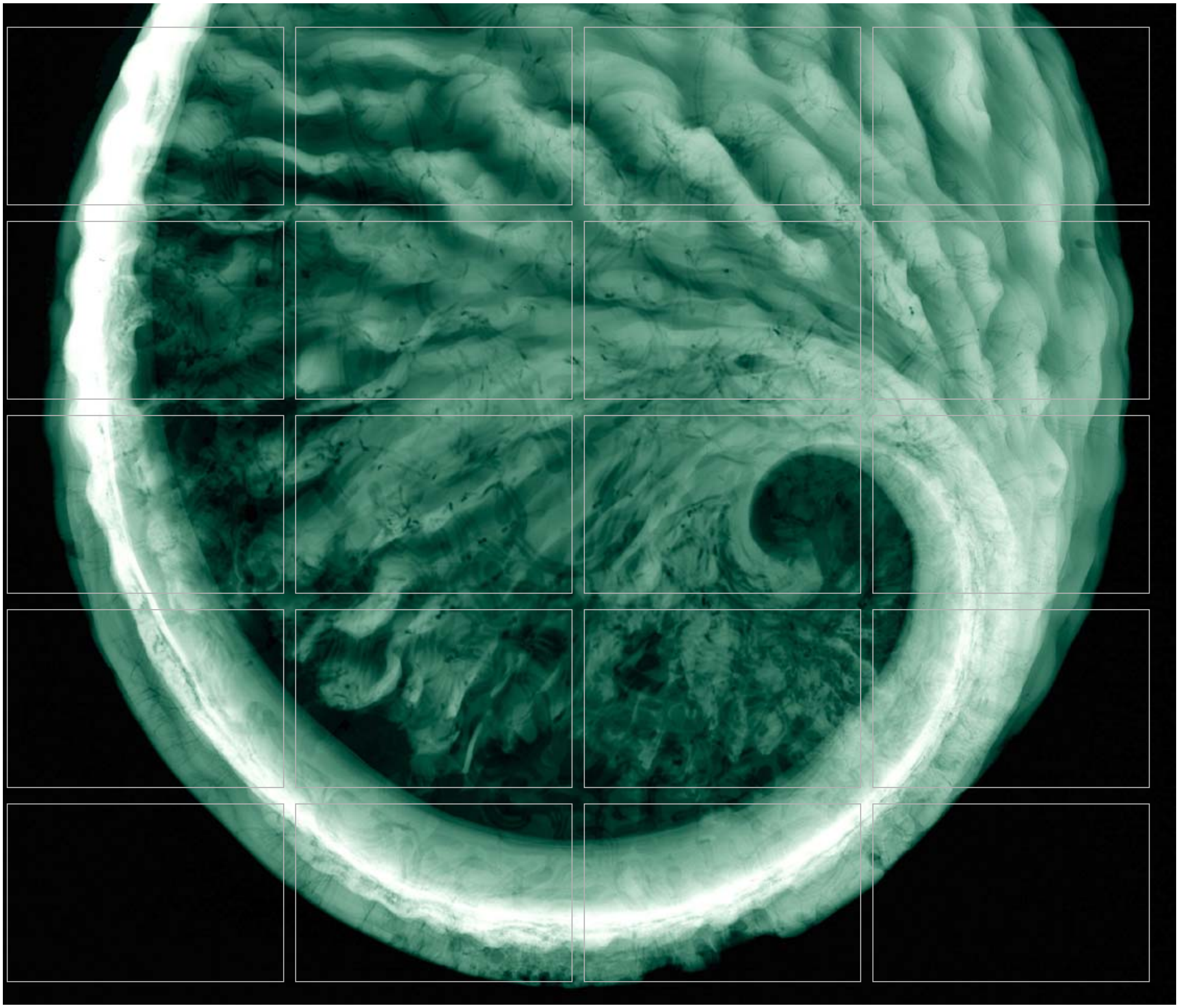

New York State Department of Environmental Conservation

Final Feasibility Study Report

Metal Etching Site
Freeport, New York
NYSDEC Site No.: 1-30-110
Work Assignment No. D003970-12

January 2007

FINAL REPORT

New York State Department of Environmental Conservation
Division of Environmental Remediation
625 Broadway
Albany, New York 12233-7017

Feasibility Study Report
Metal Etching Site

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January 2007

ERM Reference 11475

Environmental Resources Management
235 Park Avenue South, 4th Floor
New York, NY 10003

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1.0 INTRODUCTION

Environmental Resources Management (ERM) has prepared this Feasibility Report (FS) for the Metal Etching Site located in Freeport, New York to the New York State Department of Environmental Conservation (NYSDEC). ERM completed the Remedial Investigation (RI) field activities at the Metal Etching Site between May and November 2004. In addition, supplemental RI activities were performed in August 2004 and March 2005, including an Interim Remedial Measure (IRM) in March 2005. The RI was conducted to evaluate the nature, level, and extent of contamination. This FS Report has been prepared in accordance with the specifications set forth in the 21 October 2003 NYSDEC State Superfund Standby Contract, Work Assignment No. D003970-12.

1.1 PURPOSE OF THE FEASIBILITY STUDY

The purpose of an FS is to identify suitable remedial alternatives that are protective of human health and the environment and achieve site specific remedial action objectives (RAOs). The RAOs are focused on the affected media (or medium) and consider established standards, criteria, or guidance (SCGs).

This FS Report has been prepared in accordance with the approved RI/FS Work Plan, the National Contingency Plan (NCP at 40 CFR Part 300), sound engineering practices and the following documents:

- "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (Comprehensive Environmental Response Compensation and Liability Act)", US Environmental Protection Agency (USEPA), October 1988 (Interim Final);
- the New York State (NYS) Inactive Hazardous Waste Site Remedial Program (6 NYCRR Part 375); and
- NYSDEC Technical and Administrative Guidance Memorandum (TAGM) HWR-90-4030, “Selection of Remedial Actions at Inactive Hazardous Waste Sites”.

The FS establishes RAOs for the Study Area media of interest and identifies potential remedial action technologies to address these objectives. Remedial technologies that were found to be applicable to the Study Area conditions were then used to develop comprehensive remedial action alternatives. Remedial action alternatives were compared to one another for evaluation for the Site.

This FS Report is divided into five sections.

- **Section 1.0 Introduction:** The first section is an introduction to the report and contains a summary of the Metal Etching property history, the physical characteristics, the RI results, and the IRM.

- **Section 2.0 Remedial Goals and Remedial Action Objectives:** The RAOs are developed in the second section of the report, based upon an evaluation of the RI results and results of the human health and environmental exposure assessment. Where appropriate, RAOs are based on SCGs designed to protect human health and the environment.

- **Section 3.0 Identification and Screening of Remedial Action Technologies, Preliminary Remedial Alternatives, and Description of Remedial Action Alternatives:** In the third section of the report, various remedial action technologies are identified. This section also includes a screening of these technologies to determine which technologies are appropriate for the Study Area characteristics. A number of remedial action technologies are eliminated from further consideration in the FS as a result of this screening. Potential technologies are screened based on: 1) their ability to meet the RAOs, 2) implementability; and 3) short-term and long-term effectiveness. These technologies are then combined into Preliminary Remedial Alternatives, which then are screened and selected for development into full Remedial Action Alternatives.

- **Section 4.0 Evaluation of Remedial Action Technologies:** The fourth section of the FS Report evaluates the Remedial Action Alternatives developed in Section 3.0. These remedial action alternatives are evaluated using the criteria established in the NCP and addressed in the aforementioned USEPA and NYSDEC guidance documents. Section 4.0 also presents a comparative analysis of the remedