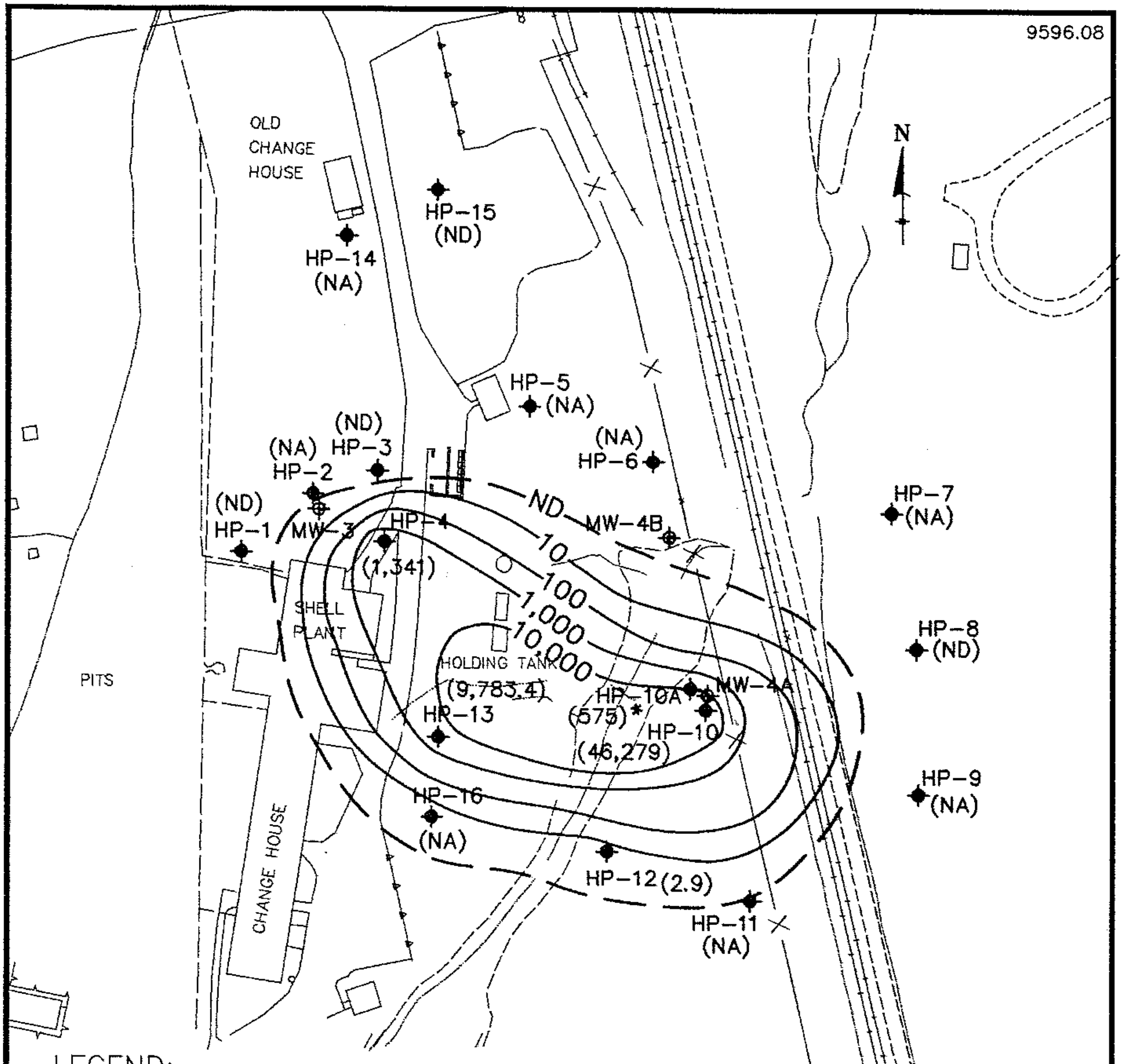
HERCULES/DYNO-NOBEL INC.
DYNO-NOBEL INC. SITE
PORT EWEN, NEW YORK

ECKENFELDER INC.

Nashville,Tennessee
Mahwah,New Jersey

9596-06 01/30/96 PLOT 1=100

9596.08



LEGEND:

MW-3 ⊕ MONITORING WELL LOCATION

HP-5 ● HYDROPUNCH® BORING LOCATION

(2.9) TVO CONCENTRATION (ppb)

—100— ISOCONCENTRATION CONTOUR (DASHED WHERE INFERRED) CONTOUR INTERVAL= LOGARITHMIC

--ND-- APPROXIMATE EXTENT OF TVO CONTAMINATION ASSOCIATED WITH SHELL PLANT

(NA) SAMPLE NOT ANALYZED

(ND) NOT DETECTED

* VALUE FOR HP-10A NOT CONTOURED. REFER TO SECTION 3.3 IN TEXT.

100 0 100

scale: feet

FIGURE 3-3

ISOCONCENTRATION MAP OF TOTAL VOLATILE ORGANICS (TVO) IN GROUNDWATER – DEEP OVERBURDEN

HERCULES/DYNO-NOBEL INC.
DYNO-NOBEL INC. SITE
PORT EWEN, NEW YORK

ECKENFELDER INC.

Nashville, Tennessee
Mahwah, New Jersey

9596-08 01/30/96 PLOT 1=100

TABLE 3-4

SUMMARY OF DETECTED CONCENTRATIONS
HYDROPUNCH® SAMPLES

Compound	Units	HP- 1 (28-29')	HP- 2 (26-29')	HP- 3 (23-24')	HP- 4 (27.5-28.5')	HP- 4 (42-43')	HP-10 (21-24')	HP-10 (37-37.5')	HP-10A (32-34')	HP-12 (42-43')
Acetone	µg/L	7.6 J	--	30 J	--	--	--	--	--	--
Chloroethane	µg/L	-- (a)	--	--	--	--	--	--	--	--
1,1-Dichloroethane	µg/L	--	--	--	39 JD	--	--	--	--	--
1,1-Dichloroethene	µg/L	--	--	--	170 D	31 JD	--	--	--	--
cis-1,2-Dichloroethene	µg/L	--	--	100	560 D	270 JD	39	240 JD	15	--
trans-1,2-Dichloroethene	µg/L	--	--	--	--	--	--	--	--	--
4-Methyl-2-Pentanone	µg/L	--	--	--	--	--	--	--	--	2.9 J
Methylene Chloride	µg/L	1 J	2.9 JB	--	14 JD	--	--	39 DB	--	--
Toluene	µg/L	--	--	--	--	--	--	--	--	--
1,1,1-Trichloroethane	µg/L	--	--	--	490 D	140 JD	--	--	--	--
1,1,2-Trichloroethane	µg/L	--	--	--	--	--	--	--	--	--
Trichloroethene	µg/L	--	--	150	1,600 D	900 D	1,300 D	46,000 D	560 D	--
Vinyl Chloride	µg/L	--	--	9.9 J	24 JD	--	--	--	--	--

J - an estimated value; B - present in the method blank; E - exceeds intrument calibration limit; D - diluted sample.

TABLE 3-4 (Continued)

SUMMARY OF DETECTED CONCENTRATIONS
HYDROPUNCH® SAMPLES

Compound	Units	HP-13 (22-22.5')	HP-13 (43-44')	HP-15 (28-29')	DUP060895 (HP-10, 21-24')	TB061295	TB062195	TB062995
Acetone	µg/L	--	--	--	--	--	--	--
Chloroethane	µg/L	--	200 E	--	--	--	--	--
1,1-Dichloroethane	µg/L	--	850 D	--	--	--	--	--
1,1-Dichloroethene	µg/L	--	8.5 J	--	--	--	--	--
cis-1,2-Dichloroethene	µg/L	--	800 D	--	12	--	--	--
trans-1,2-Dichloroethene	µg/L	--	5.9 J	--	--	--	--	--
4-Methyl-2-Pentanone	µg/L	--	--	2.9 J	--	--	--	2 J
Methylene Chloride	µg/L	--	--	--	--	0.7 J	1.1 J	--
Toluene	µg/L	--	2.1 J	--	--	--	--	--
1,1,1-Trichloroethane	µg/L	--	930 D	--	--	--	--	--
1,1,2-Trichloroethane	µg/L	--	2.9 J	--	--	--	--	--
Trichloroethene	µg/L	8.3 J	6,900 D	--	2,100 D	--	--	--
Vinyl Chloride	µg/L	--	84	--	--	--	--	--

(a) -- indicates compound
not detected

J - an estimated value; B - present in the method blank; E - exceeds intrument calibration limit; D - diluted sample.

HYDROPUNCH® SAMPLING RESULTS
(Group 1 of 4)

Sample Name	Depth (feet)	Date	Acetone (μg/L)	Benzene (μg/L)	Bromo-dichloro-methane (μg/L)	Bromoform (μg/L)	Bromo-methane (μg/L)	2-Butanone (μg/L)	Carbon Disulfide (μg/L)	Carbon Tetra-chloride (μg/L)	Chloro-benzene (μg/L)	Chloro-ethane (μg/L)
HP-1	28-29	6/23/95	7.6 J	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
HP-1	42-43	6/23/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
HP-2	26-29	6/8/95	5 U	1 U	1 U	1 U	1 U	10 U	1 U	1 U	1 U	2 U
HP-3	23-24	7/5/95	30 J	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
HP-3	43-44	7/7/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
HP-4	27.5-28.5	6/21/95	25 U	5 U	5 U	5 U	10 U	50 U	10 U	5 U	5 U	10 U
HP-4	42-43	6/21/95	125 U	25 U	25 U	25 U	50 U	250 U	50 U	25 U	25 U	50 U
HP-5	26-28	6/7/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
HP-6	23-24	6/19/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
HP-7	23-24	7/14/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
HP-8	23-24	7/13/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
HP-8	42-43	7/13/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
HP-9	22-23	7/13/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
HP-10	21-24	6/8/95	5 U	1 U	1 U	1 U	1 U	10 U	1 U	1 U	1 U	2 U
HP-10	37-37.5	6/8/95	250 U	50 U	50 U	50 U	50 U	500 U	50 U	50 U	50 U	100 U
HP-10A	32-34	6/30/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
HP-11	21-24	6/12/95	5 U	1 U	1 U	1 U	2 U	10 U	1 U	1 U	1 U	2 U
HP-12	23-24	6/28/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
HP-12	42-43	6/29/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
HP-13	22-22.5	6/16/95	5 U	1 U	1 U	1 U	2 U	10 U	1 U	1 U	1 U	2 U
HP-13	43-44	6/16/95	5 U	1 U	1 U	1 U	2 U	10 U	1 U	1 U	1 U	200 E
HP-14	25	6/6/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
HP-15	28-29	6/29/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
HP-15	43-44	6/29/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
HP-16	23-24	6/28/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
DUP060895	(HP-10, 21-24)	6/8/95	5 U	1 U	1 U	1 U	1 U	10 U	1 U	1 U	1 U	2 U

U - analyzed for, but not detected, number is reporting limit; J - an estimated value; B - present in the method blank;
E- exceeds instrument calibration limits; D - diluted sample.

HYDROPUNCH® SAMPLING RESULTS (Continued)
(Group 1 of 4)

Sample Name	Depth (feet)	Date	Acetone (µg/L)	Benzene (µg/L)	Bromo-dichloro-methane (µg/L)	Bromoform (µg/L)	Bromo-methane (µg/L)	2-Butanone (µg/L)	Carbon Disulfide (µg/L)	Carbon Tetra-chloride (µg/L)	Chloro-benzene (µg/L)	Chloro-ethane (µg/L)
DUP071395	(HP-8, 23-24')	7/13/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
EB062295		6/22/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
EB071795		7/17/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
TB060695		6/6/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
TB060795		6/7/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
TB060895		6/8/95	5 U	1 U	1 U	1 U	1 U	10 U	1 U	1 U	1 U	2 U
TB061295		6/12/95	5 U	1 U	1 U	1 U	2 U	10 U	1 U	1 U	1 U	2 U
TB061695		6/16/95	5 U	1 U	1 U	1 U	2 U	10 U	1 U	1 U	1 U	2 U
TB061995		6/19/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
TB062195		6/21/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
TB062395		6/23/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
TB062895		6/28/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
TB062995		6/29/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
TB063095		6/30/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
TB070795		7/7/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
TB071395		7/13/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U
TB071495		7/14/95	5 U	1 U	1 U	1 U	2 U	10 U	2 U	1 U	1 U	2 U

U - analyzed for, but not detected, number is reporting limit; J - an estimated value; B - present in the method blank;
E- exceeds instrument calibration limits; D - diluted sample.

TABLE 6-18
TCL VOLATILE ORGANICS
ANALYTICAL SUMMARY FOR WELL MW-1
(All values in ppb)

SAMPLE NAME	MW- 1		MW- 1	
SAMPLE DATE	9/12/95		10/21/97	
1,1,1-Trichloroethane	1	U	1	U
1,1,2,2-Tetrachloroethane	1	U	1	U
1,1,2-Trichloroethane	1	U	1	U
1,1-Dichloroethane	1	U	1	U
1,1-Dichloroethene	1	U	1	U
1,2-Dichloroethane	1	U	1	U
1,2-Dichloropropane	1	U	1	U
2-Butanone	10	U	10	U
2-Hexanone	2	U	2	U
4-Methyl-2-pentanone	2	U	2	U
Acetone	5	U	5	U
Benzene	1	U	1	U
Bromodichloromethane	1	U	1	U
Bromoform	1	U	1	U
Bromomethane	2	U	2	U
Carbon disulfide	1	U	1	U
Carbon tetrachloride	1	U	1	U
Chlorobenzene	1	U	1	U
Chloroethane	2	U	2	U
Chloroform	1	U	1	U
Chloromethane	2	U	2	U
cis-1,3-Dichloropropene	1	U	1	U
Dibromochloromethane	1	U	1	U
Ethylbenzene	1	U	1	U
Methylene chloride	1	J	1	U
Styrene	1	U	1	U
Tetrachloroethene	1	U	1	U
Toluene	1	U	1	U
trans-1,3-Dichloropropene	1	U	1	U
Trichloroethene	1	U	1.8	J
Vinyl chloride	2	U	2	U
Xylene (total)	1	U	1	U

TABLE 6-32
TCL VOLATILE ORGANICS
ANALYTICAL RESULTS SUMMARY
MONITORING WELLS MW-6 AND MW-7

(All values in ug/L)

SAMPLE NAME	MW- 6		MW- 6		MW- 7		MW- 7	
SAMPLE DATE	9/15/95		10/21/97		9/15/95		10/21/97	
1,1,1-Trichloroethane	1	U	1	U	1	U	1	U
1,1,2,2-Tetrachloroethane	1	U	1	U	1	U	1	U
1,1,2-Trichloroethane	1	U	1	U	1	U	1	U
1,1-Dichloroethane	1	U	1	U	1	U	1	U
1,1-Dichloroethene	1	U	1	U	1	U	1	U
1,2-Dichloroethane	1	U	1	U	1	U	1	U
1,2-Dichloropropane	1	U	1	U	1	U	1	U
2-Butanone	10	U	10	U	10	U	10	U
2-Hexanone	2	U	2	U	2	U	2	U
4-Methyl-2-pentanone	2	U	2	U	2	U	2	U
Acetone	5	U	5	U	5	U	5	U
Benzene	1	U	1	U	1	U	1	U
Bromodichloromethane	1	U	1	U	1	U	1	U
Bromoform	1	U	1	U	1	U	1	U
Bromomethane	2	U	2	U	2	U	2	U
Carbon disulfide	1	U	1	U	1	U	1	U
Carbon tetrachloride	1	U	1	U	1	U	1	U
Chlorobenzene	1	U	1	U	1	U	1	U
Chloroethane	2	U	2	U	2	U	2	U
Chloroform	1	U	1	U	1	U	1	U
Chloromethane	2	U	2	U	2	U	2	U
cis-1,3-Dichloropropene	1	U	1	U	1	U	1	U
Dibromochloromethane	1	U	1	U	1	U	1	U
Ethylbenzene	1	U	1	U	1	U	1	U
Methylene chloride	1	U	1	U	1	U	1	U
Styrene	1	U	1	U	1	U	1	U
Tetrachloroethene	1	U	1	U	1	U	1	U
Toluene	1	U	1	U	1	U	1	U
trans-1,3-Dichloropropene	1	U	1	U	1	U	1	U
Trichloroethene	1	U	1	U	1	U	1	U
Vinyl chloride	2	U	2	U	2	U	2	U
Xylene (total)	1	U	1	U	1	U	1	U

TABLE 6-34
TCL VOLATILE ORGANICS
ANALYTICAL RESULTS SUMMARY
MONITORING WELL CLUSTER MW-20, MW-21 AND MW-22
(All values in ug/L)

SAMPLE NAME	MW-20D		MW-20R		MW-21D		MW-21R		MW-22D		MW-22R	
SAMPLE DATE	10/20/97		10/20/97		10/20/97		10/15/97		10/20/97		10/20/97	
1,1,1-Trichloroethane	1	U	1	U	1	U	1	U	1	U	1	U
1,1,2,2-Tetrachloroethane	1	U	1	U	1	U	1	U	1	U	1	U
1,1,2-Trichloroethane	1	U	1	U	1	U	1	U	1	U	1	U
1,1-Dichloroethane	1	U	1	U	1	U	1	U	1	U	1	U
1,1-Dichloroethene	1	U	1	U	1	U	1	U	1	U	1	U
1,2-Dichloroethane	1	U	1	U	1	U	1	U	1	U	1	U
1,2-Dichloro ethene(total)	1	U	1	U	1	U	1	U	1	U	1	U
1,2-Dichloropropane	1	U	1	U	1	U	1	U	1	U	1	U
2-Butanone	10	U	10	U	10	U	10	U	10	U	10	U
2-Hexanone	2	U	2	U	2	U	2	U	2	U	2	U
4-Methyl-2-pentanone	2	U	2	U	2	U	2	U	2	U	2	U
Acetone	5	U	5	U	5	U	5	U	5	U	5	U
Benzene	1	U	1	U	1	U	1	U	1	U	1	U
Bromo dichloro methane	1	U	1	U	1	U	1	U	1	U	1	U
Bromoform	1	U	1	U	1	U	1	U	1	U	1	U
Bromo methane	2	U	2	U	2	U	2	U	2	U	2	U
Carbon disulfide	1	U	1	U	1	U	1	U	1	U	1	U
Carbon tetra chloride	1	U	1	U	1	U	1	U	1	U	1	U
Chloro benzene	1	U	1	U	1	U	1	U	1	U	1	U
Chloroethane	2	U	2	U	2	U	2	U	2	U	2	U
Chloroform	1	U	1	U	1	U	1	U	1	U	1	U
Chloromethane	2	U	2	U	2	U	2	U	2	U	2	U
cis-1,3-Dichloropropene	1	U	1	U	1	U	1	U	1	U	1	U
Dibromochloromethane	1	U	1	U	1	U	1	U	1	U	1	U
Ethylbenzene	1	U	1	U	1	U	1	U	1	U	1	U
Methylene chloride	1	U	1	U	1	U	1	U	1	U	1	U
Styrene	1	U	1	U	1	U	1	U	1	U	1	U
Tetrachloroethene	1	U	1	U	1	U	1	U	1	U	1	U
Toluene	1	U	1	U	1	U	1	U	1	U	1	U
trans-1,3-Dichloropropene	1	U	1	U	1	U	1	U	1	U	1	U
Trichloroethene	1	U	1	U	1	U	1	U	1	U	1	U
Vinyl chloride	2	U	2	U	2	U	2	U	2	U	2	U
Xylene(total)	1	U	1	U	1	U	1	U	1	U	1	U

Attachment E EDR GeoCheck Report

Port Ewen
161 Ulster Avenue
Ulster Park, NY 12487

Inquiry Number: 5620274.1s
April 12, 2019

The EDR GeoCheck® Report

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

TABLE OF CONTENTS

SECTION **PAGE**

GEOCHECK ADDENDUM

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

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GEOCHECK® - PHYSICAL SETTING SOURCE REPORT

TARGET PROPERTY ADDRESS

PORT EWEN
161 ULSTER AVENUE
ULSTER PARK, NY 12487

TARGET PROPERTY COORDINATES

Latitude (North):	41.881692 - 41˚ 52’ 54.09’’
Longitude (West):	73.987834 - 73˚ 59’ 16.20’’
Universal Tranverse Mercator:	Zone 18
UTM X (Meters):	583983.1
UTM Y (Meters):	4636922.5
Elevation:	166 ft. above sea level

USGS TOPOGRAPHIC MAP

Target Property Map:	41073-H8 KINGSTON EAST, NY
Version Date:	1980
South Map:	41073-G8 HYDE PARK, NY
Version Date:	1997
Southwest Map:	41074-G1 ROSENDALE, NY
Version Date:	1980
West Map:	41074-H1 KINGSTON WEST, NY
Version Date:	1997

EDR’s GeoCheck Physical Setting Source Addendum is provided to assist the environmental professional in forming an opinion about the impact of potential contaminant migration.

Assessment of the impact of contaminant migration generally has two principle investigative components:

1. Groundwater flow direction, and
2. Groundwater flow velocity.

Groundwater flow direction may be impacted by surface topography, hydrology, hydrogeology, characteristics of the soil, and nearby wells. Groundwater flow velocity is generally impacted by the nature of the geologic strata.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW DIRECTION INFORMATION

Groundwater flow direction for a particular site is best determined by a qualified environmental professional using site-specific well data. If such data is not reasonably ascertainable, it may be necessary to rely on other sources of information, such as surface topographic information, hydrologic information, hydrogeologic data collected on nearby properties, and regional groundwater flow information (from deep aquifers).

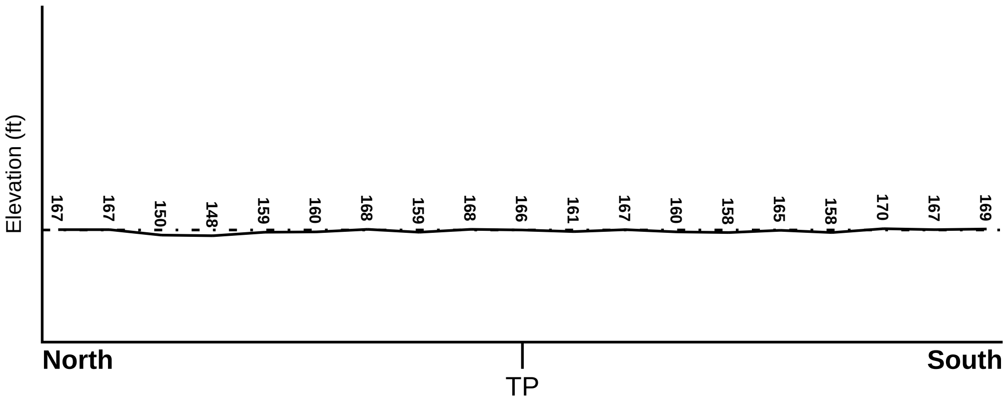
TOPOGRAPHIC INFORMATION

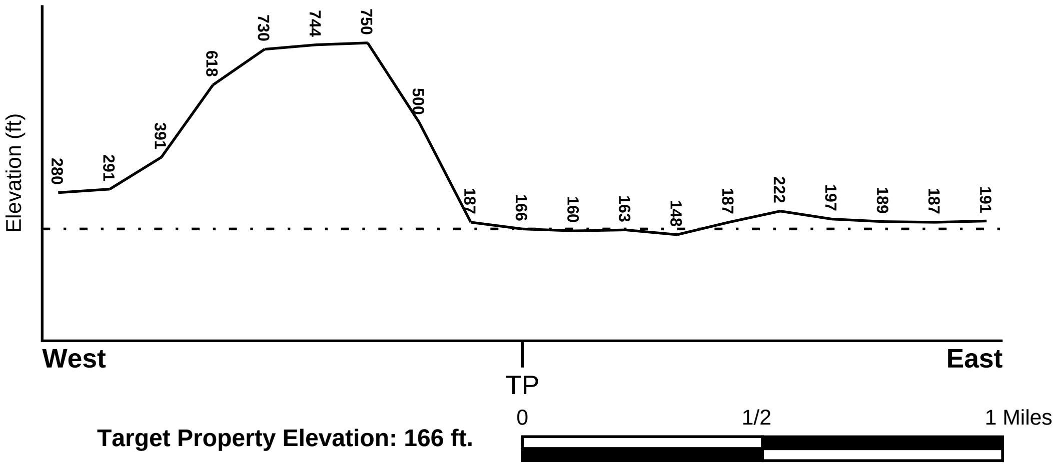
Surface topography may be indicative of the direction of surficial groundwater flow. This information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

TARGET PROPERTY TOPOGRAPHY

General Topographic Gradient: General East

SURROUNDING TOPOGRAPHY: ELEVATION PROFILES





Target Property Elevation: 166 ft.

Source: Topography has been determined from the USGS 7.5’ Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified.

HYDROLOGIC INFORMATION

Surface water can act as a hydrologic barrier to groundwater flow. Such hydrologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

Refer to the Physical Setting Source Map following this summary for hydrologic information (major waterways and bodies of water).

FEMA FLOOD ZONE

Flood Plain Panel at Target Property	FEMA Source Type
36111C0490E	FEMA FIRM Flood data

Additional Panels in search area:	FEMA Source Type
36111C0470E	FEMA FIRM Flood data
36111C0610E	FEMA FIRM Flood data
36111C0630E	FEMA FIRM Flood data

NATIONAL WETLAND INVENTORY

NWI Quad at Target Property	NWI Electronic Data Coverage
KINGSTON EAST	YES - refer to the Overview Map and Detail Map

HYDROGEOLOGIC INFORMATION

Hydrogeologic information obtained by installation of wells on a specific site can often be an indicator of groundwater flow direction in the immediate area. Such hydrogeologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

Site-Specific Hydrogeological Data*:

Search Radius:	1.25 miles
Status:	Not found

AQUIFLOW®

Search Radius: 1.000 Mile.

EDR has developed the AQUIFLOW Information System to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted by environmental professionals to regulatory authorities at select sites and has extracted the date of the report, groundwater flow direction as determined hydrogeologically, and the depth to water table.

MAP ID	LOCATION FROM TP	GENERAL DIRECTION GROUNDWATER FLOW
Not Reported		

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* ©1996 Site−specific hydrogeological data gathered by CERCLIS Alerts, Inc., Bainbridge Island, WA. All rights reserved. All of the information and opinions presented are those of the cited EPA report(s), which were completed under a Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS) investigation.

GROUNDWATER FLOW VELOCITY INFORMATION

Groundwater flow velocity information for a particular site is best determined by a qualified environmental professional using site specific geologic and soil strata data. If such data are not reasonably ascertainable, it may be necessary to rely on other sources of information, including geologic age identification, rock stratigraphic unit and soil characteristics data collected on nearby properties and regional soil information. In general, contaminant plumes move more quickly through sandy-gravelly types of soils than silty-clayey types of soils.

GEOLOGIC INFORMATION IN GENERAL AREA OF TARGET PROPERTY

Geologic information can be used by the environmental professional in forming an opinion about the relative speed at which contaminant migration may be occurring.

ROCK STRATIGRAPHIC UNIT		**GEOLOGIC AGE IDENTIFICATION**	
Era:	Paleozoic	Category:	Stratified Sequence
System:	Ordovician		
Series:	Middle Ordovician (Mohawkian)		
Code:	O2 *(decoded above as Era, System & Series)*		

Geologic Age and Rock Stratigraphic Unit Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - a digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

DOMINANT SOIL COMPOSITION IN GENERAL AREA OF TARGET PROPERTY

The U.S. Department of Agriculture's (USDA) Soil Conservation Service (SCS) leads the National Cooperative Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. Soil maps for STATSGO are compiled by generalizing more detailed (SSURGO) soil survey maps. The following information is based on Soil Conservation Service STATSGO data.

Soil Component Name:	VARYSBURG
Soil Surface Texture:	gravelly - loam
Hydrologic Group:	Class B - Moderate infiltration rates. Deep and moderately deep, moderately well and well drained soils with moderately coarse textures.
Soil Drainage Class:	Well drained. Soils have intermediate water holding capacity. Depth to water table is more than 6 feet.

Hydric Status: Soil does not meet the requirements for a hydric soil.

Corrosion Potential - Uncoated Steel:	HIGH
Depth to Bedrock Min:	> 60 inches
Depth to Bedrock Max:	> 60 inches

Soil Layer Information							
	Boundary			**Classification**			
Layer	**Upper**	**Lower**	**Soil Texture Class**	**AASHTO Group**	**Unified Soil**	**Permeability Rate (in/hr)**	**Soil Reaction (pH)**
1	0 inches	9 inches	gravelly - loam	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COARSE-GRAINED SOILS, Gravels, Gravels with fines, Silty Gravel	Max: 6.00 Min: 0.60	Max: 6.00 Min: 5.10
2	9 inches	21 inches	very gravelly - loam	Granular materials (35 pct. or less passing No. 200), Stone Fragments, Gravel and Sand.	COARSE-GRAINED SOILS, Gravels, Gravels with fines, Silty Gravel	Max: 6.00 Min: 0.60	Max: 6.00 Min: 5.10
3	21 inches	28 inches	very gravelly - loam	Granular materials (35 pct. or less passing No. 200), Stone Fragments, Gravel and Sand.	COARSE-GRAINED SOILS, Gravels, Gravels with fines, Silty Gravel	Max: 6.00 Min: 0.60	Max: 7.80 Min: 6.10
4	28 inches	41 inches	silty clay	Silt-Clay Materials (more than 35 pct. passing No. 200), Silty Soils.	FINE-GRAINED SOILS, Silts and Clays (liquid limit less than 50%), Lean Clay	Max: 0.06 Min: 0.00	Max: 7.80 Min: 6.10
5	41 inches	60 inches	silty clay	Silt-Clay Materials (more than 35 pct. passing No. 200), Silty Soils.	FINE-GRAINED SOILS, Silts and Clays (liquid limit less than 50%), Lean Clay	Max: 0.06 Min: 0.00	Max: 7.80 Min: 6.10

OTHER SOIL TYPES IN AREA

Based on Soil Conservation Service STATSGO data, the following additional subordinant soil types may appear within the general area of target property.

Soil Surface Textures:	silt loam silty clay loam channery - silt loam
Surficial Soil Types:	silt loam silty clay loam channery - silt loam
Shallow Soil Types:	gravelly - loam silty clay loam loam

	channery - silt loam channery - sandy loam silt loam sandy clay loam gravelly - sandy clay loam silty clay
Deeper Soil Types:	stratified very gravelly - fine sandy loam silt loam very channery - silt loam

LOCAL / REGIONAL WATER AGENCY RECORDS

EDR Local/Regional Water Agency records provide water well information to assist the environmental professional in assessing sources that may impact ground water flow direction, and in forming an opinion about the impact of contaminant migration on nearby drinking water wells.

WELL SEARCH DISTANCE INFORMATION

DATABASE	SEARCH DISTANCE (miles)
Federal USGS	1.000
Federal FRDS PWS	1.000
State Database	1.000

FEDERAL USGS WELL INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
1	USGS40000848350	1/2 - 1 Mile SSE
2	USGS40000848349	1/2 - 1 Mile SE
3	USGS40000848457	1/2 - 1 Mile NNE
A5	USGS40000848472	1/2 - 1 Mile North
A6	USGS40000848471	1/2 - 1 Mile North

FEDERAL FRDS PUBLIC WATER SUPPLY SYSTEM INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
4	NY0003382	1/2 - 1 Mile North
7	NY0021830	1/2 - 1 Mile South
8	NY0003382	1/2 - 1 Mile North

Note: PWS System location is not always the same as well location.

STATE DATABASE WELL INFORMATION

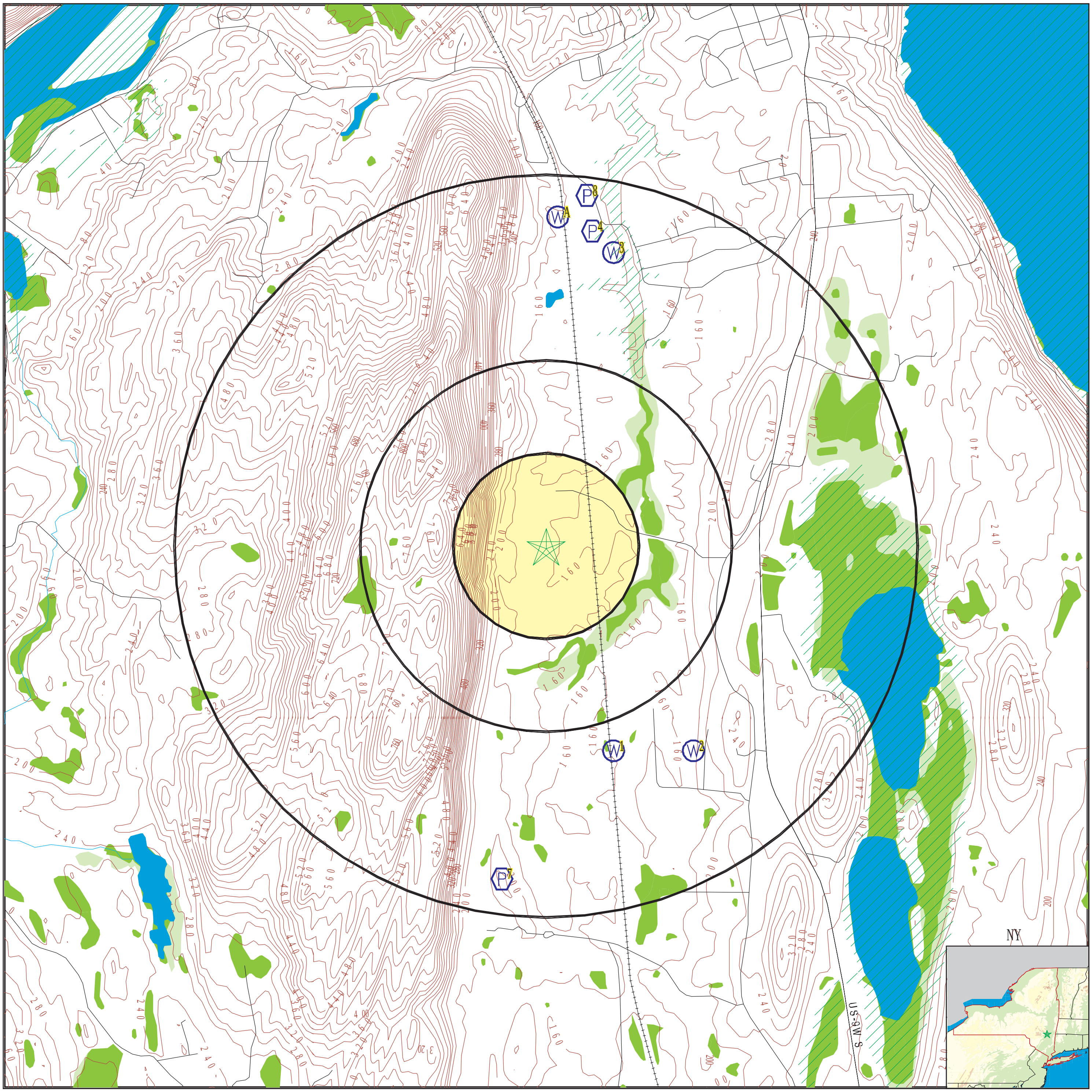
MAP ID	WELL ID	LOCATION FROM TP

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

STATE DATABASE WELL INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
No Wells Found		

PHYSICAL SETTING SOURCE MAP - 5620274.1s



0 1/4 1/2 1 Miles

- County Boundary
- Major Roads
- Contour Lines
- ◎ Earthquake epicenter, Richter 5 or greater
- Ⓦ Water Wells
- Ⓟ Public Water Supply Wells
- ● Cluster of Multiple Icons
- ↑ Groundwater Flow Direction
- (GI) Indeterminate Groundwater Flow at Location
- (GV) Groundwater Flow Varies at Location
- (HD) Closest Hydrogeological Data
- ● Oil, gas or related wells
- ▨ 100-year flood zone
- ▨ 500-year flood zone
- 🟩 National Wetland Inventory

SITE NAME:	Port Ewen	CLIENT:	EHS Support
ADDRESS:	161 Ulster Avenue Ulster Park NY 12487	CONTACT:	Brianna Sadoski
		INQUIRY #:	5620274.1s
LAT/LONG:	41.881692 / 73.987834	DATE:	April 12, 2019 12:40 pm

Map ID Direction Distance Elevation	Database	EDR ID Number
1 **SSE** **1/2 - 1 Mile** **Lower**	**FED USGS**	**USGS40000848350**

Organization ID:	USGS-NY	Organization Name:	USGS New York Water Science Center
Monitor Location:	U1184	Type:	Well
Description:	Not Reported	HUC:	02020007
Drainage Area:	Not Reported	Drainage Area Units:	Not Reported
Contrib Drainage Area:	Not Reported	Contrib Drainage Area Unts:	Not Reported
Aquifer:	Not Reported	Formation Type:	Paleozoic Erathem
Aquifer Type:	Not Reported	Construction Date:	Not Reported
Well Depth:	68	Well Depth Units:	ft
Well Hole Depth:	Not Reported	Well Hole Depth Units:	Not Reported

---

2 **SE** **1/2 - 1 Mile** **Higher**	**FED USGS**	**USGS40000848349**

Organization ID:	USGS-NY	Organization Name:	USGS New York Water Science Center
Monitor Location:	U1183	Type:	Well
Description:	Not Reported	HUC:	02020007
Drainage Area:	Not Reported	Drainage Area Units:	Not Reported
Contrib Drainage Area:	Not Reported	Contrib Drainage Area Unts:	Not Reported
Aquifer:	Not Reported	Formation Type:	Conneaut Group
Aquifer Type:	Not Reported	Construction Date:	Not Reported
Well Depth:	100	Well Depth Units:	ft
Well Hole Depth:	Not Reported	Well Hole Depth Units:	Not Reported

---

3 **NNE** **1/2 - 1 Mile** **Lower**	**FED USGS**	**USGS40000848457**

Organization ID:	USGS-NY	Organization Name:	USGS New York Water Science Center
Monitor Location:	U1203	Type:	Well
Description:	Not Reported	HUC:	02020007
Drainage Area:	Not Reported	Drainage Area Units:	Not Reported
Contrib Drainage Area:	Not Reported	Contrib Drainage Area Unts:	Not Reported
Aquifer:	Sand and gravel aquifers (glaciated regions)		
Formation Type:	Sand and Gravel	Aquifer Type:	Not Reported
Construction Date:	Not Reported	Well Depth:	50
Well Depth Units:	ft	Well Hole Depth:	Not Reported
Well Hole Depth Units:	Not Reported		

---

4 **North** **1/2 - 1 Mile** **Lower**	**FRDS PWS**	**NY0003382**

PWS ID:	NY0003382	PWS type:	System Owner/Responsible Party
PWS name:	MABIE ROGER	PWS address:	PORT EWEN WD
PWS address:	TOWN HALL-BROADWAY	PWS city:	PORT EWEN

PWS state:	NY	PWS zip:	12466
PWS ID:	NY0003382	Activity status:	Active
Date system activated:	Not Reported	Date system deactivated:	Not Reported
Retail population:	00004800	System name:	PORT EWEN WATER DISTRICT
System address:	Not Reported	System address:	RIVER ROAD
System city:	PORT EWEN	System state:	NY
System zip:	12466		
County FIPS:	055	City served:	ESOPUS (T)
Latitude:	415338	Longitude:	0735909
Latitude:	415343	Longitude:	0735910
Latitude:	415312	Longitude:	0735734

A5
North **FED USGS** **USGS40000848472**
1/2 - 1 Mile
Lower

Organization ID:	USGS-NY	Organization Name:	USGS New York Water Science Center
Monitor Location:	U1206	Type:	Well
Description:	Not Reported	HUC:	02020007
Drainage Area:	Not Reported	Drainage Area Units:	Not Reported
Contrib Drainage Area:	Not Reported	Contrib Drainage Area Unts:	Not Reported
Aquifer:	Sand and gravel aquifers (glaciated regions)		
Formation Type:	Sand and Gravel	Aquifer Type:	Not Reported
Construction Date:	Not Reported	Well Depth:	61
Well Depth Units:	ft	Well Hole Depth:	Not Reported
Well Hole Depth Units:	Not Reported		

A6
North **FED USGS** **USGS40000848471**
1/2 - 1 Mile
Lower

Organization ID:	USGS-NY	Organization Name:	USGS New York Water Science Center
Monitor Location:	U1204	Type:	Well
Description:	Not Reported	HUC:	02020007
Drainage Area:	Not Reported	Drainage Area Units:	Not Reported
Contrib Drainage Area:	Not Reported	Contrib Drainage Area Unts:	Not Reported
Aquifer:	Not Reported	Formation Type:	Paleozoic Erathem
Aquifer Type:	Not Reported	Construction Date:	Not Reported
Well Depth:	220	Well Depth Units:	ft
Well Hole Depth:	Not Reported	Well Hole Depth Units:	Not Reported

---

7
South **FRDS PWS** **NY0021830**
1/2 - 1 Mile
Higher

PWS ID:	NY0021830	PWS type:	System Owner/Responsible Party
PWS name:	MOMMSEN MARCUS	PWS address:	HUTTERIAN BRETHREN SOCIETY
PWS address:	ROSENTHAL LANE	PWS city:	ESOPUS
PWS state:	NY	PWS zip:	12487
PWS ID:	NY0021830	Activity status:	Active

Date system activated:	Not Reported	Date system deactivated:	Not Reported
Retail population:	00000280	System name:	HUTTERIAN PLEASANT VIEW
System address:	Not Reported	System address:	ROSENTHAL LANE
System city:	ULSTER PARK	System state:	NY
System zip:	12487		
County FIPS:	055	City served:	ESOPUS (T)
Population served:	101 - 500 Persons	Treatment:	Treated
Latitude:	415207	Longitude:	0735926
Latitude:	415158	Longitude:	0735917
Latitude:	415158	Longitude:	0735918

8
North
1/2 - 1 Mile
Lower

FRDS PWS **NY0003382**

PWS ID:	NY0003382	PWS type:	System Owner/Responsible Party
PWS name:	MABIE ROGER	PWS address:	PORT EWEN WD
PWS address:	TOWN HALL-BROADWAY	PWS city:	PORT EWEN
PWS state:	NY	PWS zip:	12466
PWS ID:	NY0003382	Activity status:	Active
Date system activated:	Not Reported	Date system deactivated:	Not Reported
Retail population:	00004800	System name:	PORT EWEN WATER DISTRICT
System address:	Not Reported	System address:	RIVER ROAD
System city:	PORT EWEN	System state:	NY
System zip:	12466		
County FIPS:	055	City served:	ESOPUS (T)
Latitude:	415338	Longitude:	0735909
Latitude:	415343	Longitude:	0735910
Latitude:	415312	Longitude:	0735734

GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS
RADON

AREA RADON INFORMATION

State Database: NY Radon

Radon Test Results

County	Town	Num Tests	Avg Result	Geo Mean	Max Result
ULSTER	DENNING	6	13.02	6.92	45.4
ULSTER	ESOPUS	50	3.52	2.41	15.6
ULSTER	GARDINER	48	4.3	2.76	24.6
ULSTER	HARDENBURGH	3	3.33	2.22	7.6
ULSTER	HURLEY	75	5.05	3.41	30.2
ULSTER	KINGSTON	229	4.09	2.88	21.6
ULSTER	LLOYD	96	5.7	3.31	38.1
ULSTER	MARBLETOWN	65	5.96	3.15	99.5
ULSTER	MARLBOROUGH	44	5.41	3.79	17.1
ULSTER	NEW PALTZ	132	4.18	2.75	44.3
ULSTER	OLIVE	45	5.09	3.37	27.6
ULSTER	PLATTEKILL	29	3.23	2.15	14
ULSTER	ROCHESTER	38	4.27	2.63	21.3
ULSTER	ROSENDALE	39	3.08	2.3	10.3
ULSTER	SAUGERTIES	169	7.41	2.59	175.7
ULSTER	SHANDAKEN	13	6.82	3.71	24.2
ULSTER	SHAWANGUNK	82	7.22	3.78	56.1
ULSTER	ULSTER	52	3.44	2.48	11.4
ULSTER	WAWARSING	48	4.8	2.63	31.2
ULSTER	WOODSTOCK	105	5.12	2.71	114.3

Federal EPA Radon Zone for ULSTER County: 1

Note: Zone 1 indoor average level > 4 pCi/L.
: Zone 2 indoor average level >= 2 pCi/L and <= 4 pCi/L.
: Zone 3 indoor average level < 2 pCi/L.

Federal Area Radon Information for ULSTER COUNTY, NY

Number of sites tested: 95

Area	Average Activity	% <4 pCi/L	% 4-20 pCi/L	% >20 pCi/L
Living Area	1.190 pCi/L	95%	4%	1%
Basement	2.610 pCi/L	68%	29%	2%

PHYSICAL SETTING SOURCE RECORDS SEARCHED

TOPOGRAPHIC INFORMATION

USGS 7.5’ Digital Elevation Model (DEM)
Source: United States Geologic Survey
EDR acquired the USGS 7.5’ Digital Elevation Model in 2002 and updated it in 2006. The 7.5 minute DEM corresponds to the USGS 1:24,000- and 1:25,000-scale topographic quadrangle maps. The DEM provides elevation data with consistent elevation units and projection.

HYDROLOGIC INFORMATION

Flood Zone Data: This data was obtained from the Federal Emergency Management Agency (FEMA). It depicts 100-year and 500-year flood zones as defined by FEMA. It includes the National Flood Hazard Layer (NFHL) which incorporates Flood Insurance Rate Map (FIRM) data and Q3 data from FEMA in areas not covered by NFHL.
Source: FEMA
Telephone: 877-336-2627
Date of Government Version: 2003, 2015

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002, 2005 and 2010 from the U.S. Fish and Wildlife Service.

State Wetlands Data: Freshwater Wetlands
Source: Department of Environmental Conservation
Telephone: 518-402-8961

HYDROGEOLOGIC INFORMATION

AQUIFLOW^{R} Information System
Source: EDR proprietary database of groundwater flow information
EDR has developed the AQUIFLOW Information System (AIS) to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted to regulatory authorities at select sites and has extracted the date of the report, hydrogeologically determined groundwater flow direction and depth to water table information.

GEOLOGIC INFORMATION

Geologic Age and Rock Stratigraphic Unit
Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - A digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

STATSGO: State Soil Geographic Database
Source: Department of Agriculture, Natural Resources Conservation Service (NRCS)
The U.S. Department of Agriculture’s (USDA) Natural Resources Conservation Service (NRCS) leads the national Conservation Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. Soil maps for STATSGO are compiled by generalizing more detailed (SSURGO) soil survey maps.

SSURGO: Soil Survey Geographic Database
Source: Department of Agriculture, Natural Resources Conservation Service (NRCS)
Telephone: 800-672-5559
SSURGO is the most detailed level of mapping done by the Natural Resources Conservation Service, mapping scales generally range from 1:12,000 to 1:63,360. Field mapping methods using national standards are used to construct the soil maps in the Soil Survey Geographic (SSURGO) database. SSURGO digitizing duplicates the original soil survey maps. This level of mapping is designed for use by landowners, townships and county natural resource planning and management.

PHYSICAL SETTING SOURCE RECORDS SEARCHED

LOCAL / REGIONAL WATER AGENCY RECORDS

FEDERAL WATER WELLS

PWS: Public Water Systems
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Public Water System data from the Federal Reporting Data System. A PWS is any water system which provides water to at least 25 people for at least 60 days annually. PWSs provide water from wells, rivers and other sources.

PWS ENF: Public Water Systems Violation and Enforcement Data
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Violation and Enforcement data for Public Water Systems from the Safe Drinking Water Information System (SDWIS) after August 1995. Prior to August 1995, the data came from the Federal Reporting Data System (FRDS).

USGS Water Wells: USGS National Water Inventory System (NWIS)
This database contains descriptive information on sites where the USGS collects or has collected data on surface water and/or groundwater. The groundwater data includes information on wells, springs, and other sources of groundwater.

STATE RECORDS

New York Public Water Wells
Source: New York Department of Health
Telephone: 518-458-6731

OTHER STATE DATABASE INFORMATION

Oil and Gas Well Database
Source: Department of Environmental Conservation
Telephone: 518-402-8072
These files contain records, in the database, of wells that have been drilled.

RADON

State Database: NY Radon
Source: Department of Health
Telephone: 518-402-7556
Radon Test Results

Area Radon Information
Source: USGS
Telephone: 703-356-4020
The National Radon Database has been developed by the U.S. Environmental Protection Agency (USEPA) and is a compilation of the EPA/State Residential Radon Survey and the National Residential Radon Survey. The study covers the years 1986 - 1992. Where necessary data has been supplemented by information collected at private sources such as universities and research institutions.

EPA Radon Zones
Source: EPA
Telephone: 703-356-4020
Sections 307 & 309 of IRAA directed EPA to list and identify areas of U.S. with the potential for elevated indoor radon levels.

OTHER

Airport Landing Facilities: Private and public use landing facilities
Source: Federal Aviation Administration, 800-457-6656

Epicenters: World earthquake epicenters, Richter 5 or greater
Source: Department of Commerce, National Oceanic and Atmospheric Administration

Earthquake Fault Lines: The fault lines displayed on EDR’s Topographic map are digitized quaternary faultlines, prepared in 1975 by the United State Geological Survey

PHYSICAL SETTING SOURCE RECORDS SEARCHED

STREET AND ADDRESS INFORMATION

Appendix B Sampling and Analysis Plan

Sampling and Analysis Plan

Hercules, Inc.
(#356001)
Port Ewen, Ulster
County, New York

Prepared for:

Hercules, Inc.
Dyno Nobel, Inc.

Prepared by:

EHS Support℠

May 2021

Table of Contents

List of Tables

List of Figures

List of Attachments

Acronyms

ASP	Analytical Service Protocol
bgs	below ground surface
CAMP	Community Air Monitoring Plan
CLP	Contract Laboratory Program
COC	chain-of-custody
DER	Division of Environmental Remediation
DNAPL	dense non-aqueous phase liquid
DO	dissolved oxygen
DPT	direct-push technology
DUSR	Data Usability Summary Report
EB	equipment blank
EDD	electronic data deliverable
ELAP	Environmental Laboratory Approval Program
ELGUA	ELG Utica Alloys, Inc
eV	electron volt
ft	feet
GPS	global positioning system
HASP	Health and Safety Plan
IDW	investigation-derived waste
L/min	liters per minute
LIMS	Laboratory Information Management System
LNAPL	light non-aqueous phase liquid
mL	milliliter
NAPL	non-aqueous phase liquid
NTU	nephelometric turbidity units
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
ORP	oxidation-reduction potential
PE	polyethylene
PFAS	per- and polyfluoroalkyl substances
PID	photoionization detector
PM	Project Manager
PPE	personal protective equipment
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
TB	trip blank

USCS	Unified Soil Classification System
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

1 Introduction

This Sampling and Analysis Plan (SAP) presents the methods and procedures to be used for performing remedial investigation activities at the Hercules, Inc. site ("Site") in accordance with New York State Department of Environmental Conservation (NYSDEC) Administrative Order on Consent Index# CO 3-20180508-85 effective August 3, 2018. The Site is located at 161 Ulster Avenue in Port Ewen, Ulster County, New York (**Figure 1-1**) and is listed on the New York State Inactive Hazardous Waste Site as Site No. 356001. The Site is approximately 134 acres and includes the manufacturing facility and a wetlands area that are a portion of the 412 acres that are currently owned by Dyno Nobel, Inc. (**Figure 1-2**). Acreage owned by Dyno Nobel, Inc. outside of the Site boundary is comprised of grassy, marshy, and woodlands areas. The Site has been used for the manufacture and assembly of a variety of detonators and blasting caps since 1912. Prior to its development, the land was undeveloped and primarily used for grazing and other agricultural activities. The facility is in a small valley bordered by Hussey Hill to the west and a low-lying ridge to the east (**Figure 1-1**).

1.1 Scope of Work

The major tasks for the Site remedial investigation activities, based on current or future work plans, may include all or some of the following tasks:

- Clearing and Grubbing
- Survey
- Geophysical Survey – Underground Utility Location
- Direct Push Technologies (DPT) Activities – Soil Coring/Sampling
- Sonic Coring – Soil Coring/Sampling and Geotechnical Sampling
- Sediment Sampling
- Surface Water Sampling
- Monitoring Well Installation and Abandonment
- Aquifer Testing
- Groundwater Sampling
- Water Level Measurement Collection
- Subcontractor Oversight
- Management of Investigation-Derived Waste (IDW)

Soil, sediment, and groundwater sampling procedures will comply with the NYSDEC's Division of Environmental Remediation (DER)-10 *Technical Guidance for Site Investigation and Remediation* (NYSDEC, 2010) and accepted United States Environmental Protection Agency (USEPA) guidelines.

Samples will be analyzed per NYSDEC Analytical Service Protocol (ASP) requirements and analyzed by a New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP)-certified laboratory. Category B deliverables will be provided for all samples. All analytical data will be evaluated according to the DER Data Usability Summary Report (DUSR) guidelines.

Work included in this SAP will be performed in accordance with the health and safety procedures described in EHS Support's Site-specific Health and Safety Plan (HASP).

2 General Field Guidelines

2.1 Site Hazards

Potential on-site hazards, such as underground utilities, overhead power lines, energized areas, vehicular traffic, and building hazards, will be identified prior to initiation of the fieldwork. Generally, potential hazards at the Site will be identified during a Site reconnaissance by the project team prior to the first day of the investigation field activities. Additional safety measures to be undertaken for the work performed during the investigation are addressed in the Site-specific HASP.

Field activities will not occur during adverse weather conditions such as thunderstorms, snow, wind, or extreme temperatures.

2.2 Underground Utilities

Underground utilities, including electric lines, gas lines, storm and sanitary sewers, and communication lines will be identified on-site prior to initiation of drilling and other subsurface work. Underground utility location will be accomplished as follows:

- Project team will review any existing facility drawings which identify utilities.
- Dig Safely of New York (800) 962-7962 will be contacted to initiate the locating activities. New York State law requires that Dig Safely of New York be notified at least 2 working days, and not more than 10 working days, before subsurface work is conducted.
- Companies with subsurface utilities present will locate and mark out the subsurface utility lines.
- Geophysical methods will be used to further evaluate the potential presence of underground utilities in the area of each proposed investigation location, if determined to be necessary.
- Subsurface investigation locations will be hand cleared to 5 ft below ground surface (bgs) prior to advancing borings with mechanized equipment.

2.3 Field Documentation

Field activities will be recorded in a hard-bound field book and on field records specific to the project, where applicable. Field records that will be used include field notes, well integrity checklist (if applicable), groundwater purge and sample form, equipment calibration documentation, and chain-of-custody (COC) forms. Field documentation will be sufficiently detailed to allow for reconstruction of the project activities, collection, handling, preparation, and analysis procedures performed on the samples.

2.3.1 Field Records

At the beginning of each day, the designated team member will start the daily field record by entering the following:

- Date
- Time
- Project name
- Project location
- Weather conditions
- Name of field team members present

- Level of personal protective equipment (PPE) being used if above Level D
- Make and model of equipment being used (with serial numbers) and whether it is rented (include rental company name) or owned
- Tailgate meeting
- Potential issues of concern (if applicable)

Other information to be entered into the field records for the field event includes, but is not limited to:

- Observations of field activities taking place
- Progress
- Summary of equipment preparation and/or calibration procedures
- Summary of sampling activities
- Sample location
- Sample identification
- Sample time
- Sample method
- Location of duplicate samples collected
- Significant observations
- Description of any equipment problems (including corrective action)
- Explanations of deviations from the work plan
- Names of visitors to the Site and the purpose of their visit
- Photographs will be documented (date, time, location, direction, etc.)

The entries will be completed with the signature of the person making the entry. Entries will be made in ink. No entries will be erased. If an incorrect entry is made, the information will be crossed out with a single strike, initialed, and dated by the person making the correction.

2.3.2 Monitoring Well Purging and Sampling Form

Field personnel will maintain groundwater purge and sampling information in the field book sufficient to allow reconstruction of the sample collection and handling procedures at a later time. The required information will include, but is not limited to, the following:

- Purpose of the sampling event
- Weather conditions
- Well identifier
- Date and time of sample collection
- Project name
- Sampler name
- Height of well casing relative to ground surface (stick-up or flush)
- Elevation of the top of casing
- Initial water level
- Casing diameter
- Depth to non-aqueous phase liquid (NAPL) (if applicable)
- Total well depth
- Casing volume
- Water column height
- Total well volume

- Purge method (pump, etc.)
- Water quality equipment (including type of equipment, make and model number(s), and supplier)
- Equipment used to collect sample
- Water quality parameters
- Air monitoring/photoionization detector (PID) readings
- Purge stop and start time
- Final water level
- Time of final water level
- Total volume purged (well yield)
- If the monitoring well purged dry
- Monitoring well condition and maintenance needs
- Quality control and/or duplicate sample identification (if applicable)
- Sample identification number
- Sample collection time
- Analyses requested
- Purge water container labeling procedures
- Final location of purge water collection drum or tote
- Additional comments

Upon completion of the field investigation activities, the field sampling team leader will deliver copies of field records and any applicable field forms completed during the monitoring event to the Project Manager (PM) or designee.

2.3.3 Equipment Calibration Documentation

Sampling and monitoring equipment will be calibrated daily prior to beginning field tasks with results being recorded in the field logbook. Field team members will maintain instrument proficiency by performing the prescribed calibration procedures outlined in the operation and field manuals accompanying the field monitoring instruments. Field meter calibration procedures and standards will follow the manufacturer’s prescribed methods and a copy of the field instrument calibration procedures will be kept within the field instrument housing unit to ensure proper calibration.

2.3.4 Chain-of-Custody

COC procedures will be instituted and followed throughout the sampling activities. COC procedures are outlined in **Section 13.3.7**.

3 Field Equipment Decontamination and Management of Investigation-Derived Waste

Decontamination procedures for field personnel and equipment will be followed to protect the health and safety of those present, to maintain sample integrity, and to minimize the movement of potential contamination between the work area and off-site locations. Equipment used on-site will be decontaminated prior to beginning work, between sampling locations and/or uses, and prior to demobilizing from the Site. In addition, care will be taken so as not to allow anything to come into contact with a sample or sample area, which may affect its composition.

3.1 Decontamination Area

If warranted, a decontamination area lined with polyethylene sheeting will be constructed on-site for use during decontamination of the drilling equipment. Soil and/or water collected from the decontamination activities will be managed as described in **Section 3.5**.

3.2 Personnel Decontamination

Sampling personnel will wear clean PPE prior to obtaining each sample. To avoid cross-contamination, disposable nitrile gloves will be worn by the sampling team and changed between sampling points.

3.3 Small Equipment Decontamination

Groundwater sampling and development equipment may include, but is not limited to, water level meters or interface probes, disposable polyethylene tubing, and pumps. Soil sampling equipment may include, but is not limited to, steel shovels, stainless steel spoons, tape measure, and disposable polyethylene trowels.

Non-dedicated small equipment will be decontaminated at the sample locations. When possible, dedicated, pre-cleaned, or disposable sampling equipment will be used down-hole (e.g., tubing). Disposable equipment will not be reused.

3.3.1 Decontamination Tools and Supplies

- Potable water
- Phosphate-free detergent (such as Alconox or Simple Green)
- Deionized water
- Aluminum foil
- Plastic/polyethylene sheeting
- Plastic buckets and brushes
- PPE in accordance with the HASP

3.3.2 Procedures

The first step, a soap and water wash, removes visible particulate matter and residual oils and grease. Non-dedicated (or reusable) equipment will be decontaminated prior to initial use, between locations, and before leaving the Site using an Alconox soap wash and potable water rinse, followed by a reagent-grade deionized water rinse. The equipment will be washed and scrubbed in the detergent solution. This may be preceded by a steam or high-pressure water wash to facilitate residuals removal. The second step involves a tap water rinse and a distilled/deionized water rinse to remove the detergent. It is followed by another distilled/deionized water rinse. Next, a pesticide-grade isopropanol, solvent rinse is performed for trace organics removal if organics are a concern at the Site. The solvent shall be allowed to evaporate completely and then a final distilled/deionized water rinse is performed. This rinse removes any residual traces of the solvent. If metals are a concern at the Site, a dilute (10 percent) nitric acid should be used in place of the solvent rinse.

The decontamination procedure described above can be summarized as follows:

1. Physical removal with brush or similar equipment
2. Phosphate-free detergent wash
3. Tap water rinse
4. Distilled/deionized water rinse
5. Repeat distilled/deionized water rinse
6. Solvent rinse (pesticide–grade isopropanol) or nitric acid rinse, as warranted
7. Air dry
8. Distilled/deionized water rinse

In the case of sealed-construction submersible pumps and flow-through cells, the inside of non-dedicated sampling and/or development equipment will be decontaminated by pumping the wash/rinse water through the equipment. The exterior housing will be washed and scrubbed and the pump will be fully submerged in the detergent solution, then started and allowed to run for approximately 30 seconds to clean interior parts. Sealed-construction submersible pumps will also be fully submerged and allowed to run for approximately 10 to 15 seconds in a potable water rinse.

Specific decontamination procedures associated with the sampling for per- and polyfluoroalkyl substances (PFAS) are provided in **Attachment A**.

Disposable equipment and other trash generated during these activities will be contained and managed as described in **Section 3.5**.

3.4 Large Equipment Decontamination

The following procedures will be used to decontaminate equipment used during the field activities:

- Heavy equipment and accessories (including the backhoe, bucket, and drilling rig; augers; bits; rods; tools; split-spoon samplers; and tremie pipes) will be cleaned with a high-pressure, hot water pressure washing unit between investigation locations.
- Tools, drill rods, and augers will be placed on polyethylene plastic sheets following pressure washing. Direct contact with the ground will be avoided.
- The back of the drill rig and tools, augers, and rods will be decontaminated, as necessary, at the completion of the work and prior to leaving the Site.

Specific decontamination procedures associated with sampling PFAS are provided in **Attachment A**.

Decontamination soil and/or water will be contained and managed as described in **Section 3.5**.

3.5 Management of Investigation-Derived Waste

3.5.1 *Types*

The following are types of IDW that will be containerized in United States Department of Transportation (USDOT) approved 55-gallon steel drums or a bulk tank:

- Decontamination fluids
- Drill cuttings
- Development and purge water
- PPE (may also be collected in cardboard yard box, or plastic garbage bags)
- Disposable sampling equipment
- Construction debris

3.5.2 *Labeling, Storage, and Disposal*

The drums will be labeled with the type of IDW, locations collected, and date. The drums (or roll-off container) will be stored inside the locked warehouse. IDW will be disposed of per the requirements of Section 3.3(e) of DER-10 (NYSDEC, 2010).

3.5.3 *Characterization*

Subsequently, the waste soils and water will be characterized with laboratory analyses. The analyses for the waste characterization and profiling are described on **Table 3-1**.

4 Soil Sampling Procedures

Surface and subsurface investigation activities to be conducted at the Site will consist of surface and subsurface soil sample collection, the advancement of soil borings, and the installation of monitoring wells proposed in a work plan and submitted to NYSDEC for approval. These activities will require the use of the following equipment and material:

- Field book
- Project plans
- PPE in accordance with the HASP
- Stakes
- Flagging and marking paint
- Plastic bags
- Tape measure
- Steel shovel and stainless steel spoons or disposable polyethylene trowels (surface soil)
- Decontamination supplies
- PID with a 10.6 or 11.7 electron volt (eV) lamp
- Camera
- Clear tape
- Duct tape
- Laboratory sample bottles
- Coolers and ice
- Shipping supplies

Procedures for these activities are described in the following sections. Specific sampling procedures for PFAS are provided in **Attachment A**.

4.1 Subsurface Soil Sampling

Soil samples will be collected using direct-push technology (DPT) method with a truck or tractor mounted Geoprobe, or similar unit, or using sonic drilling technology depending upon the sampling depths required. Appropriate techniques will be used to investigate the subsurface beneath the existing building and pads, etc. where warranted based on visual inspection of the building and pads and results of the proposed soil analyses around the perimeters of the building and pads.

The Geoprobe uses a 4-foot long stainless steel casing with an acetate sleeve liner. The stainless steel casing is pushed into the ground and the soil sample is collected within the acetate sleeve. After the soil boring is extracted from the ground, the sleeve is removed from the stainless steel casing, cut, and the sample is split in half along the axis. The soil samples will be visually inspected by an on-site geologist or scientist and a soil boring log will be created based upon visual examination and other field observations. Soil descriptions will be based the Unified Soil Classification System (USCS). Additionally, a PID will be used to screen lithologic samples and to evaluate the breathing zone in the work area. Soil descriptions will be transcribed into a standard boring log sheet.

Soil samples will be collected in sample containers prepared by the contracted laboratory. Sample bottles will not be cleaned or reused in the field. Representative soil samples will be cooled to 4 degrees

Celsius in the field and transported under COC command to a NYSDOH ELAP-certified analytical laboratory.

Non-disposable sampling equipment will be decontaminated between sampling locations as detailed in **Section 3.3.** If soil recovery is low and does not allow sample collection, an alternate drilling method and/or sampling methodology will be discussed with NYSDEC.

4.2 Borehole Abandonment

Locations will be properly abandoned following the collection of samples. Each borehole will be backfilled with the unused soil from the borehole that generated it to within 12 inches of the surface. Soil additives (bentonite) may be added to the cuttings to reduce permeability. The top 12 inches will be filled with a cement/bentonite grout mixture as described below. The above procedure will be followed unless one of the following occurs:

- Free product, or grossly contaminated soils are present in the cuttings.
- The borehole will be used for the installation of a monitoring well.
- The borehole has penetrated an aquitard, aquiclude, or other confining layer or extended into bedrock.

Sonic or auger soil borings not used for the construction of monitoring wells will be tremie grouted to the ground surface following the completion of the soil sampling to prevent cross-contamination of permeable zones. The borings will be filled using a cement/bentonite grout mixture. The cement will be mechanically mixed, above ground, with water from a potable water source. Bentonite will be added to ensure a lump-free consistency. The mixture will be pumped through a tremie pipe as the auger or rods are being withdrawn.

4.3 Geotechnical Evaluation

Soil samples are collected into 4- or 5-foot long plastic liners that are placed in a solid metal casing that has been driven into the ground using a hydraulic push. Once the sampler has been brought to the surface, the soil sample liner is removed from the casing. The soil sample selected for laboratory analysis is determined and that portion of the sample liner is cut away with a saw crosswise from the remaining length of liner. Soil cores will be immediately frozen on dry ice within the acetate sleeves to seal in pore fluids and preserve *in-situ* conditions to the extent possible, during transport to the laboratory. The selected tubes or section of the direct push sample liner sent in for physical soil testing will be duct taped, or end caps will be duct taped to each end of the tube or liner. The tubes or liners will be labeled with the following:

a. Site name
b. Sample ID and depth
c. Date
d. Up direction
e. Recovery, if required

Discrete intervals of the preserved section of the core will be selected in the field for additional petrophysical analyses as follows:

- Pore Fluid Saturation Testing Package (Dean Stark Method [API RP 40; API, 1998]). This testing includes the analysis of initial fluid saturations (water and oil), total porosity, grain density, bulk density, and air-filled porosity.
- Grain size analysis by method ASTM D4464 (laser method) (ASTM, 2020).
- Air/Water Displacing Oil Imbibition Tests. This testing evaluates changes in pore fluid saturation in response to increased water pressures and can be used to simulate NAPL recovery under a range of scenarios.
- Effective (drainage) porosity by method API RP 40 (API, 1998) – Modified ASTM D425 (ASTM, 2017).

5 Monitoring Well Installation and Abandonment Procedures

ELG Utica Alloys, Inc. (ELGUA) shall submit to NYSDEC for approval a work plan providing construction details (e.g., well depth and screen intervals) and the locations of the monitoring wells prior to proceeding with the field activities. A general summary of monitoring well installation and abandonment activities is provided below.

5.1 Tools and Supplies

- Field book
- Project plans
- PPE in accordance with the HASP
- Electronic oil/water interface probe
- Peristaltic pump, submersible electric pump or other purge pump
- Multi-parameter meter
- Turbidity meter
- Flow-through cell
- Decontamination supplies
- Plastic tubing
- Plastic sheeting
- PID
- 5-gallon buckets
- Funnel
- Clear tape, duct tape
- Coolers and ice
- Laboratory sample bottles
- COCs, custody seals, and Federal Express labels

5.2 Installation

Monitoring wells will be installed in accordance with the approved work plan. Non-dedicated drilling tools and equipment will be decontaminated between boring locations in accordance with the procedures presented in **Section 3**. Drilling cuttings and drilling fluids will be contained and managed as described in **Section 3.5**.

5.3 Development

After installation, but not within 24 hours, newly installed monitoring wells will be developed in accordance with NYSDEC protocols. Development of the monitoring wells will be accomplished using a centrifugal, submersible, or peristaltic pump and dedicated polyethylene tubing, or using other methods at the discretion of the field geologist. The wells will be developed until the water in the well is reasonably free of visible sediment (50 nephelometric turbidity units [NTU] if possible). A minimum of three well volumes will be evacuated from each monitoring well.

Development water from the monitoring wells will be contained and managed as described in **Section 3.5**. If NAPL is encountered during well development, the EHS Support PM should be notified immediately. The EHS Support PM will then decide if procedures should be modified.

5.4 Abandonment

Site groundwater monitoring wells approved for abandonment by NYSDEC shall be abandoned in accordance with NYSDEC's *Groundwater Monitoring Well Decommissioning Procedures* (NYSDEC, 2009).

6 Groundwater Level Measuring and Sampling Procedures

ELGUA shall submit to NYSDEC for approval a work plan providing monitoring wells to be sampled and analyses to be run prior to proceeding with the field activities. A general summary of groundwater sampling activities is provided below. Specific guidance for sampling PFAS in groundwater is provided in **Attachment A**.

6.1 Groundwater Sampling from Monitoring Wells

Groundwater samples will be collected using low-flow, low-stress purge and sampling methods. The following are the required tools and supplies:

- Field book
- Project plans
- PPE in accordance with the HASP
- Electronic oil/water interface probe
- Disposable polyethylene bailers and low-flow sampling pump
- Polypropylene rope
- Multi-parameter meter (temperature, specific conductivity, and pH meter)
- Turbidity meter
- Flow-through cell
- Decontamination supplies
- Peristaltic or submersible pump capable of achieving low-flow rates (i.e., 0.5 liters per minute or less)
- Plastic tubing
- Plastic sheeting
- PID
- 5-gallon buckets
- Funnel
- Clear tape, duct tape
- Coolers and ice
- Laboratory sample bottles
- COCs, custody seals, and Federal Express labels

6.1.1 Water Level Measurements

Upon opening the well cap, headspace will be screened for the presence of volatile organic compounds (VOCs). Prior to sample collection, static water levels will be measured and the presence or absences of NAPL (i.e., light non-aqueous phase liquid [LNAPL] and dense non-aqueous phase liquid [DNAPL]) will be determined by using an oil/water interface probe and recorded from the on-site monitoring wells. If NAPL is detected using an oil/water interface meter, the probe will give a solid tone when it encounters a nonpolar liquid (NAPL) and a constant beep when it encounters a polar liquid (water). The probe lead is a 50 to 200-foot measuring tape with 0.01-foot increments, the difference between the top of casing to the NAPL will be recorded on the field gauging log.

Upon discovery of measurable NAPL, the EHS Support PM will be contacted and appropriate notifications will be made. The PM will determine if immediate recovery efforts should be implemented.

If immediate recovery is recommended, a peristaltic pump will be used to recover the NAPL from the well. The NAPL and any water that is purged from the well with be contained and managed according to **Section 3.5**.

Monitoring wells containing a measurable amount of NAPL will be sampled and analyzed; however, the laboratory will be notified that the sample may potential contain NAPL.

6.1.2 Purging and Sampling

Following water level measurement, field personnel will purge and sample monitoring wells using either a peristaltic pump with dedicated pump tubing following low-flow/minimal drawdown purge and sample collection procedures; or using a dedicated polyethylene bailer. Prior to sample collection, groundwater will be evacuated from each well at a low-flow rate (typically between 0.1 liter per minute [L/min] and 1.0 L/min and at a rate in which the recharge rate matches the purge rate). Field measurements for pH, temperature, turbidity, dissolved oxygen (DO), oxidation-reduction potential (ORP), specific conductance and water level, as well as visual and olfactory field observations will be periodically recorded and monitored for stabilization. Purging will be considered complete when pH, specific conductivity, DO, ORP, and the temperature stabilize and when turbidity measurements fall below 50 NTU, or become stable above 50 NTU. Stability is defined as variation between field measurements of 10 percent or less and no overall upward or downward trend in the measurements. Upon stabilization of field parameters, groundwater samples will be collected and analyzed as discussed below. If filtered and unfiltered samples are required by the work plan, the unfiltered sample will be collected first and then a second sample will be field-filtered using a disposable 0.45-micron filter.

Wells with insufficient yield (i.e., low recharge rate of the well and drawdown exceeding 0.33 foot) may dewater during purging. Purging should be interrupted before the water level in the well drops below the tubing or pump intake, as this may induce cascading of the sand pack. Pumping the well dry will therefore be avoided to the extent possible in all cases. Sampling will commence as soon as the volume in the well has recovered sufficiently to allow for collection of samples. In the case of a well with insufficient yield, samples may be collected without stabilization of field parameters.

To prevent cross-contamination between groundwater sampling locations, the sampler collecting the groundwater samples will wear clean, disposable nitrile gloves and will limit their contact with the samples. Laboratory-cleaned sample bottles and dedicated sampling equipment will be used (e.g., tubing) for each sample location. Sample bottles and containers will be prepared by the contracted laboratory. Sample bottles will not be cleaned or reused in the field.

Water level measurements will be compared to previous measurements and will be used to evaluate the direction of groundwater flow and the hydraulic gradients created by the groundwater collection system. Well depth, depth to water, well diameter, and purge water calculations will be noted on the field gauging log.

6.2 Discrete Groundwater Sampling

Discrete groundwater samples will be collected at select depths using DPT. The discrete groundwater samples will be collected using a sealed-screen sampler with a retractable screen implementing low-flow purge sampling techniques until the sample is visually clear. One set of field parameters (pH, temperature, turbidity, DO, ORP, and specific conductivity) will be collected per groundwater sample. The remaining open borehole will be abandoned in accordance with the procedures in **Section 4.2**.

7 Aquifer Testing

Prior to setting packers or pumping activities, the depth to water and depth to bottom below the top of the surveyed well casing will be measured and recorded. Commercially available pressure transducers shall be placed at the center of the screen in each monitoring well. Pressure transducers will be set below the bottom packer, between the bottom and upper packer, and above the upper packer in bedrock wells. Pressure transducers will be able to measure and record the depth below water to the nearest 0.01 feet and record measurements every 5 seconds. Faster logging intervals may be used dependent on the aquifer response. After the packers are seated, pressure in the test interval should be monitored for at least 10 minutes to ensure that the transducer readings in the test interval are constant (± 0.05 ft). The well casing volume and volume of the riser pipe will be determined. Additional data collection during packer testing will include, at a minimum, the following:

- Record the manual water level measurement in test zone prior to test at the time of transducer placement and when the transducer is removed.
- Record initial pumping rate and transducer adjusted pumping rate, when necessary. Record the times and volumes when these changes occur.
- Record volume purged prior to sample collection.

The water-flow meter should be tested prior to use by running a known volume through the meter and checking its calibration. Prior to testing, several measurements need to be taken and documented. These include:

- Length of zone tested
- Length of packer(s), rubber portion only
- Length of portion of hole not tested if double packer assembly is used
- Length of entire assembly
- Length of hose or piping used in each test
- Document rationale for selection of interval

Pumping should be initiated and the pumping rate adjusted based on the responses within the packed zone and in the upper and lower zones. The rate should be set to achieve a steady pumping rate and drawdown level above the packer. The packers may need adjusted to ensure that they are adequately seated within the bedrock borehole. The change in flow rate should be recorded every 30 seconds during the initial pumping. The packed zone will be deemed unyielding (impermeable) if drawdown exceeds the top of the packer when pumping at less the 0.5 gallons per minute. The drawdown will be monitored on the computer. If significant drawdown is observed, stop pumping and monitor recovery to ± 10% of the original head. The pump assembly will include a backflow preventer to stop water already in the line from re-entering the well.

Once an appropriate flow rate is determined the interval will be pumped at a constant rate for at least 60 minutes to complete the hydraulic test. Additional pumping may occur based on the observations by the field geologist.

8 Sediment Sampling Procedures

Sediment investigation activities to be conducted at the Site will be proposed in a work plan and submitted to NYSDEC for approval. These activities will require the use of the following equipment and material:

- AMS Multi-stage sediment sampler or equivalent sampling device
- Stainless steel spatula
- Stainless steel bowls and spoons
- Decontamination supplies
- Laboratory-supplied bottleware and labels
- Cooler with ice
- Field logbook/field data sheets
- Indelible ink pen
- Sampling location map
- Water quality meter (e.g., YSI 556 or Horiba U-22) for *in-situ* water quality testing
- High-resolution global positioning system (GPS) unit
- Camera
- Cellular telephone
- Appropriate health and safety equipment

8.1 Sediment Collection for Chemical Analyses

Wading will be considered if the water depth is shallow and the substrate is cohesive enough to make wading feasible; caution will be used when conducting sampling while wading. Health and safety procedures for conducting work over water are detailed in the HASP and are a required component of the sampling.

The following procedures will be used to collect sediment samples:

1. Record coordinates at the sampling station using a high-resolution GPS.
2. Decontaminate sampling equipment and don a new pair of latex/nitrile gloves.
3. Set up the AMS Multi-stage sediment sampler (AMS sampler) with three stages to penetrate to a depth greater than 12 inches below the sediment surface.
4. Add a butyrate (or equivalent) core liner with a core catcher (if needed) to the core barrel; attach the nose cone to the loaded core barrel.
5. Advance the AMS sampler or equivalent device approximately 12 inches (deeper if depositional sediment deposit permits) into the sediment, using a slide hammer to advance the core, as needed.
6. Remove the AMS sampler from the sediment rinse/wipe the outside of the core barrel.
7. Remove the nose cone and slide the liner out of the core barrel; remove the core catcher (if possible) from the bottom of the core.
8. Cap both ends of the core liner containing the sample.
9. Place the core sample in a stand lined with a clean plastic bag on a sturdy working platform.
10. Use power shears to cut vertically along both sides of the core liner.
11. Remove the top half of the liner cut free using the power shears.
12. Log the core on the field data sheet or field notebook, describing and measuring discrete sediment intervals in terms of grain size, organic carbon content, moisture content, color, etc.

13. Section the core into the following sampling intervals using a decontaminated spoon, scoop, or trowel: 0 to 12 inches, greater than 12 inches (in 12-inch intervals).
14. Homogenize each sampling interval in a separate stainless steel bowl/tray to similar texture and color.
15. Add the homogenized samples to laboratory-supplied sampling jars designated for each sampling interval.
16. Place samples in an iced cooler as soon as possible.
17. Record all appropriate data and field observations of sediment characteristics (e.g., texture, color, odor) in the field logbook and/or field data sheet.
18. Decontaminate sampling equipment and don a new pair of latex/nitrile gloves before sampling.

Non-disposable sampling equipment will be decontaminated between sampling locations as detailed in **Section 3.3.**

9 Surface Water Sampling Procedures

Surface water samples will be collected using a peristaltic pump and polyethylene (PE) tubing. The tubing will be lowered to the desired depth using a stainless steel weight attached to the PE tubing. The water samples will be pumped directly into the sample containers from the PE tubing. The samples will be grab samples with no water quality parameters collected. The samples will be collected from the middle of the water column if there are no visible signs of contamination (e.g., heavy sheen, LNAPL). An additional sample will be collected, if possible, from the visibly contaminated zone. If filtered and unfiltered samples are required by the work plan, the unfiltered sample will be collected first and then a second sample will be field-filtered using a disposable 0.45-micron filter.

10 Air Monitoring Procedures

Two types of air monitoring will be performed during Site investigation activities: 1) breathing zone air monitoring for protection of the workers performing the Site investigation, and 2) community air monitoring at the perimeter of the work Site for protection of the local community. Air monitoring will be conducted during remedial investigation activities at the Site as described in the Site-specific Community Air Monitoring Plan (CAMP) and in accordance with the Site-specific HASP.

10.1 Breathing Zone Air Monitoring During Drilling and Sampling

Monitoring of air in the breathing zone within the work Site will be conducted periodically during the drilling and sampling activities.

- A PID will be used to monitor for VOCs or other organic vapors in the breathing zone and borehole, and to screen the samples.
- Additional air monitoring may be required as specified in the Site-specific HASP.

The PID readings will be recorded in the field book and on the boring log during drilling activities. The procedure for the PID operation and calibration is included in the HASP. Note that equipment calibration will be performed as often as needed to account for changing conditions or instrument readings. The minimum frequency of calibration is specified in the HASP; more frequent calibration will be performed if spurious readings are observed or there are other problems with the instruments.

10.2 Community Air Monitoring

Community air monitoring requires real-time monitoring for VOCs and particulates (i.e., dust) at the downwind perimeter of each designated work area when certain activities are in progress at impacted sites. The community air monitoring is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The action levels for community air monitoring require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, community air monitoring helps to confirm that work activities do not spread contamination off-site through the air. The procedures and action levels for community air monitoring are presented in the CAMP.

11 Field Instruments and Calibration

Field instruments will be calibrated immediately prior to each day's use and more frequently if required. The calibration procedures will conform to the manufacturer's standard instructions. This calibration will ensure that the equipment is functioning within the allowable tolerances established by the manufacturer and required by the project. Instrument calibrations will be documented in the project field. Records of instrument calibration will be maintained by the Field Team Leader.

Copies of the instrument manuals will be maintained on-site by the Field Team Leader. Changes to instrumentation will be noted in the field logbook.

The following field instruments will be used during the investigation:

- PID
- Multi-parameter meter (pH, specific conductivity, DO, ORP, and temperature meter)
- Turbidity meter

11.1 Portable Photoionization Detector

- The PID will be equipped with either a 10.6 or 11.7 eV lamp. In this configuration, the PID is capable of ionizing and detecting compounds that account for over 70 percent of the VOCs on the USEPA Target Compound List.
- Calibration shall be performed at the beginning of each day of use with a standard calibration gas having a concentration of 100 parts per million of isobutylene. If the unit experiences abnormal perturbation or erratic readings, more frequent or additional calibration will be required.
- Calibration data shall be recorded in the project field logbooks and on calibration forms.
- A battery check shall be completed at the beginning and end of each working day.
- Changes to the PID will be noted in the field notes (such as lamp or filter cleaning or replacement or change of instrument).

11.2 Multi-Parameter Meter

- Calibration of the meter (YSI or equivalent) shall be performed at the start of each day of use, and after very high or low readings according to manufacturer's instructions.
- National Institute of Standards and Technology traceable standard calibration solutions will be used (where applicable).
- The calibration data shall be recorded in the project field book each time it is performed.

11.3 Turbidity Meter

- The turbidity meter shall be checked at the start of each day of use according to manufacturer's instructions.

12 Analytical Program

Laboratory analyses will be performed by an accredited and appropriately certified analytical laboratory. The analytical program summarized in the following section was developed in accordance with DER-10 (NYSDEC, 2010).

12.1 Environmental Sample Analyses

Soil, groundwater, surface water, sediment, and/or soil gas samples may be analyzed for chemical, physical, and/or geotechnical methods/parameters in accordance with NYSDEC-approved work plans. The parameters and analytical methods, which may be proposed, along with details regarding sample containers, preservation, and holding times are summarized in **Table 3-1.**

12.2 Field Quality Control Samples

As part of the quality assurance/quality control (QA/QC) program, samples will be collected and prepared in the field and laboratory to provide control over the collection of environmental measurements and subsequent review, interpretation, and validation of generated analytical data. The QA/QC samples will be collected at the following frequencies:

- Field duplicates – 1 per 20 samples per media per sampling event
- Equipment blanks – 1 per 20 samples per media per day, if applicable
- Trip blanks – 1 per cooler containing VOC samples

The following section summarizes the purpose of these QA/QC samples and outlines the procedures for collecting and handling the QA/QC samples.

12.2.1 Field Duplicate Samples

Field duplicates will be collected for all media samples at a rate of 1 per 20 samples per media per sampling event. Field duplicate samples will be used to provide an estimate of the aggregate sampling and analytical precision.

Duplicates of soil, aqueous, and vapor/air samples will be obtained by alternately filling sample containers from the sample source. Sample locations for duplicate samples will be selected to confirm collection of representative samples and sufficient sample volume to fulfill the QA/QC protocols. The duplicate samples will be collected, handled, transported, and analyzed in the same manner as the samples that they duplicate.

12.2.2 Equipment or Rinsate Blanks

Equipment blanks (also called rinsate blanks) are collected to document that cross-contamination has not occurred between sample locations. An equipment blank will be collected at a rate of 1 per 20 samples per sampling event. Equipment blanks will be analyzed for VOCs. The equipment blanks will be handled, transported, and analyzed in the same manner as the samples acquired during the sampling event. Equipment blanks will be returned to the laboratory with the same set of sample bottles they accompanied to the field.

12.2.3 Trip Blank Samples

Trip blanks are used to determine whether contaminants may have been introduced during the sample shipping process. The trip blank will be prepared by the contract laboratory and transported to the Site with the sample containers. Trip blanks represent VOC vials (40-milliliter [mL] vials) filled with laboratory demonstrated analyte-free water shipped from the laboratory to the field.

A trip blank sample will accompany each cooler of VOC samples. Trip blanks will remain unopened in the shipping container (cooler) during the sampling event, and returned unopened to the laboratory from the field. They will be labeled, documented, and packaged in the same manner as samples collected during the sampling event and shipped back to the laboratory in the coolers with the samples collected for VOC analysis. One trip blank will accompany each cooler containing samples for VOC analysis.

13 Sample Naming, Labeling, and Handling

13.1 Sampling Naming

A sample naming/numbering system will be issued for identifying and tracking samples in accordance with the NYSDEC-approved work plans. Each sample collected will be assigned a unique sample identification number.

13.1.1 Environmental Samples

An identification code will be used for the identification of soil, groundwater, sediment, and surface water as defined in the NYSDEC-approved work plan or by the project team prior to implementation of investigation activities.

13.1.2 Quality Control

Duplicate samples will be identified using a sample type code and will consist of:

- Duplicate sample designation (Dup)
- Dash
- One or two digit numerical identification code
- Example: DUP-1

Equipment blanks will be identified using a five digit sample type code and will consist of:

- Equipment blank designation (EB)
- Dash
- One or two digit numerical identification code
- Example: EB-01

Trip blanks will be identified using a five digit sample type code and will consist of:

- Trip blank designation (TB)
- Dash
- One or two digit numerical identification code
- Dash
- Blank LOT number
- Example: TB-01-LOT#

13.2 Sample Labeling

Sample labels will be affixed to each sample at the time of collection. The label will include at a minimum the following information:

- Sample identification number
- Date and time sampled
- Preservatives added (as required)
- Sampler's initials
- Analyses required

The above information will be recorded in the field book, as discussed in **Section 2**. Details regarding sample shipment are provided in the following sections. Additional details regarding COC documentation and other sample analysis details will be provided in the Universal Waste Quality Assurance Project Plan (QAPP).

13.3 Sample Handling, Packing, and Shipment

Procedures for sample handling, sample packing, sample naming, sample labeling, sample shipment, COC procedures, and sample hold times are discussed in this section.

13.3.1 Sample Containers

Certified commercially clean sample containers will be obtained from the contract analytical laboratory. The appropriate sample containers for the specific analyses required for the project are listed in **Table 3-1**.

13.3.2 Sample Preservation

Samples will be pre-preserved as required to retard chemical and biological changes that may occur in response to changes in physical conditions. Chemical preservatives, if necessary, will be added to the sample containers by the laboratory prior to shipment to the field. Once groundwater samples are collected in the pre-preserved containers, the containers will be labeled (see **Section 13.2**), checked for tightness as a measure of additional security, placed in re-sealable plastic storage bags, and wrapped in protective packing material (bubble wrap). Samples will immediately be placed upright in a cooler containing ice packs to maintain the required temperature of 4 degrees Celsius. Freezing samples will not be permitted.

13.3.3 Sample Packing

The sample cooler will be lined with a laboratory-supplied plastic liner, or a clean and disposable plastic garbage liner that will adequately seal the cooler, and bubble wrap to minimize breakage during sample shipment. Glass containers will be wrapped and cushioned in a packing material such as bubble wrap to minimize breakage during sample shipment. Samples will carefully be placed upright in coolers for storage and shipment. The remainder of the cooler will be filled with ice packs sealed in double plastic bags to maintain the required temperature of 4 degrees Celsius. A temperature blank will be included in each cooler for temperature measurement purposes. The plastic liner will be adequately tied off to minimize the chance for leakage. A COC form will be provided in each shipping container. The custody seal number will be written on the COC form prior to sealing the container. The COC form should be placed in a plastic bag and adhered to the lid of the sample cooler for protection.

If the coolers are being shipped, each cooler will be taped shut to form an adequate seal around the lid to prevent leakage. Custody seals are pre-printed, adhesive-backed seals with security slots designed to break if the seals are disturbed. If custody seals are provided for individual sample bottles, they will be placed over the cap of individual sample bottles by the sampling technician. Custody seals provided by the laboratory will be affixed to the sample shipping containers (coolers, cardboard boxes, etc., as appropriate) in as many places as necessary to ensure security. Custody seals shall be signed and dated before use. Strapping tape should be placed around the lid to ensure that seals are not accidentally broken during shipment and in a manner that allows easy removal by laboratory personnel. On receipt at the laboratory, the custodian shall check (and certify, by completing logbook entries) that seals on boxes and bottles are intact. If tampering is apparent, the laboratory will contact the PM, and the sample will not be analyzed.

13.3.4 Sample Hold Times

Samples will be shipped by overnight express carrier for delivery to the contracted laboratory. Samples shall be shipped for laboratory receipt and analyses within specific holding times. This may require daily shipment of samples with short holding times. The hold time varies for each type of analysis. It will be necessary to check with the lab to verify the hold times to determine how frequently samples need to be sent to the lab. Hold times for the chemical analysis are included in **Table 3-1**.

13.3.5 Sample Shipment

Once the samples are collected, they shall remain in the custody of the sampler or another worker from the Site. The samples can also remain unattended in a locked vehicle such that tampering with the samples will not be possible. Right before shipment, a custody seal should be placed over the opening of the cooler and then the cooler should be taped all the way around with clear packing tape to prevent tampering with the samples; see **Section 13.3.3** for a full description on sample packing. Shipping containers will conform to USDOT shipping regulations. Samples will be transmitted to the analytical laboratory by shipping coolers overnight express-delivery (i.e., Federal Express) within 24 to 48 hours from the time of collection to initiate analyses within the specified holding times. Upon receipt in the laboratory, the Sample Custodian (or representative) will be responsible for obtaining the necessary shipping documentation and verifying the data entered into the laboratory sample custody records. The temperature of the coolers will be measured upon receipt at the laboratory. Shipping containers (insulated coolers) will be cleaned between shipments to prevent potential cross-contamination.

13.3.6 Sample Replacement

If unforeseen circumstances arise and a sample is broken or lost, the sample will not be replaced unless the laboratory does not have sufficient sample volume to run the sample. It is standard procedure to collect a surplus sample volume to be sent for analysis.

13.3.7 Chain-of-Custody

COC procedures will be instituted and followed throughout the sampling activities. Samples are physical evidence and will be handled according to strict COC protocols. A COC form will accompany the sample container from the initial sample container selection and preparation at the laboratory, to sample collection and preservation in the field, to the return of the samples to the laboratory. The COC form will trace the path of each individual sample container by means of a unique identification number. When possible, sample designation/location numbers will be pre-printed by the laboratory on the COC form and bottle labels.

Personnel receiving the sample containers will verify the integrity of the seals on each cooler, as well as document the presence/absence of headspace in the VOC vials. Shuttles with broken seals will be returned to the laboratory with the contents unused, assuming the cooler is intact. The receiving personnel will break the seal, inspect the contents for breakage, record the internal temperature of the shipping containers, and sign the COC form to certify receipt of the sample containers.

The field sampler is personally responsible for the care and custody of the sample until it is transferred. For proper identification in the field and proper tracking by the analytical laboratory, samples will be labeled in a clear and consistent fashion.

Field personnel will record the following information with permanent ink on the COC:

- Project identification and number
- Sample description/location
- Required analysis
- Date and time of sample collection
- Type and matrix of sample
- Number of sample containers
- Analysis requested/comments
- Sampler signature/date/time
- Airbill number
- Custody seal number

The “remarks” column of the COC form will be used to record specific considerations associated with sample acquisition such as sample type, container type, sample preservation methods, and analysis to be performed. The source of reagents, field blank water, and supplies will be documented in the field notebook. The laboratory will maintain a file of the completed original forms. Copies will be submitted as part of the final analytical report. If samples are split and sent to different laboratories, each sample will receive a unique COC form.

Samples will remain in the custody of the sampler until transfer of custody is completed. Transfer consists of:

- Delivery of samples to the laboratory sample custodian.
- Signature of the laboratory sample custodian on the COC document upon receipt of the samples, and signature of sampler upon relinquishing the samples.
- If a carrier is used to take samples between the sampler and the laboratory, then the signature on the air bill relinquishes the samples.

When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the COC. The field sampler will sign the COC form when relinquishing custody, make a copy to keep with the field logbook, and include the original form in an air-tight plastic bag in the sample cooler with the associated samples. The laboratory will assign a number for each sample upon receipt. That sample number will be placed on the sample label.

13.4 Analytical Laboratory Data Deliverables

The Category B data package includes:

- Detailed summary of the report contents and any QC outliers or corrective actions taken
- COC documentation

- Sample Information including date collected, date extracted, date analyzed, and analytical methods
- Data (including raw data) for:
  - Samples
  - Laboratory duplicates
  - Method blanks
  - Spikes and spike duplicates
  - Surrogate recoveries
  - Internal standard recoveries and retention time summary
  - Calibration standards
  - Chromatograms
  - Any other applicable QC data as applicable to NYSDEC ASP
- Method detection limits and/or instrument detection limits
- Run logs, standard preparation logs, and sample preparation logs
- Percent solids (where applicable)

The data package provided by the laboratory will contain the items discussed above in a “Contract Laboratory Program (CLP) equivalent” format. Data quality issues will be discussed in a case narrative included with the data report. The completed copies of the COC records (both external and internal) accompanying each sample from time of initial bottle preparation to completion of analyses shall be attached to the analytical reports.

The electronic data deliverable (EDD) format required is the current format per Earthsoft EQuIS Environmental Data Management Software. Each EDD shall be formatted and copied using an MS-DOS operating system. To avoid transcription errors, data will be loaded directly into the ASCII format from the Laboratory Information Management System (LIMS). If this cannot be accomplished, the consultant should be notified via letter of transmittal indicating that manual entry of data is required for a particular method of analysis. EDDs shall also undergo a QC check by the laboratory before delivery. The original data, tabulations, and electronic media are stored in a secure and retrievable fashion.

The PM or Task Manager will maintain close contact with the QA reviewer to ensure that nonconformance issues are resolved prior to use of the data.

14 References

API. (1998). Recommended Practices for Core Analysis. February.

ASTM. (2017). ASTM D425-17, Standard Test Method for Centrifuge Moisture Equivalent of Soils.

ASTM. (2020). ASTM D4464-15 - Standard Test Method for Particle Size Distribution of Catalytic Materials by Laser Light Scattering.

NYSDEC. (2009). Groundwater Monitoring Well Decommissioning Procedures. August.

NYSDEC. (2010). DER-10; Technical Guidance for Site Investigation and Remediation. May.

Tables

TABLE 3-1
SAMPLE CONTAINER, PRESERVATIVE, AND HOLDING TIME REQUIREMENTS
Hercules, Inc. Site
Port Ewen, New York

Parameter	Analytical Method	Container Type & Size	Preservation[(a)]	Holding Time[(b)]
Groundwater Samples				
TCL VOCs	8260D	3 x 40 mL glass vial	Cool to 4°C HCl	14 days
TAL Metals	6010C	1 x 250 mL polyethylene or glass bottle	HNO_3 to a pH < 2	6 months
Mercury	7470A	1 x 250 mL polyethylene or glass bottle	HNO_3 to a pH < 2	28 days
1,4-Dioxane	8270E SIM	2 x 4 oz. amber wide mouth glass jars with Teflon-lined cap	Cool to 4°C	14 days to extract; analyze 40 days from extraction
PFAS	537.1	2 x 125 mL HDPE bottle	Cool to 4°C	
Surface Water Samples				
TCL VOCs	8260D	3 x 40 mL glass vial	Cool to 4°C HCl	14 days
TAL Metals	200.7/6010C	2 x 250 mL polyethylene or glass bottle	HNO_3 to a pH < 2	6 months
Mercury	7470A	2 x 4 oz. wide mouth glass jars with Teflon-lined cap	Cool to 4°C	28 days
Total Hardness (as $CaC0_3$)	EPA SM2340C	250 mL polyethylene or glass bottle	HNO_3 to a pH < 2	180 days
Alkalinity (Bicarbonate Alkalinity as $CaCO_3$)	EPA SM2320B	250 mL polyethylene or glass bottle	Cool to 4°C	14 days
Dissolved Organic Carbon (DOC)	EPA 5310D	6 oz. wide mouth glass jars with Teflon-lined cap	Cool to 4°C	28 days
Inorganic Anions	EPA 300.0	125 mL polyethylene or glass bottle	Cool to 4°C	28 days
Soil Samples				
TCL VOCs	8260D	2 x 40 mL glass vial w/stir bar & water 1 x 40 mL glass vial w/MeOH	Freeze at < 0°C Cool to 4°C	14 days
TAL Metals	200.7/6010C	2 x 250 mL polyethylene or glass bottle	HNO_3 to a pH < 2	6 months
Mercury	7471B	2 x 4 oz. wide mouth glass jars with Teflon-lined cap	Cool to 4°C	28 days
1,4-Dioxane	8270E SIM	2 x 4 oz. amber wide mouth glass jars with Teflon-lined cap	Cool to 4°C	14 days to extract; analyze 40 days from extraction
SPLP PFAS	1312	1 x 4 oz. HDPE wide mouth jar	Cool to 4°C	28 days
Sediment Samples				
TAL Metals	200.7/6010A	4 oz. wide mouth glass jars with Teflon-lined cap	Cool to 4°C	6 months
Mercury	7471B	4 oz. wide mouth glass jars with Teflon-lined cap	Cool to 4°C	28 days
Acid Volatile Sulfides (AVS)	EPA 821-R-91-100	2 ounce glass septa cap; jar filled to zero headspace	Cool to 4°C	14 days
Simultaneously Extracted Metals (SEM) - Cadmium	EPA 6020A			
SEM - Copper	EPA 6020A			
SEM - Lead	EPA 6020A			
SEM - Mercury	EPA 6020A			
SEM - Nickel	EPA 6020A			
SEM - Silver	EPA 6020A			
SEM - Zinc	EPA 6020A			
Total Organic Carbon	Lloyd Kahn	4 oz. wide mouth glass jars with Teflon-lined cap	Cool to 4°C	14 days
Grain Size Distribution	ASTM D422	16 oz. wide mouth glass jars	None	None
Pore Water Samples				
TAL Metals	200.7/6010A	250 mL polyethylene or glass bottle	HNO_3 to a pH < 2	6 months
Mercury	7470A	4 oz. wide mouth glass jars with Teflon-lined cap	Cool to 4°C	28 days
Total Hardness (as $CaC0_3$)	EPA SM2340C	250 mL polyethylene or glass bottle	HNO_3 to a pH < 2	180 days
Alkalinity (Bicarbonate Alkalinity as $CaCO_3$)	EPA SM2320B	250 mL polyethylene or glass bottle	Cool to 4°C	14 days
Dissolved Organic Carbon (DOC)	EPA 5310D	6 oz. wide mouth glass jars with Teflon-lined cap	Cool to 4°C	28 days
Inorganic Anions	EPA 300.0	125 mL polyethylene or glass bottle	Cool to 4°C	28 days
Waste Characterization Samples (Solids)				
TCLP VOCs	1311/ 8260D	2 x 4 oz or larger wide mouth glass jars with Teflon-lined cap	Cool to 4°C	14 days to extract; analyze 14 days from extraction
TCLP SVOCs	1311/8270E	2 x 4 oz or larger amber wide mouth glass jars with Teflon-lined cap	Cool to 4°C	14 days to extract; analyze 40 days from extraction
TCLP Metals	1311/ 6010	2 x 4 oz. wide mouth glass jars with Teflon-lined cap	Cool to 4°C	14 days to extract; analyze 6 months from extraction
TCLP Mercury	1311/7470	2 x 4 oz. wide mouth glass jars with Teflon-lined cap	Cool to 4°C	14 days to extract; analyze 28 days from extraction
TAL Metals	200.7/6010C	2 x 4 oz. wide mouth glass jars with Teflon-lined cap	HNO_3 to a pH < 2	6 months
Total PCBs	8082	2 x 4 oz amber wide mouth glass jars with Teflon-lined cap	Cool to 4°C; store in dark place	1 Year; analyze 40 days from extraction
Total Petroleum Hydrocarbons (DRO)	8015 Modified	2 x 4 oz. wide mouth glass jars with Teflon-lined cap	Cool to 4°C	14 days to extract; analyze 40 days from extraction
Total Petroleum Hydrocarbons (GRO)	8015 Modified	2 x 4 oz. wide mouth glass jars with Teflon-lined cap	Cool to 4°C	14 days
Corrosivity	9045D	2 x 4 oz. wide mouth glass jars with Teflon-lined cap	Cool to 4°C	ASAP
Ignitability	1010A	2 x 4 oz amber wide mouth glass jars with Teflon-lined cap	Cool to 4°C	NONE
Reactive Cyanide and Sulfide	SW-846 7.3.3.2 (2)	2 x 4 oz or larger wide mouth glass jars with Teflon-lined cap	Cool to 4°C; store in dark place	28 days
Total Organic Halogens	9020B	2 x 4 oz amber wide mouth glass jars with Teflon-lined cap	Cool to 4°C	28 days

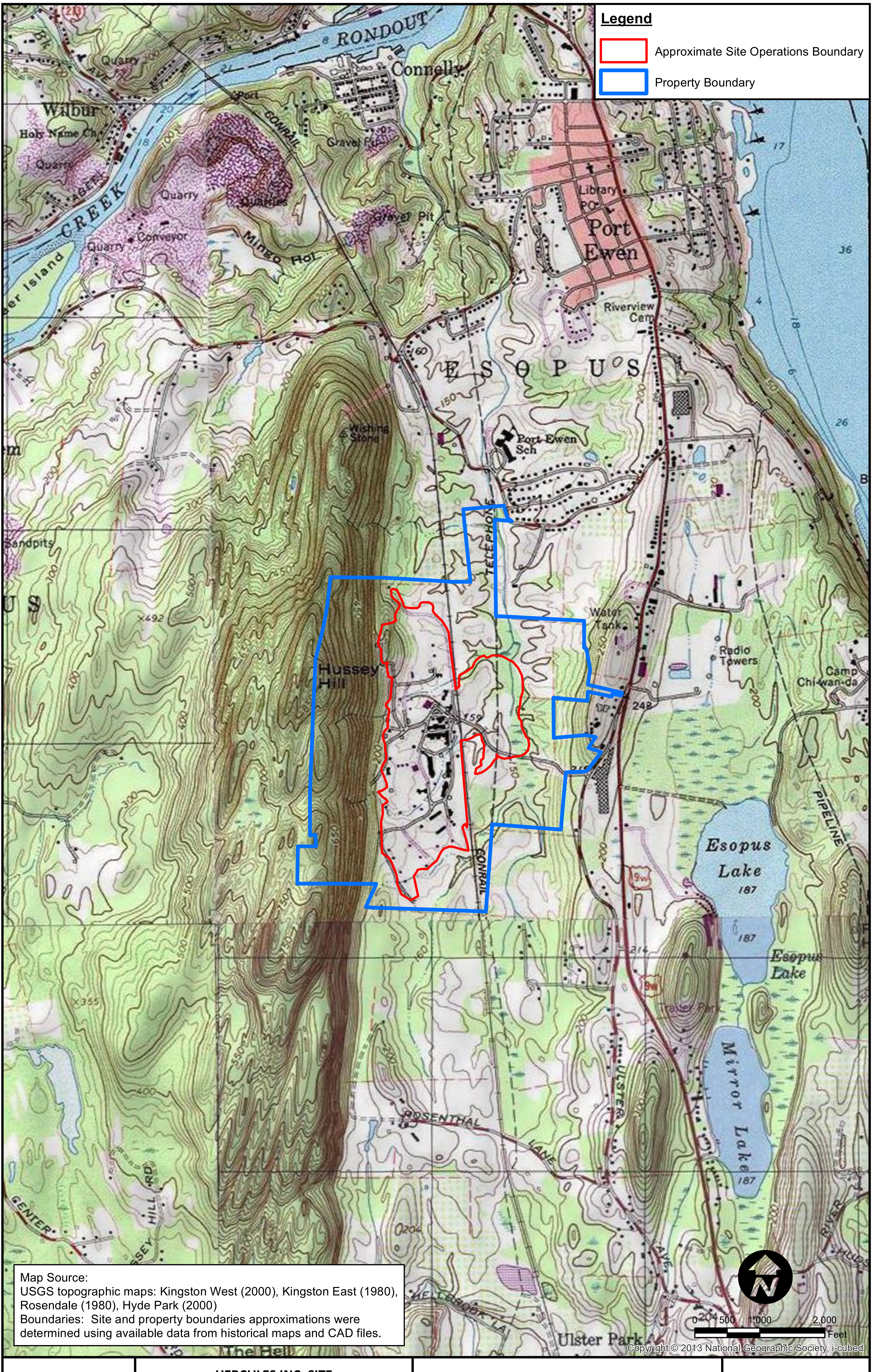
Notes:
(a) All samples to be preserved on ice during collection and transport
(b) Holding times are based on verified time of sample receipt at the laboratory

°C = degrees Celsius
ASAP = as soon as possible
$CaCO_3$ = calcium carbonate
DRO = diesel range organics
GRO = gas range organics
HCl = hydrochloric acid
HDPE = high-density polyethylene
HNO_3 = nitric acid

MeOH = methanol
mL = milliliter
oz = ounce
PCBs = Polychlorinated Biphenyls
PFAS = per- and polyfluoroalkyl substances
SIM = selected ion monitoring
SPLP = synthetic precipitation leaching procedure
SVOCs = Semi-Volatile Organic Compounds

TAL = Target Analyte List
TCL = Target Compound List
TCLP = Toxicity Characteristic Leaching Procedure
VOCs = Volatile Organic Compounds

Figures



Legend

🟥 Approximate Site Operations Boundary

🟦 Property Boundary

Map Source:
USGS topographic maps: Kingston West (2000), Kingston East (1980), Rosendale (1980), Hyde Park (2000)
Boundaries: Site and property boundaries approximations were determined using available data from historical maps and CAD files.

EHS Support

HERCULES INC. SITE
ULSTER COUNTY, NEW YORK
REGISTRY NO. 356001

SITE LOCATION MAP

FIGURE 1-1

Reviewed By: K. VanLandingham

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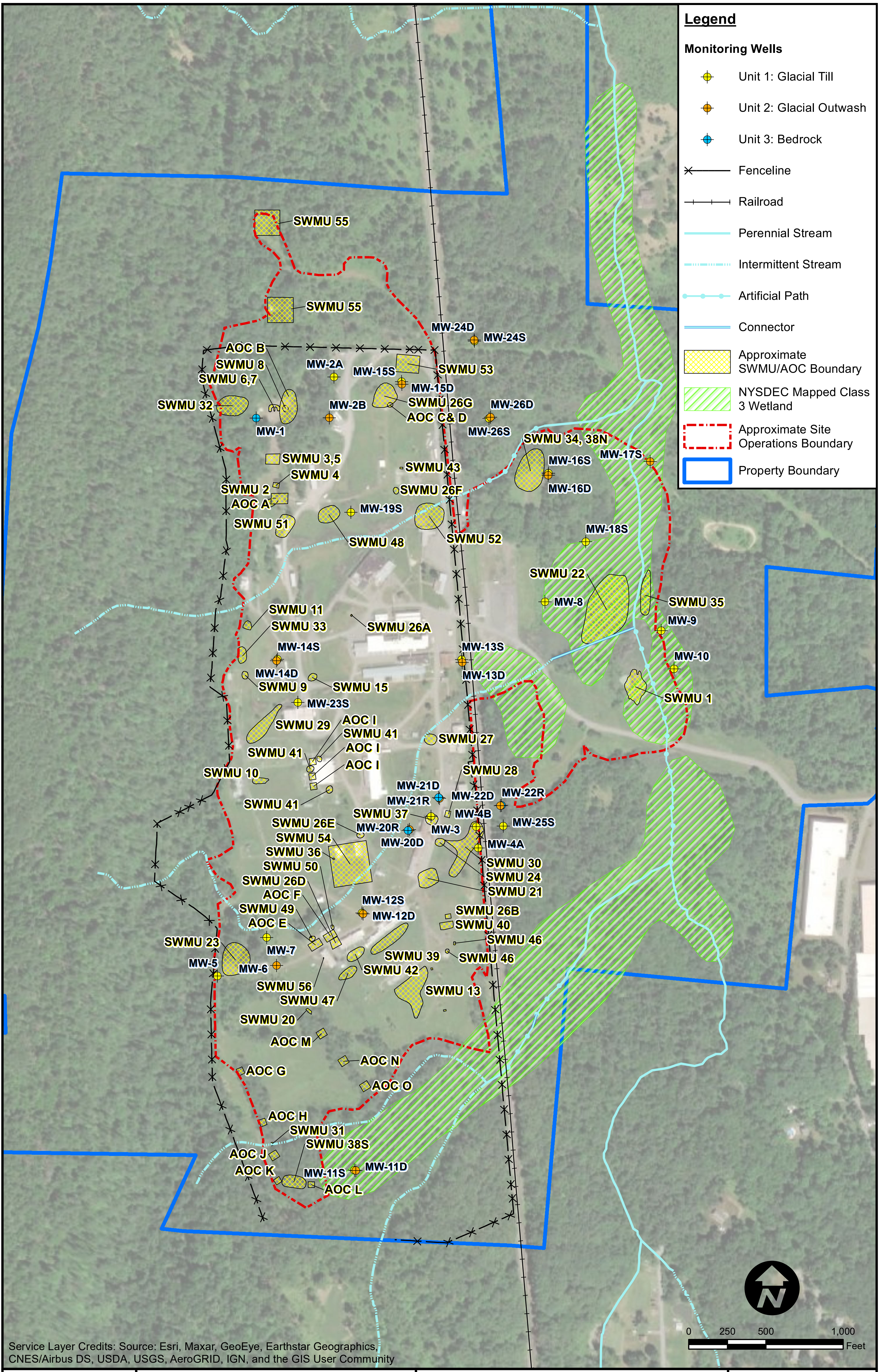

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

J:\EHSS_GIS\C00363_AshlandPortEwen\01_ANALYSIS\20190605_PublicOutreachPosters\11x17_Figures\Figure 2-2 - Site Layout.mxd

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Reviewed By: K. VanLandingham

EHS Support	HERCULES INC. SITE ULSTER COUNTY, NEW YORK REGISTRY NO. 356001	SITE LAYOUT	FIGURE 1-2

Attachment A PFAS Sampling Guidelines

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

SAMPLING, ANALYSIS, AND ASSESSMENT OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS)

Under NYSDEC's Part 375 Remedial Programs

October 2020

www.dec.ny.gov

Table of Contents

October 2020

ERRATA SHEET for

SAMPLING, ANALYSIS, AND ASSESSMENT OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) Under NYSDEC's Part 375 Remedial Programs Issued January 17, 2020

Citation and Page Number	Current Text	Corrected Text	Date
Title of Appendix I, page 32	Appendix H	Appendix I	2/25/2020
Document Cover, page 1	Guidelines for Sampling and Analysis of PFAS	Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs	9/15/2020
Routine Analysis, page 9	"However, laboratories analyzing environmental samples…PFOA and PFOS in drinking water by EPA Method 537, 537.1 or ISO 25101."	"However, laboratories analyzing environmental samples…PFOA and PFOS in drinking water by EPA Method 537, 537.1, ISO 25101, or Method 533."	9/15/2020
Additional Analysis, page 9, new paragraph regarding soil parameters	None	"In cases where site-specific cleanup objectives for PFOA and PFOS are to be assessed, soil parameters, such as Total Organic Carbon (EPA Method 9060), soil pH (EPA Method 9045), clay content (percent), and cation exchange capacity (EPA Method 9081), should be included in the analysis to help evaluate factors affecting the leachability of PFAS in site soils."	9/15/2020
Data Assessment and Application to Site Cleanup Page 10	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFAS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Target levels for cleanup of PFAS in other media, including biota and sediment, have not yet been established by the DEC.	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Preliminary target levels for cleanup of PFOA and PFOS in other media, including biota and sediment, have not yet been established by the DEC.	9/15/2020
Water Sample Results Page 10	PFAS should be further assessed and considered as a potential contaminant of concern in groundwater or surface water (…) If PFAS are identified as a contaminant of concern for a site, they should be assessed as	PFOA and PFOS should be further assessed and considered as potential contaminants of concern in groundwater or surface water (…) If PFOA and/or PFOS are identified as contaminants of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
	part of the remedy selection process in accordance with Part 375 and DER-10.		
Soil Sample Results, page 10	"The extent of soil contamination for purposes of delineation and remedy selection should be determined by having certain soil samples tested by Synthetic Precipitation Leaching Procedure (SPLP) and the leachate analyzed for PFAS. Soil exhibiting SPLP results above 70 ppt for either PFOA or PFOS (individually or combined) are to be evaluated during the cleanup phase."	"Soil cleanup objectives for PFOA and PFOS will be proposed in an upcoming revision to 6 NYCRR Part 375-6. Until SCOs are in effect, the following are to be used as guidance values. " [Guidance Value Table] "PFOA and PFOS results for soil are to be compared against the guidance values listed above. These guidance values are to be used in determining whether PFOA and PFOS are contaminants of concern for the site and for determining remedial action objectives and cleanup requirements. Site-specific remedial objectives for protection of groundwater can also be presented for evaluation by DEC. Development of site-specific remedial objectives for protection of groundwater will require analysis of additional soil parameters relating to leachability. These additional analyses can include any or all the parameters listed above (soil pH, cation exchange capacity, etc.) and/or use of SPLP. As the understanding of PFAS transport improves, DEC welcomes proposals for site-specific remedial objectives for protection of groundwater. DEC will expect that those may be dependent on additional factors including soil pH, aqueous pH, % organic carbon, % Sand/Silt/Clay, soil cations: K, Ca, Mg, Na, Fe, Al, cation exchange capacity, and anion exchange capacity. Site-specific remedial objectives should also consider the dilution attenuation factor (DAF). The NJDEP publication on DAF can be used as a reference: https://www.nj.gov/dep/srp/guidance/rs/daf.pdf. "	9/15/2020
Testing for Imported Soil Page 11	Soil imported to a site for use in a soil cap, soil cover, or as backfill is to be tested for PFAS in general conformance with DER-10, Section 5.4(e) for the PFAS Analyte List (Appendix F) using the analytical procedures discussed below and the criteria in DER-10 associated with SVOCs.	Testing for PFAS should be included any time a full TAL/TCL analyte list is required. Results for PFOA and PFOS should be compared to the applicable guidance values. If PFOA or PFOS is detected in any sample at or above the guidance values then the source of backfill should be rejected, unless a site-specific exemption is provided by DER based on SPLP testing, for example. If the concentrations of PFOA and PFOS in leachate are at or above 10 ppt (the Maximum Contaminant Levels established for drinking water by the New York State Department of Health), then the soil is not acceptable.	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
	If PFOA or PFOS is detected in any sample at or above 1 µg/kg, then soil should be tested by SPLP and the leachate analyzed for PFAS. If the SPLP results exceed 10 ppt for either PFOA or PFOS (individually) then the source of backfill should be rejected, unless a site-specific exemption is provided by DER. SPLP leachate criteria is based on the Maximum Contaminant Levels proposed for drinking water by New York State's Department of Health, this value may be updated based on future Federal or State promulgated regulatory standards. Remedial parties have the option of analyzing samples concurrently for both PFAS in soil and in the SPLP leachate to minimize project delays. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.	PFOA, PFOS and 1,4-dioxane are all considered semi-volatile compounds, so composite samples are appropriate for these compounds when sampling in accordance with DER-10, Table 5.4(e)10. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.	
Footnotes	None	[1] TOP Assay analysis of highly contaminated samples, such as those from an AFFF (aqueous film-forming foam) site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances. [2] The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the soil cleanup objective for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).	9/15/2020

October 2020

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs

Objective

New York State Department of Environmental Conservation's Division of Environmental Remediation (DER) performs or oversees sampling of environmental media and subsequent analysis of PFAS as part of remedial programs implemented under 6 NYCRR Part 375. To ensure consistency in sampling, analysis, reporting, and assessment of PFAS, DER has developed this document which summarizes currently accepted procedures and updates previous DER technical guidance pertaining to PFAS.

Applicability

All work plans submitted to DEC pursuant to one of the remedial programs under Part 375 shall include PFAS sampling and analysis procedures that conform to the guidelines provided herein.

As part of a site investigation or remedial action compliance program, whenever samples of potentially affected media are collected and analyzed for the standard Target Analyte List/Target Compound List (TAL/TCL), PFAS analysis should also be performed. Potentially affected media can include soil, groundwater, surface water, and sediment. Based upon the potential for biota to be affected, biota sampling and analysis for PFAS may also be warranted as determined pursuant to a Fish and Wildlife Impact Analysis. Soil vapor sampling for PFAS is not required.

Field Sampling Procedures

DER-10 specifies technical guidance applicable to DER's remedial programs. Given the prevalence and use of PFAS, DER has developed "best management practices" specific to sampling for PFAS. As specified in DER-10 Chapter 2, quality assurance procedures are to be submitted with investigation work plans. Typically, these procedures are incorporated into a work plan, or submitted as a stand-alone document (e.g., a Quality Assurance Project Plan). Quality assurance guidelines for PFAS are listed in Appendix A - Quality Assurance Project Plan (QAPP) Guidelines for PFAS.

Field sampling for PFAS performed under DER remedial programs should follow the appropriate procedures outlined for soils, sediments or other solids (Appendix B), non-potable groundwater (Appendix C), surface water (Appendix D), public or private water supply wells (Appendix E), and fish tissue (Appendix F).

QA/QC samples (e.g. duplicates, MS/MSD) should be collected as specified in DER-10, Section 2.3(c). For sampling equipment coming in contact with aqueous samples only, rinsate or equipment blanks should be collected.

Equipment blanks should be collected at a minimum frequency of one per day per site or one per twenty samples, whichever is more frequent.

Analysis and Reporting

As of October 2020, the United States Environmental Protection Agency (EPA) does not have a validated method for analysis of PFAS for media commonly analyzed under DER remedial programs (non-potable waters, solids). DER has developed the following guidelines to ensure consistency in analysis and reporting of PFAS.

The investigation work plan should describe analysis and reporting procedures, including laboratory analytical procedures for the methods discussed below. As specified in DER-10 Section 2.2, laboratories should provide a full Category B deliverable. In addition, a Data Usability Summary Report (DUSR) should be prepared by an independent, third party data validator. Electronic data submissions should meet the requirements provided at: https://www.dec.ny.gov/chemical/62440.html.

DER has developed a *PFAS Analyte List* (Appendix F) for remedial programs to understand the nature of contamination at sites. It is expected that reported results for PFAS will include, at a minimum, all the compounds listed. If lab and/or matrix specific issues are encountered for any analytes, the DER project manager, in consultation with the DER chemist, will make case-by-case decisions as to whether certain analytes may be temporarily or permanently discontinued from analysis at each site. As with other contaminants that are analyzed for at a site, the *PFAS Analyte List* may be refined for future sampling events based on investigative findings.

Routine Analysis

Currently, New York State Department of Health's Environmental Laboratory Approval Program (ELAP) does not offer certification for PFAS in matrices other than finished drinking water. However, laboratories analyzing environmental samples for PFAS (e.g., soil, sediments, and groundwater) under DER's Part 375 remedial programs need to hold ELAP certification for PFOA and PFOS in drinking water by EPA Method 537, 537.1, ISO 25101, or Method 533. Laboratories should adhere to the guidelines and criteria set forth in the DER's laboratory guidelines for PFAS in non-potable water and solids (Appendix H - Laboratory Guidelines for Analysis of PFAS in Non-Potable Water and Solids). Data review guidelines were developed by DER to ensure data comparability and usability (Appendix H - Data Review Guidelines for Analysis of PFAS in Non-Potable Water and Solids).

LC-MS/MS analysis for PFAS using methodologies based on EPA Method 537.1 is the procedure to use for environmental samples. Isotope dilution techniques should be utilized for the analysis of PFAS in all media. Reporting limits for PFOA and PFOS in aqueous samples should not exceed 2 ng/L. Reporting limits for PFOA and PFOS in solid samples should not exceed 0.5 µg/kg. Reporting limits for all other PFAS in aqueous and solid media should be as close to these limits as possible. If laboratories indicate that they are not able to achieve these reporting limits for the entire *PFAS Analyte List*, site-specific decisions regarding acceptance of elevated reporting limits for specific PFAS can be made by the DER project manager in consultation with the DER chemist.

Additional Analysis

Additional laboratory methods for analysis of PFAS may be warranted at a site, such as the Synthetic Precipitation Leaching Procedure (SPLP) and Total Oxidizable Precursor Assay (TOP Assay).

In cases where site-specific cleanup objectives for PFOA and PFOS are to be assessed, soil parameters, such as Total Organic Carbon (EPA Method 9060), soil pH (EPA Method 9045), clay content (percent), and cation exchange capacity (EPA Method 9081), should be included in the analysis to help evaluate factors affecting the leachability of PFAS in site soils.

SPLP is a technique used to determine the mobility of chemicals in liquids, soils and wastes, and may be useful in determining the need for addressing PFAS-containing material as part of the remedy. SPLP by EPA Method 1312 should be used unless otherwise specified by the DER project manager in consultation with the DER chemist.

Impacted materials can be made up of PFAS that are not analyzable by routine analytical methodology. A TOP Assay can be utilized to conceptualize the amount and type of oxidizable PFAS which could be liberated in the environment, which approximates the maximum concentration of perfluoroalkyl substances that could be generated if all polyfluoroalkyl substances were oxidized. For example, some polyfluoroalkyl substances may degrade or transform to form perfluoroalkyl substances (such as PFOA or PFOS), resulting in an increase in perfluoroalkyl substance concentrations as contaminated groundwater moves away from a source. The TOP Assay converts, through oxidation, polyfluoroalkyl substances (precursors) into perfluoroalkyl substances that can be detected by routine analytical methodology.[1]

Commercial laboratories have adopted methods which allow for the quantification of targeted PFAS in air and biota. The EPA's Office of Research and Development (ORD) is currently developing methods which allow for air emissions characterization of PFAS, including both targeted and non-targeted analysis of PFAS. Consult with the DER project manager and the DER chemist for assistance on analyzing biota/tissue and air samples.

Data Assessment and Application to Site Cleanup

Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Preliminary target levels for cleanup of PFOA and PFOS in other media, including biota and sediment, have not yet been established by the DEC.

Water Sample Results

PFOA and PFOS should be further assessed and considered as potential contaminants of concern in groundwater or surface water if PFOA or PFOS is detected in any water sample at or above 10 ng/L (ppt) and is determined to be attributable to the site, either by a comparison of upgradient and downgradient levels, or the presence of soil source areas, as defined below. In addition, further assessment of water may be warranted if either of the following screening levels are met:

a. any other individual PFAS (not PFOA or PFOS) is detected in water at or above 100 ng/L; or
b. total concentration of PFAS (including PFOA and PFOS) is detected in water at or above 500 ng/L

If PFOA and/or PFOS are identified as contaminants of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.

Soil Sample Results

Soil cleanup objectives for PFOA and PFOS will be proposed in an upcoming revision to 6 NYCRR Part 375-6. Until SCOs are in effect, the following are to be used as guidance values.

---

[1] TOP Assay analysis of highly contaminated samples, such as those from an AFFF (aqueous film-forming foam) site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances.

Guidance Values for Anticipated Site Use	PFOA (ppb)	PFOS (ppb)
Unrestricted	0.66	0.88
Residential	6.6	8.8
Restricted Residential	33	44
Commercial	500	440
Industrial	600	440
Protection of Groundwater[2]	1.1	3.7

PFOA and PFOS results for soil are to be compared against the guidance values listed above. These guidance values are to be used in determining whether PFOA and PFOS are contaminants of concern for the site and for determining remedial action objectives and cleanup requirements. Site-specific remedial objectives for protection of groundwater can also be presented for evaluation by DEC. Development of site-specific remedial objectives for protection of groundwater will require analysis of additional soil parameters relating to leachability. These additional analyses can include any or all the parameters listed above (soil pH, cation exchange capacity, etc.) and/or use of SPLP.

As the understanding of PFAS transport improves, DEC welcomes proposals for site-specific remedial objectives for protection of groundwater. DEC will expect that those may be dependent on additional factors including soil pH, aqueous pH, % organic carbon, % Sand/Silt/Clay, soil cations: K, Ca, Mg, Na, Fe, Al, cation exchange capacity, and anion exchange capacity. Site-specific remedial objectives should also consider the dilution attenuation factor (DAF). The NJDEP publication on DAF can be used as a reference: https://www.nj.gov/dep/srp/guidance/rs/daf.pdf.

Testing for Imported Soil

Testing for PFAS should be included any time a full TAL/TCL analyte list is required. Results for PFOA and PFOS should be compared to the applicable guidance values. If PFOA or PFOS is detected in any sample at or above the guidance values then the source of backfill should be rejected, unless a site-specific exemption is provided by DER based on SPLP testing, for example. If the concentrations of PFOA and PFOS in leachate are at or above 10 ppt (the Maximum Contaminant Levels established for drinking water by the New York State Department of Health), then the soil is not acceptable.

PFOA, PFOS and 1,4-dioxane are all considered semi-volatile compounds, so composite samples are appropriate for these compounds when sampling in accordance with DER-10, Table 5.4(e)10. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.

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[2] The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the guidance value for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).

Appendix A - Quality Assurance Project Plan (QAPP) Guidelines for PFAS

The following guidelines (general and PFAS-specific) can be used to assist with the development of a QAPP for projects within DER involving sampling and analysis of PFAS.

General Guidelines in Accordance with DER-10

- Document/work plan section title – Quality Assurance Project Plan
- Summarize project scope, goals, and objectives
- Provide project organization including names and resumes of the project manager, Quality Assurance Officer (QAO), field staff, and Data Validator
    - The QAO should not have another position on the project, such as project or task manager, that involves project productivity or profitability as a job performance criterion
- List the ELAP-approved lab(s) to be used for analysis of samples
- Include a site map showing sample locations
- Provide detailed sampling procedures for each matrix
- Include Data Quality Usability Objectives
- List equipment decontamination procedures
- Include an "Analytical Methods/Quality Assurance Summary Table" specifying:
    - Matrix type
    - Number or frequency of samples to be collected per matrix
    - Number of field and trip blanks per matrix
    - Analytical parameters to be measured per matrix
    - Analytical methods to be used per matrix with minimum reporting limits
    - Number and type of matrix spike and matrix spike duplicate samples to be collected
    - Number and type of duplicate samples to be collected
    - Sample preservation to be used per analytical method and sample matrix
    - Sample container volume and type to be used per analytical method and sample matrix
    - Sample holding time to be used per analytical method and sample matrix
- Specify Category B laboratory data deliverables and preparation of a DUSR

Specific Guidelines for PFAS

- Include in the text that sampling for PFAS will take place
- Include in the text that PFAS will be analyzed by LC-MS/MS for PFAS using methodologies based on EPA Method 537.1
- Include the list of PFAS compounds to be analyzed (*PFAS Analyte List*)
- Include the laboratory SOP for PFAS analysis
- List the minimum method-achievable Reporting Limits for PFAS
    - Reporting Limits should be less than or equal to:
        - Aqueous – 2 ng/L (ppt)
        - Solids – 0.5 µg/kg (ppb)
- Include the laboratory Method Detection Limits for the PFAS compounds to be analyzed
- Laboratory should have ELAP certification for PFOA and PFOS in drinking water by EPA Method 537, 537.1, EPA Method 533, or ISO 25101
- Include detailed sampling procedures
    - Precautions to be taken
    - Pump and equipment types
    - Decontamination procedures
    - Approved materials only to be used
- Specify that regular ice only will be used for sample shipment

- Specify that equipment blanks should be collected at a minimum frequency of 1 per day per site for each matrix

Appendix B - Sampling Protocols for PFAS in Soils, Sediments and Solids

General

The objective of this protocol is to give general guidelines for the collection of soil, sediment and other solid samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Containers

Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in to contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel spoon
- stainless steel bowl
- steel hand auger or shovel without any coatings

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Sampling is often conducted in areas where a vegetative turf has been established. In these cases, a pre-cleaned trowel or shovel should be used to carefully remove the turf so that it may be replaced at the conclusion of sampling. Surface soil samples (e.g. 0 to 6 inches below surface) should then be collected using a pre-cleaned, stainless steel spoon. Shallow subsurface soil samples (e.g. 6 to ~36 inches below surface) may be collected by digging a hole using a pre-cleaned hand auger or shovel. When the desired subsurface depth is reached, a pre-cleaned hand auger or spoon shall be used to obtain the sample.

When the sample is obtained, it should be deposited into a stainless steel bowl for mixing prior to filling the sample containers. The soil should be placed directly into the bowl and mixed thoroughly by rolling the material into the middle until the material is homogenized. At this point the material within the bowl can be placed into the laboratory provided container.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A soil log or sample log shall document the location of the sample/borehole, depth of the sample, sampling equipment, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix C - Sampling Protocols for PFAS in Monitoring Wells

General

The objective of this protocol is to give general guidelines for the collection of groundwater samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include: stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation’s Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including plumbers tape and sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel inertia pump with HDPE tubing
- peristaltic pump equipped with HDPE tubing and silicone tubing
- stainless steel bailer with stainless steel ball
- bladder pump (identified as PFAS-free) with HDPE tubing

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Monitoring wells should be purged in accordance with the sampling procedure (standard/volume purge or low flow purge) identified in the site work plan, which will determine the appropriate time to collect the sample. If sampling using standard purge techniques, additional purging may be needed to reduce turbidity levels, so samples contain a limited amount of sediment within the sample containers. Sample containers that contain sediment may cause issues at the laboratory, which may result in elevated reporting limits and other issues during the sample preparation that can compromise data usability. Sampling personnel should don new nitrile gloves prior to sample collection due to the potential to contact PFAS containing items (not related to the sampling equipment) during the purging activities.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Collect one equipment blank per day per site and minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers
- Additional equipment blank samples may be collected to assess other equipment that is utilized at the monitoring well
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A purge log shall document the location of the sample, sampling equipment, groundwater parameters, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix D - Sampling Protocols for PFAS in Surface Water

General

The objective of this protocol is to give general guidelines for the collection of surface water samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include: stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel cup

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Where conditions permit, (e.g. creek or pond) sampling devices (e.g. stainless steel cup) should be rinsed with site medium to be sampled prior to collection of the sample. At this point the sample can be collected and poured into the sample container.

If site conditions permit, samples can be collected directly into the laboratory container.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Collect one equipment blank per day per site and minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A sample log shall document the location of the sample, sampling equipment, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix E - Sampling Protocols for PFAS in Private Water Supply Wells

General

The objective of this protocol is to give general guidelines for the collection of water samples from private water supply wells (with a functioning pump) for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Drinking water samples collected using this protocol are intended to be analyzed for PFAS by ISO Method 25101. The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include: stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation’s Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials (e.g. plumbers tape), including sample bottle cap liners with a PTFE layer.

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Locate and assess the pressure tank and determine if any filter units are present within the building. Establish the sample location as close to the well pump as possible, which is typically the spigot at the pressure tank. Ensure sampling equipment is kept clean during sampling as access to the pressure tank spigot, which is likely located close to the ground, may be obstructed and may hinder sample collection.

Prior to sampling, a faucet downstream of the pressure tank (e.g., washroom sink) should be run until the well pump comes on and a decrease in water temperature is noted which indicates that the water is coming from the well. If the homeowner is amenable, staff should run the water longer to purge the well (15+ minutes) to provide a sample representative of the water in the formation rather than standing water in the well and piping system including the pressure tank. At this point a new pair of nitrile gloves should be donned and the sample can be collected from the sample point at the pressure tank.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- If equipment was used, collect one equipment blank per day per site and a minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers.
- A field reagent blank (FRB) should be collected at a rate of one per 20 samples. The lab will provide a FRB bottle containing PFAS free water and one empty FRB bottle. In the field, pour the water from the one bottle into the empty FRB bottle and label appropriately.
- Request appropriate data deliverable (Category B) and an electronic data deliverable
- For sampling events where multiple private wells (homes or sites) are to be sampled per day, it is acceptable to collect QC samples at a rate of one per 20 across multiple sites or days.

Documentation

A sample log shall document the location of the private well, sample point location, owner contact information, sampling equipment, purge duration, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate and available (e.g. well construction, pump type and location, yield, installation date). Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appendix F - Sampling Protocols for PFAS in Fish

This appendix contains a copy of the latest guidelines developed by the Division of Fish and Wildlife (DFW) entitled "General Fish Handling Procedures for Contaminant Analysis" (Ver. 8).

Procedure Name: General Fish Handling Procedures for Contaminant Analysis

Number: FW-005

Purpose: This procedure describes data collection, fish processing and delivery of fish collected for contaminant monitoring. It contains the chain of custody and collection record forms that should be used for the collections.

Organization: Environmental Monitoring Section
Bureau of Ecosystem Health
Division of Fish and Wildlife (DFW)
New York State Department of Environmental Conservation (NYSDEC)
625 Broadway
Albany, New York 12233-4756

Version: 8

Previous Version Date: 21 March 2018

Summary of Changes to this Version: Updated bureau name to Bureau of Ecosystem Health. Added direction to list the names of all field crew on the collection record. Minor formatting changes on chain of custody and collection records.

Originator or Revised by: Wayne Richter, Jesse Becker

Date: 26 April 2019

Quality Assurance Officer and Approval Date: Jesse Becker, 26 April 2019

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

GENERAL FISH HANDLING PROCEDURES FOR CONTAMINANT ANALYSES

A. Original copies of all continuity of evidence (i.e., Chain of Custody) and collection record forms must accompany delivery of fish to the lab. A copy shall be directed to the Project Leader or as appropriate, Wayne Richter. All necessary forms will be supplied by the Bureau of Ecosystem Health. Because some samples may be used in legal cases, it is critical that each section is filled out completely. Each Chain of Custody form has three main sections:

1. The top box is to be filled out **and signed** by the person responsible for the fish collection (e.g., crew leader, field biologist, researcher). This person is responsible for delivery of the samples to DEC facilities or personnel (e.g., regional office or biologist).

2. The second section is to be filled out **and signed** by the person responsible for the collections while being stored at DEC, before delivery to the analytical lab. This may be the same person as in (1), but it is still required that they complete the section. Also important is the **range of identification numbers** (i.e., tag numbers) included in the sample batch.

3. Finally, the bottom box is to record any transfers between DEC personnel and facilities. Each subsequent transfer should be **identified, signed, and dated**, until laboratory personnel take possession of the fish.

B. The following data are required on each **Fish Collection Record** form:

1. Project and Site Name.

2. DEC Region.

3. All personnel (and affiliation) involved in the collection.

4. Method of collection (gill net, hook and line, etc.)

5. Preservation Method.

C. The following data are to be taken on each fish collected and recorded on the **Fish Collection Record** form:

1. Tag number - Each specimen is to be individually jaw tagged at time of collection with a unique number. Make sure the tag is turned out so that the number can be read without opening the bag. Use tags in sequential order. For small fish or composite samples place the tag inside the bag with the samples. The Bureau of Ecosystem Health can supply the tags.

2. Species identification (please be explicit enough to enable assigning genus and species). Group fish by species when processing.

3. Date collected.

4. Sample location (waterway and nearest prominent identifiable landmark).

5. Total length (nearest mm or smallest sub-unit on measuring instrument) and weight (nearest g or

smallest sub-unit of weight on weighing instrument). Take all measures as soon as possible with calibrated, protected instruments (e.g. from wind and upsets) and prior to freezing.

6. Sex - fish may be cut enough to allow sexing or other internal investigation, but do not eviscerate. Make any incision on the right side of the belly flap or exactly down the midline so that a left-side fillet can be removed.

D. General data collection recommendations:

1. It is helpful to use an ID or tag number that will be unique. It is best to use metal striped bass or other uniquely numbered metal tags. If uniquely numbered tags are unavailable, values based on the region, water body and year are likely to be unique: for example, R7CAY11001 for Region 7, Cayuga Lake, 2011, fish 1. If the fish are just numbered 1 through 20, we have to give them new numbers for our database, making it more difficult to trace your fish to their analytical results and creating an additional possibility for errors.

2. Process and record fish of the same species sequentially. Recording mistakes are less likely when all fish from a species are processed together. Starting with the bigger fish species helps avoid missing an individual.

3. If using Bureau of Ecosystem Health supplied tags or other numbered tags, use tags in sequence so that fish are recorded with sequential Tag Numbers. This makes data entry and login at the lab and use of the data in the future easier and reduces keypunch errors.

4. Record length and weight as soon as possible after collection and before freezing. Other data are recorded in the field upon collection. An age determination of each fish is optional, but if done, it is recorded in the appropriate “Age” column.

5. For composite samples of small fish, record the number of fish in the composite in the Remarks column. Record the length and weight of each individual in a composite. All fish in a composite sample should be of the same species and members of a composite should be visually matched for size.

6. Please submit photocopies of topographic maps or good quality navigation charts indicating sampling locations. GPS coordinates can be entered in the Location column of the collection record form in addition to or instead for providing a map. These records are of immense help to us (and hopefully you) in providing documented location records which are not dependent on memory and/or the same collection crew. In addition, they may be helpful for contaminant source trackdown and remediation/control efforts of the Department.

7. When recording data on fish measurements, it will help to ensure correct data recording for the data recorder to call back the numbers to the person making the measurements.

E. Each fish is to be placed in its own individual plastic bag. For small fish to be analyzed as a composite, put all of the fish for one composite in the same bag but use a separate bag for each composite. It is important to individually bag the fish to avoid difficulties or cross contamination when processing the fish for chemical analysis. Be sure to include the fish’s tag number inside the bag, preferably attached to the fish with the tag number turned out so it can be read. Tie or otherwise secure the bag closed. **<u>The Bureau of Ecosystem Health will supply the bags.</u>** If necessary, food grade bags may be procured from a suitable vendor (e.g., grocery store). It is preferable to redundantly label each bag with a manila tag tied between the knot and the body of the bag. This tag should be labeled with the project name, collection location, tag number, collection date, and fish species. If scales are collected, the scale envelope should be labeled with the same information.

F. Groups of fish, by species, are to be placed in one large plastic bag per sampling location. **The Bureau of Ecosystem Health will supply the larger bags.** Tie or otherwise secure the bag closed. Label the site bag with a manila tag tied between the knot and the body of the bag. The tag should contain: project, collection location, collection date, species and **tag number ranges**. Having this information on the manila tag enables lab staff to know what is in the bag without opening it.

G. Do not eviscerate, fillet or otherwise dissect the fish unless specifically asked to. If evisceration or dissection is specified, the fish must be cut along the exact midline or on the right side so that the left side fillet can be removed intact at the laboratory. If filleting is specified, the procedure for taking a standard fillet (SOP PREPLAB 4) must be followed, including removing scales.

H. Special procedures for PFAS: Unlike legacy contaminants such as PCBs, which are rarely found in day to day life, PFAS are widely used and frequently encountered. Practices that avoid sample contamination are therefore necessary. While no standard practices have been established for fish, procedures for water quality sampling can provide guidance. The following practices should be used for collections when fish are to be analyzed for PFAS:
    No materials containing Teflon.
    No Post-it notes.
    No ice packs; only water ice or dry ice.
    Any gloves worn must be powder free nitrile.
    No Gore-Tex or similar materials (Gore-Tex is a PFC with PFOA used in its manufacture).
    No stain repellent or waterproof treated clothing; these are likely to contain PFCs.
    Avoid plastic materials, other than HDPE, including clipboards and waterproof notebooks.
    Wash hands after handling any food containers or packages as these may contain PFCs. Keep pre-wrapped food containers and wrappers isolated from fish handling.
    Wear clothing washed at least six times since purchase.
    Wear clothing washed without fabric softener.
    Staff should avoid cosmetics, moisturizers, hand creams and similar products on the day of sampling as many of these products contain PFCs (Fujii et al. 2013). Sunscreen or insect repellent should not contain ingredients with "fluor" in their name. Apply any sunscreen or insect repellent well downwind from all materials. Hands must be washed after touching any of these products.

I. All fish must be kept at a temperature <45° F (<8° C) immediately following data processing. As soon as possible, freeze at -20° C ± 5° C. Due to occasional freezer failures, daily freezer temperature logs are required. The freezer should be locked or otherwise secured to maintain chain of custody.

J. In most cases, samples should be delivered to the Analytical Services Unit at the Hale Creek field station. Coordinate delivery with field station staff and send copies of the collection records, continuity of evidence forms and freezer temperature logs to the field station. For samples to be analyzed elsewhere, non-routine collections or other questions, contact Wayne Richter, Bureau of Ecosystem Health, NYSDEC, 625 Broadway, Albany, New York 12233-4756, 518-402-8974, or the project leader about sample transfer. Samples will then be directed to the analytical facility and personnel noted on specific project descriptions.

K. A recommended equipment list is at the end of this document.

page ______ of ______

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF FISH AND WILDLIFE
FISH COLLECTION RECORD

Project and Site Name ____ DEC Region ____________

Collections made by (include all crew) ____

Sampling Method: ☐Electrofishing ☐Gill netting ☐Trap netting ☐Trawling ☐Seining ☐Angling ☐Other ______________________

Preservation Method: ☐Freezing ☐Other ________________ Notes (SWFDB survey number): ______________________

FOR LAB USE ONLY- LAB ENTRY NO.	COLLECTION OR TAG NO.	SPECIES	DATE TAKEN	LOCATION	AGE	SEX &/OR REPROD. CONDIT	LENGTH ( )	WEIGHT ( )	REMARKS

richter: revised 2011, 5/7/15, 10/4/16, 3/20/17; becker: 3/23/17, 4/26/19

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
CHAIN OF CUSTODY

I, ______________________________, of ____ collected the
(Print Name) (Print Business Address)

following on ____________________, 20____ from ____
(Date) (Water Body)

in the vicinity of ____
(Landmark, Village, Road, etc.)

Town of ____, in __________________________________ County.

Item(s) ____

____

Said sample(s) were in my possession and handled according to standard procedures provided to me prior to collection. The sample(s) were placed in the custody of a representative of the New York State Department of Environmental Conservation on ____________________________________, 20______.

____ ____________________________
Signature Date

I, ___________________________________, received the above mentioned sample(s) on the date specified and assigned identification number(s) ____ to the sample(s). I have recorded pertinent data for the sample(s) on the attached collection records. The sample(s) remained in my custody until subsequently transferred, prepared or shipped at times and on dates as attested to below.

____ ____________________
Signature Date

SECOND RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
THIRD RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
FOURTH RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
RECEIVED IN LABORATORY BY (Print Name)	TIME & DATE	REMARKS
SIGNATURE	UNIT	
LOGGED IN BY (Print Name)	TIME & DATE	ACCESSION NUMBERS
SIGNATURE	UNIT	

richter: revised 21 April 2014; becker: 23 March 2017, 26 April, 2019

NOTICE OF WARRANTY

By signature to the chain of custody (reverse), the signatory warrants that the information provided is truthful and accurate to the best of his/her ability. The signatory affirms that he/she is willing to testify to those facts provided and the circumstances surrounding the same. Nothing in this warranty or chain of custody negates responsibility nor liability of the signatories for the truthfulness and accuracy of the statements provided.

HANDLING INSTRUCTIONS

On day of collection, collector(s) name(s), address(es), date, geographic location of capture (attach a copy of topographic map or navigation chart), species, number kept of each species, and description of capture vicinity (proper noun, if possible) along with name of Town and County must be indicated on reverse.

Retain organisms in manila tagged plastic bags to avoid mixing capture locations. Note appropriate information on each bag tag.

Keep samples as cool as possible. Put on ice if fish cannot be frozen within 12 hours. If fish are held more than 24 hours without freezing, they will not be retained or analyzed.

Initial recipient (either DEC or designated agent) of samples from collector(s) is responsible for obtaining and recording information on the collection record forms which will accompany the chain of custody. This person will seal the container using packing tape and writing his signature, the time and the date across the tape onto the container with indelible marker. Any time a seal is broken, for whatever purpose, the incident must be recorded on the Chain of Custody (reason, time, and date) in the purpose of transfer block. Container then is resealed using new tape and rewriting signature, with time and date.

EQUIPMENT LIST

Scale or balance of appropriate capacity for the fish to be collected.

Fish measuring board.

Plastic bags of an appropriate size for the fish to be collected and for site bags.

Individually numbered metal tags for fish.

Manila tags to label bags.

Small envelops, approximately 2” x 3.5”, if fish scales are to be collected.

Knife for removing scales.

Chain of custody and fish collection forms.

Clipboard.

Pens or markers.

Paper towels.

Dish soap and brush.

Bucket.

Cooler.

Ice.

Duct tape.

Appendix G – PFAS Analyte List

Group	Chemical Name	Abbreviation	CAS Number
Perfluoroalkyl sulfonates	Perfluorobutanesulfonic acid	PFBS	375-73-5
	Perfluorohexanesulfonic acid	PFHxS	355-46-4
	Perfluoroheptanesulfonic acid	PFHpS	375-92-8
	Perfluorooctanesulfonic acid	PFOS	1763-23-1
	Perfluorodecanesulfonic acid	PFDS	335-77-3
Perfluoroalkyl carboxylates	Perfluorobutanoic acid	PFBA	375-22-4
	Perfluoropentanoic acid	PFPeA	2706-90-3
	Perfluorohexanoic acid	PFHxA	307-24-4
	Perfluoroheptanoic acid	PFHpA	375-85-9
	Perfluorooctanoic acid	PFOA	335-67-1
	Perfluorononanoic acid	PFNA	375-95-1
	Perfluorodecanoic acid	PFDA	335-76-2
	Perfluoroundecanoic acid	PFUA/PFUdA	2058-94-8
	Perfluorododecanoic acid	PFDoA	307-55-1
	Perfluorotridecanoic acid	PFTriA/PFTrDA	72629-94-8
	Perfluorotetradecanoic acid	PFTA/PFTeDA	376-06-7
Fluorinated Telomer Sulfonates	6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2
	8:2 Fluorotelomer sulfonate	8:2 FTS	39108-34-4
Perfluorooctane-sulfonamides	Perfluroroctanesulfonamide	FOSA	754-91-6
Perfluorooctane-sulfonamidoacetic acids	N-methyl perfluorooctanesulfonamidoacetic acid	N-MeFOSAA	2355-31-9
	N-ethyl perfluorooctanesulfonamidoacetic acid	N-EtFOSAA	2991-50-6

Appendix H - Laboratory Guidelines for Analysis of PFAS in Non-Potable Water and Solids

General

New York State Department of Environmental Conservation's Division of Environmental Remediation (DER) developed the following guidelines for laboratories analyzing environmental samples for PFAS under DER programs. If laboratories cannot adhere to the following guidelines, they should contact DER's Quality Assurance Officer, Dana Barbarossa, at dana.barbarossa@dec.ny.gov prior to analysis of samples.

Isotope Dilution

Isotope dilution techniques should be utilized for the analysis of PFAS in all media.

Extraction

For water samples, the entire sample bottle should be extracted, and the sample bottle rinsed with appropriate solvent to remove any residual PFAS.

For samples with high particulates, the samples should be handled in one of the following ways:

1. Spike the entire sample bottle with isotope dilution analytes (IDAs) prior to any sample manipulation. The sample can be passed through the SPE and if it clogs, record the volume that passed through.
2. If the sample contains too much sediment to attempt passing it through the SPE cartridge, the sample should be spiked with isotope dilution analytes, centrifuged and decanted.
3. If higher reporting limits are acceptable for the project, the sample can be diluted by taking a representative aliquot of the sample. If isotope dilution analytes will be diluted out of the sample, they can be added after the dilution. The sample should be homogenized prior to taking an aliquot.

If alternate sample extraction procedures are used, please contact the DER remedial program chemist prior to employing. Any deviations in sample preparation procedures should be clearly noted in the case narrative.

Signal to Noise Ratio

For all target analyte ions used for quantification, signal to noise ratio should be 3:1 or greater.

Blanks

There should be no detections in the method blanks above the reporting limits.

Ion Transitions

The ion transitions listed below should be used for the following PFAS:

PFOA	413 > 369
PFOS	499 > 80
PFHxS	399 > 80
PFBS	299 > 80
6:2 FTS	427 > 407
8:2 FTS	527 > 507
N-EtFOSAA	584 > 419
N-MeFOSAA	570 > 419

Branched and Linear Isomers

Standards containing both branched and linear isomers should be used when standards are commercially available. Currently, quantitative standards are available for PFHxS, PFOS, NMeFOSAA, and NEtFOSAA. As more standards become available, they should be incorporated in to the method. All isomer peaks present in the standard should be integrated and the areas summed. Samples should be integrated in the same manner as the standards.

Since a quantitative standard does not exist for branched isomers of PFOA, the instrument should be calibrated using just the linear isomer and a technical (qualitative) PFOA standard should be used to identify the retention time of the branched PFOA isomers in the sample. The total response of PFOA branched and linear isomers should be integrated in the samples and quantitated using the calibration curve of the linear standard.

Secondary Ion Transition Monitoring

Quantifier and qualifier ions should be monitored for all target analytes (PFBA and PFPeA are exceptions). The ratio of quantifier ion response to qualifier ion response should be calculated for each target analyte and the ratio compared to standards. Lab derived criteria should be used to determine if the ratios are acceptable.

Reporting

Detections below the reporting limit should be reported and qualified with a J qualifier.

The acid form of PFAS analytes should be reported. If the salt form of the PFAS was used as a stock standard, the measured mass should be corrected to report the acid form of the analyte.

Appendix I - Data Review Guidelines for Analysis of PFAS in Non-Potable Water and Solids

General

These guidelines are intended to be used for the validation of PFAS analytical results for projects within the Division of Environmental Remediation (DER) as well as aid in the preparation of a data usability summary report. Data reviewers should understand the methodology and techniques utilized in the analysis. Consultation with the end user of the data may be necessary to assist in determining data usability based on the data quality objectives in the Quality Assurance Project Plan. A familiarity with the laboratory's Standard Operating Procedure may also be needed to fully evaluate the data. If you have any questions, please contact DER's Quality Assurance Officer, Dana Barbarossa, at dana.barbarossa@dec.ny.gov.

Preservation and Holding Time

Samples should be preserved with ice to a temperature of less than 6°C upon arrival at the lab. The holding time is 14 days to extraction for aqueous and solid samples. The time from extraction to analysis for aqueous samples is 28 days and 40 days for solids.

Temperature greatly exceeds 6ºC upon arrival at the lab*	Use professional judgement to qualify detects and non-detects as estimated or rejected
Holding time exceeding 28 days to extraction	Use professional judgement to qualify detects and non-detects as estimated or rejected if holding time is grossly exceeded

*Samples that are delivered to the lab immediately after sampling may not meet the thermal preservation guidelines. Samples are considered acceptable if they arrive on ice or an attempt to chill the samples is observed.

Initial Calibration

The initial calibration should contain a minimum of five standards for linear fit and six standards for a quadratic fit. The relative standard deviation (RSD) for a quadratic fit calibration should be less than 20%. Linear fit calibration curves should have an R^2 value greater than 0.990.

The low-level calibration standard should be within 50% - 150% of the true value, and the mid-level calibration standard within 70% - 130% of the true value.

%RSD >20%	J flag detects and UJ non detects
R^2 >0.990	J flag detects and UJ non detects
Low-level calibration check <50% or >150%	J flag detects and UJ non detects
Mid-level calibration check <70% or >130%	J flag detects and UJ non detects

Initial Calibration Verification

An initial calibration verification (ICV) standard should be from a second source (if available). The ICV should be at the same concentration as the mid-level standard of the calibration curve.

ICV recovery <70% or >130%	J flag detects and non-detects

Continuing Calibration Verification

Continuing calibration verification (CCV) checks should be analyzed at a frequency of one per ten field samples. If CCV recovery is very low, where detection of the analyte could be in question, ensure a low level CCV was analyzed and use to determine data quality.

CCV recovery <70 or >130%	J flag results

Blanks

There should be no detections in the method blanks above the reporting limits. Equipment blanks, field blanks, rinse blanks etc. should be evaluated in the same manner as method blanks. Use the most contaminated blank to evaluate the sample results.

Blank Result	Sample Result	Qualification
Any detection	<Reporting limit	Qualify as ND at reporting limit
Any detection	>Reporting Limit and >10x the blank result	No qualification
>Reporting limit	>Reporting limit and <10x blank result	J+ biased high

Field Duplicates

A blind field duplicate should be collected at rate of one per twenty samples. The relative percent difference (RPD) should be less than 30% for analyte concentrations greater than two times the reporting limit. Use the higher result for final reporting.

RPD >30%	Apply J qualifier to parent sample

Lab Control Spike

Lab control spikes should be analyzed with each extraction batch or one for every twenty samples. In the absence of lab derived criteria, use 70% - 130% recovery criteria to evaluate the data.

Recovery <70% or >130% (lab derived criteria can also be used)	Apply J qualifier to detects and UJ qualifier to non detects

Matrix Spike/Matrix Spike Duplicate

One matrix spike and matrix spike duplicate should be collected at a rate of one per twenty samples. Use professional judgement to reject results based on out of control MS/MSD recoveries.

Recovery <70% or >130% (lab derived criteria can also be used)	Apply J qualifier to detects and UJ qualifier to non detects of parent sample only
RPD >30%	Apply J qualifier to detects and UJ qualifier to non detects of parent sample only

Extracted Internal Standards (Isotope Dilution Analytes)

Problematic analytes (e.g. PFBA, PFPeA, fluorotelomer sulfonates) can have wider recoveries without qualification. Qualify corresponding native compounds with a J flag if outside of the range.

Recovery <50% or >150%	Apply J qualifier
Recovery <25% or >150% for poor responding analytes	Apply J qualifier
Isotope Dilution Analyte (IDA) Recovery <10%	Reject results

Secondary Ion Transition Monitoring

Quantifier and qualifier ions should be monitored for all target analytes (PFBA and PFPeA are exceptions). The ratio of quantifier ion response to qualifier ion response should be calculated from the standards for each target analyte. Lab derived criteria should be used to determine if the ratios are acceptable. If the ratios fall outside of the laboratory criteria, qualify results as an estimated maximum concentration.

Signal to Noise Ratio

The signal to noise ratio for the quantifier ion should be at least 3:1. If the ratio is less than 3:1, the peak is discernable from the baseline noise and symmetrical, the result can be reported. If the peak appears to be baseline noise and/or the shape is irregular, qualify the result as tentatively identified.

Branched and Linear Isomers

Observed branched isomers in the sample that do not have a qualitative or quantitative standard should be noted and the analyte should be qualified as biased low in the final data review summary report. Note: The branched isomer peak should also be present in the secondary ion transition.

Reporting Limits

If project-specific reporting limits were not met, please indicate that in the report along with the reason (e.g. over dilution, dilution for non-target analytes, high sediment in aqueous samples).

Peak Integrations

Target analyte peaks should be integrated properly and consistently when compared to standards. Ensure branched isomer peaks are included for PFAS where standards are available. Inconsistencies should be brought to the attention of the laboratory or identified in the data review summary report.

Appendix C Quality Assurance Project Plan

Quality Assurance Project Plan

Hercules, Inc. (#356001)

Port Ewen, Ulster County, New York

Prepared for:

Hercules, Inc.
Dyno Nobel, Inc.

Prepared by:

EHS Support

May 2021

Table of Contents

List of Tables

List of Figures

Acronyms

%R	percent recovery
AAS	Atomic Absorption Spectrometry
ASP	Analytical Service Protocol
CAR	corrective action report
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
COC	chain-of-custody
COPC	constituent of potential concern
DER	Division of Environmental Remediation
DPT	direct push technologies
DUSR	Data Usability Summary Report
EDD	electronic data deliverable
ELAP	Environmental Laboratory Accreditation Program
ELGUA	ELG Utica Alloys, Inc.
GC	gas chromatography
HASP	Health and Safety Plan
HPLC	high-performance liquid chromatography
ICP	Inductively Coupled Plasma
IDW	investigation-derived waste
LIMS	Laboratory Information Management System
MDL	method detection limit
mL	milliliter
MS/MSD	matrix spike/matrix spike duplicate
NCM	nonconformance memo
NIOSH	National Institute of Occupational Safety and Health
NIST	National Institute of Standard and Technology
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
PCB	polychlorinated biphenyl
PID	photoionization detector
PM	Project Manager
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RI	remedial investigation
RPD	relative percent difference
SAP	Sampling and Analysis Plan

SOP	standard operating procedure
SPLP	Synthetic Precipitation Leaching Procedure
TCLP	Toxicity Characteristic Leaching Procedure
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
VOA	volatile organic analysis

1 Introduction

This Quality Assurance Project Plan (QAPP) has been prepared in support of the remedial investigation activities at the Hercules, Inc. site ("Site") in accordance with New York State Department of Environmental Conservation (NYSDEC) Administrative Order on Consent Index# CO 3-20180508-85 effective August 3, 2018. The QAPP will assure the accuracy and precision of data collection during the remedial investigation (RI) and data interpretation periods. The QAPP identifies procedures for sample collection to mitigate the potential for cross-contamination, as well as analytical requirements necessary to allow for independent data validation. The QAPP has been prepared in accordance with United States Environmental Protection Agency's (USEPA's) *Requirements for Quality Assurance Project Plans for Environmental Data Operations* (USEPA, 1998); the USEPA Region II *CERCLA Quality Assurance Manual* (USEPA, 1989); and NYSDEC's Division of Environmental Remediation (DER)-10 *Technical Guidance for Site Investigation and Remediation* (NYSDEC, 2010). Samples collected pursuant to the NYSDEC-approved work plans will be analyzed by a New York State Department of Health (NYSDOH) Environmental Laboratory Accreditation Program (ELAP)-certified laboratory. The laboratory will provide a NYSDEC Analytical Service Protocol (ASP) Category B deliverable data package to allow for data validation.

1.1 Project Description

The Site is located at 161 Ulster Avenue in Port Ewen, Ulster County, New York (**Figure 1-1**) and is listed on the New York State Inactive Hazardous Waste Site as Site No. 356001. The Site is approximately 134 acres and includes the manufacturing facility and a wetlands area that are a portion of the 412 acres that are currently owned by Dyno Nobel, Inc. (**Figure 1-2**). Acreage owned by Dyno Nobel, Inc. outside of the Site boundary is comprised of grassy, marshy, and woodlands areas. The Site has been used for the manufacture and assembly of a variety of detonators and blasting caps since 1912. Prior to its development, the land was undeveloped and primarily used for grazing and other agricultural activities. The facility is in a small valley bordered by Hussey Hill to the west and a low-lying ridge to the east (**Figure 1-1**).

1.2 Scope of Work

The major tasks for the Site RI scope of work, based on current or future work plans, may include all or some of the following tasks:

- Clearing and Grubbing
- Survey
- Geophysical Survey – Underground Utility Location
- Direct Push Technologies (DPT) Activities – Soil Coring/Sampling
- Sonic Coring – Soil Coring/Sampling and Geotechnical Sampling
- Sediment Sampling
- Surface Water Sampling
- Monitoring Well Installation and Abandonment
- Aquifer Testing
- Groundwater Sampling
- Water Level Measurement Collection

- Subcontractor Oversight
- Management of Investigation-Derived Waste (IDW)

Work included in this QAPP will be performed in accordance with the Site-specific Sampling and Analysis Plan (SAP) and the health and safety procedures described in EHS Support LLC's ("EHS Support") Site-specific Health and Safety Plan (HASP).

1.3 Data Quality Objectives

The data quality objectives for the remedial investigation activities are to define the following:

- Site physical and hydrogeological characteristics
- Physical and chemical characteristics of constituent of potential concern (COPC) sources
- Nature and extent of Site COPCs
- Potential receptors and associated exposure pathways
- Fate and transport of COPCs

2 Project Organization and Responsibility

The principal organizations involved in verifying achievement of data collection goals for the RI include:

- NYSDEC
- NYSDOH
- Hercules, Inc.
- Dyno Nobel, Inc.
- EHS Support
- Independent environmental laboratory(s)
- Independent third-party data validator

The roles, responsibilities, and required qualifications of these organizations are discussed in the following subsections.

2.1 NYSDEC and NYSDOH

It is the responsibility of NYSDEC, in conjunction with NYSDOH, to review Site work plans and supporting documents, for completeness and conformance with the Site-specific cleanup objectives and to accept or reject these documents based on this review. The NYSDEC also has the responsibility and authority to review and approve quality assurance (QA) documentation collected during Site investigation and remedial activities to confirm that the QAPP was followed.

2.2 Hercules, Inc. and Dyno Nobel, Inc.

Hercules, Inc. and Dyno Nobel, Inc. will be responsible for complying with the QA requirements as specified herein and for monitoring and controlling the quality of Site investigation and remedial activities either directly or through their designated environmental consultant and/or legal counsel. Hercules, Inc. and Dyno Nobel, Inc. will also have the authority to select Remedial Action Contractor(s) to assist them in fulfilling these responsibilities. The designated Project Manager (PM) is responsible for implementing the project and has the authority to commit the resources necessary to meet project objectives and requirements.

2.3 EHS Support

EHS Support is the primary consultant on this project and is responsible for the performance of services required to implement each phase of the Work Plan, including, but not limited to, field operations, laboratory testing, data management, data analysis, and reporting. Any member of EHS Support staff may fill more than one of the identified project positions (e.g., field team leader and Site safety and health officer). The various QA, field, laboratory, and management responsibilities of key project personnel are defined below:

EHS Support PM

The PM has the responsibility for ensuring that the project meets the Site-specific cleanup objectives. The PM will report directly to the Hercules, Inc. and Dyno Nobel, Inc. Project Coordinator(s) and the

NYSDEC/NYSDOH Project Coordinators and is responsible for technical and project oversight. The PM will:

- Define project objectives, develop detailed work plans, and work plan schedules.
- Establish project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task.
- Acquire and apply technical and corporate resources as needed to assure performance within budget and schedule constraints.
- Develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product.
- Review the work performed on each task to assure its quality, responsiveness, and timeliness.
- Review and analyze overall task performance with respect to planned requirements and authorizations.
- Review and approve deliverables before their submission to NYSDEC.
- Develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product.
- Ultimately be responsible for the preparation and quality of interim and final reports.
- Represent the project team at meetings.

EHS Support Field Team Leader

The Field Team Leader will support the EHS Support PM Manager. The Field Team Leader is responsible for leading and/or coordinating the day-to-day activities of the various resource specialists under their supervision. The Field Team Leader is a highly experienced environmental professional and will report directly to the EHS Support PM and/or Technical Manager. Specific responsibilities include:

- Coordinate day-to-day with the PM/Technical Manager on technical issues in specific areas of expertise.
- Oversee, perform, and provide support for subcontractors who may conduct the field activities identified in the work plans.
- Develop and implement field-related work plans, ensure schedule compliance, and adhere to management-developed study requirements.
- Coordinate and manage field staff (including supervising sampling and field laboratory staff).
- Act as field sample custodian (including supervising sample collectionand sample packaging.
- Implement quality control (QC) for technical data provided by the field staff including field measurement data.
- Adhere to work schedules provided by the PM.
- Authorize, write, and approve text and graphics required for field team efforts.
- Coordinate and oversee technical efforts of subcontractors assisting the field team.
- Identify problems at the field team level, resolve difficulties in consultation with the EHS Support PM/Technical Manager, implement and document corrective action procedures, and communicate with the field team and upper management.
- Participate in preparing the final report(s).
- Locate the sample and monitoring well locations.
- Maintain the field logbook(s) and sample documentation (per NYSDEC sample tracking protocol) including project photographs.

Health and Safety Officer

The Health and Safety Officer is responsible for ensuring compliance with the Site-specific HASP. Additionally, they will use air-monitoring instruments when on-site to indicate whether or not an upgrade in the level of personal protection is necessary. The Field Team Leader for this project will serve as the Health and Safety Officer.

2.4 Laboratory Team and Responsibilities

The various responsibilities of key project laboratory personnel are defined below:

Laboratory PM or Task Manager

The Laboratory PM or Task Manager will report directly to the EHS Support PM and will be responsible for the following:

- Ensure resources of the laboratory are available on an as-required basis.
- Coordinate laboratory analyses.
- Supervise in-house chain-of-custody (COC).
- Schedule sample analyses.
- Oversee data review.
- Oversee preparation of analytical reports.
- Approve final analytical reports prior to submission to EHS Support and/or NYSDEC.

Laboratory QA Officer

The QA Officer has overall responsibility for the data before it leaves the laboratory. The QA Officer will be independent of the laboratory management but will communicate data issues through the Laboratory PM. In addition, the QA Officer will perform the following:

- Oversee laboratory quality assurance.
- Conduct a detailed data review.
- Determine whether to implement laboratory corrective actions, if required.
- Define appropriate laboratory QA procedures.
- Prepare laboratory standard operating procedures.

2.5 Validation Team and Responsibilities

An independent third party will validate the data collected as part of the RI and remedial activities.

Data Validator(s)

The validator is responsible for ensuring data validation is performed in accordance with the QAPP, coordinating laboratory corrective measures, and providing technical assistance to NYSDEC data reviewers.

3 Project Objectives for the Measurement of Data

The QA/QC objectives for measurement data include precision, accuracy, representativeness, completeness, and comparability. These objectives are defined in the following subsections. They are formulated to meet the requirements of the USEPA SW-846 (USEPA, 1986)**.**

3.1 Precision

Precision is an expression of the reproducibility of measurements of the same parameter under a given set of conditions. Specifically, it is a quantitative measurement of the variability of a group of measurements compared to their average value (USEPA, 1987). Precision is usually stated in terms of standard deviation, but other estimates such as the coefficient of variation (relative standard deviation), range (maximum value minus minimum value), relative range, and relative percent difference (RPD) are common.

For this project, field sampling precision will be determined by analyzing coded duplicate samples (labeled so that the laboratory does not recognize them as duplicates) for the same parameters, and then, during data validation (**Section 7**), calculating the RPD for field duplicate sample results.

Analytical precision will be determined by the laboratory by calculating the RPD for the results of the analysis of internal QC duplicates and matrix spike duplicates. The formula for calculating RPD is as follows:

$$RPD = \left(\frac{|V1 - V2|}{\frac{V1 + V2}{2}} \right) * 100$$

Where:
RPD = relative percent difference
V1, V2 = the two values to be compared
|V1 - V2| = the absolute value of the difference between the two values
(V1 + V2)/2 = the average of the two values

QC limits for soil samples, aqueous samples, and vapor/air samples will be the limits the contracted laboratory has in place at the time of analyses.

3.2 Accuracy

Accuracy is a measure of the degree of agreement of a measured value with the true or expected value of the quantity of concern (Taylor, 1987), or the difference between a measured value and the true or accepted reference value. The accuracy of an analytical procedure is best determined by the analysis of a sample containing a known quantity of material and is expressed as the percent of the known quantity which is recovered or measured. The recovery of a given analyte is dependent upon the sample matrix, method of analysis, and the specific compound or element being determined. The concentration of the analyte relative to the detection limit of the analytical method is also a major factor in determining the accuracy of the measurement. Concentrations of analytes that are close to the detection limits are less accurate because they are more affected by such factors as instrument "noise." Higher concentrations will not be as affected by instrument noise or other variables and thus will be more accurate.

Sampling accuracy may be determined through the assessment of the analytical results of field blanks and trip blanks for each sample set. Analytical accuracy is typically assessed by examining the percent recoveries of surrogate compounds that are added to each sample (organic analyses only), and the percent recoveries of matrix spike compounds added to selected samples and laboratory blanks. Additionally, initial and continuing calibrations shall be established and be within method control limits. Instrument and method analytical accuracy can then be determined for any sample set.

Accuracy is normally measured as the percent recovery (%R) of a known amount of analyte, called a spike, added to a sample (matrix spike) or a blank (blank spike). The %R is calculated as follows:

$$\%R = \left(\frac{SSR - SR}{SA}\right) * \ 100$$

Where:
%R = percent recovery
SSR = spike sample result – the concentration of analyte obtained by analyzing the sample with the spike added
SR = sample result – the background value, i.e., the concentration of the analyte obtained by analyzing the sample
SA = spiked analyte – the concentration of the analyte spike added to the sample

QC limits for soil samples, aqueous samples, and vapor/air samples will be those of the contracted laboratory in place at the time of analyses.

3.3 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that is most concerned with the proper design of the sampling program (USEPA, 1987). Samples shall represent the environmental media being sampled. Selection of sample locations and sampling procedures will incorporate consideration of obtaining the most representative sample possible.

Field and laboratory procedures will be performed to ensure, to the degree that is technically possible, that the data derived represents the in-place quality of the material sampled. Every effort will be made to ensure that chemical compounds will not be introduced into the sample via sample containers, handling, and analysis. Decontamination of sampling devices and digging equipment will be performed between samples as outlined in the SAP. Analysis of field blanks, trip blanks, and method blanks will also be performed to monitor for potential sample contamination from field and laboratory procedures.

The assessment of representativeness also shall consider the degree of heterogeneity in the material from which the samples are collected. Sampling heterogeneity will be evaluated during data validation through the analysis of coded field duplicate samples. The analytical laboratory will also follow acceptable procedures to assure the samples are adequately homogenized prior to taking aliquots for analysis, so the reported results are representative of the sample received.

COC procedures will be followed to document that contamination of samples has not occurred during container preparation, shipment, and sampling. Details of blank, duplicate, and COC procedures are presented in **Sections 5** and **6**.

3.4 Completeness

Completeness is defined as the percentage of measurements made which are judged to be valid (USEPA, 1987). The QC objective for completeness is generation of valid data for at least 90 percent of the analyses requested. Completeness is defined as follows for sample measurements:

$$\%C = \left(\frac{V}{T}\right) * 100$$

Where:
%C = percent completeness
V = number of measurements judged valid
T = total number of measurements

3.5 Comparability

Comparability expresses the degree of confidence with which one data set can be compared to another (USEPA, 1987). The comparability of data collected for this project will be ensured by the following:

- Use identified standard methods for both sampling and analysis phases of this project.
- Require traceability of analytical standards and/or source materials to the USEPA or National Institute of Standards and Technology (NIST).
- Require that calibrations be verified with an independently traceable standard from a source other than that used for calibration (if applicable).
- Use standard reporting units and reporting formats, including reporting QC data.
- Perform a complete data validation on the analytical results, including the use of data qualifiers in all cases where appropriate.
- Require validation qualifiers to be considered any time an analytical result is used for any purpose.

These steps will ensure that future users of either the data or the conclusions drawn from them will be able to judge the comparability of these data and conclusions.

4 Sampling Program

The sampling program will provide data concerning the presence and the nature and extent of contamination of groundwater, soil, sediment, and surface water on-site. Soil borings, sediment and surface water sample collection, and groundwater monitoring wells will be used to evaluate Site conditions. This section presents sample collection procedures, sample container preparation procedures, sample preservation procedures, sample holding times, and field QC sample requirements.

4.1 Sample Collection

Soil, groundwater, surface water, and sediment samples may be collected as part of the remedial investigation. The location and frequency of sampling and the methods selected for field procedures and laboratory analysis are described in detail in the Site-specific work plans.

4.2 Sample Container Preparation and Sample Preservation

Certified commercially clean sample containers will be obtained from the contract analytical laboratory. The appropriate sample containers for the specific analyses required for the project are listed in **Table 4-1**. Samples will be pre-preserved as required to retard chemical and biological changes that may occur in response to changes in physical conditions. Chemical preservatives, if necessary, will be added to the sample containers by the laboratory prior to shipment to the field. Once groundwater samples are collected in the pre-preserved containers, the containers will be labeled, checked for tightness as a measure of additional security, placed in re-sealable plastic storage bags, and wrapped in protective packing material (bubble wrap). Samples will immediately be placed upright in a cooler containing ice packs to maintain the required temperature of 4 degrees Celsius. Freezing samples will not be permitted.

Sample preservation will be verified at the laboratory just prior to extraction, digestion, and/or analysis, and the pH will be recorded in the extraction/digestion logbook. If the samples are improperly preserved, a QA/QC discrepancy form will be submitted to the laboratory manager and QA coordinator for appropriate follow-up action (i.e., evaluation of the data during the data validation process and, if necessary, additional instruction of personnel regarding proper procedures).

4.3 Sample Holding Times

The sample holding times for organic and inorganic parameters are given in **Table 4-1** and shall be in accordance with the NYSDEC ASP requirements. Holding times for Synthetic Precipitation Leaching Procedure (SPLP) and Toxicity Characteristic Leaching Procedure (TCLP) samples are given in **Table 4-1**. The NYSDEC ASP holding times shall be strictly adhered to by the laboratory. Any holding time exceedances shall be reported to ELGUA and the EHS Support PM.

4.4 Field Quality Control Samples

To assess field sampling and decontamination performance, two types of "blanks" will be collected and submitted to the laboratory for analysis. In addition, the precision of field sampling procedures will be assessed by collecting coded field duplicates and matrix spike/matrix spike duplicates (MS/MSDs). The blanks will include the following.

- Trip Blanks – A trip blank will be prepared before the sample containers are sent by the laboratory. The trip blank will consist of two 40-milliliter (mL) volatile organic analysis (VOA) vials containing distilled, deionized water, which accompanies the other water sample bottles into the field and back to the laboratory. A trip blank will be included with each shipment of water samples for volatiles analysis. The trip blank will be analyzed for volatile organic compounds to assess any contamination from sampling, transport, storage, and internal laboratory procedures.
- Field/Equipment Rinsate Blanks – Rinsate blanks will be taken at a frequency of 1 per 20 field samples per sample matrix. Rinsate blanks are used to determine the effectiveness of the decontamination procedures for sampling equipment. The rinsate blank is a sample of reagent water provided by the laboratory that has passed through a decontaminated bailer or other sampling apparatus. It is usually collected as a last step in the decontamination procedure, prior to taking an environmental sample. The rinsate blank may be analyzed for all or some of the parameters of interest.

The duplicates collected to assess field/laboratory precision will consist of the following.

- Coded Field Duplicate – To determine the representativeness of the sampling methods, coded field duplicates will be collected. The samples are termed "coded" because they will be labeled in such a manner that the laboratory will not be able to determine that they are field duplicate samples. This will eliminate any possible bias that could arise. Field duplicates will be taken at a frequency of 1 per 20 field samples per sample matrix.
- MS/MSD – MS/MSD samples (MS/MSD for organics; MS and laboratory duplicate for inorganics) will be collected at a frequency of 1 pair per 20 field samples. MS/MSD samples are used to assess the effect of the sample matrix on the recovery of target compounds or target analytes. The advisory acceptance limits for MS/MSD %R and RPDs will be the limits the contracted laboratory has in place at the time of analyses.

The general level of QC effort will be 1 field (blind) duplicate and 1 equipment blank for every 20 or fewer investigative samples of a given matrix. Additional sample volume will also be provided to the laboratory to allow one Site-specific MS/MSD or MS/laboratory duplicate for every 20 or fewer investigative samples of a given matrix.

4.5 Decontamination Procedures

Decontamination will be performed in accordance with the Site-specific SAP and/or NYSDEC-approved, Site-specific work plan. Sampling methods and equipment have been chosen to minimize decontamination requirements and prevent the possibility of cross-contamination.

Decontamination procedures for field personnel and equipment will be followed to protect the health and safety of those present, to maintain sample integrity, and to minimize the movement of contamination between the work areas. Equipment used will be decontaminated prior to beginning work, between sampling locations and/or uses, and prior to demobilizing from the Site. In addition, care will be taken so as not to allow anything to come into contact with a sample or sample area, which may affect its composition.

Details regarding decontamination procedures are provided in the SAP. The decontamination procedure described above may be summarized as follows:

1. Physical removal of contaminants
2. Phosphate-free detergent wash
3. Tap water rinse
4. Distilled/deionized water rinse
5. Repeat distilled/deionized water rinse
6. Solvent rinse (pesticide-grade isopropanol) or nitric acid rinse, as warranted
7. Air dry
8. Distilled/deionized water rinse

Waters generated by decontamination or by developing, purging, or pumping the monitoring wells will be stored in drums or an on-site holding tank. The drill rig and associated tooling will be decontaminated using the methods described in the SAP. Fluids generated during decontamination will be collected in the plastic-lined pool. Decontamination wastes will be transferred into drums or an on-site holding tank to wait for off-site disposal at an appropriate permitted disposal facility.

4.6 Field Instruments Calibration

Field instruments will be calibrated in accordance with the manufacturer’s standard instructions immediately prior to each day's use. This calibration will ensure that the equipment is functioning within the allowable tolerances established by the manufacturer and required by the project. Records of instrument calibration will be maintained by the Field Team Leader. Copies of the instrument manuals will be maintained on-site by the Field Team Leader.

Calibration procedures for instruments used for monitoring health and safety hazards (e.g., photoionization detector [PID] and explosimeter) are provided in the HASP. More frequent calibration may be needed depending on conditions encountered in the field.

5 Sampling Handling and Custody

This section presents sample handling and custody procedures for both the field and laboratory. Implementation of proper custody procedures for samples collected in the field is the responsibility of field personnel. Both laboratory and field personnel involved in the collection and transfer of samples will be trained as to the purpose and procedures for sample custody prior to implementation.

Evidence of sample traceability and integrity is provided by COC procedures. These procedures document the sample traceability from the selection and preparation of the sample containers by the laboratory, to sample collection, sample shipment, laboratory receipt, and analysis.

5.1 Field Sample Custody

The following items describe proper field sample custody:

- Sample bottles shall be obtained pre-cleaned from the laboratory or directly from an approved retail source.
- Containers will be prepared in a manner consistent with the NYSDEC ASP bottle-washing procedures.
- Coolers or boxes containing cleaned bottles should be sealed with a custody tape seal during transport to the field or while in storage prior to use.
- Containers will have assigned lot numbers to ensure traceability through the supplier.
- As few persons as possible should handle samples.
- The sample collector is personally responsible for the care and custody of samples collected until the samples are transferred to another person or dispatched properly under COC rules.
- The sample collector will record sample data in the field notebook and on a groundwater purge and sample form.
- The PM will determine whether proper custody procedures were followed during the fieldwork and decide if additional samples are required.

A sample is considered to be in a person's custody if the sample is:

- In a person's possession
- Maintained in view after possession is accepted and documented
- Locked and tagged with custody tape seals so that no one can tamper with it after having been in physical custody
- In a secured area that is restricted to authorized personnel

5.1.1 Chain-of-Custody Form

A COC form accompanies the sample containers from the time they are selected and prepared at the laboratory, to shipment to the field for sample collection and preservation, to their return to the laboratory. Triplicate copies of the COC form shall be completed for each sample set collected. The COC form lists the field personnel responsible for taking samples, the project name and number, the name of the analytical laboratory to which the samples are sent, and the method of sample shipment (if applicable). The COC form also lists a unique description of every sample bottle in the set. If samples are split and sent to different laboratories, a copy of the COC form will be sent with each sample.

The "REMARKS" space on the COC form is used to indicate if the sample is an MS, MSD, or any other sample information for the laboratory. Since they are not specific to any one sample point, trip and field blanks are indicated on separate rows. Once bottles are properly accounted for on the COC form, a sampler will write their signature and the date and time on the first "RELINQUISHED BY" space. The sampler will also write the method of shipment, the shipping cooler identification number, the custody seal number(s), and the shipper airbill number (if applicable) on the top of the COC. Errors in field records will be crossed out with a single line in ink and initialed and dated by the author.

One copy of the COC is retained by sampling personnel and the other two copies are put into a sealable plastic bag and taped inside the lid of the shipping cooler.

5.1.2 *Custody Seals*

Custody seals are preprinted adhesive-backed seals with security slots designed to break if the seals are disturbed. If custody seals are provided for individual sample bottles they will be placed over the cap of individual sample bottles by the sampling technician. Custody seals provided by the laboratory will be affixed to the sample shipping containers (coolers, cardboard boxes, etc., as appropriate) in as many places as necessary to ensure security. Custody seals shall be signed and dated before use. Strapping tape should be placed around the lid to ensure that seals are not accidentally broken during shipment and in a manner that allows easy removal by laboratory personnel. On receipt at the laboratory, the custodian shall check (and certify, by completing logbook entries) that seals on boxes and bottles are intact. If tampering is apparent, the laboratory will contact the PM, and the sample will not be analyzed.

5.2 Sample Handling, Packaging, and Shipping

The transportation and handling of samples shall be accomplished in a manner that not only protects the integrity of the sample but also prevents any detrimental effects due to the possible hazardous nature of samples. Regulations for packaging, marking, labeling, and shipping hazardous materials are promulgated by the United States Department of Transportation (USDOT) in the Code of Federal Regulations (CFR), 49 CFR 171 through 177.

5.2.1 *Sample Packaging*

Samples shall be packaged carefully to avoid breakage or contamination and shall be shipped to the laboratory at proper temperatures. The following sample packaging requirements will be followed:

- The field sampler is personally responsible for the care and custody of the samples until they are transferred or properly dispatched. As few people as possible should handle the samples.
- Bottles will be identified by the use of sample labels with sample numbers, sampling locations, date/time of collection, and type of analysis.
- Samples are accompanied by a properly completed COC form secured to the inside top of each cooler. The sample numbers and locations will be listed on the COC form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person, a mobile laboratory, permanent laboratory, or to/from a secure storage area.
- Samples will be properly packaged on ice at 4 degrees Celsius for shipment and dispatched to the appropriate laboratory for analysis. Shipping containers will be secured with tape and custody seals for shipment to the laboratory.

5.2.2 *Shipping Procedures*

Samples will be transmitted to the analytical laboratory by shipping coolers overnight express-delivery (i.e., Federal Express) within 24 to 48 hours from the time of collection. Upon receipt in the laboratory, the Sample Custodian (or representative) will be responsible for obtaining necessary shipping documentation and verifying the data entered in the laboratory sample custody records.

5.3 Laboratory Sample Custody

The PM or Field Team Leader will notify the laboratory of upcoming field sampling activities and the subsequent shipment of samples to the laboratory. This notification will include information concerning the number and type of samples to be shipped as well as the anticipated date of arrival.

The designated sample custodian at the laboratory will be responsible for maintaining the COC for samples received at the laboratory. Among other things, the custodian shall adhere to the following basic requirements.

Upon receipt, the Sample Custodian (or designee) is responsible for completing the following:

- Inspect and document the condition of the shipping containers and sample bottles upon receipt. Measure and record the temperature (if appropriate). If appropriate at this time, measure the pH of the samples and enter the measurements in the sample log-in book (pH measurements may be taken before analysis if…).
- Verify the presence or absence of the following information for the sample shipment; note any discrepancies on the COC form:
    - Custody form
    - Sample tags/labels/seals
    - Proper sample preservation
- Unload the samples from the cooler(s)/container(s), assign an identification number to each sample container, and affix a barcode label to each sample container for logging in and out of the Laboratory Information Management System (LIMS). Adherence to this procedure will ensure that samples can be referenced in the computer tracking system.
- Record the laboratory sample ID number, job number, and client name in the sample log-in book and the database. Also record the requested turnaround time or due date, holding time, date and time collected, analytical method, matrix, and refrigerator storage location.
- Place samples in the secured refrigerator location. Alert the appropriate Section Leader of samples with short holding times or rush turnaround time requests. Note: after analysis, the analysts will return sample containers to the environmental chamber in the appropriate area.

The Laboratory PM will contact the EHS Support PM or Technical Manager to resolve discrepancies and problems such as absent documents, conflicting information, unclear analytical requests, broken custody seals, and unsatisfactory sample condition (e.g., improper preservation, leaking sample bottle).

The Laboratory PM or assistant would then record the resolution of discrepancies and problems on the COC form. The Laboratory PM may email the revised custody form back to EHS Support's PM or Technical Manager for verification. A copy of the tracking record will accompany the laboratory report and will become a permanent part of the project records.

6 Analytical Procedures

Laboratory analyses will be performed by an accredited and appropriately certified analytical laboratory. Inorganic, general analytical, and organic methods that may be performed by the laboratory for this project are listed in **Table 4-1**. Environmental data will be reported to the analyte's laboratory-specific method detection limit (MDL). MDLs will be adjusted on a sample-by-sample basis, as necessary, based on dilutions and sample volume.

During analysis, if an item is out of the control range, actions can be immediately taken to correct minor problems, such as recalibration, retuning, or a minor repair (e.g., replacement of a minor part) of a malfunctioning instrument or the correction of poor analytical technique being used by an analyst. These occurrences are documented in the appropriate injection, run, or analysis logbooks. Similarly, routine instrument maintenance malfunctions and power failures are also documented in the appropriate instrument maintenance logbooks. These events do not require a formal notice of corrective action, provided reported analytical results are not affected. The analyst is responsible for addressing these minor issues.

However, corrective action is taken immediately when data discrepancies are discovered, deviations and departures from laboratory standard operating procedures (SOPs) have occurred, and/or per the client’s request. Corrective actions taken are documented using the laboratory's corrective action system consisting of a nonconformance memo (NCM) or a corrective action report (CAR).

A nonconformance is defined as any occurrence that prevents the laboratory from delivering data that is compliant with the control criteria published (or incorporated by reference) in the referenced method, SOP, regulatory document, and/or applicable QA plan. The NCM is written via the LIMS and is used to document specific nonconformance conditions and to specify the necessary action(s) taken to correct the specific problem.

The LIMS uses a program called the Nonconformance Module to initiate electronic NCMs and qualify affected data. The LIMS Nonconformance Module program is used to document nonconformance situations for laboratory investigation and review, and it also provides the template for addressing non-compliant data in the final report Case Narrative. When an analyst encounters a nonconformance situation, the problem is presented to the supervisor for resolution. The supervisor may elect to discuss it with the Technical Manager or have a representative contact the client to decide on a logical course of action. Once an approach is agreed upon, the analyst documents it using the laboratory's corrective action system. This information can then be supplied to the client in the form of a footnote or a case narrative with the report.

The CAR form is used in situations where a recurring problem or breakdown in systems is observed that warrants a more thorough investigation than a single-event NCM.

A CAR may be initiated from several types of situations, such as:

- Specific NCM
- Observed trend or frequency of events that warrants corrective action
- Audit finding
- Client complaint

The Laboratory QA department handles the corrective action issues. Corrective actions specific to quality controls for analytical methods are presented in the laboratory's QA.

6.1 Analytical Capabilities

The analytical laboratory is fully equipped for analysis of all types of water, air, and soil samples for chemical contaminants, bacteriological quality, and general characterization. Proven and approved analytical techniques are used and are backed up by a rigorous system of QC and QA checks to ensure reliable and defensible data. Laboratory work is performed in accordance with guidelines established by USEPA, the NYSDOH, and the National Institute of Occupational Safety and Health (NIOSH). Organic analysis is accomplished by gas chromatography (GC), high-performance liquid chromatography (HPLC), and or GC/mass spectrometry. Liquid, soil, and air samples are analyzed routinely for pesticides, polychlorinated biphenyls (PCBs), volatile organics, extractable organics, and other groups of compounds, as necessary. The laboratory uses two types of instruments for analysis of metals in various matrices – Atomic Absorption Spectrometry (AAS) and Inductively Coupled Plasma (ICP). Laboratory procedures to be used for sample preparation and analysis are referenced in the NYSDEC ASP.

6.2 Quality Control Samples

Laboratory QC consists of analysis of laboratory blanks, duplicates, spikes, standards, and QC check samples as appropriate to the methodology. These laboratory QC samples are described in the following sections.

6.2.1 Laboratory Blanks

Three types of laboratory blanks, one or more of which will be used depending on the analysis, are as follows:

- Method blanks consist of analyte-free water and are subjected to every step of the analytical procedure to determine possible contamination.
- Reagent blanks are similar to method blanks but incorporate only one of the preparation reagents in the analysis. When a method blank indicates significant contamination, one or more reagent blanks are analyzed to determine the source.
- Calibration blanks consist of pure reagent matrix and are used to zero an instrument's response, thus establishing the baseline.

6.2.2 Calibration Standards

A calibration standard may be prepared in the laboratory by dissolving a known amount of a pure compound in an appropriate matrix. The final concentration calculated from the known quantities is the true value of the standard. The results obtained from these standards are used to generate a standard curve and thereby quantify the compound in the environmental sample. A minimum of three calibration standards will be used to generate a standard curve for the analyses.

6.2.3 Reference Standard

A reference standard is prepared in the same manner as a calibration standard but from a different source. Reference standards may be obtained from USEPA. The final concentration calculated from the known quantities is the "true" value of the standard. The important difference in a reference standard is that it is not carried through the same process used for the environmental samples, but is analyzed without digestion or extraction. A reference standard result is used to validate an existing concentration calibration standard file or calibration curve.

6.2.4 Spike Sample

A sample spike is prepared by adding to an environmental sample (before extraction or digestion) a known amount of pure compound of the same type that is to be assayed for in the environmental sample. Spikes are added at 1 to 10 times the expected sample concentration or approximately 10 times the MDL. These spikes simulate the background and interferences found in the actual samples, and the calculated percent recovery of the spike is taken as a measure of the accuracy of the total analytical method. A blank spike is the same as a spike sample except the spike is added to analyte-free water. The blank spike is used to determine whether the sample preparation and analysis are under control.

6.2.5 Surrogate Standard

A surrogate is prepared by adding a known amount of pure compound to the environmental sample; the compound selected is not one expected to be found in the sample, but is similar to the compound of interest. Surrogate compounds are added to the sample prior to extraction or digestion. Surrogate spike concentrations indicate the percent recovery of the analytes and, therefore, the efficiency of the methodology.

6.2.6 Internal Standard

Internal standards are similar to surrogate standards in chemical composition but are used to quantify the concentration of analytes sampled based on the relative response factor. Internal standards are added to the environmental sample just prior to instrumental analysis.

6.2.7 Laboratory Duplicate or Matrix Spike Duplicate

Laboratory duplicates are aliquots of the same sample that are split prior to analysis and treated the same throughout the analytical method. Spikes and duplicates for the batch are normally aliquots of the same sample. For organics, spikes are added at approximately 10 times the MDL. The RPD between the values of the MS and MSD for organics or between the original and the duplicate for inorganics is taken as a measure of the precision of the analytical method. In general, the tolerance limit for RPDs between laboratory duplicates should not exceed 20 percent for validation in homogeneous samples.

6.2.8 Check Standard/Samples

Inorganic and organic check standards or samples are prepared with reference standards or are available from USEPA. They are used as a means of evaluating analytical techniques of the analyst. Check standards or samples are subjected to the entire sample procedure, including extraction, digestion, etc., as appropriate for the analytical method used. The check standard or sample can provide information on the accuracy of the analytical method independent of various sample matrices.

6.3 Laboratory Instrumentation

Laboratory capabilities will be demonstrated initially for instrument and reagent/standards performance as well as accuracy and precision of analytical methodology. The following is a discussion of reagent/standard procedures and brief descriptions of calibration procedures for major instrument types:

- Standards are obtained directly from USEPA or through a reliable commercial supplier with a proven record for quality standards. Commercially supplied standards will be traceable to USEPA or NIST reference standards and appropriate documentation will be obtained from the supplier. In cases where documentation is not available, the laboratory will analyze the standard and compare the results to a known USEPA-supplied or previous NIST-traceable standard.
- Sections of the laboratory will have SOPs for standard and reagent procedures to document specific standard receipt, documentation, and preparation activities. In general, the individual SOPs incorporate the following items:
  - Documentation and labeling of date received, lot number, date opened, and expiration date
  - Documentation of traceability
  - Preparation, storage, and labeling of stock and working solutions
  - Establishing and documenting expiration dates and disposal of unusable standards
- Each laboratory instrument will be labeled clearly with a unique identifier that relates to laboratory calibration documentation. Laboratory SOPs and calibration procedures are detailed in the laboratory’s QA Manual, which is available to NYSDEC upon request.

7 Data Reporting and Validation

7.1 Laboratory Deliverables

7.1.1 Laboratory Data Package

Final analytical reports will be Category B data packages and will include the following:

- Detailed summary of the report contents and any QC outliers or corrective actions taken
- COC documentation
- Sample Information including the date collected, date extracted, date analyzed, and analytical methods
- Data (including raw data) for:
    - Samples
    - Laboratory duplicates
    - Method blanks
    - Spikes and spike duplicates
    - Surrogate recoveries
    - Internal standard recoveries and retention time summary
    - Calibration standards
    - Chromatograms
    - Any other applicable QC data as applicable to NYSDEC ASP
- MDLs and/or instrument detection limits
- Run logs, standard preparation logs, and sample preparation logs
- Percent solids (where applicable)

The data package provided by the laboratory will contain items discussed above in a "Contract Laboratory Program (CLP)-equivalent" format. Data quality issues will be discussed in a case narrative included with the data report. The completed copies of the COC records (both external and internal) accompanying each sample from the time of the initial bottle preparation to completion of the analysis shall be attached to the analytical reports.

The electronic data deliverable (EDD) format required is the current format per Earthsoft EQuIS Environmental Data Management Software. Each EDD shall be formatted and copied using an MS-DOS operating system. To avoid transcription errors, data will be loaded directly into the ASCII format from the LIMS. If this cannot be accomplished, the consultant should be notified via letter of transmittal indicating that manual entry of data is required for a particular method of analysis. EDDs shall also undergo a QC check by the laboratory before delivery. The original data, tabulations, and electronic media are stored in a secure and retrievable fashion.

The Laboratory PM or Task Manager will maintain close contact with the QA reviewer to ensure nonconformance issues are resolved prior to use of the data.

7.1.2 Quality Assurance Reports

For the laboratory, a general QA report summarizing problems encountered throughout the laboratory effort, including sample custody, analyses, and reporting, is provided to the EHS Support PM. This report identifies areas of concern and possible resolutions to ensure data quality. Upon completion of a project sampling effort, analytical and QC data will be included in a comprehensive report that summarizes the work and provides a data evaluation. A discussion of the validity of the results in the context of QA/QC procedures will be made, as well as a summation of QA/QC activity. Serious analytical or sampling problems will be reported to NYSDEC. Time and type of corrective action, if needed, will depend on the severity of the problem and relative overall project importance. Corrective actions may include altering procedures in the field, conducting an audit, or modifying laboratory protocol. Corrective actions will be implemented after notification and approval of NYSDEC. In addition to the laboratory report narrative, QA data validation reports that include any contractual requirements will also be provided to NYSDEC. These QA reports will be submitted with the analytical data at the conclusion of the project.

7.2 Data Validation and Usability

Prior to the submission of the report to NYSDEC, data will be evaluated for precision, accuracy, and completeness.

QA/QC requirements from both methodology and company protocols will be strictly adhered to during sampling and analytical work. Data generated will be reviewed by comparing and interpreting results from instrumental responses, retention time, determination of percent recovery of spiked samples or blanks, and reproducibility of duplicate sample results. Calculations and data manipulations are included in the appropriate methodology references. Control charts and calibration curves will be used to review the data and identify outlying results.

7.2.1 Data Validation

A third-party validator will be responsible for an independent review of analytical work performed under the NYSDEC ASP protocol. The functions will be to assess and summarize the quality and reliability of the data to determine its usability and to document for the historical record of each Site any factors affecting data usability, such as discrepancies, poor laboratory practices, and Site locations that are difficult to analyze. The data validator will be responsible for determining completeness and compliance. Information available to the data validator for performance of these functions includes the NYSDEC ASP Category B data package information from the sampling team regarding field conditions and field QA samples, along with COC and shipping forms. The data package is designed to provide the necessary documentation to verify compliance with NYSDEC ASP protocol and the accuracy and reliability of the reported results.

The laboratory will deliver the data package to the project QA coordinator for processing prior to submission to the data validator. The project QA coordinator will review the report for immediate problems, summarize the data for in-house use, and process the work order for the third-party data validation subcontract. In order to effectively review the data package, the data validator will obtain a general overview of each case. This includes the exact number of samples, their assigned numbers, and their matrix. If a problem arises between the data validator and the laboratory, the data validator shall submit written questions to the laboratory. The laboratory will be required to respond in writing to correct any deficiencies. If the data validator does not receive a written response from the laboratory within the specified time, the data in question shall be considered non-compliant. Sampling locations will be obtained from the sampling records, such as the COC forms. This information is necessary for preparing the data summary, evaluating adherence to sample holding times, matrix problem discussion, and discussing any contaminants detected in the samples.

The following is a brief outline of the data validation process:

- Compile samples with the dates of sampling, laboratory receipt, and analysis.
- Compile QC samples, such as field blanks, field duplicates, MS/MSD samples, laboratory blanks, and laboratory replicates.
- Review COC documents for completeness and correctness.
- Review laboratory analytical procedure and instrument performance criteria.
- Qualify data that is outside acceptable QC criteria ranges.
- Prepare a memorandum summarizing any problems encountered and the potential effects on data usability.
- Prepare a data summary, including validated results, with sample matrix, location, and identification.
- Tabulate field duplicates, laboratory replicate, and blank results.

Copies of data validation and usability reports, as well as data summary packages, will be provided to the NYSDEC project manager. In addition, copies of analytical raw data will be provided to NYSDEC upon request.

7.2.2 Data Usability

A Data Usability Summary Report (DUSR) will be provided after review and evaluation of the analytical data package. The DUSR will contain required elements listed in Appendix 2B of DER-10 (NYSDEC, 2010). The DUSR will include a description of the samples and analytical procedures used. Any data deficiencies, protocol deviations, or QC problems will be discussed as to their effect on data results. The report will also include any suggestions for resampling or reanalysis.

8 References

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Tables

TABLE 4-1
SAMPLE CONTAINER, PRESERVATIVE, AND HOLDING TIME REQUIREMENTS
Hercules, Inc. Site
Port Ewen, New York

Parameter	Analytical Method	Container Type & Size	Preservation[a]	Holding Time[b]
Groundwater Samples				
TCL VOCs	8260D	3 x 40 mL glass vial	Cool to 4°C HCl	14 days
TAL Metals	6010C	1 x 250 mL polyethylene or glass bottle	HNO_3 to a pH < 2	6 months
Mercury	7470A	1 x 250 mL polyethylene or glass bottle	HNO_3 to a pH < 2	28 days
1,4-Dioxane	8270E SIM	2 x 4 oz. amber wide mouth glass jars with Teflon-lined cap	Cool to 4°C	14 days to extract; analyze 40 days from extraction
PFAS	537.1	2 x 125 mL HDPE bottle	Cool to 4°C	
Surface Water Samples				
TCL VOCs	8260D	3 x 40 mL glass vial	Cool to 4°C HCl	14 days
TAL Metals	200.7/6010C	2 x 250 mL polyethylene or glass bottle	HNO_3 to a pH < 2	6 months
Mercury	7470A	2 x 4 oz. wide mouth glass jars with Teflon-lined cap	Cool to 4°C	28 days
Total Hardness (as $CaC0_3$)	EPA SM2340C	250 mL polyethylene or glass bottle	HNO_3 to a pH < 2	180 days
Alkalinity (Bicarbonate Alkalinity as $CaCO_3$)	EPA SM2320B	250 mL polyethylene or glass bottle	Cool to 4°C	14 days
Dissolved Organic Carbon (DOC)	EPA 5310D	6 oz. wide mouth glass jars with Teflon-lined cap	Cool to 4°C	28 days
Inorganic Anions	EPA 300.0	125 mL polyethylene or glass bottle	Cool to 4°C	28 days
Soil Samples				
TCL VOCs	8260D	2 x 40 mL glass vial w/stir bar & water 1 x 40 mL glass vial w/MeOH	Freeze at < 0°C Cool to 4°C	14 days
TAL Metals	200.7/6010C	2 x 250 mL polyethylene or glass bottle	HNO_3 to a pH < 2	6 months
Mercury	7471B	2 x 4 oz. wide mouth glass jars with Teflon-lined cap	Cool to 4°C	28 days
1,4-Dioxane	8270E SIM	2 x 4 oz. amber wide mouth glass jars with Teflon-lined cap	Cool to 4°C	14 days to extract; analyze 40 days from extraction
SPLP PFAS	1312	1 x 4 oz. HDPE wide mouth jar	Cool to 4°C	28 days
Sediment Samples				
TAL Metals	200.7/6010A	4 oz. wide mouth glass jars with Teflon-lined cap	Cool to 4°C	6 months
Mercury	7471B	4 oz. wide mouth glass jars with Teflon-lined cap	Cool to 4°C	28 days
Acid Volatile Sulfides (AVS)	EPA 821-R-91-100	2 ounce glass septa cap; jar filled to zero headspace	Cool to 4°C	14 days
Simultaneously Extracted Metals (SEM) - Cadmium	EPA 6020A			
SEM - Copper	EPA 6020A			
SEM - Lead	EPA 6020A			
SEM - Mercury	EPA 6020A			
SEM - Nickel	EPA 6020A			
SEM - Silver	EPA 6020A			
SEM - Zinc	EPA 6020A			
Total Organic Carbon	Lloyd Kahn	4 oz. wide mouth glass jars with Teflon-lined cap	Cool to 4°C	14 days
Grain Size Distribution	ASTM D422	16 oz. wide mouth glass jars	None	None
Pore Water Samples				
TAL Metals	200.7/6010A	250 mL polyethylene or glass bottle	HNO_3 to a pH < 2	6 months
Mercury	7470A	4 oz. wide mouth glass jars with Teflon-lined cap	Cool to 4°C	28 days
Total Hardness (as $CaC0_3$)	EPA SM2340C	250 mL polyethylene or glass bottle	HNO_3 to a pH < 2	180 days
Alkalinity (Bicarbonate Alkalinity as $CaCO_3$)	EPA SM2320B	250 mL polyethylene or glass bottle	Cool to 4°C	14 days
Dissolved Organic Carbon (DOC)	EPA 5310D	6 oz. wide mouth glass jars with Teflon-lined cap	Cool to 4°C	28 days
Inorganic Anions	EPA 300.0	125 mL polyethylene or glass bottle	Cool to 4°C	28 days
Waste Characterization Samples (Solids)				
TCLP VOCs	1311/ 8260D	2 x 4 oz or larger wide mouth glass jars with Teflon-lined cap	Cool to 4°C	14 days to extract; analyze 14 days from extraction
TCLP SVOCs	1311/8270E	2 x 4 oz or larger amber wide mouth glass jars with Teflon-lined cap	Cool to 4°C	14 days to extract; analyze 40 days from extraction
TCLP Metals	1311/ 6010	2 x 4 oz. wide mouth glass jars with Teflon-lined cap	Cool to 4°C	14 days to extract; analyze 6 months from extraction
TCLP Mercury	1311/7470	2 x 4 oz. wide mouth glass jars with Teflon-lined cap	Cool to 4°C	14 days to extract; analyze 28 days from extraction
TAL Metals	200.7/6010C	2 x 4 oz. wide mouth glass jars with Teflon-lined cap	HNO_3 to a pH < 2	6 months
Total PCBs	8082	2 x 4 oz amber wide mouth glass jars with Teflon-lined cap	Cool to 4°C; store in dark place	1 Year; analyze 40 days from extraction
Total Petroleum Hydrocarbons (DRO)	8015 Modified	2 x 4 oz. wide mouth glass jars with Teflon-lined cap	Cool to 4°C	14 days to extract; analyze 40 days from extraction
Total Petroleum Hydrocarbons (GRO)	8015 Modified	2 x 4 oz. wide mouth glass jars with Teflon-lined cap	Cool to 4°C	14 days
Corrosivity	9045D	2 x 4 oz. wide mouth glass jars with Teflon-lined cap	Cool to 4°C	ASAP
Ignitability	1010A	2 x 4 oz amber wide mouth glass jars with Teflon-lined cap	Cool to 4°C	NONE
Reactive Cyanide and Sulfide	SW-846 7.3.3.2 (2)	2 x 4 oz or larger wide mouth glass jars with Teflon-lined cap	Cool to 4°C; store in dark place	28 days
Total Organic Halogens	9020B	2 x 4 oz amber wide mouth glass jars with Teflon-lined cap	Cool to 4°C	28 days

Notes:

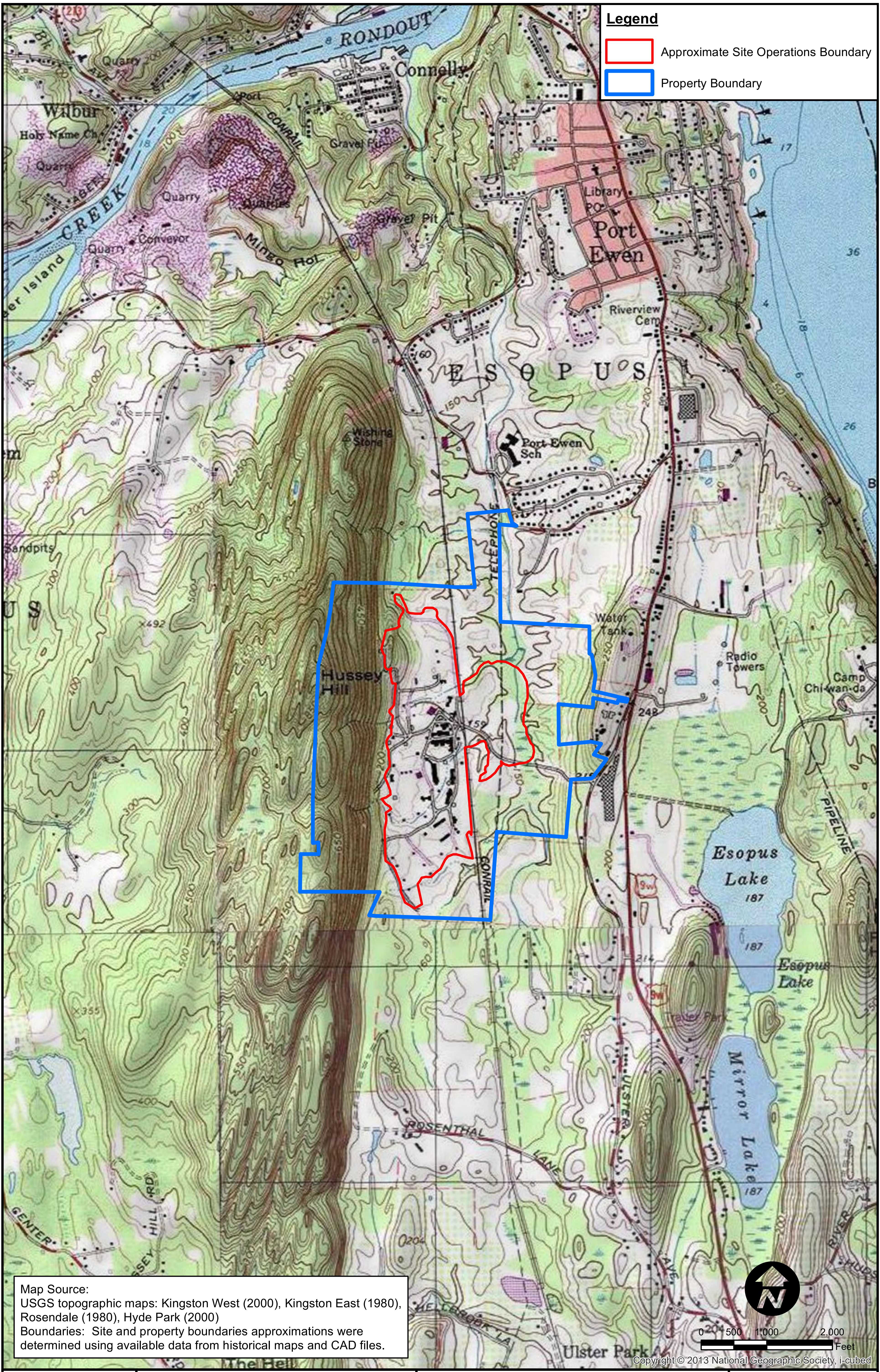
(a) All samples to be preserved on ice during collection and transport

(b) Holding times are based on verified time of sample receipt at the laboratory

°C = degrees Celsius
ASAP = as soon as possible
$CaCO_3$ = calcium carbonate
DRO = diesel range organics
GRO = gas range organics
HCl = hydrochloric acid
HDPE = high-density polyethylene
HNO_3 = nitric acid
MeOH = methanol
mL = milliliter

oz = ounce
PCBs = Polychlorinated Biphenyls
PFAS = per- and polyfluoroalkyl substances
SIM = selected ion monitoring
SPLP = synthetic precipitation leaching procedure
SVOCs = Semi-Volatile Organic Compounds
TAL = Target Analyte List
TCL = Target Compound List
TCLP = Toxicity Characteristic Leaching Procedure
VOCs = Volatile Organic Compounds

Figures



Map Source:
USGS topographic maps: Kingston West (2000), Kingston East (1980), Rosendale (1980), Hyde Park (2000)
Boundaries: Site and property boundaries approximations were determined using available data from historical maps and CAD files.

Copyright:© 2013 National Geographic Society, i-cubed

EHS Support	HERCULES INC. SITE ULSTER COUNTY, NEW YORK REGISTRY NO. 356001	SITE LOCATION MAP	FIGURE 1-1

Reviewed By: K. VanLandingham

J:\EHSS_GIS\C00363_AshlandPortEwen\01_ANALYSIS\20190605_PublicOutreachPosters\11x17_Figures\Figure 1-1 - Site Location Map.mxd

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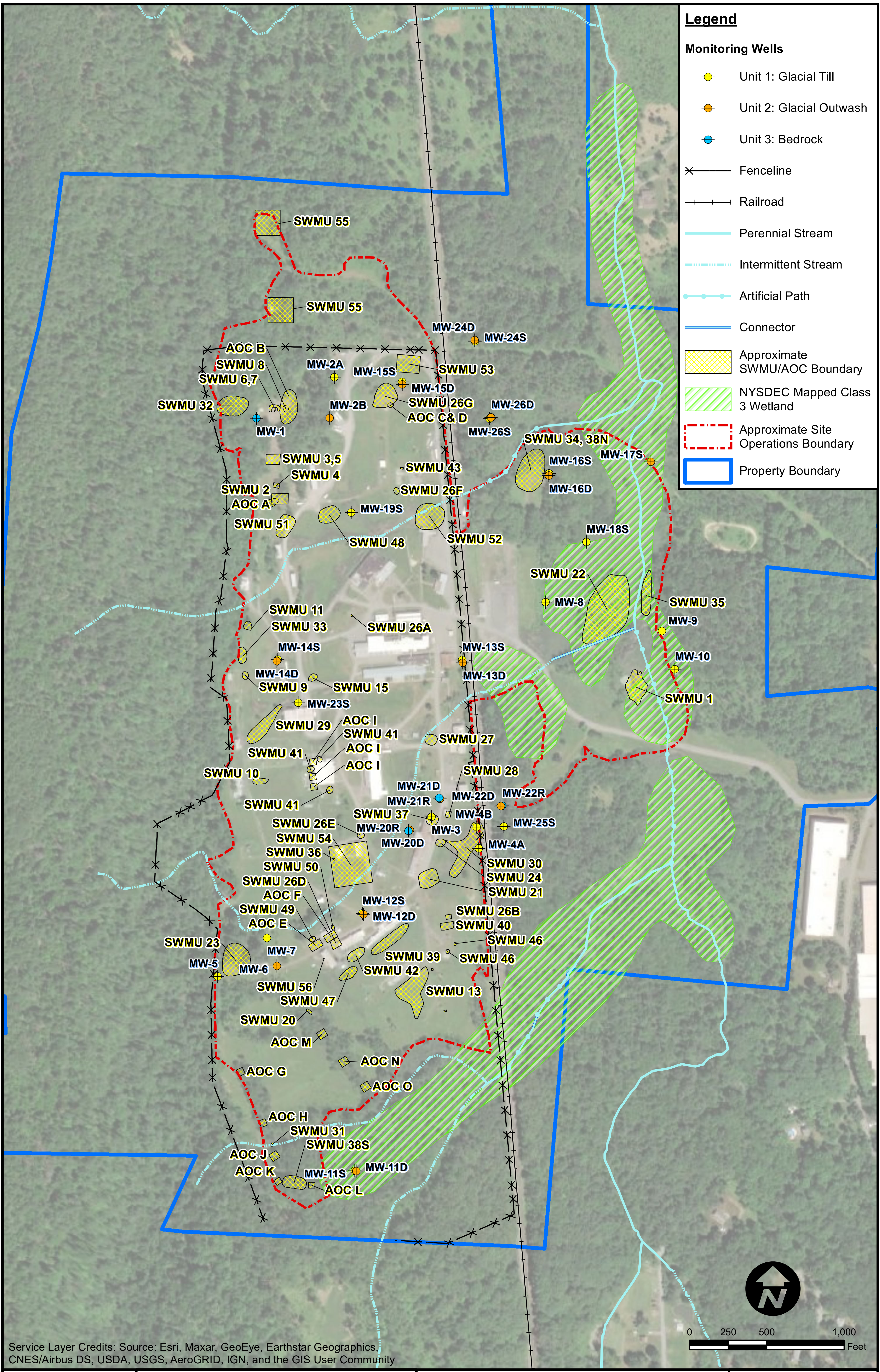

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

J:\EHSS_GIS\C00363_AshlandPortEwen\01_ANALYSIS\20190605_PublicOutreachPosters\11x17_Figures\Figure 2-2 - Site Layout.mxd

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Reviewed By: K. VanLandingham

EHS Support	HERCULES INC. SITE ULSTER COUNTY, NEW YORK REGISTRY NO. 356001	SITE LAYOUT	FIGURE 1-2

Appendix D Health and Safety Plan

Health and Safety Plan

Hercules, Inc. Site (#356001)

Prepared for:

Hercules, Inc. and Dyno Nobel, Inc.

Prepared by:

EHS Support

January 2021

Table of Contents

List of Appendices

Health and Safety Plan Approval

This Health and Safety Plan (HASP) was prepared for employees performing work that poses physical and/or chemical exposure risks to EHS Support LLC ("EHS Support") employees and EHS Support subcontractors. It was prepared based on the best available information regarding the hazards known or suspected to be present on the project Site. While it is not possible to identify, evaluate, and protect against all possible hazards in advance of the Site visit, adherence to the requirements of the HASP will significantly reduce the potential for occupational injury. This HASP will be updated as necessary to include new project activities, risks, or changes in organizational structure.

By signing below, I acknowledge that I have reviewed and hereby approve this HASP. This HASP has been written for the exclusive use of EHS Support's employees and direct contractors. The plan is written for specified Site conditions, dates, and personnel, and must be amended if these conditions change. This HASP is only valid for one year after approval.

Written by:

Shannon D. Barr

January 26, 2021

Shannon Barr
EHS Support H&S Specialist

Date

Approved by:

Krista VanLandingham

January 26, 2021

Kristin VanLandingham
EHS Support Project Manager

Date

1 Introduction

This Health and Safety Plan (HASP) summarizes health and safety hazard information for EHS Support LLC ("EHS Support") field activities related to work conducted for the Hercules, Inc. Site (#356001) located at Click or tap here to enter text.. The EHS Support HASP delineates procedures that will allow personnel to identify and predict hazards, work safely, and respond quickly and appropriately to Site emergencies. All Site work will be conducted in accordance with the following:

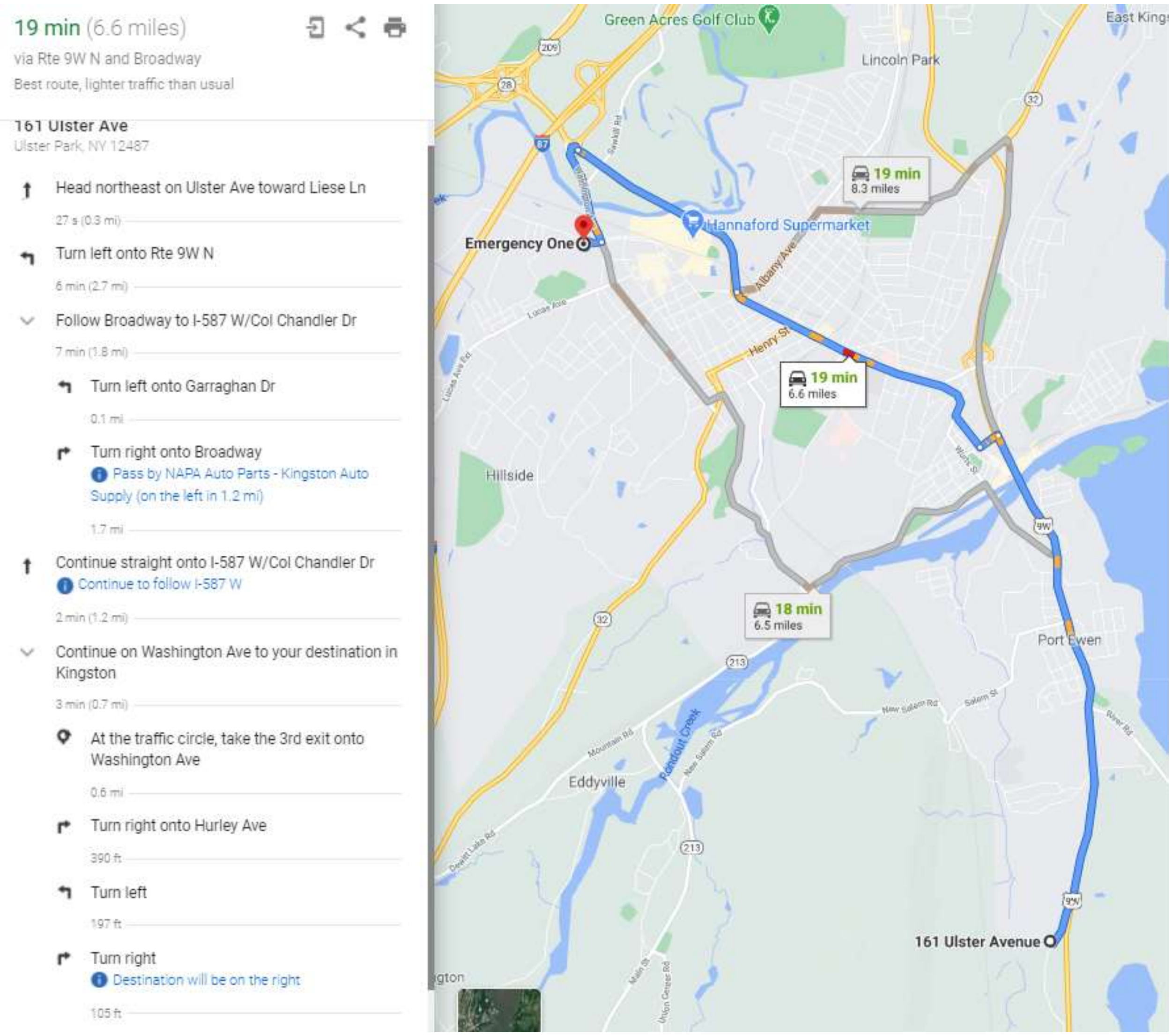
- EHS Support standard operating procedures
- Occupational Safety and Health Administration (OSHA) regulations in the Code of Federal Regulations (CFR), Title 29 Parts 1904, 1910, and 1926 as applicable
- Any applicable state safety regulations

Organizational Structure	
EHS Support has established a chain of command with lines of authority, responsibility, and communication for this project. The Project Manager (PM) has the responsibility and authority to direct all Site operations and is ultimately responsible for the overall management of the project. The field work covered by this HASP will be overseen or managed by a Field Team Leader who is responsible for the proper implementation and execution of the comprehensive work plan. Each field project will have a Site Safety Officer (SSO) who has the responsibility and authority to implement the HASP and verify compliance with the plan. Other personnel needed to conduct the proposed work will be assigned.	
PM	Is responsible for appropriately staffing the project to safely and effectively implement the work plan. They will also ensure that company funds are available for the Field Team Leader to provide appropriate personal protective equipment (PPE) and monitoring equipment.
Field Team Leader	Is responsible for the safe and proper implementation of the work plan. They will have the authority to expend company resources to ensure that PPE and other safety equipment are available and in good working order. They will communicate with the PM regarding implementation of the work plan.
SSO	Is responsible for the implementation of this HASP. They will communicate any issues arising from changing Site conditions, upgrades in PPE, decontamination procedures, and needs for monitoring equipment with the Site PM or Field Team Leader. The SSO will ensure that other workers assigned to the project are following the HASP.
Field Team Members (EHS Support Personnel, Contractors, and Subcontractors)	The field team members are responsible for complying with the HASP, notifying the SSO of hazardous or potentially hazardous conditions, and carrying out assigned tasks during field operations.
Site Visitors and State/Federal Agency Representatives	Any visitor to the project site is responsible for complying with all aspects of this HASP.
Note: It is expected that other employees assigned to the project will follow the HASP and report all potential safety concerns to the SSO.	

1.1 Project Personnel and Emergency Contact Information

Emergency Phone Numbers		
Emergency (fire, police, ambulance)		911
Emergency Facility Specific		
HealthAlliance Hospital	396 Broadway Kingston, NY 12401	845-331-3131
Emergency One, Kingston, NY	40 Hurley Ave Kingston, NY 12401	845-338-5600 Weekdays: 8-8 Weekends: 8-4
Site/Client Contacts		
Client PM or Contact	Edward Meeks, Hercules, Inc. Fred Jardinico, Dyno Nobel, Inc. Kathleen Blessing, Dyno Nobel, Inc.	(302) 955-3433 (860) 408-1812 (860) 408-1845
Site Contact	Fred Jardinico	(860) 408-1812 (office) (845) 544-2951 (mobile)
EHS Support Contacts		
Project Manager	Kristin VanLandingham	850-251-0582
Task/Field Lead		
Site Safety Officer		
Project Health and Safety	Shannon Barr	724-859-8322
Field Team Members		
H&S Service Line Lead	Monica Meyer	724-762-7951
Human Resources	Sarah Kitchen	724-422-8472
Contractors		
Subcontractors		
Utility Locator Company		

Emergency Phone Numbers		
State/Federal Agency		
Kiera Thompson	NYSDEC	518-402-9662
Incident Notification Process		
1. Dial 911/Facility or Site Emergency Number as applicable		
2. Facility contact (if applicable)	Fred Jardinico	
3. Contact EHS Support PM	Kristin VanLandingham	
4. Contact H&S Service Line Lead	Monica Meyer	
5. Client incident reporting number	1-800-ASHLAND	
Other Emergency Information		
Location of assembly areas		
Location of storm shelter		
Nearest First Aid Kit/AED	Provided by EHS Support personnel and AED provided by emergency first responder personnel	
Nearest Eyewash/Shower		

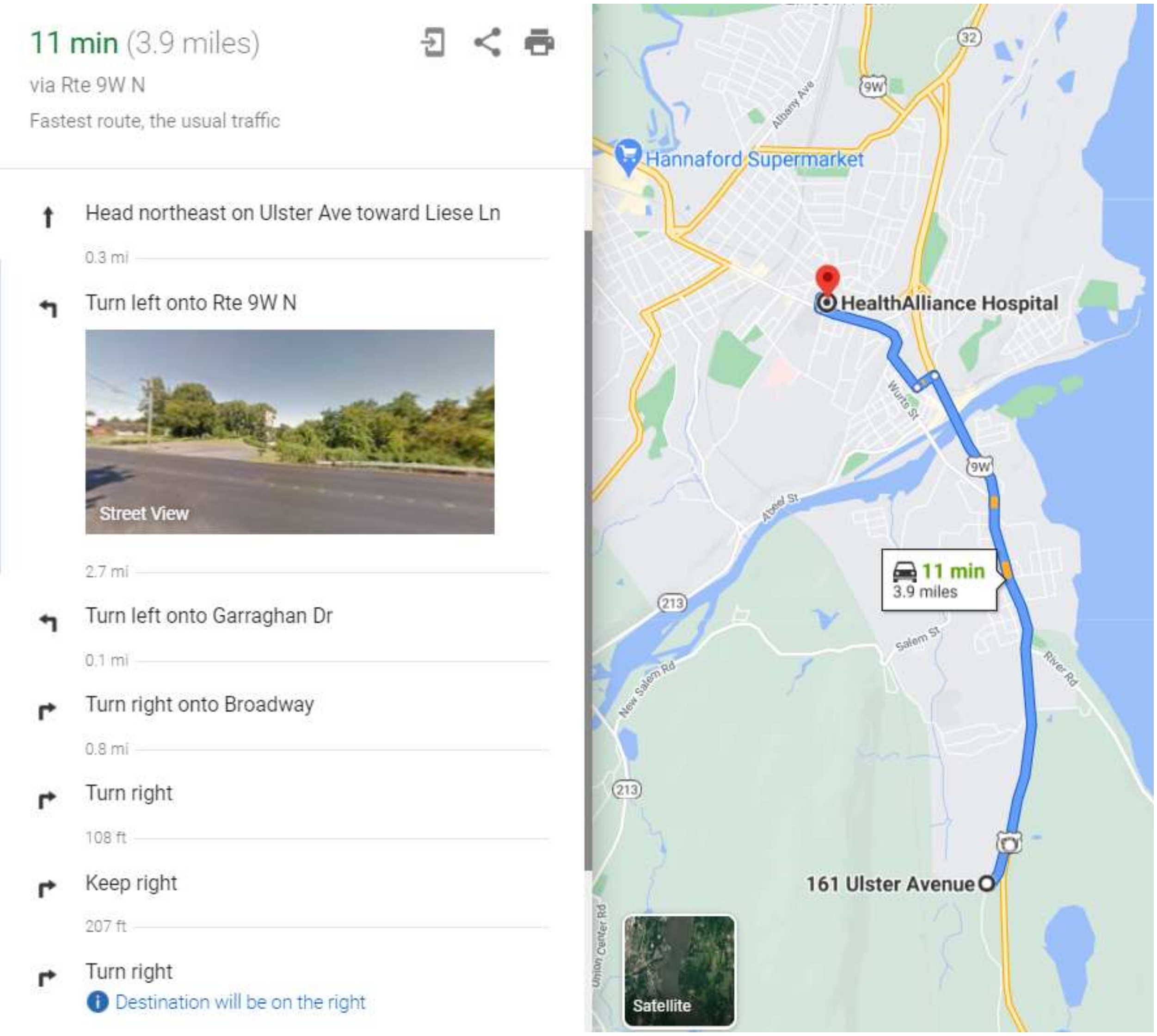


19 min (6.6 miles)
via Rte 9W N and Broadway
Best route, lighter traffic than usual

161 Ulster Ave
Ulster Park, NY 12487

- Head northeast on Ulster Ave toward Liese Ln
  27 s (0.3 mi)
- Turn left onto Rte 9W N
  6 min (2.7 mi)
- Follow Broadway to I-587 W/Col Chandler Dr
  7 min (1.8 mi)
  - Turn left onto Garraghan Dr
    0.1 mi
  - Turn right onto Broadway
    Pass by NAPA Auto Parts - Kingston Auto Supply (on the left in 1.2 mi)
    1.7 mi
- Continue straight onto I-587 W/Col Chandler Dr
  Continue to follow I-587 W
  2 min (1.2 mi)
- Continue on Washington Ave to your destination in Kingston
  3 min (0.7 mi)
  - At the traffic circle, take the 3rd exit onto Washington Ave
    0.6 mi
  - Turn right onto Hurley Ave
    390 ft
  - Turn left
    197 ft
  - Turn right
    Destination will be on the right
    105 ft

Figure 1-1 Occupational Clinic Map and Directions



11 min (3.9 miles)

via Rte 9W N

Fastest route, the usual traffic

Head northeast on Ulster Ave toward Liese Ln

0.3 mi

Turn left onto Rte 9W N

2.7 mi

Turn left onto Garraghan Dr

0.1 mi

Turn right onto Broadway

0.8 mi

Turn right

108 ft

Keep right

207 ft

Turn right

Destination will be on the right

Figure 1-2 Hospital Map and Directions

2 Scope of Work

Project/Task Number	REM_C00363_2021-300	**HASP Preparation Date**	1/19/2021
Activity Duration (days/weeks/months)	Year	**Anticipated Start Date of Current Work**	April 2021
State of the Site/Facility	Active	**Site Access**	Road/Vehicle
Site Topography	• Flat • Muddy • Swampy • Uneven • Wooded/Forest • Heavy vegetation		
Normal Shift Work	Yes		
Lone Working	No		
Traffic	Light		
Major Tasks *The Job Safety Analysis (JSA) Form must be completed for each task. This form includes the task, hazard controls, and personal protective equipment (PPE) used for each task.*	• Asphalt and/or concrete coring/chipping • Direct push drilling • Driving • Drum handling • Groundwater sampling • Hand augering • Handling of compressed gasses • Hollow stem augering • Land based ecological surveys • Off-site transportation of waste • Over water sediment and surface water sampling/other ecological activities • Pressure washing during decontamination • Slug test • Soil sampling • Sub slab soil gas sampling • Surface and sediment sampling (manual – maximum waist deep) • Surface soil sampling/stockpiling sampling (non-intrusive) • Waste soil/cutting management from drilling • Well gauging • Well installation • Well surveying • Working near water • Working over water		

Equipment Needed	• Asphalt and/or Concrete Corer • Compressed gasses • Direct Push Drill Rig • Drum dolly • Dry ice for samples • Dust meter • Hand auger • Hand tools • Hollow Stem Auger • Machete • Personal protective equipment • PID • Pressure washer • Sampling containers/equipment and coolers • Slug test equipment • Sonic drill rig • Stakes and hammer • Waste drums • Water sampling equipment • Well gauge

See **Figure 2-1** for the Site location map and **Figure 2-2** for the Site plan.

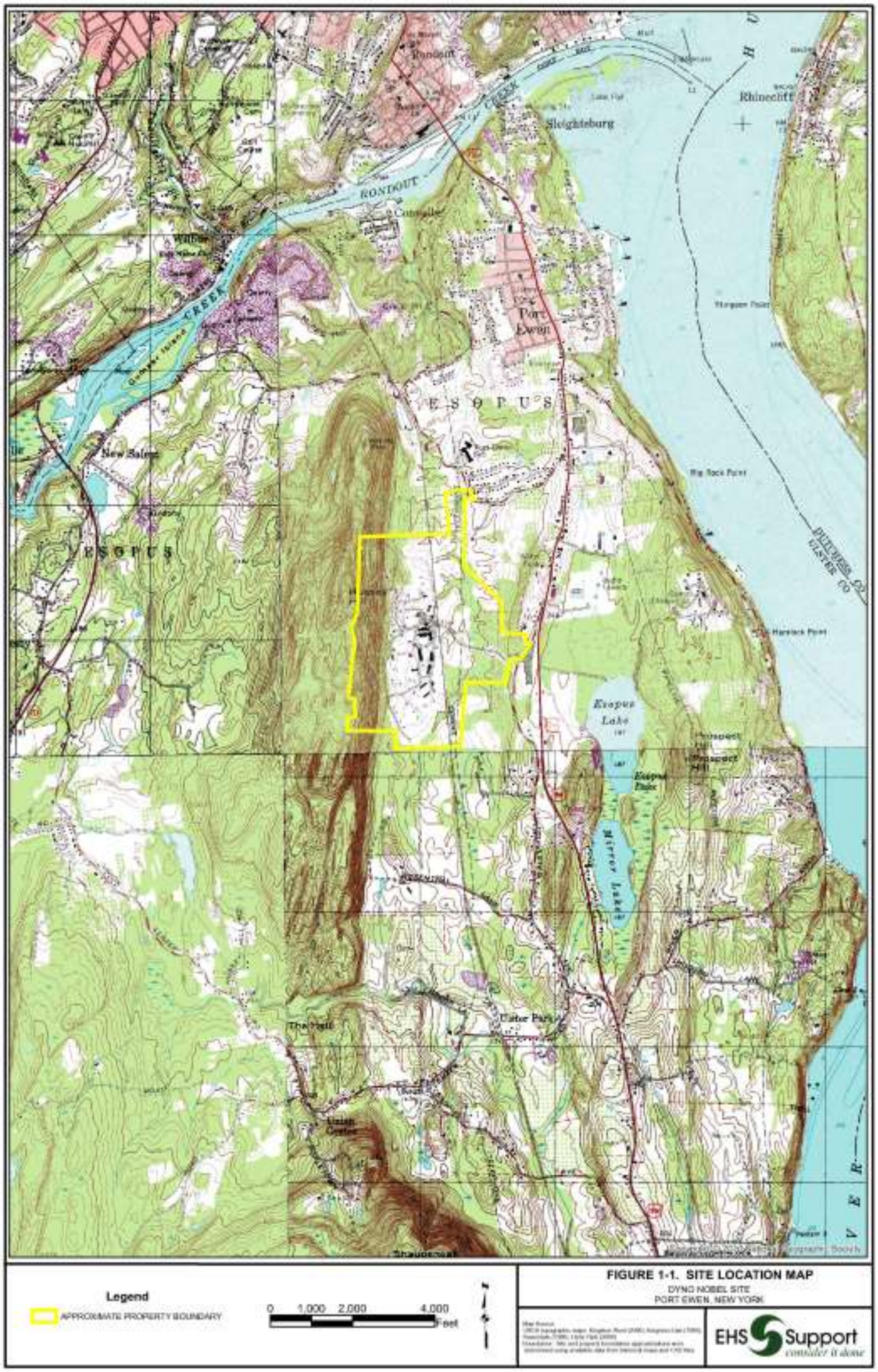


Figure 2-1 Site Location Map

Figure 2-2 Site Plan

3 Task/Operation Preliminary Health and Safety Hazard Assessment

Physical Hazards	Asphalt and/or concrete coring/chipping	• Ignition sources • High noise levels • Airborne particulates and dusts • Sharp materials and hand hazards • Underground utilities
	Direct push drilling	• Eye hazards • Head hazard • Foot hazards • Hand hazards • Cuts/lacerations • Moving equipment • Noise hazards • Dust/Contact with contaminants
	Driving	• Injury to self or other from accidents
	Drum handling	• Ergonomic hazards from moving materials (Back or muscle strain) • Cuts/lacerations from sharp edges • Foot hazards • Hand hazards • Contact with contaminants
	Groundwater sampling	• Struck by - traffic or other moving equipment • Pinch points • Slips, trips, and falls • Exposure to contaminants • Hand hazards • Eye hazards • Ergonomics - strains and awkward postures
	Hand augering	• Underground utilities • Ergonomics - strains and awkward postures • Slips, trips, and falls • Exposure to contaminants • Hand hazards • Eye hazards
	Handling of compressed gasses	• Pressurized, projectile hazard • Contact with contents • Foot hazards • Crush hazards
	Hollow stem augering	• Struck by - traffic or other moving equipment • Pinch points • Slips, trips, and falls • Exposure to contaminants • Hand hazards • Eye hazards • Ergonomics - strains and awkward postures • Rotating parts • Head hazards

	Land based ecological surveys	• Slips, trips, falls • Hand hazards • Foot hazards • Contact with contaminants • Eye hazards
	Off-site transportation of waste	• Injury to self or other from accidents • Ergonomic hazards from moving materials (Back or muscle strain) • Contact with contaminants
	Over water sediment and surface water sampling/other ecological activities	• Drowning • Contact with contaminants • Slips, trips, and falls • Falls off the boat • Noise exposure • Pinch points • Ergonomic hazards (Muscle strain/injuries from improper lifting) • Heat/cold stress • Lightning • Eye hazards • Foot hazards • Hand hazards • Fire, flame, explosion from gasoline engine fuel
	Pressure washing during decontamination	• Flying particles and particulates • Noise exposure • Exposure to pressurized water • Fire, flame, explosion from gasoline engine fuel • Contact with contaminants • Sprins and strains • Cuts and abrasions
	Slug test	• Muscle strain • Contact with contaminants • Foot hazards • Eye hazards
	Soil sampling	• Ergonomic hazards (material handling and awkward postures) • Hand hazards • Slips, trips, and falls • Contact with contaminants • Eye hazards

	Sub slab soil gas sampling	• Slips, trips and falls • Ergonomic hazards (material handling and awkward postures) • Hazardous atmospheres • Struck by mobile vehicles and equipment • Hand hazards • Head hazards • Eye hazards • Foot hazards • Contact with contaminants • Ergonomic hazards • Electrical hazards
	Surface and sediment sampling (manual – maximum waist deep)	• Drowning • Contact with contaminants • Slips, trips, and falls • Pinch points • Ergonomic hazards (Muscle strain/injuries from improper lifting) • Heat/cold stress • Lightning • Eye hazards • Foot hazards • Hand hazards
	Surface soil sampling/stockpiling sampling (non-intrusive)	• Ergonomic hazards (material handling and awkward postures) • Hand hazards • Slips, trips, and falls • Contact with contaminants • Eye hazards • Struck by mobile vehicles and equipment
	Waste soil/cutting management from drilling	• Ergonomic hazards (material handling) • Hand hazards • Slips, trips, and falls • Contact with contaminants • Eye hazards • Struck by mobile vehicles and equipment
	Well gauging	• Slips, trips and falls • Contact with contaminants • Ergonomic hazards (lifting, positing, and awkward postures) • Hazardous atmospheres

	Well installation	• Contact with contaminants • Ergonomic hazards • Extreme temperatures • Eye hazards • Flying debris • Foot hazards • Hand hazards • Head hazards • High pressure fluids • Noise exposure • Pinch points • Rotating equipment • Slips, trips and falls • Struck by mobile equipment • Underground utilities
	Well surveying	• Slips, trips and falls • Contact with contaminants • Hazardous atmospheres
	Working near water	• Drowning • Contact with contaminants • Slips, trips, and falls • Eye hazards • Foot hazards • Hand hazards
	Working over water	• Drowning • Contact with contaminants • Slips, trips, and falls • Falls off the boat • Noise exposure • Pinch points • Ergonomic hazards (Muscle strain/injuries from improper lifting) • Heat/cold stress • Lightning • Eye hazards • Foot hazards • Hand hazards • Fire, flame, explosion from gasoline engine fuel
Biological Hazards	• Bees • Fire ants • Poison Ivy • Poison Sumac • Snakes • Spiders • Ticks • Wasps	

Environmental Hazards and Site-Specific Conditions	- Aboveground utilities - Cold stress - Heat stress - Near hunting grounds/remote area during hunting season - Overgrown vegetation - Potential for Unexploded ordinance - Subsurface utilities
Environmental Release/Spill Containment	EHS Support does not respond to major spills. Personnel will have equipment and/or absorbents on hand to clean minor spills related to the materials being handled for the work scope. For major spills, contact the appropriate agency. In the event of a spill or leak: 1. **Evacuate** (injured parties and all non-essential personnel). 2. **Stop, Coordinate and Eliminate** (stop source of incident (e.g. spill), coordinate shut down of equipment, and eliminate sources of ignition and sparks for flammables or incompatibles that could catch fire, explode, or vigorously react. Wear appropriate PPE). 3. **Notify** (call 911 for the appropriate response agency). 4. **Secure** the area. 5. **Treat** (provide immediate treatment to injured and affected personnel). 6. **Identify** material (if unknown) and identify PPE, hazard and response procedures using SDSs). 7. **Contain/Isolate** (contain released material/incident using emergency response equipment and/or set up perimeter to isolate area). 8. **Meet** the spill response crew and advise them of the spill location and the material spilled. 9. **Document** spill/environmental issue electronically via form located in the Issues section of MyMomentum. **10. Investigate and Remediate**
Chemical Hazards *Note: See* **Appendix H** *for safety data sheets*	Chlorinated Hydrocarbons Heavy Metals Volatile Organic Carbons

4 Employee Training and Medical Requirements

4.1 Site-Specific Training Requirements

Training Type	**Applies To:**			
	All Personnel	**EHS Support Employees**	**Contractor Site Personnel**	**Personnel Entering the Exclusion Zone**
40-hour HAZWOPER training with a current 8-hour refresher certificate	☒	☐	☐	☐
Daily Tailgate Safety Meetings	☒	☐	☐	☐
Pre-mobilization PSA and project kick off meeting	☒	☐	☐	☐

4.2 Site-Specific Medical Requirements

Type	**Applies To:**		
	All Personnel	**EHS Support Employees**	**Contractor Site Personnel**
Annual physical	☐	☒	☐

5 Hazard Controls

5.1 Engineering and Administrative Controls

EHS Support will implement engineering and administrative controls to prohibit access to hazardous areas, warn of physical hazards and/or otherwise minimize the likelihood of worker injury or exposure. Specific engineering and administrative controls for each EHS Support activity are listed in the Job Safety Analysis in **Appendix B**.

5.2 Personal Protective Equipment

Equipment	Comments
Steel Toe Boots/Shoes	
Safety Vest	
Hearing Protection	Only around heavy equipment
Hard Hat	Only around overhead hazards
Safety Glasses with Side Shields	On active plant
Cotton or Leather Work Gloves	
Chemical Resistant Gloves (Nitrile)	
All work is anticipated to be completed in Level D or modified Level D. ***NOTE: If Site conditions suggest another level than Level D or Modified Level D for EHS Support personnel, and they are not currently trained for necessary level with the appropriate equipment, stop and do not perform this work.***	

6 Air Monitoring

Periodic air monitoring will be conducted using direct-reading instruments (i.e., PID), and by collecting and analyzing personal samples. Air monitoring will be conducted with a PID with a 10.6 eV or other applicable lamp calibrated to isobutylene to evaluate concentrations of VOCs. The monitoring equipment must be calibrated in accordance with the manufacturer's instructions. In addition, the results of daily instrument calibrations must be recorded in the field notebook or the Field Instrument Calibration Log included in Error! Reference source not found.. Continuous monitoring of the Operator's B reathing Zone (OBZ) is required during intrusive work. Document readings in the field notes or the Air Monitoring Log included in **Appendix D**.

Refer to the Community Air Monitoring Plan dated July 17, 2018 for sampling details and exposure limits.

7 Site Control, Decontamination, and Emergency Contingency Plan

Is the Site securely fenced?	Yes
Coordination with Owners or Operators	EHS Support must receive permission to access private property from landowners and site operators.
Personnel and PPE Decontamination	• Deposit disposable PPE in a waste container • Wash hands and face whenever leaving the Site and before eating, drinking, smoking, or using restroom facilities
Equipment Decontamination	Refer to the following SOPs for specific decontamination requirements and procedures: • SOP 9 – Field Decontamination • SOP 10 – Decontamination of Heavy Equipment
Medical Emergencies	Field personnel may administer first aid on a voluntary basis if they are trained to do so. Remember to follow “universal precautions” if blood or bodily fluids are present (i.e., assume all blood and bodily fluids are contaminated and avoid contact with these fluids). Use nitrile or latex gloves when performing first aid. Contact the EHS Support H&S Program Manager if you are exposed to another individual’s blood or bodily fluids. For serious injuries or illnesses, transport the victim to the hospital via ambulance by calling 911. If exposure to hazardous substances is suspected, or if any symptoms of exposure are experienced, leave the contaminated area. If a dermal or ocular exposure is suspected, wash the affected area with plenty of water for a minimum of 15 minutes. If symptoms are serious in nature, seek medical assistance immediately. In the event of any work-related injury or illness, contact the EHS Support PM and an EHS Support Safety Specialist by phone. All accidents and injuries will be reported using the electronic New Injury Report form located in the Issues section of MyMomentum.

HASP Revisions

HASP Section	Updated By	Site Safety Officer Initials	Date	Comment(s)

Acronyms

AED	automatic external defibrillator
CFR	Code of Federal Regulations
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
JSA	Job Safety Analysis
NYSDEC	New York State Department of Environmental Conservation
OBZ	Operator’s Breathing Zone
OSHA	Occupational Safety and Health Administration
PID	photoionization detector
PM	Project Manager
PPE	personal protective equipment
PSA	Project Safety Analysis
SDS	Safety Data Sheets
SOP	Standard Operating Procedure
SSO	Site Safety Officer
VOC	volatile organic compound

Appendix A PSA Checklist

Project Safety Analysis (PSA)

The purpose of the PSA Form and the PSA call is to ensure that all predictable hazards are identified and addressed before work begins. It should be considered the initial health and safety kickoff call for the proposed work and will be held prior of each field mobilization. Clients and contractors may provide additional information during the PSA call regarding Site characteristics and activities that could change hazard/safety analyses. Therefore, the HASP should be updated with any applicable information provided by the PSA analysis. The main objective of the PSA call is to review the information in this HASP and discuss known and predictable hazards.

The blank PSA form shall be completed by the PM, or designated representative, reviewed with the project team during a PSA call, and kept on-site by the SSO. The PSA call shall be conducted at least three days prior to commencement of work. The PSA call is required for all new projects involving two or more employees or subcontractors for periods of 3 or more days of field efforts, or when there is a change in project scope or project personnel. A PSA call encompassing new work tasks. The PSA call shall include, at a minimum, the following participants:

- EHS Support PM
- EHS Support Site Task Manager/Field Team Leader
- EHS Support SSO
- EHS Support H&S Specialist
- EHS Support contractor representative
- *Client PM
- *Client Site contact
- *Client H&S representative

*These participants are optional.

The PSA form is designed to be populated prior to the PSA call, and the sections that are not applicable to the upcoming mobilization may be removed from the document.

Personnel visiting the site for short periods of time (e.g., health and safety audits, client visits, or subcontractors preforming other duties) or during the middle of a major field mobilization, and who cannot attend the initial PSA, will be provided appropriate pre-job safety training based on the activities they may perform via the Daily Tailgate Safety Form.

PSA Process:

1. PM or designated representative completes the PSA form.
2. PSA call is scheduled with the project team at least three days prior to commencement of work.
3. PSA form and HASP is provided to all PSA call attendees via the call invite or sent prior to the call to allow for attendee review and preparation.
4. Update PSA form with any changes or new information during the PSA call and update HASP, if necessary.

General Project Information

Project Name	Ashland Port Ewen	**PSA Date**	Click or tap to enter a date.
Site/Project Name	Hercules, Inc. Site (#356001)	**Project Location**	161 Ulster Avenue, Port Ewen Ulster County, New York
PSA Participants (Note: If these key participants are not available, consider postponing the PSA.)			
EHS Support Project Manager	Kristin VanLandingham	**EHS Support Task Manager/Field Team Leader**	Click or tap here to enter text.
EHS Support H&S Dept. Representative	Shannon Barr	**EHS Support Site Safety Officer**	Click or tap here to enter text.
Client Site Contact	Click or tap here to enter text.	**Subcontractor Representative(s)**	Click or tap here to enter text.
Scope of Work			
State of the Site/Facility	Active	**Site Access**	Road/Vehicle
Site Topography	• Flat • Muddy • Swampy • Uneven • Wooded/Forest • Heavy vegetation		
Normal Shift Work	Yes		
Lone Working	No		
Traffic	Light		

Major Tasks	• Asphalt and/or concrete coring/chipping • Direct push drilling • Driving • Drum handling • Groundwater sampling • Hand augering • Handling of compressed gasses • Hollow stem augering • Land based ecological surveys • Off-site transportation of waste • Over water sediment and surface water sampling/other ecological activities • Pressure washing during decontamination • Slug test • Soil sampling • Sub slab soil gas sampling • Surface and sediment sampling (manual – maximum waist deep) • Surface soil sampling/stockpiling sampling (non-intrusive) • Waste soil/cutting management from drilling • Well gauging • Well installation • Well surveying • Working near water • Working over water
Equipment Needed	• Asphalt and/or Concrete Corer • Compressed gasses • Direct Push Drill Rig • Drum dolly • Dry ice for samples • Dust meter • Hand auger • Hand tools • Hollow Stem Auger • Machete • Personal protective equipment • PID • Pressure washer • Sampling containers/equipment and coolers • Slug test equipment • Sonic drill rig • Stakes and hammer • Waste drums • Water sampling equipment • Well gauge
Location of assembly areas	
Location of storm shelter	
Nearest First Aid Kit/AED	Provided by EHS Support personnel and AED provided by emergency first responder personnel
Nearest Eyewash/Shower	

Site Personnel Information

Item	Yes	No	N/A	PSA Discussion Topics	Comments
Do the personnel serving in the field have adequate safety expertise, training, and experience to serve in their respective project roles:					Click or tap here to enter text.
• Transportation Workers Identification Credential (TWIC)	☐	☐	☐		
• First Aid/CPR	☐	☐	☐		
• Hot Work	☐	☐	☐		
• Confined Spaces	☐	☐	☐		
• Fire Watch	☐	☐	☐		
• Other:	☐	☐	☐		
Are there any Short Service Employees Working on the Field Team? (EHS Support or subcontractors)	☐	☐	☐	Who is serving as the field mentor for those individuals?	Click or tap here to enter text.
				How will the short service worker be identified? (e.g., color of hard hat, sticker etc.)	Click or tap here to enter text.
Are there subcontractors working on this project?	☐	☐	☐	A subcontractor representative must participate in the PSA call	Click or tap here to enter text.
				Proper subcontractor documents in the file and have been vetted by the H&S team	Click or tap here to enter text.
				Are the subcontractors required to be HAZWOPER trained under 29 CFR 1910.120(a)? Do we have verification of training?	Click or tap here to enter text.
Are EHS Support employees supervising subcontractors?	☐	☐	☐	Do they have the 8-hour Supervisor training in accordance with 1910.120(e)(4) and (e)(8)?	Click or tap here to enter text.

Documentation Checklist

Item	Yes	No	N/A	PSA Discussion Topics	Comments
Is the HASP current for the scope of work? Provide date and title of HASP in the Comments.	☐	☐	☐		Click or tap here to enter text.
Has a copy of the current HASP been made available to the PSA call attendees and have the attendees reviewed?	☐	☐	☐		Click or tap here to enter text.
Is there a written scope of work for the project? Provide date and title of the document in the Comments.	☐	☐	☐		Click or tap here to enter text.

Task Specific Physical Hazards

Activity	Yes	No	N/A	PSA Discussion Topics	Yes	No	N/A	Comments
After hours/night work	☐	☐	☐	Is there adequate supplemental or task lighting?	☐	☐	☐	Click or tap here to enter text.
				How is the site secured during off-shifts?	☐	☐	☐	Click or tap here to enter text.
				Is there a buddy system in place?	☐	☐	☐	Click or tap here to enter text.
				Is there a plan for fatigue management?	☐	☐	☐	Click or tap here to enter text.
Audit Due Diligence in Operational Areas of Facility	☐	☐	☐	Will employees have an escort through the facility?	☐	☐	☐	Click or tap here to enter text.
				Will the site provide site-specific visitor/contractor training?	☐	☐	☐	Click or tap here to enter text.
				Has the PM or field team been made aware of site-specific PPE?	☐	☐	☐	Click or tap here to enter text.
				Have high hazard/off limit areas of the facility been discussed with the client?	☐	☐	☐	Click or tap here to enter text.
				Does the facility have specific emergency action protocols?	☐	☐	☐	Click or tap here to enter text.
Concrete or Asphalt Cutting or Coring	☐	☐	☐	How will dust be mitigated? (i.e. wet process)	☐	☐	☐	Click or tap here to enter text.
				High noise exposures during this process will need either distance or hearing protection	☐	☐	☐	Click or tap here to enter text.
Drilling	☐	☐	☐	How will personnel be protected from rotating equipment/moving parts?	☐	☐	☐	Click or tap here to enter text.
				Will there be any suspended loads?	☐	☐	☐	Click or tap here to enter text.
				What requirements will there be for spotters?	☐	☐	☐	Click or tap here to enter text.
				Has adequate clearing and leveling been conducted to accommodate drill rigs and supplies to provide a safe work area?	☐	☐	☐	Click or tap here to enter text.

Activity	Yes	No	N/A	PSA Discussion Topics	Yes	No	N/A	Comments
				Ground crew working in the vicinity of heavy equipment will be minimized to prevent struck by and caught between accident types.	☐	☐	☐	Click or tap here to enter text.
				The following policies will be discussed with the operators: • Keep hands on machine controls and will not engage in distractions (texting, cell phones, radios) while equipment is moving and/or movement is not locked out • Seat belts will be worn while operating equipment.	☐	☐	☐	Click or tap here to enter text.
				Crew will wear traffic vests (Type II, white or yellow) when not wearing overprotective coveralls (i.e. Tyvek).	☐	☐	☐	Click or tap here to enter text.
Driving	☐	☐	☐	Will transportation involve personal, rental, or company vehicle? If "yes," include in the Comments if the car is a personal car, rental car, or a company car.	☐	☐	☐	Click or tap here to enter text.
				Is the vehicle appropriate for the project scope?	☐	☐	☐	Click or tap here to enter text.
				Are drivers familiar with vehicle to be used (e.g., brakes, mirrors, lights, small vs large or SUV)?	☐	☐	☐	Click or tap here to enter text.
				Will work and travel exceed 12 hours?	☐	☐	☐	Click or tap here to enter text.
				Will travel to site exceed 200 miles? *If yes, is there a journey management plan?*	☐	☐	☐	Click or tap here to enter text.
				Are directions to the site available?	☐	☐	☐	Click or tap here to enter text.
Electrical	☐	☐	☐	Ensure all electric services are installed by a licensed electrician.	☐	☐	☐	Click or tap here to enter text.

Activity	Yes	No	N/A	PSA Discussion Topics	Yes	No	N/A	Comments
				Extension cords will be used in a manner that they are protected from damage and inspected prior to use to check for damage (i.e. cuts, breaks, splices, or missing prongs).	☐	☐	☐	Click or tap here to enter text.
				If equipment needs maintenance, how will energy control and isolation be completed?	☐	☐	☐	Click or tap here to enter text.
Excavations and Trenches	☐	☐	☐	Who is the competent person?	☐	☐	☐	Click or tap here to enter text.
				How will the excavation be sloped/shored/barricaded?	☐	☐	☐	Click or tap here to enter text.
Groundwater Sampling	☐	☐	☐	Traffic (flow and congestion)?	☐	☐	☐	Click or tap here to enter text.
				Pinch points when opening well heads	☐	☐	☐	Click or tap here to enter text.
				How will ergonomic concerns (i.e., lifting, repetitive motion, materials handling, awkward postures) be mitigated?	☐	☐	☐	Click or tap here to enter text.
				What hand protection will be used to protect against COC exposures?	☐	☐	☐	Click or tap here to enter text.
Heavy Equipment Use	☐	☐	☐	Traffic (flow and congestion)?	☐	☐	☐	Click or tap here to enter text.
				What are requirements for spotters?	☐	☐	☐	Click or tap here to enter text.
				How will daily equipment inspections be documented?	☐	☐	☐	Click or tap here to enter text.
Hot Work	☐	☐	☐	Verify with designated client representative that the planned hot work operations conform to the client's hot work procedures and permit requirements	☐	☐	☐	Click or tap here to enter text.
				How will atmospheric testing be completed?	☐	☐	☐	Click or tap here to enter text.
				Do you have a fire watch with an appropriate fire extinguisher?	☐	☐	☐	Click or tap here to enter text.

Activity	Yes	No	N/A	PSA Discussion Topics	Yes	No	N/A	Comments
				Are there any known flammable or combustible materials in the hot work areas?	☐	☐	☐	Click or tap here to enter text.
Industrial Waste Characterization	☐	☐	☐	What tools will be used to collect soil samples?	☐	☐	☐	Click or tap here to enter text.
				How will potential exposures to vapors and chemicals be mitigated?	☐	☐	☐	Click or tap here to enter text.
Land Based Ecological Surveys	☐	☐	☐	Will work be done near water or sloped ground?	☐	☐	☐	Click or tap here to enter text.
				How are task locations accessed?	☐	☐	☐	Click or tap here to enter text.
Off-site Transportation of Waste	☐	☐	☐	How are moving vehicles/traffic flow managed?	☐	☐	☐	Click or tap here to enter text.
Overwater sediment and surface water sampling	☐	☐	☐	Does the site have a float plan?	☐	☐	☐	Click or tap here to enter text.
				Be aware of the water conditions in the fieldwork area. Know where currents, rapids, and obstructions exist and the locations of shallow and deep spots.	☐	☐	☐	Click or tap here to enter text.
				How will weather conditions be monitored?	☐	☐	☐	Click or tap here to enter text.
				How will the vessel be accessed?	☐	☐	☐	Click or tap here to enter text.
				How will the vessel be secured when not in use?	☐	☐	☐	Click or tap here to enter text.
				Have the proper authorities been notified and permits been approved for work on this waterway?	☐	☐	☐	Click or tap here to enter text.
				Do passengers have appropriate training and PPE?	☐	☐	☐	Click or tap here to enter text.
Pressure washing	☐	☐	☐	Minimum wand length is 48”	☐	☐	☐	Click or tap here to enter text.
				All personnel using pressure washing equipment shall be trained in the proper use and inspection of the equipment	☐	☐	☐	Click or tap here to enter text.

Activity	Yes	No	N/A	PSA Discussion Topics	Yes	No	N/A	Comments
				Do personnel need special PPE to complete pressure washing (i.e. Tyvek suits or face shields)?	☐	☐	☐	Click or tap here to enter text.
Remedial Excavation Works	☐	☐	☐	Who is the competent person?	☐	☐	☐	Click or tap here to enter text.
				How will the excavation be sloped/shored/barricaded?	☐	☐	☐	Click or tap here to enter text.
				Will persons need to enter the excavation?	☐	☐	☐	Click or tap here to enter text.
Remedial Piping Installation	☐	☐	☐	Do any permits need to be obtained prior to starting work? (i.e. hot work)	☐	☐	☐	Click or tap here to enter text.
				Will rigging be used to suspend loads during placement?	☐	☐	☐	Click or tap here to enter text.
				How will pipes be placed? (i.e. manually or use of mechanical placement)	☐	☐	☐	Click or tap here to enter text.
Site Visit/Site Inspection	☐	☐	☐	Will employees have an escort through the facility?	☐	☐	☐	Click or tap here to enter text.
				Will the site provide site-specific visitor/contractor training?	☐	☐	☐	Click or tap here to enter text.
				Has the PM or field team been made aware of site-specific PPE?	☐	☐	☐	Click or tap here to enter text.
				Have high hazard/off limit areas of the facility been discussed with the client?	☐	☐	☐	Click or tap here to enter text.
Surface and Sediment Sampling (manual - maximum waist deep)	☐	☐	☐	What PPE needs to be utilized to enter the water? (i.e. waders, PFD)	☐	☐	☐	Click or tap here to enter text.
				How deep is the water expected to be and how swift the current?	☐	☐	☐	Click or tap here to enter text.
				Do field workers need a special permit to access water?	☐	☐	☐	Click or tap here to enter text.

Activity	Yes	No	N/A	PSA Discussion Topics	Yes	No	N/A	Comments
				Where/how will the task locations be accessed (i.e. kayak, riverbank, dock) and how is the terrain at the access point (i.e. sloped, rocky, swampy)?	☐	☐	☐	Click or tap here to enter text.
Waste soil/cutting management from drilling	☐	☐	☐	Determine fill capacity based on materials and weather conditions. • The maximum weight a 55-gallon drum can weight by regulation is 400 KG or 832 pounds if the drums weight more than 800lbs the waste contractor could refuse to pick up the drums. If working in cold weather conditions (i.e., temperatures below freezing), space should be left in water based IDW drums to allow for expansion.	☐	☐	☐	Click or tap here to enter text.
				Does the waste removal contractor have proper mechanical means to move full drums? (i.e. forklift with drum grappler)	☐	☐	☐	Click or tap here to enter text.
				Has a staging area been decided? • Ensure space is left in between the drums for easy removal and inspection • Segregate waste types.	☐	☐	☐	Click or tap here to enter text.
Well Installation	☐	☐	☐	Traffic (flow and congestion)?	☐	☐	☐	Click or tap here to enter text.
				What are requirements for spotters?	☐	☐	☐	Click or tap here to enter text.
				How will daily equipment inspections be documented?	☐	☐	☐	Click or tap here to enter text.
Well Surveying	☐	☐	☐	Traffic (flow and congestion)?	☐	☐	☐	Click or tap here to enter text.
				Pinch points when opening well heads	☐	☐	☐	Click or tap here to enter text.

Activity	Yes	No	N/A	PSA Discussion Topics	Yes	No	N/A	Comments
				How will ergonomic concerns (i.e., lifting, repetitive motion, materials handling, awkward postures) be mitigated?	☐	☐	☐	Click or tap here to enter text.
				What hand protection will be used to protect against COC exposures?	☐	☐	☐	Click or tap here to enter text.

Site Conditions Assessment

Site Condition	Yes	No	N/A	PSA Discussion Topics	Yes	No	N/A	Comments
Heavy Wooded Site Area/High areas of vegetation where ecology present	☐	☐	☐	Does vegetation need to be cleared? If so, what tools will be used?	☐	☐	☐	Click or tap here to enter text.
High activity site with heavy equipment	☐	☐	☐	Will spotters be used?	☐	☐	☐	Click or tap here to enter text.
				How will ground crew communicate with operators?	☐	☐	☐	Click or tap here to enter text.
				If traffic is continually flowing (i.e. trucks continually entering/exiting the site) has a traffic flow plan been developed?	☐	☐	☐	Click or tap here to enter text.
Potential for unexploded ordinance	☐	☐	☐	Are explosion hazards throughout the site, or only in exclusion zone?	☐	☐	☐	Click or tap here to enter text.
				Smoking, open flames, and spark generating equipment will only be allowed in designated areas. Have those areas been defined?	☐	☐	☐	Click or tap here to enter text.
Activity in Private Homes or Third-Party Premises	☐	☐	☐	Have access permits been obtained?	☐	☐	☐	Click or tap here to enter text.
Remote Site with limited services	☐	☐	☐	Are field members CPR/AED/First Aid trained and comfortable providing care if needed?	☐	☐	☐	Click or tap here to enter text.
				Who on the field team will provide a first aid kit and eye wash?	☐	☐	☐	Click or tap here to enter text.
Absence of Cell Phone Reception	☐	☐	☐	How will team members communicate?	☐	☐	☐	Click or tap here to enter text.
				How will emergency response be contacted in the event of an emergency?	☐	☐	☐	Click or tap here to enter text.
Poor access requiring 4WD	☐	☐	☐	Do we have the appropriate rental vehicles?	☐	☐	☐	Click or tap here to enter text.
				Are we using ATVs?	☐	☐	☐	Click or tap here to enter text.

<table>
<tr><th>Site Condition</th><th>Yes</th><th>No</th><th>N/A</th><th>PSA Discussion Topics</th><th>Yes</th><th>No</th><th>N/A</th><th>Comments</th></tr>
<tr><td rowspan="4">High crime/area subject to civil disobedience</td><td rowspan="4">☐</td><td rowspan="4">☐</td><td rowspan="4">☐</td><td>Are there any site-specific/special clearance requirements for site access (e.g., government installation, site security notification)?</td><td>☐</td><td>☐</td><td>☐</td><td>Click or tap here to enter text.</td></tr>
<tr><td>If “yes,” were arrangements made to comply with the requirements?</td><td>☐</td><td>☐</td><td>☐</td><td>Click or tap here to enter text.</td></tr>
<tr><td>Is pre-site visit drug testing required?</td><td>☐</td><td>☐</td><td>☐</td><td>Click or tap here to enter text.</td></tr>
<tr><td>Is local Area Safety Council Training required?</td><td>☐</td><td>☐</td><td>☐</td><td>Click or tap here to enter text.</td></tr>
<tr><td rowspan="5">Overhead Utilities</td><td rowspan="5">☐</td><td rowspan="5">☐</td><td rowspan="5">☐</td><td>Has an avoidance plan been prepared?</td><td>☐</td><td>☐</td><td>☐</td><td>Click or tap here to enter text.</td></tr>
<tr><td>Have project overhead utility hazards been identified?</td><td>☐</td><td>☐</td><td>☐</td><td>Click or tap here to enter text.</td></tr>
<tr><td>Will ground crew member been assigned as a spotter to any piece of heavy equipment that is working close enough to an overhead line so that a part of the machine does not infringe on the safe distance?</td><td>☐</td><td>☐</td><td>☐</td><td>Click or tap here to enter text.</td></tr>
<tr><td>On the first day, team members must designate power line crossing points and post signs stating DANGER OVERHEAD POWER LINES.</td><td>☐</td><td>☐</td><td>☐</td><td>Click or tap here to enter text.</td></tr>
<tr><td>Safe distances from overhead power lines must be maintained (see table below)
<table>
<tr><th>System Voltage (kilovolts)</th><th>Minimum Distance Required Clearance (feet)</th></tr>
<tr><td>0 -50</td><td>10</td></tr>
<tr><td>51 – 100</td><td>12</td></tr>
<tr><td>101 – 200</td><td>15</td></tr>
<tr><td>201 – 300</td><td>20</td></tr>
<tr><td>301 – 500</td><td>25</td></tr>
</table></td><td>☐</td><td>☐</td><td>☐</td><td>Click or tap here to enter text.</td></tr>
</table>

Site Condition	Yes	No	N/A	PSA Discussion Topics	Yes	No	N/A	Comments
				501 – 750 35 751 – 1000 45				
Underground Utilities	☐	☐	☐	How will underground utility clearance be conducted?	☐	☐	☐	Click or tap here to enter text.
				Has a public one-call been requested?	☐	☐	☐	Click or tap here to enter text.
				Private utility mark out be used?	☐	☐	☐	Click or tap here to enter text.
				Is there a minimum clearance of 5 feet from the edge of utility markings and proposed drilling locations?	☐	☐	☐	Click or tap here to enter text.
				Will the upper 4 feet of all intrusive work be manually cleared by hand augering/probing, air jet, or other similar method?	☐	☐	☐	Click or tap here to enter text.
				If intrusive work must be conducted within the required 5-foot minimum clearance, has the specific work been reviewed by an EHS Support H&S Specialist and the PM?	☐	☐	☐	Click or tap here to enter text.
Local Hunting Season	☐	☐	☐	Are there nearby woods where hunters could be?	☐	☐	☐	Click or tap here to enter text.
				What specific colors/highly visible clothing should be worn?	☐	☐	☐	Click or tap here to enter text.
				How will crew members make themselves “known” in the area? (i.e. making noise or using 4-ways on equipment)	☐	☐	☐	Click or tap here to enter text.
				Do we need to adjust working times to accommodate for typical hunting times (i.e. dawn and dusk)?	☐	☐	☐	Click or tap here to enter text.
Biological Hazards	☒	☐	☐	Alligators	☐	☒	☐	Click or tap here to enter text.
				Bears	☐	☒	☐	Click or tap here to enter text.

Site Condition	Yes	No	N/A	PSA Discussion Topics	Yes	No	N/A	Comments
				Bees	☒	☐	☐	Click or tap here to enter text.
				Fire Ants	☒	☐	☐	Click or tap here to enter text.
				Poison Ivy	☒	☐	☐	Click or tap here to enter text.
				Poison Sumac	☒	☐	☐	Click or tap here to enter text.
				Snakes	☒	☐	☐	Click or tap here to enter text.
				Spiders	☒	☐	☐	Click or tap here to enter text.
				Ticks	☒	☐	☐	Click or tap here to enter text.
				Wasps	☒	☐	☐	Click or tap here to enter text.
				Other:	☐	☐	☐	Click or tap here to enter text.
Potential for Thunderstorms	☐	☐	☐	Is there a designated area where will the field team can take temporary shelter when lightning is seen, or thunder is heard?	☐	☐	☐	Click or tap here to enter text.
				30 minutes must pass since the last detected lightning strike or thunderclap, how will the team keep track?	☐	☐	☐	Click or tap here to enter text.
Potential for Tornadoes	☐	☐	☐	How will the field team track severe weather alerts for tornado warnings and watches?	☐	☐	☐	Click or tap here to enter text.
				Does the site have a site-specific evacuation and muster point? If not, the field team should define one upon arriving to the site.	☐	☐	☐	Click or tap here to enter text.
Potentials for Hurricanes	☐	☐	☐	Has the weather been checked prior to mobilization for potential hurricanes?	☐	☐	☐	Click or tap here to enter text.
Potential for snow/ice	☐	☐	☐	Is snow and ice in the forecast?	☐	☐	☐	Click or tap here to enter text.
				How will snow and ice be removed from access areas (i.e. walkways and roads) on the site?	☐	☐	☐	Click or tap here to enter text.

Site Condition	Yes	No	N/A	PSA Discussion Topics	Yes	No	N/A	Comments
Other Site-Specific Hazards	☐	☐	☐	Discuss any other site-specific hazards known to the site or encountered during other mobilization efforts.	☐	☐	☐	Click or tap here to enter text.

Site Required Personal Protective Equipment (PPE)

Equipment	Comments
Steel Toe Boots/Shoes	
Safety Vest	
Hearing Protection	Only around heavy equipment
Hard Hat	Only around overhead hazards
Safety Glasses with Side Shields	On active plant
Cotton or Leather Work Gloves	
Chemical Resistant Gloves (Nitrile)	
All work is anticipated to be completed in Level D or modified Level D. ***NOTE: If Site conditions suggest another level than Level D or Modified Level D for EHS Support personnel, and they are not currently trained for necessary level with the appropriate equipment, stop and do not perform this work.***	

Appendix B Job Safety Analysis Worksheet

Issue Date	Oct. 12, 2017
Revision No.	003
Revision Date	Aug. 24, 2020

Job Safety Analysis (JSA)

Using the information accumulated regarding the potential hazards posed to EHS Support employees from your site-specific health and safety plan (HASP), an evaluation of the hazards must be conducted. The evaluation will be done as a JSA. A JSA is a method by which assigned jobs are reviewed to determine how to control hazards posed during the assigned tasks. The hierarchy of hazard control is as follows:

- Elimination – completely remove the hazard from the work environment.
- Substitution – substitute tools or chemicals to reduce the hazard.
- Engineering controls – install barriers or use mechanical means to reduce the hazard (e.g., ventilation).
- Administrative controls – change schedules, employee rotation, signage, and training to reduce exposure.
- Work practice controls – change the way tasks are conducted to reduce exposure.
- Personal Protective Equipment (PPE) – assign PPE when controls do not abate the hazard.

A JSA worksheet will be completed for each job that will be performed by EHS Support employees. The JSA is an important accident prevention tool that works by finding hazards and eliminating or controlling them before they have a chance to become accidents. The JSA can be used for job clarification and hazard awareness, as a guide in new employee training, for retraining existing employees, as a refresher on jobs which run infrequently, as an accident investigation tool, and for informing employees of specific job hazards and protective measures. JSAs should be completed by keeping in mind the potential risks of the separate tasks that comprise the job, as well as past injury/illness history of the task(s). Each job is broken into tasks that are listed on the worksheet. The hazards are then ranked using a calculation that accounts for the potential severity and the potential likelihood of the identified hazards. Before completing the JSA form, consider the following:

- The purpose of the job – what has to be done and who has to do it?
- The activities involved – how is it done, when is it done, and where is it done?

Employees assigned to perform the jobs being evaluated should be involved in the completion of the JSA form. The process for completing a JSA should include an observation and/or experience with how an EHS Support employee conducts the task/job and an operational review of the task/job.

Prior to conducting tasks that require the use of physical labor or mechanical equipment, the hazards of these tasks and mitigation measures to be used must be reviewed. If at any time tasks have not been addressed in the HASP, the Project Manager (PM) or Site Safety Officer (SSO) must review the hazards associated with that task. The time involved and level of crew involvement should be appropriate to the tasks being performed. This discussion of additional hazards should be documented in some manner (e.g., JSA, field book, Daily Tailgate Safety Meeting form). A daily Site safety briefing is required to discuss and document the tasks to be conducted that day, specific hazards associated with the tasks, and any lessons learned from the previous day. The meetings are to be held prior to the commencement of any tasks. The Daily Tailgate Safety Meeting form is in Error! Reference source not found. of the HASP or located on MyMomentum.info.

Client:
Project:
Location:

JSA Title:

Page **of**

☐ New
☐ Revised

Work Activity Description:

Project / Field Team Members:

JSA Author(S): **Date:**
Reviewed By: **Date:**
Approved By: **Date:**

Risk Assessment Matrix		**Likelihood Ratings**					
Consequences Ratings		**A**	**B**	**C**	**D**	**E**	**F**
People	**Property**	**1** Very remote (1 in 1,000,000)	**2** Remote (1 in 100,000)	**3** Possible (1 in 10,000)	**4** Probable (1 in 1,000)	**5** Likely (1 in 100)	**6** Almost certain (1 in 10)
1 = No Injury / Illness	1 = No damage	**1 - Low**	**2- Low**	**3- Low**	**4- Low**	**5- Low**	**6- Low**
2 = Injury / Illness — first aid only	2 = Slight damage	**2- Low**	**4- Low**	**6- Low**	**8- Low**	**10- Medium**	**12- Medium**
3 = Injury / Illness — medical treatment	3 = Minor damage	**3- Low**	**6- Low**	**9- Medium**	**12- Medium**	**15- Medium**	**18- High**
4 = Disabling injury (restricted work or days away from work)	4 = Local damage	**4- Low**	**8- Low**	**12- Medium**	**16- Medium**	**20- High**	**24- High**
5 = Long-term disability or major disabling injury	5 = Major damage	**5- Low**	**10- Medium**	**15- Medium**	**20- High**	**25- High**	**30- High**
6 = Fatality	6 = Catastrophic damage	**6- Low**	**12- Medium**	**18- High**	**24- High**	**30- High**	**36- High**

Minimum Required PPE (See Critical Actions for Task-Specific Requirements)

☐ Safety Vest
☐ Hard Hat
☐ Lifeline / Body Harness
☐ Safety Glasses
☐ Goggles
☐ Face Shield
☐ Hearing Protection
☐ Safety Boots / Shoes
☐ Respirator (provide type)
☐ Protective Outerwear
☐ Chemical Protective Outerwear
☐ Fire Extinguisher
☐ Nitrile Gloves
☐ Leather or Work Gloves
☐ Other:

Job Steps (List Every Step in The Task)	**Potential Hazards** (List Every Hazard Associated with Every Step in The Task)	**Baseline Risk Score**	**Hazard Controls / Protection Measures**	**Post Prevention Risk Score**
Example: Access monitoring wells	• Pinch points from opening well • Metal plate covers/caps • Insects (bees, wasps etc.) • Poisonous spiders • Slips/Trips/Falls • Contaminated water / vapors	6 - Low	• Wear proper gloves to access and use tools to remove metal plate covers if necessary. • Be aware of insects and spiders in well annulus. • Watch where you are walking, avoid uneven surfaces. • Wear safety glasses, proper gloves (Nitrile). Allow well to vent long enough for vapors to dissipate.	3 - Low

Instructions for Completing the Job Safety Analysis Form

Complete a Job Safety Analysis (JSA) for all tasks being conducted on-site that may pose a hazard to EHS Support employees. Assigned jobs should be reviewed to determine how to control or minimize the hazards, as well as protect employees from these hazards. Each job is broken into tasks; the tasks are listed in order and an associated hazard ranking is calculated for each. This JSA worksheet was developed to aid in the review of jobs/tasks. The JSA is an important accident prevention tool that works by finding hazards and eliminating them before they become accidents. The JSA can be used for job clarification and hazard awareness, as a guide in new employee training, for retraining existing employees, as a refresher on jobs which run infrequently, as an accident investigation tool, and for informing employees of specific job hazards and protective measures.

Keep in mind the potential risks of the separate tasks that comprise the job, as well as the past injury/illness history of the task(s) when completing the JSA. Consider the following when completing the JSA:

- The purpose of the job — What must be done? Who will do it?
- The activities involved — How is it done? When is it done? Where is it done?

Employees assigned to perform the jobs being evaluated should be involved in the completion of the JSA form. The process for completing a JSA must include the following: a visual observation of (or experience with) how an EHS Support employee conducts the task/job and an operational review of the job/task. ALL JSAs SHOULD BE REVIEWED AT LEAST ANNUALLY OR AFTER AN INCIDENT/ACCIDENT AND REVISED AS NECESSARY. When applicable, this worksheet should be included in the site-specific health and safety plans (HASPs).

The following provides column-by-column instructions for completing the JSA form.

Column-by-Column Instructions

Job Steps

Examine a specific job/task by breaking it down into a list of steps (tasks) to discover the potential hazards employees may encounter.

Each job/task or operation will consist of a set of steps. For example, the job might be to collect a soil sample using a trowel. To determine where a step begins or ends, look for a change of activity as in a change in direction, movement, or tools. In the example, preparing the sampling equipment is one step. The next step might be to walk to the sample location (a change in activity). The following step may be clearing the area where the sample will be collected. Filling a sample container would be another step and so on.

Be sure to list all the steps needed to perform the job. It is OK if you break the job down into many small tasks rather than group too many of them together. Some steps may not be performed each time, for example, clearing a sample location. Not all sample collection areas will require clearing. However, if that step is generally part of the job, it should be listed.

Potential Hazards

A hazard is a potential physical, chemical, or environmental danger. The purpose of the JSA is to identify as many hazards as can be predicted. Consider the entire universe of the task when identifying hazards. Ask the five “Ws" and one "H" questions, who, what, when, where, why, and how. For example: who is conducting the step; what tools, equipment, and chemicals are used to complete the step; when is the task/step being conducted (e.g., time of day/year, light/dark conditions, cold/hot conditions); where is the task being conducted; why is the task being conducted (e.g., contamination); how will the step be conducted (e.g., what position will your body be in for the task — crouching, bending, standing, sitting).

To identify hazards, ask yourself these questions about each step of the task:

- Is there the chance the employee may strike against, be struck by, or otherwise making injurious contact with an object or a vehicle?
- Can an employee be caught in, by, or between objects?
- Is there potential for slipping, tripping, or falling?
- Could an employee suffer strains from pushing, pulling, lifting, bending, or twisting?
- What equipment will the employee use during the task?
- Is the environment hazardous to safety and/or health (e.g., over exposure to heat/cold, bees, snakes, ticks, spiders, fire ants, poison ivy/oak, heat, gases, mists, fumes)?
- Are there contaminants of concern present? Can the employee's activity cause a potential exposure to those contaminants?
- What is someone else doing that could negatively impact me/others or the project?

Close observation and knowledge of the job is important. Examine each step carefully to find and identify hazards: include the actions, conditions, and possibilities that could lead to an accident. Compiling an accurate and complete list of potential hazards will allow you to develop the recommended safety procedures needed to prevent accidents.

Baseline Risk Score & Post Prevention Risk Score

The Baseline Risk Score is an assessment of the risk level in the task prior to performing and acting on the findings of the JSA. The Post Prevention Risk Score provides an assessment of the risk level in the task after implementing the control and protection measures assigned by the JSA. The risk score is calculated by multiplying the Severity of the injury/illness by the Likelihood of the injury/illness occurring. Use the following matrix to determine the risk score:

Risk Assessment Matrix		Likelihood Ratings					
Consequences Ratings		**A**	**B**	**C**	**D**	**E**	**F**
People	**Property**	**1** Very remote (1 in 1,000,000)	**2** Remote (1 in 100,000)	**3** Possible (1 in 10,000)	**4** Probable (1 in 1000)	**5** Likely (1 in 100)	**6** Almost certain (1 in 10)
1 = No Injury / Illness	1 = No damage	**1 - Low**	**2- Low**	**3- Low**	**4- Low**	**5- Low**	**6- Low**
2 = Injury / Illness — first aid only	2 = Slight damage	**2- Low**	**4- Low**	**6- Low**	**8- Low**	**10- Medium**	**12- Medium**
3 = Injury / Illness — medical treatment	3 = Minor damage	**3- Low**	**6- Low**	**9- Medium**	**12- Medium**	**15- Medium**	**18- High**
4 = Disabling injury (restricted work or days away from work)	4 = Local damage	**4- Low**	**8- Low**	**12- Medium**	**16- Medium**	**20- High**	**24- High**
5 = Long-term disability or major disabling injury	5 = Major damage	**5- Low**	**10- Medium**	**15- Medium**	**20- High**	**25- High**	**30- High**
6 = Fatality	6 = Catastrophic damage	**6- Low**	**12- Medium**	**18- High**	**24- High**	**30- High**	**36- High**

To determine the risk level, complete the following:

1. Calculate the Baseline Risk score and enter it in the appropriate column on the JSA form. The baseline risk scores are used to determine the urgency of action or implementation of hazard controls (see the risk scores below).
2. Assign controls/protections for the identified hazards greater than a Baseline Prevention Risk Score of 4.
3. Re-calculate the score accounting for the changes the controls/protections will make — this new score is the Post Prevention Risk score.
4. Enter the Post Prevention Risk score in the appropriate column on the JSA form.

Using the risk scores below, determine the action to take based on the Post Prevention Risk score. (Note: If the Post Prevention Risk Score remains greater or equal to 9, the job should be suspended until controls/protections are implemented to lower the risk score.)

The risk scores are:

- 1 to 6 (Acceptable Risk) — No additional action needed.
- 5 to 8 (Low) — Review the operation/activity and take any steps necessary to reduce and control the risks.
- 9 to 16 (Medium) — Inform Site Safety Officer and seek further advice before proceeding any further with the operation/activity.
- 17 or Greater (High) — STOP the activity immediately. Review with Site Safety Officer and Project Manager and reduce the risks identified. Contact a member of the H&S Team if further guidance is needed.

Hazard Controls / Protection Measures

Using the first three columns of the JSA form as a guide, decide what actions or procedures are necessary to eliminate or minimize the hazards that could lead to an accident, injury, or occupational illness. Keep in mind the Occupational Safety and Health Administration (OSHA) requirement to control hazards before assigning personal protective equipment.

To begin minimizing/eliminating hazards, implement the following in order they are presented below:

1. Engineering controls to remove or abate the hazard
2. Administrative controls to protect from the hazard
3. Work practice controls (e.g., provide job instruction training)
4. Personal protective equipment
5. Good housekeeping
6. Good ergonomics (positioning the person in relation to the machine or other elements in such a way as to improve safety)

Once actions and/or procedures have been defined, enter them in the “Hazard Controls / Protection Measures” column on the form. Keep in mind the following:

1. List all appropriate safe operating procedures. Begin with an action word. Say exactly what needs to be done to correct the hazard, such as "lift using your leg muscles." Avoid general statements such as "be careful," "watch out," or “work safely.”
2. List the required PPE necessary to perform each step of the job if controls cannot completely abate the hazard.
3. Give a recommended action or procedure for each hazard. Serious hazards should be corrected immediately.

EHS Support

Issue Date	Oct. 12, 2017
Revision No.	002
Revision Date	Jan. 8, 2019

Job Safety Analysis (JSA)

Client: **Project:** **Location:**	**JSA Title:** Concrete Coring	**Page** 1 **of** 2	☒ New ☐ Revised

Work Activity Description: Site Walk Unload equipment and tools Set up equipment at each location Core Concrete Site clean up	**Project / Field Team Members:**	**JSA Author(S):** Anton Heitger	**Date:** 11/18/2018
		Reviewed By:	**Date:**
		Approved By: Shannon Barr	**Date:** 2/8/2019

Minimum Required PPE (See Critical Actions for Task-Specific Requirements)			
☒ Safety Vest	☐ Goggles	☐ Air Purifying Respirator	☒ Gloves (Chemical / Leather)
☒ Hard Hat	☐ Face Shield	☐ Supplied Respirator	☐ Fire Extinguisher
☐ Lifeline / Body Harness	☒ Hearing Protection	☐ Protective Outerwear	☐ Other:
☒ Safety Glasses	☒ Safety Boots / Shoes	☐ Chemical Protective Outerwear	

Job Steps (List Every Step in The Task)	**Potential Hazards** (List Every Hazard Associated with Every Step in The Task)	**Baseline Risk Score** (L X S)	**Hazard Controls / Protection Measures**	**Post Prevention Risk Score** (L X S)
Site walk to observe and mark location(s) of proposed drilling locations	Slips, trips, falls.	1	• Clear route to each location. • Use lights to provide adequate lighting for work / walking area.	1
Unloading equipment and tools	Muscle strain Pinch points	2	• Use proper lifting techniques. • Use buddy system for lifting. • Keep hands and finger clear of pinch-points and wear appropriate gloves.	1
Set up equipment at each location	Contact with moving parts Pinch points Exertion Trips/falls	3	• Keep clear of moving parts. • Wear proper PPE. • Proper lifting techniques. • Secure Coring Machine prior to drilling.	1

			• Use light stands and headlamps to light work area.	
Core Concrete	Flying debris Dust in breathing zone Slips/Trips/Falls Rotating equipment Electrocution Pinch points Noise	12	• Keep concrete wet while coring. • Use shop vac to keep area clean while coring and after coring. • Use light stands and headlamps to keep work area lit while coring. • Maintains safe distance from rotating parts (core barrel). • Use GFCI on electrical cords and lights. • Wear proper PPE (glove, safety glasses, hard hat, ear plugs).	3
Site cleanup	Muscle strain Pinch points Slips/Trips/Falls	2	• Use proper lifting techniques. • Use buddy system for lifting. • Keep hands and finger clear of pinch -points and wear appropriate gloves. • Use shop vac to keep area clean while coring and after coring. • Use light stands and headlamps to light work area.	1

Job Safety Analysis (JSA)

Client: **Project:** **Location:**	**JSA Title:** Groundwater Monitoring and Sampling	**Page** 1 **of 2**	☒ New ☐ Revised

Work Activity Description: Opening and closing monitoring wells. Groundwater gauging, purging, and sample collection. Site clean-up.	**Project / Field Team Members:**	**JSA Author(S):** Mark Smith	**Date:** 7/11/2017
		Reviewed By:	**Date:**
		Approved By:	**Date:**

Minimum Required PPE (See Critical Actions for Task-Specific Requirements)			
☒ Safety Vest	☐ Goggles	☐ Air Purifying Respirator	☒ Gloves (Chemical / Leather)
☐ Hard Hat	☐ Face Shield	☐ Supplied Respirator	☒ Fire Extinguisher
☐ Lifeline / Body Harness	☐ Hearing Protection	☐ Protective Outerwear	☐ Other:
☒ Safety Glasses	☒ Safety Boots / Shoes	☐ Chemical Protective Outerwear	

Job Steps (List Every Step in The Task)	**Potential Hazards** (List Every Hazard Associated with Every Step in The Task)	**Baseline Risk Score** (L X S)	**Hazard Controls / Protection Measures**	**Post Prevention Risk Score** (L X S)
Assess the work area	Traffic, other work conducted in area, access to monitoring wells	1	• Adjust approach to avoid potential hazards	1
Isolate work area	Vehicle, equipment, and pedestrian traffic	18	• Create barricade around work area: Use work vehicle, cones, caution tape	6
Access monitoring wells	Pinch points from opening well • Metal plate covers/caps Contact with: • Insects (bees, wasps etc.) • Poisonous spiders Slips/Trips/Falls Exposure • contaminated water	9	• Wear proper gloves to access and use tools to remove metal plate covers if necessary. • Be aware of insects and spiders in well annulus. • Watch where you are walking, avoid uneven surfaces. • Open well caps from an upwind position.	3

	• vapors			
Calibrate and check equipment operation	Inaccurate data and poor data quality. Work stoppage due to equipment malfunction	1	• Ensure equipment is working properly and calibrated within acceptable range(s)	1
Collection of water levels	Potential exposure to impacted groundwater and vapors	15	• Wear safety glasses, proper gloves (Nitrile). Allow well to vent long enough for vapors to dissipate. • Use Organic Vapor Analyzer (OVA) such as PID or FID to verify existence or absence of vapors at monitoring well.	8
Installation of purging and sampling equipment into monitoring well	Pinch points installing sampling equipment. Strains installing pump. Splash hazards while installing sampling equipment. Hand cuts or abrasions.	9	• Wear appropriate PPE (gloves), keep hands clear of well while installing sampling equipment. • Lower equipment slowly. • Use proper body position while installing equipment • Use proper safety knife when cutting tubing or twine.	3
Purging and sampling	Slips, trips, falls. Exposure to impacted groundwater, vapors, sample preservative, and decontamination fluids.	9	• Avoid walking or stepping across sample tubing and equipment cords. • Wear appropriate PPE (gloves, safety glasses) and minimize potential for splash hazards by reducing flow rate to fill sample containers. • Use approved transfer containers when sampling with bailer.	3
Removal of purging and sampling equipment from monitoring well.	Pinch points removing sampling equipment. Strains removing pump. Splash hazards while removing sampling equipment.	9	• Use proper PPE (gloves, safety glasses). • Use proper lifting techniques. • Remove equipment slowly to prevent splashing.	3
Site Clean-up and sample packaging	Slips/Trips/Falls Strains Vehicle, equipment, and pedestrian traffic	9	• Watch where you are walking, avoid uneven surfaces. • Use proper lifting techniques when loading equipment and sample coolers (bend at the knees, keep back straight, use buddy system). • Remove work area barricades last.	3

Issue Date	Oct. 12, 2017
Revision No.	002
Revision Date	Jan. 8, 2019

Job Safety Analysis (JSA)

Client: **Project:** **Location:**	**JSA Title:** Monitoring Well Installation	**Page** 1 **of 3**	☒ New ☐ Revised

Work Activity Description: Installation of monitoring well(s) using various drilling technologies (Direct Push Technology (DPT), Hollow Stem Auger (HSA).	**Project / Field Team Members:**	**JSA Author(S):** Mark Smith	**Date:** 7/14/2017
		Reviewed By:	**Date:**
		Approved By:	**Date:**

Minimum Required PPE (See Critical Actions for Task-Specific Requirements)			
☒ Safety Vest	☐ Goggles	☐ Air Purifying Respirator	☒ Gloves (Chemical / Leather)
☒ Hard Hat	☐ Face Shield	☐ Supplied Respirator	☒ Fire Extinguisher
☐ Lifeline / Body Harness	☒ Hearing Protection	☐ Protective Outerwear	☐ Other:
☒ Safety Glasses	☒ Safety Boots / Shoes	☐ Chemical Protective Outerwear	

Job Steps (List Every Step in The Task)	**Potential Hazards** (List Every Hazard Associated with Every Step in The Task)	**Baseline Risk Score** (L X S)	**Hazard Controls / Protection Measures**	**Post Prevention Risk Score** (L X S)
Site walk to observe and mark location(s) of proposed monitoring wells	Slips, trips, falls. Vehicle and pedestrian traffic	18	• Clear route to each location.	6
Locate and mark overhead and underground utilities	Electrical shock, operational underground utilities	36	• Observe and mark all utilities. • Maintain safe distance from all utilities • Install barricades around utilities	12
Mobilization of rig to location	Vehicle and pedestrian traffic Uneven surfaces	18	• Use ground guides/flagmen to clear way, watch for potential obstructions, and manage traffic	6
Set up of rig at location	Contact with moving parts Pinch points	12	• Keep clear of moving parts • Wear proper PPE	8

	Exertion		• Proper lifting techniques • Ensure safety interlocks are in place and operational	
Preparation to drill (handling of augers and drill rods)	Pinch points Muscle strain	12	• Use mechanical lifting devices • Use buddy system for lifting and proper lifting techniques	8
General operation of rig	Slips, trips, falls High pressure fluids Struck by equipment Flying debris Chemical exposure Extreme temperatures Rotating equipment Pinch points Noise	25	• Assure stepping and standing areas are clean and dry. • Maintain 3 points of contact while on rig. • Assure all hydraulic lines are secure and fittings tightened properly. • Maintains safe distance from rotating parts. • Wear proper PPE (glove, safety glasses, hard hat, ear plugs) •	8
Advancement of drilling equipment into ground	Rotating equipment Heavy lifting Flying debris	25	• Maintain proper drill speed, torque, and force. • Keep hands on controls at all times • Proper lifting techniques	8
Handling of soil cuttings (IDW)	Slips, trips, falls, strains, rotating equipment	18	• Maintain proper footing, stay clear of rotating drill, use proper shovel, use proper techniques when operating shovel, use equipment to assist movement of IDW drums.	6
Installation of well construction materials (well screen, riser, sand, bentonite)	Muscle strains Pinch Points Sharp edges and objects	12	• Use mechanical devices to lift heavy objects. • Use buddy system to lift where mechanical device is not practicable • Use proper tools for cutting open bags of sand and bentonite (Safety knife) • Wear cut resistance gloves	8
Removal of drilling equipment from boring	Rotating equipment Heavy lifting	25	• Maintain proper drill speed, torque, and force. • Keep hands on controls at all time.	8

			- Proper lifting techniques	
De-mobilization from location	Vehicle and pedestrian traffic Uneven surfaces	18	- Use ground guides/flagmen to clear way, watch for potential obstructions, and manage traffic	6

Issue Date	June 4, 2019
Revision No.	001
Revision Date	

Job Safety Analysis (JSA)

Client: **Project:** **Location:**	**JSA Title:** Moving Drums (empty and full)	**Page** 1 **of** 2	☒ New ☐ Revised

Work Activity Description: Moving drums (empty and full) Opening drums Closing drums	**Project / Field Team Members:**	**JSA Author(S):** Brianna Sadoski	**Date:** 06/04/2019
		Reviewed By:	**Date:**
		Approved By:	**Date:**

Minimum Required PPE (See Critical Actions for Task-Specific Requirements)			
☒ Safety Vest	☐ Goggles	☐ Air Purifying Respirator	☒ Gloves (Chemical / Leather)
☐ Hard Hat	☐ Face Shield	☐ Supplied Respirator	☐ Fire Extinguisher
☐ Lifeline / Body Harness	☐ Hearing Protection	☐ Protective Outerwear	☐ Other:
☒ Safety Glasses	☒ Safety Boots / Shoes	☐ Chemical Protective Outerwear	

Job Steps (List Every Step in The Task)	**Potential Hazards** (List Every Hazard Associated with Every Step in The Task)	**Baseline Risk Score** (L X S)	**Hazard Controls / Protection Measures**	**Post Prevention Risk Score** (L X S)
Opening drums	Hand or finger pinches Exposure to fumes or spills Muscle strain	6	• Wear gloves to protect hands and fingers from pinches • Wear safety glasses to avoid any exposure to eyes from splashes • Slowly remove lid to avoid tipping or splashing from drum • Read label and SDS to understand nature of material stored in drum	4
Closing drums	Hand or finger pinches Muscle strain	6	• Wear gloves to protect hands and fingers from pinches • Avoid tipping of drum to prevent muscle strain	4

Using a dolly to move full or heavy drums	Muscle strain Hand/foot injury Tripping/falling Skin or eye contact with chemicals Spills	12	• Ensure drum is fully closed • Wear safety shoes • Use a dolly to prevent excess muscle strain • Secure the drum to the dolly using dolly straps • Make sure the path is clear in front of the moving dolly • Read SDS for chemical being handled and know where a spill cleanup kit is located in the event of a spill • Be aware of floor drains along travel path to avoid any chemical entering the waste system in case of a spill • Seek assistance with tipping the drum onto the dolly • Use proper body mechanics when handling heavy/awkward loads • Push drums versus pulling onto a dolly to prevent from falling on a worker	8
Removal of drum from dolly	Muscle strain Hand/foot injury Spills	12	• Wear safety shoes • Check drum to ensure it is not damaged • Ensure placement of drum on flat surface	8
Moving empty drum	Muscle strain Hand/foot injury Tripping/falling	12	• Wear safety shoes and gloves • Use both hands to roll upright drum along the bottom of drum • Ensure a clear path, and move drum slowly	12

Job Safety Analysis (JSA)

Client: **Project:** **Location:**	**JSA Title:** Soil boring and sampling	**Page** 1 **of 2**	☐ New ☒ Revised

Work Activity Description: Clear underground and overhead utilities Equipment set up Conduct boring activity (drill rig, hand auger) Collection of soil sample Site clean up	**Project / Field Team Members:**	**JSA Author(S):** Mark Smith	**Date:** 7/20/2017
		Reviewed By:	**Date:**
		Approved By: Shannon Barr	**Date:** 2/8/2019

Minimum Required PPE (See Critical Actions for Task-Specific Requirements)			
☒ Safety Vest	☐ Goggles	☐ Air Purifying Respirator	☒ Gloves (Chemical / Leather)
☒ Hard Hat	☐ Face Shield	☐ Supplied Respirator	☐ Fire Extinguisher
☐ Lifeline / Body Harness	☒ Hearing Protection	☐ Protective Outerwear	☐ Other:
☒ Safety Glasses	☒ Safety Boots / Shoes	☐ Chemical Protective Outerwear	

Job Steps (List Every Step in The Task)	**Potential Hazards** (List Every Hazard Associated with Every Step in The Task)	**Baseline Risk Score** (L X S)	**Hazard Controls / Protection Measures**	**Post Prevention Risk Score** (L X S)
Set up equipment at location	Vehicle and pedestrian traffic Overhead electric lines Underground utilities	18	• Use spotters and ground guides • Use caution tape and cones • Maintain proper distance from overhead • electric lines • Properly clear all underground utilities and maintain safe distance away	6
Unloading equipment and tools	Muscle strain Pinch points	12	• Use proper lifting techniques • Use buddy system for lifting • Keep hands and finger clear of pinch points and wear appropriate gloves	6

Perform soil boring via DPT, HSA, and Hand Auger	Flying debris Muscle strain Noise Potential exposure to vapors and chemicals	12	• Proper PPE (Gloves, eye protection, hearing protection) • Use proper lifting techniques • Proper body positioning when using hand auger • Monitor area with OVA	6
Collect soil samples	Exposure to vapors and chemicals	12	• Wear proper PPE (Nitrile gloves, safety glasses) • Properly label samples and preserve properly	8
Site clean up	Slips, trips, falls Muscle strain	6	• Proper PPE (gloves, eye protection) • Ensure area is policed (free of trash, tools, etc.) • Properly dispose of all trash	3

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Revision Date	Jan. 8, 2019

Job Safety Analysis (JSA)

Client: **Project:** **Location:**	**JSA Title:** Soil Boring/Vapor Monitoring	**Page** 1 of 2	☒ New ☐ Revised

Work Activity Description: Utilizing a drill rig to extract soil cores, screen the soil cores with a PID, and collect soil samples.	**Project / Field Team Members:**	**JSA Author(S):** Brianna Sadoski	**Date:** 11/6/2018
		Reviewed By:	**Date:**
		Approved By:	**Date:**

Minimum Required PPE (See Critical Actions for Task-Specific Requirements)

☒ Safety Vest	☐ Goggles	☐ Air Purifying Respirator	☒ Gloves (Chemical / Leather)
☒ Hard Hat	☐ Face Shield	☐ Supplied Respirator	☒ Fire Extinguisher
☐ Lifeline / Body Harness	☒ Hearing Protection	☐ Protective Outerwear	☒ Other: Traffic Cones
☒ Safety Glasses	☒ Safety Boots / Shoes	☐ Chemical Protective Outerwear	

Job Steps (List Every Step in The Task)	**Potential Hazards** (List Every Hazard Associated with Every Step in The Task)	**Baseline Risk Score** (L X S)	**Hazard Controls / Protection Measures**	**Post Prevention Risk Score** (L X S)
Assess the work area	Traffic, other work conducted in area, access to sample locations	1	• Adjust approach to avoid potential hazards.	1
Locate overhead power lines	Energy sources/electrical shock	18	• Confirm voltages. • Post safe zone with cones, flags. • Safety zone is 10’ minimum distance away from powerlines.	6
Equipment Mobilization	Contact with vehicle/drilling equipment, rough/sharp edges, pinch points. Exertion/strains	18	• Establish work zone, wear cut-resistant work gloves, use proper lifting techniques. • Use a machine and/or additional persons to lift heavy equipment.	6

Isolate work area	Vehicle, equipment, and pedestrian traffic	18	• Create barricade around work area: Use work vehicle, cones, caution tape.	6
Calibrate and check equipment operation	Inaccurate data and poor data quality. Work stoppage due to equipment malfunction	1	• Ensure equipment is working properly and calibrated within acceptable range(s).	1
Perform Soil Boring	Contact with debris. Exposure to vapors/chemicals, noise. Explosion/Fire	18	• Wear safety glasses. • Monitor area with calibrated PID. Stop work if action levels are exceeded. Continuous air monitoring – ensure LEL is below 10%. • Wear Hearing Protection around drilling rig. Wear chemical resistant gloves.	6
Collect Soil Samples	Exposure to vapors/chemicals. Contact with debris and chemicals. Environmental	15	• Wear chemical resistant gloves. • Wear safety glasses. • Ensure samples are labeled and placed in proper container.	5
Site Clean-up and sample packaging	Slips/Trips/Falls Strains Vehicle, equipment, and pedestrian traffic	18	• Watch where you are walking, avoid uneven surfaces. • Use proper lifting techniques when loading equipment, shoveling soil cuttings into drums, and lifting sample coolers (bend at the knees, keep back straight, use buddy system). • Remove work area barricades last.	6

Job Safety Analysis (JSA)

Client: **Project:** **Location:**	**JSA Title:** Sonic Drilling	**Page** 1 **of 2**	☒ New ☐ Revised

Work Activity Description: Oversight for Sonic Drilling	**Project / Field Team Members:**	**JSA Author(S):** Rebecca Snyder	**Date:** 11/15/2018
		Reviewed By:	**Date:**
		Approved By:	**Date:**

Minimum Required PPE (See Critical Actions for Task-Specific Requirements)

☒ Safety Vest	☒ Goggles	☐ Air Purifying Respirator	☒ Gloves (Chemical / Leather)
☒ Hard Hat	☐ Face Shield	☐ Supplied Respirator	☒ Fire Extinguisher
☐ Lifeline / Body Harness	☒ Hearing Protection	☐ Protective Outerwear	☐ Other:
☒ Safety Glasses	☒ Safety Boots / Shoes	☐ Chemical Protective Outerwear	

Job Steps (List Every Step in The Task)	**Potential Hazards** (List Every Hazard Associated with Every Step in The Task)	**Baseline Risk Score** (L X S)	**Hazard Controls / Protection Measures**	**Post Prevention Risk Score** (L X S)
Equipment Placement	• Mobilization, Small aisleway, Equipment size, obstacles (ground, sides, or overhead)	12	• Use smaller drill rig, use spotter, move obstacles out of way, coordinate with on-site manager and building personnel	4
Utilities	• Electrical Hazard • Subsurface Utilities	15	• Ensure One-Call Public Utilities Call has been conducted, On-Site review of As-Builts, assess the need for hand Auger, use spotters for raising or lowering mast, conduct private locate (as necessary) • Identify overhead utilities, define safe work distance from utility (electrical, subsurface)	8
Exam Drill Rig for Safety Prevention Measures (Fire extinguisher, Safety Stops)	• Fire, Rig Hazard, Rig Safety	8	• Request to see daily rig inspection and review	3

			• Use Drill Rig Inspection Form (SOP-10 Field Form) as a guideline to check for operability and function. • Check fire extinguisher is present, has been checked annually, and has fire suppressant • Press emergency stop buttons to ensure rig will shut down once pressed. • Use chocks, as needed, for rigs on wheels. • Maintain 3 points of contact while climbing up/down truck/equipment	
Drilling	• Eye injury, flying objects, noise, foot or hand injury, fire, caught in	25	• Donn proper PPE (see above) • Establish safe-work distance/- exclusion zone of 3 feet away from moving or rotating parts (i.e., augers, sampling rods, drive shafts, etc.), use shovels to remove soils, assess first 12’ for potential contact with underground utilities, stop intrusive work if non-native material is encountered, do not advance borehole without air monitoring being performed (consult site-specific HASP for PELs, use Kevlar/all-purpose gloves while handling soils and rubber/Kevlar glove if handling groundwater	10
Good Housekeeping	• Potential trip hazards, hand safety hazard, clutter	20	• Assess work area for trip hazards. Move trip hazard(s), if possible. • Wear protective gloves to avoid possible punctures or cuts • Discard waste or debris properly. • Return unused equipment to proper storage location. • Clean area and/or secure area when completed for the day. Include any safety measures to protect people when away from work area.	6

Issue Date	Oct. 12, 2017
Revision No.	002
Revision Date	Jan. 8, 2019

Job Safety Analysis (JSA)

Client: **Project:** **Location:**	**JSA Title:** Surface Water Sampling	**Page** 1 **of 2**	☒ New ☐ Revised

Work Activity Description: Surface Water Sampling	**Project / Field Team Members:**	**JSA Author(S):** Peter O'Konski	**Date:** 1/13/2015
		Reviewed By:	**Date:**
		Approved By:	**Date:**

Minimum Required PPE (See Critical Actions for Task-Specific Requirements)

☒ Safety Vest	☐ Goggles	☐ Air Purifying Respirator	☒ Gloves (Chemical / Leather)
☒ Hard Hat	☐ Face Shield	☐ Supplied Respirator	☐ Fire Extinguisher
☐ Lifeline / Body Harness	☒ Hearing Protection	☐ Protective Outerwear	☐ Other:
☒ Safety Glasses	☒ Safety Boots / Shoes	☐ Chemical Protective Outerwear	

Job Steps (List Every Step in The Task)	**Potential Hazards** (List Every Hazard Associated with Every Step in The Task)	**Baseline Risk Score** (L X S)	**Hazard Controls / Protection Measures**	**Post Prevention Risk Score** (L X S)
Site Mobilization	• Exertion • Struck by with heavy equipment/vehicles	18	• Use proper lifting procedures (bend at knees, straight back) when lifting heavy objects such as ice chests. • Be aware of moving forklifts and vehicles on site. Wear a high visibility vest.	6
Access to sampling locations	• Slips/Trips • Struck by heavy equipment/vehicles • Contact with animals/insects, snakes and spiders. • Contact with vegetation	18	• Ensure secure footing; be aware of uneven or sloped areas. Additionally, slick conditions may occur due to rain, snow or ice. • Wear high visibility vest and be aware of forklift and vehicle traffic • Wear insect repellant if necessary. Avoid contact with animals, snakes or spider.	6

	• Environmental – weather conditions		• Avoid contact with poisonous plants such as poison ivy or poison oak. Avoid trip hazards such as limbs or vines. • Avoid sampling in hazardous weather or when lightning is present.	
Sample Collection	• Contact with skin/eyes • Slip/Trips • Environmental – Weather Conditions	12	• Wear safety glasses to avoid splash hazards. Wear nitrile or latex gloves to avoid contact with chemicals. • Ensure proper footing. Use a sampling telescopic pole for hard to reach sample points. • Wear warm clothing in cold weather and ensure to drink liquids especially in warm weather.	8
Sample Shipment	• Exertion/Strain • Contact with chemicals	12	• Use proper lifting procedures (bend at knees, straight back) when lifting heavy objects such as ice chests. • Wear gloves if handling dry ice.	8

Issue Date	Oct. 12, 2017
Revision No.	002
Revision Date	Jan. 8, 2019

Job Safety Analysis (JSA)

Client: **Project:** **Location:**	**JSA Title:** Underground Utility Survey / Site Walk	**Page** 1 **of** 2	☐ New ☒ Revised

Work Activity Description: Site Walk to review boring locations, survey boring locations with underground utility locating equipment (Ground Penetrating Radar (GPR), Electromagnetic (EM) Locator, plumbing snake, etc.,)	**Project / Field Team Members:**	**JSA Author(S):** Anton Heitger	**Date:** 11/13/2018
		Reviewed By:	**Date:**
		Approved By: Shannon Barr	**Date:** 2/8/2019

Minimum Required PPE (See Critical Actions for Task-Specific Requirements)			
☒ Safety Vest	☐ Goggles	☐ Air Purifying Respirator	☒ Gloves (Chemical / Leather)
☒ Hard Hat	☐ Face Shield	☐ Supplied Respirator	☐ Fire Extinguisher
☐ Lifeline / Body Harness	☐ Hearing Protection	☐ Protective Outerwear	☐ Other:
☒ Safety Glasses	☒ Safety Boots / Shoes	☐ Chemical Protective Outerwear	

Job Steps (List Every Step in The Task)	**Potential Hazards** (List Every Hazard Associated with Every Step in The Task)	**Baseline Risk Score** (L X S)	**Hazard Controls / Protection Measures**	**Post Prevention Risk Score** (L X S)
Site walk to review and locate proposed soil borings, or proposed monitoring wells	• Slips, trips, falls. • Vehicle and pedestrian traffic	9	• Clear pathway to boring locations if in tall grass / vegetation • Look at ground to review walking surfaces • Use Spotter if working near high traffic areas and wear high visibility clothing (vest, shirt, jacket, etc.)	3
Unload utility surveying equipment	• Muscle Strains • Pinch points • Struck by vehicular traffic	12	• Unload one piece of equipment at a time, team lift as needed. • Do not jump from bed of truck or vehicle.	3

			• Keep hands/fingers out of door hinges, GPR wheels, or other pinch points • Wear leather / heavy gloves to unload equipment • Park off the road and use Spotter if working near high traffic areas • Wear high visibility clothing (vest, shirt, jacket, etc.)	
Use GPR / EM locator to locate underground utilities	• Slips, trips, and falls • Struck by vehicular traffic • Electric shock from operational Underground utilities	9	• Scan walking area and plan path before walking • Look up every few seconds from the GPR and EM screens to watch for traffic and look at surroundings • Use Spotter if working near high traffic areas and roadways • Wear high visibility clothing (vest, shirt, jacket, etc.) • Maintain safe distance from live electrical utilities	3
Paint ground to mark underground utilities	• Breathe in paint fumes • Paint on skin / in eyes	4	• Use long handled marking stick to keep spray paint cans from face. • Spray paint downward to mark utilities and away from body if clearing out nozzle. • Wear safety glasses when marking utilities with paint.	2
Open Manholes to locate sewers and snake drains	• Muscle Strains • Pinch Points • Fall Hazard	9	• Use “J” hook or long handled hook to open manholes. Lift with legs not back. • Place additional pry bar or hook between manhole cover and entryway to prevent pinched fingers. • Cover manhole while not accessing or looking into sewers.	3

Snake drains to locate sewer lines	• Confined Space Entry • Sewage on plumbing snake in contact with skin / eyes.	9	• Do NOT enter manholes to snake sewers without confined space permit. • Wipe off and clean plumbing snake while reeling back into holder. • Wear rubber / nitrile gloves and safety glasses while handling plumbing snake.	3

Job Safety Analysis (JSA)

Client: **Project:** **Location:**	**JSA Title:** Well Gauging	**Page** 1 **of 2**	☐ New ☒ Revised

Work Activity Description: Well Gauging	**Project / Field Team Members:**	**JSA Author(S):** Richard Landis	**Date:** 10/13/2017
		Reviewed By:	**Date:**
		Approved By: Shannon Barr	**Date:** 2/8/2019

Minimum Required PPE (See Critical Actions for Task-Specific Requirements)			
☐ Safety Vest	☐ Goggles	☐ Air Purifying Respirator	☒ Gloves (Chemical / Leather)
☐ Hard Hat	☐ Face Shield	☐ Supplied Respirator	☐ Fire Extinguisher
☐ Lifeline / Body Harness	☐ Hearing Protection	☐ Protective Outerwear	☐ Other:
☒ Safety Glasses	☒ Safety Boots / Shoes	☐ Chemical Protective Outerwear	

Job Steps (List Every Step in The Task)	**Potential Hazards** (List Every Hazard Associated with Every Step in The Task)	**Baseline Risk Score** (L X S)	**Hazard Controls / Protection Measures**	**Post Prevention Risk Score** (L X S)
Walk to the monitoring well and check for bees/insects around well casing and underneath the lid	Uneven terrain; slip, trip, and fall hazards; bees, spiders, ticks; poisonous plants; live and dead brush and tree limbs	12	• High leather boots, long pants, safety glasses, wear Tyvek as warranted, situational awareness, observe monitoring well for bee activity, insect repellant sprayed on boots and pants, pants taped to boots at the ankles	8
Unlock and slowly open the monitoring well casing lid and remove leather gloves once safely open	Bees, spiders, insects; volatile VOC vapors	12	• Gently tap the lid before opening the lid and observe for the presence of bees; leather gloves; know if anyone is allergic to bee stings and have them stay back; position up-wind of monitoring well	9

Test water level interface probe to ensure battery power is sufficient and sound is audible	Ergonomic strain	9	• Utilize proper lifting techniques when picking up the batteries or bending down to test the batteries	3
Slowly lower probe down the inside of the monitoring well until sound begins to be audible	Volatile VOC vapors	12	• VOC vapors should not be present; if present – stop work and evaluate	8
Bring probe tape to the side of the well casing to "sense" the water level and read depth in feet and tenths of feet. If casing is marked use that location. Record measurement.	Volatile VOC vapors: exposure to COCs on probe upon withdraw from the casing	12	• Nitrile gloves, safety glasses with side shields, VOC vapors should not be present	8

EHS Support

Issue Date	June 4, 2019
Revision No.	001
Revision Date	

Job Safety Analysis (JSA)

Client: **Project:** **Location:**	**JSA Title:** Traveling and working on ice	**Page** 1 **of** 2	☒ New ☐ Revised

Work Activity Description: Walking on ice and snow Working on ice and snow Shoveling snow, pickaxing ice Driving in adverse weather conditions	**Project / Field Team Members:**	**JSA Author(S):** Brianna Sadoski	**Date:** 06/04/2019
		Reviewed By:	**Date:**
		Approved By:	**Date:**

Minimum Required PPE (See Critical Actions for Task-Specific Requirements)

☒ Safety Vest	☐ Goggles	☐ Air Purifying Respirator	☒ Gloves (Chemical / Leather)
☐ Hard Hat	☐ Face Shield	☐ Supplied Respirator	☐ Fire Extinguisher
☐ Lifeline / Body Harness	☐ Hearing Protection	☐ Protective Outerwear	☐ Other:
☒ Safety Glasses	☒ Safety Boots / Shoes	☐ Chemical Protective Outerwear	

Job Steps (List Every Step in The Task)	**Potential Hazards** (List Every Hazard Associated with Every Step in The Task)	**Baseline Risk Score** (L X S)	**Hazard Controls / Protection Measures**	**Post Prevention Risk Score** (L X S)
Walking on ice and snow	Slips, trips, falls	9	• Where possible, clear walking surfaces of snow and ice, and spread deicer • Wear proper footwear with good treads • Take short steps and walk at a slow pace	6
Working on ice and snow	Cold stress	6	• Wear warm layers of clothing • Take frequent breaks in warm areas • Watch for signs of frostbite and hypothermia • Stay hydrated	3
Shoveling snow	Slips, trips, falls Muscle injury	9	• Wear gloves • Scoop small amounts of snow at a time	6

	Cold stress		• Push snow instead of lifting it where possible • Use proper lifting techniques, lift with the legs and do not turn or twist the body	
Chipping ice using pickaxe	Slips, trips, falls Muscle injury Cold stress	9	• Wear gloves and safety shoes • Maintain proper posture • Position feet shoulder width apart	6
Driving in adverse weather conditions	Motor vehicle accident	18	• Drive slowly according to road conditions • Leave excess distance between vehicles and objects when stopping • Install chains when necessary • Clean off windshields properly • Verify that wiper fluids are full and that defroster and heater work • Make sure yellow safety lights work • Use lights whenever you operate vehicle	12

Issue Date	Oct. 12, 2017
Revision No.	002
Revision Date	May 20, 2019

Job Safety Analysis (JSA)

Client: **Project:** **Location:**	**JSA Title: Working in Extreme Heat (above 80 degrees Fahrenheit)**	**Page 1 of** 2	☒ New ☐ Revised

Work Activity Description: This JSA covers performing any outdoor field activities during extreme heat conditions.	**Project / Field Team Members:**	**JSA Author(S):** Rick Henterly	**Date:** 5/10/2019
		Reviewed By:	**Date:**
		Approved By:	**Date:**

Minimum Required PPE (See Critical Actions for Task-Specific Requirements)

☒ Safety Vest	☐ Goggles	☐ Air Purifying Respirator	☒ Gloves (Chemical / Leather)
☐ Hard Hat	☐ Face Shield	☐ Supplied Respirator	☐ Fire Extinguisher
☐ Lifeline / Body Harness	☐ Hearing Protection	☒ Protective Outerwear	☐ Other:
☒ Safety Glasses	☒ Safety Boots / Shoes	☐ Chemical Protective Outerwear	

Job Steps (List Every Step in The Task)	**Potential Hazards** (List Every Hazard Associated with Every Step in The Task)	**Baseline Risk Score** (L X S)	**Hazard Controls / Protection Measures**	**Post Prevention Risk Score** (L X S)
Complete field tasks during high temperatures – preparing for the field mobilization	Skin hives, sunburn, elevated core body temperature, increased pulse, heat exhaustion, fever, heat stroke, muscle cramps	9	Determine a cool area before entering the field where workers can cool themselves, such as an air-conditioned vehicle or building, or shaded area as secondary option. If possible, perform work in shaded area or bring sun shade (e.g., beach umbrella or pop-up canopy) to avoid contact with the sun; additionally, as possible plan to avoid working or limit activities in the hottest period of the day (generally 2-4pm);	2

Completing field tasks during high temperatures – working in the field	Skin hives, sunburn, elevated core body temperature, increased pulse, heat exhaustion, fever, heat stroke, muscle cramps	9	Drink non-caffeinated fluids before entering the field for hydration; Wear multiple clothing layers to allow for adjustments in outdoor temperature; wear loose-fitting, ventilated clothing that covers exposed skin to avoid sunburn and wear sunscreen on exposed skin surfaces; wear eye protection with UV protection; drink two to four cups of water hourly to avoid dehydration; spread out physical demands during the work day to limit exertions at any one time; apply a wet, cool cloth on the neck as needed to control body temperature; take a minimum 30 minute break a minimum of every four hours out of the sun for rest and hydration;	2

EHS Support

Issue Date	Oct. 12, 2017
Revision No.	002
Revision Date	May 20, 2019

Job Safety Analysis (JSA)

Client: **Project:** **Location:**	**JSA Title:** Working in Extreme Cold (below 40 degrees Fahrenheit)	**Page 1 of 4**	☒ New ☐ Revised

Work Activity Description: This JSA covers performing any outdoor field activities during extreme cold conditions.	**Project / Field Team Members:**	**JSA Author(S):** Rick Henterly	**Date:** 5/10/2019
		Reviewed By:	**Date:**
		Approved By:	**Date:**

Minimum Required PPE (See Critical Actions for Task-Specific Requirements)

☒ Safety Vest	☐ Goggles	☐ Air Purifying Respirator	☒ Gloves (Chemical / Leather)
☐ Hard Hat	☐ Face Shield	☐ Supplied Respirator	☐ Fire Extinguisher
☐ Lifeline / Body Harness	☐ Hearing Protection	☒ Protective Outerwear	☒ Other: Winter weather clothing: head covering, insulated gloves, appropriate socks
☒ Safety Glasses	☒ Safety Boots / Shoes	☐ Chemical Protective Outerwear	

Job Steps (List Every Step in The Task)	**Potential Hazards** (List Every Hazard Associated with Every Step in The Task)	**Baseline Risk Score** (L X S)	**Hazard Controls / Protection Measures**	**Post Prevention Risk Score** (L X S)
Completing field tasks during low temperatures – prior to mobilization	Dehydration, frostbite, hypothermia	9	Determine a heated area before entering the field where workers can warm themselves; if precipitation is expected, determine access to field activity locations that could be impacted by wet/icy/snow-covered conditions and plan entry/exit techniques and routes in advance; if precipitation is expected, bring extra dry socks, shoes, gloves, and waterproof outerwear; Before mobilizing to field activity, ensure vehicle is equipped with the following: functional heat, snow scraper, cold-weather appropriate windshield wiper fluid, functional defrosters on front and back, tire chains if identified during PSA;	2

Completing field tasks during low temperatures – working in the field	Dehydration, frostbite, hypothermia	9	Wear multiple clothing layers to allow for adjustments in outdoor temperature or entering heated spaces; Wear insulated headwear (such as insulated hood or hat) to prevent heat loss through the head; wear insulated, correct-sized gloves to protect hands and fingers from cold exposure; wear insulated socks and appropriate footwear to protect feet and toes from cold exposure; drink fluids before entering the field and during field activities; If shivering or numbness is identified, enter a heated space (building or vehicle) to warm body and assess; Stop work and spend a minimum of 30 minutes in a heated space a minimum of every four hours of outdoor exposure;	2
Completing field tasks during low temperatures in precipitation	Dehydration, frostbite, hypothermia	12	Wear multiple clothing layers to allow for adjustments in outdoor temperature or entering heated spaces; Wear insulated headwear (such as insulated hood or hat) to prevent heat loss through the head; wear insulated, correct-sized gloves to protect hands and fingers from cold exposure; wear insulated socks and appropriate (ideally waterproof) footwear to protect feet and toes from cold exposure; remove any wet clothes immediately and replace with dry clothes; drink fluids before entering the field and during field activities; If shivering or numbness is identified, enter a heated space (building or vehicle) to warm body and assess; Stop work and spend a minimum of 30 minutes in a heated space a minimum of every four hours of outdoor exposure;	2
Completing field tasks during low temperatures with limited mobility (such as during pump tests or monitoring)	Dehydration, frostbite, hypothermia, muscle tightness and fatigue	9	Wear multiple clothing layers to allow for adjustments in outdoor temperature or entering heated spaces; Wear insulated headwear (such as insulated hood or hat) to prevent heat loss through the head; wear insulated, correct-sized gloves to protect hands and fingers from cold exposure; wear insulated socks and appropriate footwear to protect	2

			feet and toes from cold exposure; drink fluids before entering the field and during field activities; stand up and stretch/walk/move body and fingers and toes every 10 minutes to ensure blood flow and muscle stretching; If shivering or numbness is identified, enter a heated space (building or vehicle) to warm body and assess; Stop work and spend a minimum of 30 minutes in a heated space a minimum of every four hours of outdoor exposure;	
Using a vehicle on-site during low temperatures	Injury from vehicle accident or impact, vehicle damage, damage to site infrastructure, injury to other people or damage to other vehicles from impacts	9	Slow driving speed if precipitation is present; Avoid driving on steep hills or muddy roads or trails where vehicle could lose control – find alternate vehicle or walking access routes. keep windows and headlights free from obstructions; If visibility is reduced to less than five feet in front of vehicle, find a safe (e.g., off the road) location to pull over and stop driving till conditions improve;	2

Appendix C Daily Tailgate Safety Meeting Form

Issue Date	Jan. 2, 2013
Revision No.	005
Revision Date	Oct.1, 2020

Daily Tailgate Safety Form

General Information			
Project Name/Location: Click or tap here to enter text.		**Name(s) of Person(s) Conducting Meeting:** Click or tap here to enter text.	
Date: Click or tap to enter a date.	**Time:** Click or tap here to enter text.	**Weather:** Click or tap here to enter text.	
Lone Worker			
☐ No **If no, continue to rest of form*	☐ Yes ***If yes, complete check-in person and daily tasks/hazards section below*	**Check-In Person:** Click or tap here to enter text.	**Check-In Frequency:** Click or tap here to enter text. *(i.e. arrival, lunch, and de-mob; or every 2 hours)*
Subcontractor(s):			

Day 1/Project Restart topics to cover:

Who is: ☐ PM(s) ☐ SSO ☐ Client ☐ Client PM ☐Subs ☐ Contact for Emergency

Chain of command for communicating hazards, incidents, stop work, etc.?

Location of: ☐ 1st Aid Kits ☐ Fire Extinguishers ☐ SDSs ☐ JSAs ☐ Emergency Contacts ☐ Hospital/Clinic

☐ What is different on the site from what was covered during the PSA call?

☐ What are we doing today that is not captured on the JSAs?

☐ What are obvious unique risks identified?

☐ Other EHS Support, Client, Sub or Other Party activities that may pose a hazard to today's activities?

☐ Complete all pre-use inspections (i.e., heavy equipment, power/hand tools, fall protection, electrical) and turn in to Project Manager at the end of the field event

**Regroup during/after lunch to discuss morning activities and plan for afternoon activities.*

Discuss the following – review of previous day's outcomes (Check if YES):

☐ Incidents?
☐ Issues with Equipment?
☐ Topics from Corp H&S or Client to Cover?
☐ Other: Click or tap here to enter text.
☐ Lessons Learned?
☐ Issues with PPE?
☐ Any Stop Work Interventions?
☐ Audits/Inspections Performed?
☐ Any work deviate from plan? – Notify PM & client
☐ Corrective Actions Worked?
☐ Communication Changes?

Notes: Click or tap here to enter text.

**All incidents and audits shall be uploaded to MyMomentum.*

Prework authorization – check activities to be conducted that require permit issuance or completion of a checklist, or similar, before work begins:

☐ Not Applicable ☐ Access Permits ☐ Confined Space ☐ Energy Isolation (LOTO) ☐ Hot Work ☐ Steam ☐ Live Electrical

☐ Buried or Overhead Utilities ☐ Excavation/Trenching ☐ Mechanical Lifting Ops ☐ Pressure System ☐ Working at Height

☐ Float Plan ☐ Other: Click or tap here to enter text.

Permit Name/Numbers and Notes: Click or tap here to enter text.

Today’s Task(s)	
1. Click or tap here to enter text.	2. Click or tap here to enter text.
3. Click or tap here to enter text.	4. Click or tap here to enter text.
5. Click or tap here to enter text.	6. Click or tap here to enter text.

Potential Hazards Associated – Review the known risks from the JSA Hazard Rating (left column) and determine if risk level has changed (check risk level of Low (L), Medium (M), High (H) - refer to Risk Assessment Matrix on JSA Form). If the risk has increased to HIGH, the JSA shall be updated and new controls implemented.

Previous Hazard Rating – Tasks with	L	M	H	Tailgate Hazard Rating	L	M	H
☐ Mechanical (i.e., augers, moving parts)	☐	☐	☐	☐ Mechanical (i.e., augers, moving parts)	☐	☐	☐
☐ Pressure (i.e., gas cylinders, wells)	☐	☐	☐	☐ Pressure (i.e., gas cylinders, wells)	☐	☐	☐
☐ Electrical (i.e., utilities, equip. repair/shut down)	☐	☐	☐	☐ Electrical (i.e., utilities, equip. repair/shut down)	☐	☐	☐
☐ Radiation (i.e., alpha, sun, laser)	☐	☐	☐	☐ Radiation (i.e., alpha, sun, laser)	☐	☐	☐
☐ Security (i.e., lighting, equipment, check-ins)	☐	☐	☐	☐ Security (i.e., lighting, equipment, check-ins)	☐	☐	☐
☐ Gravity (i.e., ladder, scaffold, trips)	☐	☐	☐	☐ Gravity (i.e., ladder, scaffold, trips)	☐	☐	☐
☐ Chemical (i.e., fuel, acid, waste)	☐	☐	☐	☐ Chemical (i.e., fuel, acid, waste)	☐	☐	☐
☐ Motion (i.e., traffic, moving water)	☐	☐	☐	☐ Motion (i.e., traffic, moving water)	☐	☐	☐
☐ Driving (i.e., boat, ATV, skid steer)	☐	☐	☐	☐ Driving (i.e., boat, ATV, skid steer)	☐	☐	☐
☐ Sound (i.e., machinery, generators)	☐	☐	☐	☐ Sound (i.e., machinery, generators)	☐	☐	☐
☐ Environment (i.e., heat, cold, rain)	☐	☐	☐	☐ Environment (i.e., heat, cold, rain)	☐	☐	☐
☐ Biological (i.e., ticks, snakes, poison ivy)	☐	☐	☐	☐ Biological (i.e., ticks, snakes, poison ivy	☐	☐	☐
☐ Personal (i.e., alone, night, not fit for duty)	☐	☐	☐	☐ Personal (i.e., alone, night, not fit for duty)	☐	☐	☐
☐ Other: Click or tap here to enter text.	☐	☐	☐	☐ Other: Click or tap here to enter text.	☐	☐	☐
Proposed Corrective Actions	**Yes**	**No**	**N/A**	**Proposed Corrective Actions**	**Yes**	**No**	**N/A**
Protective Clothing/Equipment Required	☐	☐	☐	Work Permit Required	☐	☐	☐
Delineate Work Areas to Protect Workers and/or Public	☐	☐	☐	Other:	☐	☐	☐
Comments: Click or tap here to enter text.							

Attendees
Site Workers (including EHS Support Contractors and Subcontractors) by signing here, you are stating the following: • You have been involved in the Daily Tailgate Safety Meeting, the review of the JSAs, and understand the hazards and control measures associated with each task you are about to perform. • You are aware of your authority and obligation to 'Stop Work' **Fit for duty:** • You are physically and mentally fit for duty. • You are not under the influence of any type of medication, drugs, or alcohol that could negatively affect your ability to work safely. • You are aware of your responsibility to immediately report any illness, injury (regardless of where or when it occurred), or fatigue issue you may have to the EHS Support SSO. • You leave the site uninjured unless you have otherwise notified the EHS Support SSO.
EHS Support Site Safety Officer: ______________________________ ___________________________________ Name Signature

Site Personnel Name and Affiliation	Signature	Site Personnel Name and Affiliation	Signature
Click or tap here to enter text.		Click or tap here to enter text.	
Click or tap here to enter text.		Click or tap here to enter text.	
Click or tap here to enter text.		Click or tap here to enter text.	

Site Visitors – Not involved in work activities				
Name (print)	**Company Name**	**Arrival Time**	**Depart Time**	**Signature** *(I have been informed of today's activities and site safety parameters)*
Click or tap here to enter text.	Click or tap here to enter text.			
Click or tap here to enter text.	Click or tap here to enter text.			
Click or tap here to enter text.	Click or tap here to enter text.			

Post Daily Activities Review – To be completed once activities for day have concluded and BEFORE leaving the Site		
Were there any incidents or near misses?	☐ Yes* ☐ No	If yes, details: Click or tap here to enter text.
Where there any 'Stop Work' interventions?	☐ Yes ☐ No	If yes, details: Click or tap here to enter text.
Where there any areas for improvement noted?	☐ Yes ☐ No	If yes, details: Click or tap here to enter text.
Was the site audited by EHS Support, client, or regulatory representative?	☐ Yes* ☐ No	If yes, details: Click or tap here to enter text.
The job site is being left in a safe condition and there were no reports of injury or first aid.	☐ Yes ☐ No	
EHS Support SSO Signature: ______________________________		

** If response is YES, entry into MyMomentum is required.*

Please upload into SharePoint under your project in a folder titled Daily Tailgate Safety Forms.

Appendix D Air Monitoring Log

EHS Support

Issue Date	Aug. 16, 2013
Revision No.	002
Revision Date	Jan. 8, 2019

Air Monitoring Log

Project Information

Company Name:
Address:
Telephone:
Date:
Project Name:
Client:
Site Location:
Operation Monitored:
Instrument:
Model:
Serial No.:
Calibration Date:
Probe:
Settings:
Temp/Rel. Hum:
Wind:
Indoor:
Outdoor:
Interference:
Operator Name:

Air Monitoring Log

Sample No.	*Time*	*LEL*	*O_2*	*H_2S*	*CO*	*Location*	*Comments*

Appendix E Corrective Action Form

Issue Date	Jan. 2, 2014
Revision No.	001
Revision Date	Jan. 8, 2019

Corrective Action Form

Item No.	**Corective Actions** (Must match Causative Factor)	**Responsible Party**	**Due Date**	**Date Completed**	**Details**
			Select Date	Select Date	
			Select Date	Select Date	
			Select Date	Select Date	
			Select Date	Select Date	
			Select Date	Select Date	
			Select Date	Select Date	
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			Select Date	Select Date	

Appendix F Incident Forms

Issue Date	Nov. 6, 2012
Revision No.	00
Revision Date	June 9, 2020

New Injury Report Form

Case No. ________________________

Employee Information (To be Completed by Injured Employee)		
Employee's First Name:	**Employee's Last Name**	**Date of Birth:**
Address, City, State, Zip:		
Phone Number(s): Home: **Other:**	**Job Title:**	**Time in Occupation at EHS Support:**

Accident Information			
Date of Accident:	**Start Shift Time:**	**Time of Accident:**	**Project Site Name:**
Location of Accident (Be Specific –Place, Address, Customer Site, Area/Department, Well Location or Name, etc.):			

Type of Injury:

☐ Burn
☐ Concussion
☐ Contusion
☐ **Other:**
☐ Cut/Laceration/Puncture
☐ Eye Injury
☐ Foreign Body in Eye
☐ Fracture/Dislocation
☐ Frostbite
☐ Hearing Loss
☐ Heat Exhaustion
☐ Heat Stroke
☐ Insect Bite/Sting
☐ Poisoning
☐ Pushing/Pulling
☐ Respiratory Condition
☐ Skin Disorder
☐ Sprain/Strain

Part(s) of the Body Injured (Check <u>**all**</u> that apply): **Please circle either left or right for the injured body part.**

☐ Ankle (Left or Right)
☐ Arm (Left or Right)
☐ Back
☐ Ear (Left or Right)
☐ Eye (Left or Right)
☐ Face
☐ **Other (Describe):**
☐ Finger(s) (Left Hand or Right Hand)
☐ Foot (Left or Right)
☐ Groin
☐ Hand (Left or Right)
☐ Head
☐ Hip (Left or Right)
☐ Hypothermia
☐ Leg (Left or Right)
☐ Lower Torso
☐ Nose
☐ Neck
☐ Shin (Left or Right)
☐ Shoulder (Left or Right)
☐ Stomach
☐ Upper Torso
☐ Whole Body

Cause of injury:

☐ Airborne Material
☐ Caught Between Objects
☐ Collapse
☐ Environmental Conditions
☐ Equipment Failure
☐ Exposure to Chemicals
☐ Falling Objects
☐ **Other (Describe):**
☐ Fall from Heights
☐ Flying Object
☐ Hearing Loss
☐ Heat Index
☐ Hot Objects/Liquids
☐ Improper Hydration
☐ Lifting
☐ Open Flame
☐ Poisoning
☐ Pushing/Pulling
☐ Radiant Heat
☐ Respiratory Condition
☐ Sharp Object
☐ Skin Disorder
☐ Slip
☐ Struck by an Object
☐ Trip
☐ Vehicle Accident

Describe the injury in detail. Where possible, include equipment type and names, material being processed or handled, and exact accident location. Also, describe the actual injury, including body area.

Injury First Reported To:	**Date Reported to Supervisor:**

Witness(es) Name and Phone Number(s):

Who will complete the follow up investigation? (Typically, a member of the H&S Service Line)

Treatment Information

Was first aid administered on site? ☐Yes ☐No

Did employee seek medical attention? ☐Yes ☐No

Type of medical treatment given: ☐ No Medical Treatment/Precautionary Report ☐ First Aid/In House
☐ Occupational Health Center/Clinic ☐ Hospitalized Overnight
☐ Emergency Room

Treatment rendered (forward copies of all treatment notes to the H&S Safety Specialist in charge of investigating the incident):

Name of the facility where initial medical treatment was given:

Treating physician's name: **Facility Phone Number**:

Date of Treatment:

Did employee miss any days of work? ☐Yes ☐No **If yes, date of first day missed**:

Who should be notified of the incident? (Typically, the H&S Service Line, Project Manager, and Michele Powell (if medical treatment is rendered)**:**

I hereby declare that the statements provided in this document are; to the best of my knowledge and belief, complete and true.

Fraud Notice: Any Individual filing misleading or incomplete information knowingly and with the intent to defraud is in violation of Section1102 of the Pennsylvania Workers' Compensation Act and may also be subject to criminal and civil penalties through Pennsylvania Act165.

Employee Signature: ______________________________________ **Date:** ____________________________

Original Signature Required

Please submit the information listed on this form into MyMomentum.

Incident Investigation Report

☐ **INITIAL REPORT** ☐ **FINAL REPORT**

'Initial Reports' are subject to revision, and must include all applicable information

[Accident Investigation Reports shall be completed by the Employee's Project Manager or Site Safety Officer]

General Information

Employee's First Name Click here to enter text.	**Employee's Last Name** Click here to enter text.	**Date of Incident** Click here to enter a date.
Type of Incident	**Project Manage/Site Safety Officer Name** Click here to enter text.	**Time of Incident** Click here to enter a time.

Location (Be Specific – Place, Address, Customer Site, Area/Department, etc.):
Click here to enter text.

Was this the employee's usual occupation?
☐ Yes ☐ No If No, Describe. Click here to enter text.

Was the employee performing a normal job task?
☐ Yes ☐ No If No, Describe. Click here to enter text.

Do you have any reason to believe this employee's injury did *not* occur at work?
☐ Yes ☐ No If Yes, list the Reasons: Click here to enter text.

Time in Occupation
Choose an item.

Employee's Job Title
Click here to enter text.

Personal Injury Information

Did employee work until end of shift?
☐Yes ☐ No

Was employee sent for drug test?
☐Yes ☐ No

Was employee sent for treatment immediately following injury?
☐Yes ☐ No

☐First-Aid (In-House)
☐Emergency Room (Hospital)
☐Clinic or Doctor's Office

Name and Address of Clinic or Physician:
Click here to enter text.

Possible Bloodborne Pathogens Exposure

Any bodily fluids requiring cleanup? ☐ Yes ☐ No If Yes, who performed the cleanup? Click here to enter text.

Was the Bloodborne Pathogens Control Plan followed? ☐ Yes ☐ No

Property Damage

Property Damaged: Click here to enter text. **Property Owned By:** Click here to enter text.	**Extent of Damage:** Click here to enter text.

Injury Investigation

Incident Sequence

Instructions: Describe in reverse order of occurrence, events preceding the injury and accident. Starting with the injury and moving back in time, reconstruct the sequence of events that led to the injury.

❶ Injury Event Click here to enter text.
❷ Incident Event Click here to enter text.
❸ Preceding Event 1 Click here to enter text.
❹ Preceding Event 2 Click here to enter text.
❺ Preceding Event 3 Click here to enter text.

Describe the Incident:

Click here to enter text.

Injury Classification

Nature of Injury:

☐Slip / Fall
☐Strain
☐Sprain
☐Struck Against
☐Struck By
☐Puncture
☐Caught in/or between
☐Overexertion
☐Burn
☐Fall from Elevation
☐Fall from Same Level
☐Contact with Electrical Current
☐Other (describe) Click here to enter text.

Type of Injury:

☐Abrasion
☐Amputation
☐Burn
☐Contusion
☐Crush Injury
☐Dermatitis
☐Eye - Foreign Body
☐Fracture
☐Illness
☐Infection
☐Inhalation
☐Laceration
☐Puncture
☐Repetitive Motion
☐Sprain
☐Tendonitis
☐Other: (describe) Click here to enter text.

Incident Sketch and/or Photograph(s) (Attach):

Witness(s) Interviews:

(1) Name: Click here to enter text. Phone Number: Click here to enter text.
Statement: Click here to enter text.

(2) Name: Click here to enter text. Phone Number: Click here to enter text.
Statement: Click here to enter text.

Casual Factors (Check all factors that contributed to the incident.)

☐Inadequate training
☐Failure to Follow a Standard Operating Procedure
☐Failure to Comply with Direction
☐Hazardous Work Condition
☐Failure to use Personal Protective Equipment
☐Improper use of Equipment, Tools and/or Machinery
☐Equipment/Machine/ Tool Malfunction
☐Failure to work at a safe speed/pace
☐Improper body mechanics (i.e. unsafe lifting technique)
☐Unsafe work environment or condition
☐Failure to obey safety policy
☐Unsafe Act
☐Horseplay
☐Other: Click here to enter text.

Comments: Click here to enter text.

Root Cause Determination

List all potential root causes of the incident. Use techniques such as "5 Why's" to determine why the contributing factors listed above exist. Consider the Who, What, When, Where, and How for determining the root cause.

Click here to enter text.

Corrective Actions

List immediate corrective actions taken to ensure safe resumption of activity, if applicable.

Corrective actions must be listed for all incidents.

☐Retrain Employee (s)
☐Implement a new or revised job procedure
☐Use additional Protective Equipment
☐Repair or Modify Equip./Machinery/Tools
☐Install Machine Guarding
☐Other (Please Describe Below)

Comments: Click here to enter text.

Corrective Action	*Person Responsible*	*Target Date*	*Date Completed*
1. Click here to enter text.	Click here to enter text.	Click to enter date	Click to enter date
2. Click here to enter text.	Click here to enter text.	Click to enter date	Click to enter date
3. Click here to enter text.	Click here to enter text.	Click to enter date	Click to enter date
4. Click here to enter text.	Click here to enter text.	Click to enter date	Click to enter date
5. Click here to enter text.	Click here to enter text.	Click to enter date	Click to enter date

Disciplinary Action Required? ☐ Yes ☐ No (If yes, attach rationale and actions on separate form)

☐ Safe to resume operation ☐ Have not resumed operation	Investigator Signature (Electronic) Click here to enter text.	Date Click here to enter a date.

Management Review

☐ Corrective action verified?
☐ Corrective action effective?
☐ Corrective action applicable to other areas?
☐ Investigation closed

Follow up action(s)/remark(s):
Click here to enter text.

Project Manager or Site Safety Officer Signature:

Health and Safety Program Manager Signature:

Appendix G Safety Data Sheets

SIGMA-ALDRICH

sigma-aldrich.com

SAFETY DATA SHEET

Version 4.6
Revision Date 12/29/2015
Print Date 05/01/2016

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : Arsenic

Product Number : 202657
Brand : Aldrich
Index-No. : 033-001-00-X

CAS-No. : 7440-38-2

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA

Telephone : +1 800-325-5832
Fax : +1 800-325-5052

1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Acute toxicity, Oral (Category 4), H302
Acute toxicity, Inhalation (Category 3), H331
Acute aquatic toxicity (Category 1), H400
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram

Signal word Danger

Hazard statement(s)

H302	Harmful if swallowed.
H331	Toxic if inhaled.
H410	Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P261	Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.

P301 + P312 + P330	IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you feel unwell. Rinse mouth.
P304 + P340 + P311	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER or doctor/ physician.
P391	Collect spillage.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Formula : As
Molecular weight : 74.92 g/mol
CAS-No. : 7440-38-2
EC-No. : 231-148-6
Index-No. : 033-001-00-X

Hazardous components

Component	Classification	Concentration
Arsenic		
	Acute Tox. 4; Acute Tox. 3; Aquatic Acute 1; Aquatic Chronic 1; H302, H331, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed

No data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture

Arsenic oxides

5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information

No data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Wear respiratory protection. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.
For personal protection see section 8.

6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols.Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.
Provide appropriate exhaust ventilation at places where dust is formed.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.
Storage class (TRGS 510): Non-combustible, acute toxic Cat. 1 and 2 / very toxic hazardous materials

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Arsenic	7440-38-2	TWA	0.01 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Lung cancer Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed human carcinogen		
		C	0.0020 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen See Appendix A 15 minute ceiling value		

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Arsenic	7440-38-2	inorganic arsenic plus methylated metabolites	35µg As/l	In urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of the workweek (After four or five consecutive working days			

		with exposure)			
		inorganic arsenic plus methylated metabolites	35µg As/l	Urine	ACGIH - Biological Exposure Indices (BEI)
		End of the workweek (After four or five consecutive working days with exposure)			

8.2 Exposure controls

Appropriate engineering controls

Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

Personal protective equipment

Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N99 (US) or type P2 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: Pieces Colour: grey
b)	Odour	No data available
c)	Odour Threshold	No data available

d)	pH	No data available
e)	Melting point/freezing point	Melting point/range: 817 °C (1,503 °F) - lit.
f)	Initial boiling point and boiling range	613 °C (1,135 °F) - lit.
g)	Flash point	Not applicable
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapour pressure	No data available
l)	Vapour density	No data available
m)	Relative density	5.727 g/mL at 25 °C (77 °F)
n)	Water solubility	No data available
o)	Partition coefficient: n-octanol/water	No data available
p)	Auto-ignition temperature	No data available
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety information

No data available

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10. STABILITY AND REACTIVITY

10.1 Reactivity

No data available

10.2 Chemical stability

Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions

No data available

10.4 Conditions to avoid

Heat Exposure to air may affect product quality.

10.5 Incompatible materials

Oxidizing agents, Halogens, Palladium undergoes a violent reaction with arsenic, Zinc, Platinum oxide, Nitrogen trichloride, Bromine azide

10.6 Hazardous decomposition products

Other decomposition products - No data available
In the event of fire: see section 5

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11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - Rat - 763 mg/kg
Remarks: Behavioral:Ataxia. Diarrhoea

LD50 Oral - Mouse - 145 mg/kg
Remarks: Behavioral:Ataxia. Diarrhoea

Inhalation: No data available

Dermal: No data available

No data available

Skin corrosion/irritation
No data available

Serious eye damage/eye irritation
No data available

Respiratory or skin sensitisation
No data available

Germ cell mutagenicity
No data available

Carcinogenicity

This is or contains a component that has been reported to be carcinogenic based on its IARC, OSHA, ACGIH, NTP, or EPA classification.

IARC:	1 - Group 1: Carcinogenic to humans (Arsenic)
NTP:	Known to be human carcinogen (Arsenic)
	Known to be human carcinogen (Arsenic)
OSHA:	OSHA specifically regulated carcinogen (Arsenic)

Reproductive toxicity
No data available

No data available

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

Additional Information
RTECS: CG0525000

Absorption into the body leads to the formation of methemoglobin which in sufficient concentration causes cyanosis. Onset may be delayed 2 to 4 hours or longer.

Stomach - Irregularities - Based on Human Evidence
Stomach - Irregularities - Based on Human Evidence

---

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish	LC50 - Pimephales promelas (fathead minnow) - 9.9 mg/l - 96.0 h
Toxicity to daphnia and other aquatic invertebrates	EC50 - Daphnia magna (Water flea) - 3.8 mg/l - 48 h

12.2 Persistence and degradability

No data available

12.3 Bioaccumulative potential

No data available

12.4 Mobility in soil

No data available

12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.
Very toxic to aquatic life with long lasting effects.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

Contaminated packaging

Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)

UN number: 1558	Class: 6.1	Packing group: II	

Proper shipping name: Arsenic
Reportable Quantity (RQ): 1 lbs

Poison Inhalation Hazard: No

IMDG

UN number: 1558	Class: 6.1	Packing group: II	EMS-No: F-A, S-A

Proper shipping name: ARSENIC
Marine pollutant:yes

IATA

UN number: 1558	Class: 6.1	Packing group: II	

Proper shipping name: Arsenic

15. REGULATORY INFORMATION

SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Arsenic	7440-38-2	2007-07-01

SARA 311/312 Hazards

Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Arsenic	7440-38-2	2007-07-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Arsenic	7440-38-2	2007-07-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
Arsenic	7440-38-2	2007-07-01

California Prop. 65 Components

WARNING! This product contains a chemical known to the State of California to cause cancer. Arsenic	CAS-No. 7440-38-2	Revision Date 2008-10-10

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
H302	Harmful if swallowed.
H331	Toxic if inhaled.
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.

HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

NFPA Rating

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

Preparation Information

Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

Version: 4.6 Revision Date: 12/29/2015 Print Date: 05/01/2016

SIGMA-ALDRICH sigma-aldrich.com

SAFETY DATA SHEET

Version 4.7
Revision Date 12/29/2015
Print Date 04/30/2016

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : Lead

Product Number : 391352
Brand : Aldrich

CAS-No. : 7439-92-1

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA

Telephone : +1 800-325-5832
Fax : +1 800-325-5052

1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Acute toxicity, Oral (Category 4), H302
Carcinogenicity (Category 2), H351
Reproductive toxicity (Category 2), H361
Specific target organ toxicity - repeated exposure (Category 2), H373
Acute aquatic toxicity (Category 1), H400
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram

Signal word Warning

Hazard statement(s)

H302	Harmful if swallowed.
H351	Suspected of causing cancer.
H361	Suspected of damaging fertility or the unborn child.
H373	May cause damage to organs through prolonged or repeated exposure.
H410	Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and

	understood.
P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P312 + P330	IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you feel unwell. Rinse mouth.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P391	Collect spillage.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

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3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Formula : Pb
Molecular weight : 207.20 g/mol
CAS-No. : 7439-92-1
EC-No. : 231-100-4

Hazardous components

Component	Classification	Concentration
Lead		
	Acute Tox. 4; Carc. 2; Repr. 2; STOT RE 2; Aquatic Acute 1; Aquatic Chronic 1; H302, H351, H361, H373, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

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4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed

No data available

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5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture

Lead oxides

5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information

No data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.
For personal protection see section 8.

6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols.Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.
Provide appropriate exhaust ventilation at places where dust is formed.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Keep in a dry place.
Storage class (TRGS 510): Non-combustible, acute toxic Cat.3 / toxic hazardous materials or hazardous materials causing chronic effects

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
	Remarks	See 1910.1025		
Lead	7439-92-1	TWA	0.05 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Confirmed animal carcinogen with unknown relevance to humans		
		TWA	0.05 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Hematologic effects Peripheral Nervous System impairment Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans		

		TWA	0.05 mg/m3	USA. NIOSH Recommended Exposure Limits
		See Appendix C		

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Lead	7439-92-1	Lead	30µg/ 100 ml	In blood	ACGIH - Biological Exposure Indices (BEI)
	Remarks	Not critical			
		Lead	30µg/ 100 ml	In blood	ACGIH - Biological Exposure Indices (BEI)
		Not critical			

8.2 Exposure controls

Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection

Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: powder
b)	Odour	No data available
c)	Odour Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	Melting point/range: 327.4 °C (621.3 °F) - lit.
f)	Initial boiling point and boiling range	1,740 °C (3,164 °F) - lit.
g)	Flash point	Not applicable
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapour pressure	No data available
l)	Vapour density	No data available
m)	Relative density	No data available
n)	Water solubility	No data available
o)	Partition coefficient: n-octanol/water	No data available
p)	Auto-ignition temperature	No data available
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety information

No data available

10. STABILITY AND REACTIVITY

10.1 Reactivity

No data available

10.2 Chemical stability

Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions

No data available

10.4 Conditions to avoid

No data available

10.5 Incompatible materials

Strong acids

10.6 Hazardous decomposition products

Other decomposition products - No data available
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
No data available

Inhalation: No data available

Dermal: No data available

No data available

Skin corrosion/irritation
No data available

Serious eye damage/eye irritation
No data available

Respiratory or skin sensitisation
No data available

Germ cell mutagenicity

Rat
Cytogenetic analysis

Carcinogenicity

Limited evidence of carcinogenicity in animal studies

IARC: 2B - Group 2B: Possibly carcinogenic to humans (Lead)

NTP: Reasonably anticipated to be a human carcinogen (Lead)

Reasonably anticipated to be a human carcinogenThe reference note has been added by TD based on the background information of the NTP. (Lead)

OSHA: 1910.1025 (Lead)

OSHA specifically regulated carcinogen (Lead)

Reproductive toxicity
Suspected human reproductive toxicant

Reproductive toxicity - Rat - Inhalation
Effects on Newborn: Biochemical and metabolic.

Reproductive toxicity - Rat - Oral
Effects on Newborn: Behavioral.

Reproductive toxicity - Mouse - Oral
Effects on Fertility: Female fertility index (e.g., # females pregnant per # sperm positive females; # females pregnant per # females mated). Effects on Fertility: Pre-implantation mortality (e.g., reduction in number of implants per female; total number of implants per corpora lutea).

Developmental Toxicity - Rat - Inhalation
Effects on Embryo or Fetus: Fetotoxicity (except death, e.g., stunted fetus). Specific Developmental Abnormalities: Blood and lymphatic system (including spleen and marrow).

Developmental Toxicity - Rat - Oral
Specific Developmental Abnormalities: Blood and lymphatic system (including spleen and marrow). Effects on Newborn: Growth statistics (e.g., reduced weight gain).

Developmental Toxicity - Rat - Oral
Effects on Embryo or Fetus: Fetotoxicity (except death, e.g., stunted fetus). Effects on Embryo or Fetus: Fetal death.

Developmental Toxicity - Mouse - Oral
Effects on Embryo or Fetus: Fetotoxicity (except death, e.g., stunted fetus). Effects on Embryo or Fetus: Fetal death.

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
May cause damage to organs through prolonged or repeated exposure.

Aspiration hazard
No data available

Additional Information
RTECS: OF7525000

anemia

Stomach - Irregularities - Based on Human Evidence
Stomach - Irregularities - Based on Human Evidence

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish	mortality LOEC - Oncorhynchus mykiss (rainbow trout) - 1.19 mg/l - 96.0 h
	LC50 - Micropterus dolomieui - 2.2 mg/l - 96.0 h
	mortality NOEC - Salvelinus fontinalis - 1.7 mg/l - 10.0 d
Toxicity to daphnia and other aquatic invertebrates	mortality LOEC - Daphnia (water flea) - 0.17 mg/l - 24 h
	mortality NOEC - Daphnia (water flea) - 0.099 mg/l - 24 h
Toxicity to algae	mortality EC50 - Skeletonema costatum - 7.94 mg/l - 10 d

12.2 Persistence and degradability
No data available

12.3 Bioaccumulative potential

Bioaccumulation	Oncorhynchus kisutch - 2 Weeks - 150 µg/l Bioconcentration factor (BCF): 12

12.4 Mobility in soil
No data available

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects
An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.
Very toxic to aquatic life with long lasting effects.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product
Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
UN number: 3077 Class: 9 Packing group: III
Proper shipping name: Environmentally hazardous substances, solid, n.o.s. (Lead)
Reportable Quantity (RQ): 10 lbs

Poison Inhalation Hazard: No

IMDG

UN number: 3077	Class: 9	Packing group: III	EMS-No: F-A, S-F

Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Lead)
Marine pollutant:yes

IATA

UN number: 3077	Class: 9	Packing group: III

Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Lead)

Further information

EHS-Mark required (ADR 2.2.9.1.10, IMDG code 2.10.3) for single packagings and combination packagings containing inner packagings with Dangerous Goods > 5L for liquids or > 5kg for solids.

15. REGULATORY INFORMATION

SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Lead	7439-92-1	1994-04-01

SARA 311/312 Hazards

Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Lead	7439-92-1	1994-04-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Lead	7439-92-1	1994-04-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
Lead	7439-92-1	1994-04-01

California Prop. 65 Components

	CAS-No.	Revision Date
WARNING! This product contains a chemical known to the State of California to cause cancer. Lead	7439-92-1	1989-07-10

	CAS-No.	Revision Date
WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm. Lead	7439-92-1	1989-07-10

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Carc.	Carcinogenicity
H302	Harmful if swallowed.
H351	Suspected of causing cancer.
H361	Suspected of damaging fertility or the unborn child.
H373	May cause damage to organs through prolonged or repeated exposure.

H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.

HMIS Rating

Health hazard:	1
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

NFPA Rating

Health hazard:	1
Fire Hazard:	0
Reactivity Hazard:	0

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

Preparation Information

Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

Version: 4.7 Revision Date: 12/29/2015 Print Date: 04/30/2016

SIGMA-ALDRICH

sigma-aldrich.com

SAFETY DATA SHEET

Version 4.11
Revision Date 12/02/2015
Print Date 04/30/2016

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : Mercury

Product Number : 261017
Brand : Sigma-Aldrich
Index-No. : 080-001-00-0

CAS-No. : 7439-97-6

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA

Telephone : +1 800-325-5832
Fax : +1 800-325-5052

1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Acute toxicity, Inhalation (Category 2), H330
Reproductive toxicity (Category 1B), H360
Specific target organ toxicity - repeated exposure (Category 1), H372
Acute aquatic toxicity (Category 1), H400
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram

Signal word Danger

Hazard statement(s)

H330	Fatal if inhaled.
H360	May damage fertility or the unborn child.
H372	Causes damage to organs through prolonged or repeated exposure.
H410	Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.

P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P284	Wear respiratory protection.
P304 + P340 + P310	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER or doctor/ physician.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P391	Collect spillage.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

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3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Formula : Hg
Molecular weight : 200.59 g/mol
CAS-No. : 7439-97-6
EC-No. : 231-106-7
Index-No. : 080-001-00-0

Hazardous components

Component	Classification	Concentration
Mercury		
	Acute Tox. 2; Repr. 1B; STOT RE 1; Aquatic Acute 1; Aquatic Chronic 1; H330, H360, H372, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

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4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed

No data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture

Mercury/mercury oxides.

5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information

No data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Wear respiratory protection. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.
For personal protection see section 8.

6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up

Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Store under inert gas.
Storage class (TRGS 510): Non-combustible, acute toxic Cat. 1 and 2 / very toxic hazardous materials

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Mercury	7439-97-6	C	0.1 mg/m3	USA. NIOSH Recommended Exposure Limits
	Remarks	Potential for dermal absorption		
		CEIL	1.0mg/10m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		TWA	0.05 mg/m3	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000
		Skin notation		

		TWA	0.025 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Kidney damage Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen Danger of cutaneous absorption		
		TWA	0.05 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential for dermal absorption		

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Mercury	7439-97-6	Mercury	0.0400 mg/g	In urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	Prior to shift (16 hours after exposure ceases)			
		Mercury	15.0000 µg/l	In blood	ACGIH - Biological Exposure Indices (BEI)
		End of shift at end of workweek			

8.2 Exposure controls

Appropriate engineering controls

Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

Personal protective equipment

Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: liquid Colour: silver, white
b)	Odour	odourless
c)	Odour Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	Melting point/range: -38.87 °C (-37.97 °F) - lit.
f)	Initial boiling point and boiling range	356.6 °C (673.9 °F)
g)	Flash point	Not applicable
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapour pressure	< 0.01 hPa (< 0.01 mmHg) at 20 °C (68 °F) 1 hPa (1 mmHg) at 126 °C (259 °F)
l)	Vapour density	6.93 - (Air = 1.0)
m)	Relative density	13.55 g/cm3 at 25 °C (77 °F)
n)	Water solubility	0.00006 g/l at 25 °C (77 °F)
o)	Partition coefficient: n-octanol/water	No data available
p)	Auto-ignition temperature	No data available
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety information

Relative vapour density 6.93 - (Air = 1.0)

10. STABILITY AND REACTIVITY

10.1 Reactivity
No data available

10.2 Chemical stability
Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions
No data available

10.4 Conditions to avoid
No data available

10.5 Incompatible materials
Strong oxidizing agents, Ammonia, Azides, Nitrates, Chlorates, Copper

10.6 Hazardous decomposition products
Other decomposition products - No data available
In the event of fire: see section 5

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11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
No data available

LC50 Inhalation - Rat - male - 2 h - < 27 mg/m3

Dermal: No data available

No data available

Skin corrosion/irritation
No data available

Serious eye damage/eye irritation
No data available

Respiratory or skin sensitisation
No data available

Germ cell mutagenicity
No data available

Carcinogenicity

This product is or contains a component that is not classifiable as to its carcinogenicity based on its IARC, ACGIH, NTP, or EPA classification.

IARC:	3 - Group 3: Not classifiable as to its carcinogenicity to humans (Mercury)
NTP:	No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.
OSHA:	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity
Presumed human reproductive toxicant

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
Causes damage to organs through prolonged or repeated exposure.

Aspiration hazard
No data available

Additional Information
RTECS: OV4550000

Mercury accumulates in almost all tissues, especially in the:, Kidney, Effects due to ingestion may include:, Nausea, Vomiting, Diarrhoea, intestinal bleeding

Stomach - Irregularities - Based on Human Evidence
Stomach - Irregularities - Based on Human Evidence

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish mortality LC50 - Cyprinus carpio (Carp) - 0.160 mg/l - 96 h

12.2 Persistence and degradability

No data available

12.3 Bioaccumulative potential

Bioaccumulation Carassius auratus (goldfish) - 1,789 d
- 0.25 µg/l

Bioconcentration factor (BCF): 155,986

12.4 Mobility in soil

No data available

12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.
Very toxic to aquatic life with long lasting effects.

No data available

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging

Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)

UN number: 2809 Class: 8 (6.1) Packing group: III
Proper shipping name: A,W Mercury
Reportable Quantity (RQ): 1 lbs

Poison Inhalation Hazard: No

IMDG

UN number: 2809 Class: 8 (6.1) Packing group: III EMS-No: F-A, S-B
Proper shipping name: MERCURY
Marine pollutant:yes

IATA

UN number: 2809 Class: 8 (6.1) Packing group: III
Proper shipping name: Mercury

15. REGULATORY INFORMATION

SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards

Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Mercury	7439-97-6	2007-07-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Mercury	7439-97-6	2007-07-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
Mercury	7439-97-6	2007-07-01

California Prop. 65 Components

	CAS-No.	Revision Date
WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm. Mercury	7439-97-6	2013-12-20

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
H330	Fatal if inhaled.
H360	May damage fertility or the unborn child.
H372	Causes damage to organs through prolonged or repeated exposure.
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.
Repr.	Reproductive toxicity

HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

NFPA Rating

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

Preparation Information

Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

Version: 4.11 Revision Date: 12/02/2015 Print Date: 04/30/2016

Appendix H Miscellaneous Safety Forms

Ashland, Inc. Underground Utility Clearance Expectations

1. Intrusive work will be developed and planned with full communication and input from the Ashland project manager.
2. Intrusive boring locations will be planned outside of the underground utility critical zone (the area 5 feet vertically or horizontally of a located or suspected utility) whenever possible.
3. All underground utility clearance work will be conducted under the supervision of at least one competent person experienced with underground utility clearance. The consultant project manager maintains primary responsibility for a complete utility clearance.
4. All employees and subcontractors have Stop Work Authority.
5. Any near miss or utility contact incident will be thoroughly investigated by the project team including the Ashland project manager.
6. Intrusive work will always be preceded by a visual site inspection by a competent person experienced with underground utility clearance to identify and/or confirm underground utility locations.
7. The Ashland UUC Checklist will be completed by a competent person prior to commencement of intrusive activities, and any variance request must be reviewed and approved by the Ashland project manager prior to initiating the intrusive work. The UUC Checklist includes minimum clearance requirements and is to be used in addition to consultant-specific requirements.
8. All federal, state, and applicable local regulations governing utility clearance will always be followed.
9. The Ashland project manager will be updated regarding proposed intrusive work, and the Ashland project manager will be integrated in the process of underground utility identification, clearance, locating, and final approval to begin the intrusive work.
10. If Ashland’s UUC requirements, as described in this document and the Ashland UUC checklist, cannot be satisfied due to field conditions encountered after the project commences, all intrusive work must stop until the consultant project manager and the Ashland project manager agree on a reasonable alternative or appropriate variance.

ASHLAND
With good chemistry great things happen.

Utility Clearance (UC) Checklist

GENERAL INFORMATION		
Project Name	**Ashland Project Manager**	
Project Address, City, State, Zip:		
Consultant Project Manager	**Competent UC Person Completing Checklist**	
PROJECT PLANNING		
Written Scope of Work and Figure Completed	☐Yes	☐No
Scope of Work and Figure Approved by Ashland PM?	☐Yes	☐No
Has a site walk been performed to identify potential underground and aboveground utilities and obstructions?	☐Yes	☐No
Have aboveground utilities or obstructions been identified within 20 feet of the location of the proposed work?	☐Yes	☐No
If Yes, can the work location be moved to avoid the hazard? If not, follow the appropriate federal regulations regarding safe working distances from electrical lines.	☐Yes	☐No
Do utility drawings exist for location?	☐Yes	☐No
If Yes, have they been acquired and reviewed? **Check if Not Applicable** ☐	☐Yes	☐No
Additional Comments (Provide any relevant notes from site walk and drawing review)		
PUBLIC UTILITY MARKOUT		
Date of Public One-Call	**Ticket Number(s)**	
Date of Public Markout Completed	**Date That Public Utility Markings Expire**	
List the Contacted Utilities		
PRIVATE UTILITY MARKOUT		
Is the boring location on private property? *If YES, then private utility markout is REQUIRED* ***Signature of Ashland PM waiving this requirement** ____________________________________	☐Yes	☐No
Method of UUC utilized:		
Company providing Private UUC:		

Date Private UUC completed:		
Did the Private UUC contractor provide a detailed sketch/drawing/figure of the identified utilities?	☐Yes	☐No
Are any borings located within the Critical Zone (Area 5 feet vertically or horizontally of a located or suspected utility? If NO, then manual clearance (e.g. hand auger) to 4 feet below ground surface is required. *If YES, then manual clearance to a Minimum depth of 6 feet below ground surface and Minimum width of 120% of the boring diameter is REQUIRED.* ***Signature of Ashland PM waiving this requirement** ____ ***Signature of consultant health and safety manager waiving this requirement** ____	☐Yes	☐No

Please note that the above clearances are the Minimum. The further the distance from a utility the better.

INTRUSIVE WORK		
Has a visual site inspection of all locations been completed and private and public utility markings been reviewed?	☐Yes	☐No
Is manual vertical clearance required?	☐Yes	☐No
Has the competent on-site UC person shared any documented results of the Private UUC with the person completing the intrusive work?	☐Yes	☐No
Method of manual clearance utilized:		
Company providing manual clearance: **Date manual clearance completed:**		
EXPLANATION FOR ANY WAIVED REQUIREMENT(S) – REQUIRED:		

Signature of Person Completing Checklist:____

Date of Completion: ____

Utility Clearance (UC) Checklist

GENERAL INFORMATION	
Project Name	EHS Support Project Manager
Project Address, City, State, Zip	
Competent UC Person Completing Checklist	Client Contact/Project Manager

PROJECT PLANNING		
Written Scope of Work and Figure Completed	☐ YES	☐ NO
Scope of Work and Figure Approved by PM?	☐ YES	☐ NO
Has a site walk been performed to identify potential underground and aboveground utilities and obstructions?	☐ YES	☐ NO
Have aboveground utilities or obstruction been identified within 20 feet of the location of the proposed work?	☐ YES	☐ NO
If Yes, can the work location be moved to avoid the hazard? If not, follow the appropriate federal regulations regarding safe working distances from electrical lines.	☐ YES	☒ NO
Have utility maps been requested of site personnel?	☐ YES	☐ NO
Do utility drawings exist for location?	☐ YES	☐ NO
If Yes, have they been acquired and reviewed? Check if Not Applicable ☐	☐ YES	☐ NO
Does the HASP or other relevant document specifically address the course of action following contact with a utility?	☐ YES	☐ NO
Additional Comments (Provide any relevant notes from site walk and drawing review)		

PUBLIC UTILITY MARKOUT

Date of Public One-Call	Ticket Number(s)
One-Call Request Time	Utility Service Name
Utility Service Number	Utility Service Contact Person
Date of Public Markout Completed	Date Public Utility Markings Expire
List the Contacted Utilities	

PRIVATE UTILITY MARKOUT

Is the boring location on private property? If YES, then private utility markout is REQUIRED **Signature of EHS Support PM waiving this requirement*	☐ YES	☐ NO
Method of underground utility clearance (UUC) utilized:		
Company providing Private UUC: Date Private UUC completed:		
Did the UUC contractor provide all existing utility figures prior to the markout?	☐ YES	☐ NO
Did the Private UUC contractor provide a detailed sketch/drawing/figure of the identified utilities?	☐ YES	☐ NO
Are any borings located within the Critical Zone (Area 5 feet vertically or horizontally of a located or suspected utility? If NO, then manual clearance (e.g. hand auger) to ~~4~~ 5 feet below ground surface is required. If YES, then manual clearance to a Minimum depth of 6 feet below ground surface and Minimum width of 120% of the boring diameter is REQUIRED. ***Signature of EHS Manager waiving this requirement** **X**____	☐ YES	☐ NO
Please note the above clearances are the minimum. The farther the distance from the utility, the better.		

INTRUSIVE WORK		
Has a visual site inspection of all locations been completed and private and public utility markings been reviewed?	☐ YES	☐ NO
Is manual vertical clearance required?	☐ YES	☐ NO
Has the competent on-site UUC person shared any documented results of the Private UUC with the person completing the intrusive work?	☐ YES	☐ NO
Method of manual clearance utilized:		
Company providing manual clearance: Date manual clearance completed:		
EXPLANATION FOR ANY WAIVED REQUIREMENT(s) – REQUIRED:		

Signature of Person Completing Checklist: ____

Date of Completion: ____

EHS Support

Issue Date	Mar. 7, 2013
Revision No.	001
Revision Date	Jan. 8, 2019

Damage Information Reporting Tool (DIRT) Field Form

☐ Near Miss ☐ Utility Strike

Part A – Who is Submitting this Information

☐ Electric
☐ Insurance
☐ Private Water
☐ State Regulator
☐ Engineer/Design
☐ Liquid Pipeline
☐ Public Works
☐ Telecommunications
☐ Equipment Manufacturer
☐ Locator
☐ Railroad
☐ Unknown/Other
☐ Excavator
☐ Natural Gas
☐ Road Builders

Name of the person providing the information:

Name of EHS Support Project Manager Gathering Information:

Part B – Date and Location of Event

Date of Event:

Country:

State:

County:

City:

Street Address:

Nearest Intersection:

Right of Way where event occurred:

Public: ☐ City Street ☐ State Highway ☐ County Road ☐ Interstate Highway ☐ Public-Other

Private: ☐ Private Business ☐ Private Land Owner ☐ Private Easement ☐ Pipeline
☐ Power/Transmission Line ☐ Dedicated Public Utility Easement
☐ Federal Land ☐ Railroad ☐ Data Not Collected ☐ Unknown/Other

Part C – Affected Facility Information

What type of facility operation was affect?

☐ Cable Television ☐ Electric ☐ Natural Gas ☐ Liquid Pipeline ☐ Sewer (Sanitary Sewer)
☐ Steam ☐ Telecommunications ☐ Water ☐ Unknown/Other

What type of facility was affected?

☐ Distribution ☐ Gathering ☐ Service/Drop ☐ Transmission ☐Unknown/Other

Was the facility part of a joint trench?

☐ Unknown ☐ Yes ☐ No

Was the facility owner a member of One-Call Center?

☐ Unknown ☐ Yes ☐ No

Part D – Excavation Information

Type of Excavator

☐ Contractor ☐ County ☐ Developer ☐ Farmer ☐ Municipality ☐Occupant
☐ Railroad ☐ State ☐ Utility ☐ Date not collected ☐ Unknown/Other

Type of Excavation Equipment

☐ Auger ☐ Backhoe/Trackhoe ☐ Boring ☐ Drilling ☐ Directional Drilling
☐ Explosives ☐ Farm Equipment ☐ Hand tools ☐ Grader/Scraper ☐ Milling Equipment
☐ Trencher ☐ Vacuum Equipment ☐ Probing Device ☐ Data Not Collected ☐ Unknown/Other

Type of Work Performed

☐ Drainage ☐ Bldg Construction ☐ Electric ☐ Engineering/Survey ☐ Bldg Demolition
☐ Fencing ☐ Grading ☐ Irrigation ☐ Landscaping ☐ Liquid Pipeline
☐ Milling ☐ Natural Gas ☐ Pole ☐ Road Work ☐ Sewer (san/storm)
☐ Steam ☐ Site Development ☐ Water ☐ Telecommunication ☐ Storm Drain/Culvert
☐ Waterway Improvement ☐ Data Not Collected ☐ Unknown/Other

Part E – Notification

Was the One-Call Center notified?

☐ Yes (If YES, Part F is required) ☐ No (If NO, Skip Part F)

If Yes, which One-Call Center?

If Yes, please provide ticket number:

Part F – Locating and Marking

Type of Locator

☐ Utility Owner ☐ Contract Locator ☐ Data Not Collected ☐ Unknown/Other

Were facility marks visible in the area of excavation?

☐ Yes ☐ No ☐ Data Not Collected ☐ Unknown/Other

Were facilities marked correctly?

☐ Yes ☐ No ☐ Data Not Collected ☐ Unknown/Other

Part G – Excavator Downtime

Did Excavator Incur Downtime?

☐ Yes ☐ No

If yes, how much time?

☐ Unknown ☐ Less than 1 hour ☐ 1 hour ☐ 2 hours ☐ 3 hours or more Exact Value____

Estimated cost of down time?

☐ Unknown ☐ $0 ☐ $1 to 500 ☐ $501 to 1,000 ☐ $1,001 to 2,500 ☐ $2,501 to 5,000
☐ $5,001 to 25,000 ☐ $25,001 to 50,000 ☐ $50,001 and over Exact Value_____

Part H – Description of Damage

Was there damage to a facility?

☐ Yes ☐ No (i.e., near miss)

Did the damage cause an interruption in service?

☐ Yes ☐ No ☐ Data Not Collected ☐ Unknown/Other

If Yes, duration of interruption?

☐ Unknown ☐ <1 hour ☐ 1-2 hrs ☐ 2-4 hrs ☐ 4-8 hrs ☐ 8-12 hrs ☐ 12-24 hrs
☐ 1-2 days ☐ 2-3 days ☐ 3 or more days Exact Value _____ ☐ Data Not Collected

Approximately how many customers were affected?

☐ Unknown ☐ 0 ☐ 1 ☐ 2 to 10 ☐ 11 to 50 ☐ 51 or more Exact Value _______

Estimated cost of damage/repair/restoration?

☐ Unknown ☐ $0 ☐ $1 to 500 ☐ $501 to 1,000 ☐ $1,001 to 2,500 ☐ $2,501 to 5,000
☐ $5,001 to 25,000 ☐ $25,001 to 50,000 ☐ $50,001 and over Exact Value_____

Number of people injured?

☐ Unknown ☐ 0 ☐ 1 ☐ 2 to 9 ☐ 10-19 ☐ 20 to 49 ☐ 50 to 99
☐ 100 or more Exact Value _____

Number of fatalities?

☐ Unknown ☐ 0 ☐ 1 ☐ 2 to 9 ☐ 10-19 ☐ 20 to 49 ☐ 50 to 99
☐ 100 or more Exact Value _____

Part I – Injury Reporting

Refer to EHS Support Incident Report form and Investigation Report Form

Attach completed investigation form to DIRT Form

Part J – Description of Root Cause

One-Call Notification Practices Not Sufficient

☐ No notification made to the One-Call Center
☐ Notification to One-Call Center made, but not sufficient
☐ Wrong information provided to One-Call Center

Locating Practices Not Sufficient

☐ Facility could not be found or located
☐ Facility marking or location not sufficient
☐ Facility was not located or marked
☐ Incorrect facility records/map

Excavation Practices Not Sufficient

☐ Failure to maintain marks
☐ Failure to support exposed facilities
☐ Failure to use hand tools where required
☐ Failure to test-hole (pot-hole)
☐ Improper backfilling practices
☐ Failure to maintain clearance
☐ Other insufficient excavation Practices

Miscellaneous Root Causes

☐ One-Call Center error
☐ Abandoned facility
☐ Deteriorated facility
☐ Previous damage
☐ Lack of/Insufficient Training
☐ Lack of/Insufficient Management Control
☐ Did not follow procedure(s)/requirement(s)
☐ Data Not Collected
☐ Other

Part K – Additional Comments

Witness Name:	**Witness Phone Number:**
Witness Name:	**Witness Phone Number:**

I hereby declare that the statements provided in this document are; to the best of my knowledge and belief, complete and true.

Signature: ____ Date: __________________________

Please submit to the EHS Support Health and Safety Program Manager.

EHS Support

Issue Date	Jan 2, 2014
Revision No.	002
Revision Date	Jan. 8, 2019

Field Instrument Calibration Log

Project Information			
Project Name	Project Location	Name	Date

Field Instrument Calibration Log													
Equipment Information								**Initial Reading(s)**			**Final Reading(s)**		
Date	**Type (FID, PID, IR)**	**Make**	**Model #**	**Lamp Ev (10.6 or 11.8)**	**Serial #**	**Calibration Gas (Type and Concentration)**	**Cylinder/ Batch #**	**Equipment Reading (PPM)**	**Time**	**Name of Person Performing Calibration**	**Equipment Reading (PPM)**	**Time**	**Name of Person Performing Calibration**

EHS Support

Issue Date	Oct. 12, 2017
Revision No.	001
Revision Date	Jan. 8, 2019

Heavy Equipment Safety Checklist

Project Name: ___________________________________ Date: ______________________________

Project Location: _________________________________ Inspector: __________________________

Operator(s): ____

Equipment Type: ____

Category	Inspection Items	Yes	No	N/A	Action(s) Needed
Records	Equipment inspection and maintenance records available				
	Operator training records available				
	Is a list of all chemicals being used on the current job kept on file and made available to all employees? (Check SDS book and verify its location is known to each employee)				

Category	Inspection Items	Pass	Fail	N/A	Action(s) Needed
Equipment	Emergency stop(s) functional (verify)				
	Leveling devices/ Outriggers/ Tracks (no damage)				
	Protective guards on moving parts (drill shaft, drive shafts, belts, chain drives and universal joints)				
	Fuel, hydraulic lines, oil reservoirs properly filled				
	No fluid leaks (pneumatic/hydraulic)				
	Operator controls, panel and gauges functional				
	Warning lights functional				
	Brakes and clutches functional				
	Steps and handholds (condition and cleanliness)				
	Tires (sidewall condition, cuts, tread condition)				
	Cracked welds/unusual wear patterns around attachment				
	Safety latches on hooks				
	Slings, chokers, and lifting devices (no damage)				
	Shackles/Clevises (no damage)				
	Fire extinguisher (10 lb. or larger; fully charged and inspected)				
PPE	Proper safety gear worn given the work environment				

Category	Inspection Items	Pass	Fail	N/A	Action(s) Needed
Fire Prevention	No smoking or open flames is observed within exclusion zone				
	Flammable liquids not stored within 50 ft (15.2m)				
Exclusion/ Work Zones	Exclusion/work zone has been established with proper controls				
Overhead Obstructions	Except where electrical distribution and transmission lines have been de-energized and visibly grounded, drill rigs will be operated proximate to under, by, or near power lines as follows: • 50 KV or less - minimum clearance of 10 feet • 50 KV to 200 KV – minimum clearance of 15 feet. • 200 KV or higher – add 5 feet for every 100KV over 200KV If voltage is unknown, maintain at least 20 feet of clearance.				
	Spotter is utilized around overhead obstructions ≤15 feet				
Housekeeping	Proper housekeeping measures implemented				
Repairs	Repairs, when possible, are conducted offsite to reduce the risk of any onsite incidents				
Support Vehicles	Vehicles are road ready (tires, seatbelts, lights, brakes, mirrors, windshield wipers)				
	Trailers are properly hitched with working brake lights				
	Vehicles meet height and weight requirements				
	Equipment is secured.				
Other	First Aid Kit available onsite				
	Proper safety measures on elevated decks				

Comments:

____
____
____
____

Signature: _____________________________________ Date: ____________________

Issue Date	Sep. 18, 2014
Revision No.	001
Revision Date	Jan. 8, 2019

Personal Air Sampling Form

PROJECT INFORMATION

Project/Company Name

Project Number

Project/Company Location

Field Technician

Sample Date

Weather Conditions

Wind Direction/Speed

Relative Humidity

Shift ☐ Day ☐ Evening ☐ Night **Shift Length** _________ hours

Sample Location ☐ Indoor ☐ Outdoor

Location Description:

POTENTIAL HAZARDOUS SOURCE(S)

☐ Non-Ionizing Radiation: Type (e.g. microwave, radiofrequency, infrared): ____

☐ Inhalation – Type: ☐ Metal: ____________ ☐ Dust: _____________ ☐ Mist ____________ ☐ Acid: ___________________

☐ Base: _____________ ☐ Solvent: _______________ ☐ Fumes: _______________ ☐ Other: ___________________________

☐ Biological Inhalation – Type: ☐ Mold ☐ Bacteria ☐ Other: ____

☐ Blank (Air not drawn through media) Location: ____

Area Sample: ☐ Source ☐ Background (located at area not impacted by source) ☐ Other: ____________________________

Frequency of Operation: ☐ Daily ☐ 2–3/Week ☐ Weekly ☐ 2–3/Month ☐ Monthly ☐ ___/Year ☐ Yearly ☐ Other ___

Duration of Operation: ☐ <15 min ☐ 15–30 min ☐ 30–60 min ☐ 1–4 hours ☐ 4–6 hours ☐ 6–8 hours ☐ >8 hours

Exposure Represents: ☐ Typical Work Activity ☐ Typical Area Conditions ☐ Unusual Event: ___________________________

Comments: ____

Employee Name or ID ______________________ Job Title ________________________ Job Performed ____________________

Balance of Day: ☐ Balance of Shift Represented by Sampling Period ☐ Balance of Shift had No Exposure to Contaminant or Source

Type of PPE Used (respirator, open face, closed face, shield, gloves, body protections, etc.):_______________________________________

Pump Make and Model: ______________________

Pump SN: _________________________________

Pump Number: _____________________________

Sampler Type: ☐ Filter ☐ Passive Badge ☐ Tubes

Filter Type: ☐ PVC ☐ PTFE ☐ MCEF ☐

Other: ___________________________

Filter Diameter: ____ mm Filter Pore Size ____ µm

Passive Badge or Tube Type: ____________________

Media Expiration Date: ________

Sample Inlet ☐ BZ (Worn on Lapel)

☐ (Fixed BZ (Location near nose/mouth)

Total Volume Pumped (mL or L): ________________

Pump Operation	**Calibration by**	**Temp**	**Flow**	**Sampling Time**	
		°F / °C	**__L/min**	**On**	**Off**
Pre Sample					
Post Sample					
Average/ Totals	☒	☒	Ave. Flow	Sample Time (min)	

Comments:

Sample ID	Time	Analyses	QA/QC Sample	Remarks

Metals (Pb, Be, Cu, Al, Cr, Ni, etc.)
Dusts (nuisance, silica, asbestos, fiberglass, insulation, etc.)
Mists (spray inhalation, painting, fluxes)
Fumes (welding, brazing torch cutting, glues, etc.)
Acids (hydrochloric, sulfuric)
Bases (sodium hydroxide)
PVC – Polyvinyl Chloride
PTFE – Teflon
MCE – Mixes Celluose Ester
BZ – Breathing Zone

Signature: ____ Date: ______________________________

SOP 3 –UTILITY CLEARANCE

Application:

The purpose of this procedure is to ensure that all aboveground and subsurface utilities (e.g., electrical lines, gas lines, telephone lines, etc.) are located and marked before initiating any intrusive activities (drilling, test pits, trenching) or using long handled tools or equipment (e.g., back hoes, drill rigs) that can impact overhead lines. Compliance with this procedure will allow the work to be conducted safely and will minimize the potential for damaging utilities.

Materials:

EHS Utility Clearance (UC) Checklist (**Attachment 1**)
Bound field log book
Black or blue ink pens
Wooden stakes
Spray paint
Camera
Flagging tape
Hand auger or post-hole digger
Facility as-built drawings
Replacement batteries or parts for instruments (if applicable)

Procedure:

Pre-site Mobilization

1. The EHS UC Checklist will be completed by a competent person prior to commencement of intrusive activities, and any variance request must be reviewed and approved by the EHS project manager prior to initiating the intrusive work or using long handled tools or equipment (e.g., back hoes, drill rigs) that can impact overhead lines. The UC Checklist includes minimum clearance requirements and is to be used in addition to consultant-specific requirements. Please ensure that the EHS Support project manager, the client project manager, and all field personnel actively participate in the planning of proposed work locations and the utility clearance procedures.

2. Gather information on the on-site and off-site areas where activities will be conducted. This information should include the following:

- Site address
- Nearest cross street or street intersection
- Map grid (if applicable)
- Site boundaries
- As-built drawings

3. Before start of subsurface activities, place a call to the federally-mandated national “Call Before You Dig” number, 811, at least 72 hours prior to field activities. State specific information can be found on the “Call Before You Dig” website: www.call811.com. Provide the utility locating service with any information they request concerning the site and work activity in order to locate utilities at the site. (In California, the proposed drilling locations must be marked with white spray paint before contacting the locating services.) The date of call, utility clearance ticket number and utilities to be located should be documented in EHS UC Checklist (see **Attachment 1**). The ticket number will be used by the various

utility companies to reference the clearance request (see note below). The public utility companies will typically mark their lines up to the property lines unless a junction box or meter is present on the site. However, request that the utility companies mark their utilities in the work areas on the site.

Note: Some utilities (e.g., sewer, water, cable TV) may not be included with the utility locating service. These utility companies will have to be contacted directly by EHS Support for clearance before the start of intrusive activities.

a. If the site is located on private property, three lines of evidence, at a minimum, shall be obtained. Lines of evidence may include:
   As-built drawings
   Statement from and site walk with site contact who is familiar with property
   Marked utilities
   Use of hand-held magnetic or magnetic-cable locating device to clear work area
   Ground penetrating radar

b. If three lines of evidence cannot be obtained, or where uncertainty exists concerning the presence of underground utilities, a private utility locating company must be used to mark utilities. In this case, the private utility locating company shall provide a detailed and scaled drawing of utilities located on-site. The competent person should request a field sketch or drawing of identified utilities from the private utility locating company before the locator leaves the site.

4. Prior to working with tools and equipment that can impact overhead lines, survey the site for overhead lines. Look up! Consider all overhead lines as energized until the electric utility indicates otherwise or an electrician verifies that that the line is not energized and has been grounded.

   a. If overhead lines are present, call the utility company and find out what voltage is on the lines. Ask if the utility company can shut off the lines while you are working near them.
   b. If overhead lines cannot be shut down, ask the utility company if they can install insulation near the lines during the time you will be working near them.

Site Mobilization

1. Verify that all utility companies listed by the locating service(s) have marked all underground lines in the area and whether the lines have been marked.

2. Take photographs and detailed documentation of ground markings, flags, overhead lines, etc. in the case that the markings are washed away. Photo documentation and associated drawings must be onsite and cross-checked prior to intrusive activities.

3. Conduct a site walk prior to field activities. Review all available as-built utility diagrams and plans with the site contact to identify other potential areas where underground lines may be present. Check the drawings to ensure they are as-builts and not design plans. During the site walk, attempt to obtain a general knowledge of the types of utilities present in the work areas. Check to see whether major electrical lines are aboveground. In addition to being a potential hazard for aboveground work, the presence of aboveground lines may indicate that there are non-underground lines in that portion of the site. Underground sewer lines may be traced using the locations of manholes and storm water grates.

Note: As-built drawings are not always accurate for locating underground lines.

4. Clear each proposed work area with the performing contractor using utility markings, photographs, drawings, etc.

a. For subsurface activities, a minimum of <u>five</u> feet clearance should exist between utilities and proposed drilling locations; if five feet of horizontal clearance is not possible, manual clearance to a minimum of <u>six</u> feet below ground surface AND a minimum width of 120% of the boring diameter is required. If a utility conflict is identified, adjust the proposed location(s) using the criteria given above. If a drilling/boring location is located outside the five foot clearance zone, a manual clearance is only required <u>four</u> feet below ground surface.

b. If aboveground lines cannot be shut down and/or insulation applied, a minimum safe distance of 20 feet must be established. Have a brief job site meeting to discuss the planned work as it relates to power lines and identify tools and equipment that could come into contact with the lines. Consider the need for a designated person to monitor activities around the lines.
   i. Only use nonconductive ladders when working near overhead power lines.
      ii. Employees are not permitted to approach or carry any conductive object closer than 10 feet to an energized line.

5. Discuss the site conditions with the subcontractor (e.g., driller, excavator), and recommend that care be used at the start of the field activities. Field personnel should always consider the presence of unidentified utilities at each work area. Ensure the work is conducted safely.

6. If the scope of the field activities expands to a new on-site or off-site area(s) that have not been previously cleared, the above UC procedures must be followed beginning with public and private utility markout. (Remember, the new request will require another 72-hour period before all underground utilities can be cleared.)

Utility Strike

1. Utility strikes (unplanned contact with utilities resulting in damage to the utility or its protective coating) shall be reported in accordance with the EHS Support Incident Reporting Procedure – EHSMS 8.1, utilizing the Damage Information Reporting Tool (DIRT) form (see Attachment 2).

2. All damaged utilities shall be repaired by a qualified and/or licensed professional.

Training

1. Conduct a briefing for site employees regarding the hazards associated with working near the utilities and the means by which the operation will maintain a safe working environment. Detail the methods used to isolate the utility and the hazards presented by breaching the isolation.

Appendix E Community Air Monitoring Plan

Appendix E – Community Air Monitoring Plan

This Community Air Monitoring Plan (CAMP) has been designed to conform to the guidelines presented by the New York State Department of Health (NYSDOH) in Appendix 1A of the New York State Department of Conservation (NYSDEC), Division of Environmental Remediation (DER)-10, Technical Guidance for Site Investigation and Remediation. It has been prepared for the Hercules, Inc. site (the "Site") located in Port Ewen, Ulster County, New York (NYS 356001) to provide a measure of protection for the downwind community from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, it provides a measure of protection for the downwind communities from potential airborne contaminant releases as a direct result of investigative and remedial activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shut down. Additionally, the CAMP helps to confirm that work activities did not spread contaminants off-site through the air.

Activities completed under this scope of work include land survey, soil sampling, groundwater sampling, monitoring well installation, sediment sampling, surface water sampling, and investigation derived waste management (i.e., handling soil and groundwater in drums). The primary constituents of concern are metals and volatile organic compounds (VOCs).

Real-time air monitoring for volatile compounds at the perimeter of the exclusion zone will be conducted. Monitoring for odors will also be conducted and odor suppressant foams and water sprays will be readily available to address dust and odor emissions. The following procedures will be implemented during field activities as appropriate:

Continuous monitoring will be completed for all ground intrusive activities. Continuous monitoring will be conducted with a flame ionization detector (FID) or photoionization detector (PID) within the work zone to monitor any change in Site conditions. Any sustained readings above background for greater than 15 minutes will require a stop-work action. Continuous monitoring will include screening soil cores and worker breathing zones, as well as establishing background concentrations and a downwind perimeter of the immediate work area.

Periodic monitoring will be completed during non-intrusive activities. Site-specific non-intrusive activities include groundwater gauging, groundwater sampling, and surveying. Periodic monitoring will be conducted with an FID or PID within the work zone during each sampling event to monitor changes in Site conditions. Any sustained reading above background for great than 15 minutes will require a stop-work action. Periodic monitoring includes taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil monitoring during well bailing/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the middle of a public park, or adjacent to a school or residence.

VOC Monitoring, Response Levels, and Actions

VOCs will be monitored within the work zone and at the downwind perimeter of the immediate work area (i.e., the exclusion zone) continuously or as otherwise specified. Upwind concentrations will be measured at the start of each workday and periodically thereafter to establish background conditions, particularly if wind direction changes. The monitoring work will be performed using equipment appropriate to measure the types of contaminants known or suspected to be present (i.e., FID or PID). The equipment will be calibrated at a minimum daily. The equipment will be capable of calculating 15-minute running average concentrations, which will be compared to the following levels.

1. If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.
2. If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels over 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less – but in no case less than 20 feet – is below 5 ppm over background for the 15-minute average.
3. If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shut down and corrective action taken.
4. All 15-minute readings must be recorded and be available for NYSDEC and NYSDOH personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations should be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should be performed using real-time monitoring equipment capable of measuring particulate matter less than micrometers in size (PM-10) and capable of integrating over a period of minutes (or less) for comparison to the airborne particulate action level. The equipment must be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

1. If the downwind PM-10 particulate level is 100 micrograms per cubic meter (µg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 µg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.
2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 µg/m^3 above the upwind level, work must be stopped, and a re-evaluation of activities must be initiated. Work can resume if dust suppression measures and other controls

are successful in reducing the downwind PM-10 particulate concentration to within 150 µg/m^3 of the upwind level and in preventing visible dust migration.

3. All readings must be recorded and be available for NYSDEC and NYSDOH personnel to review.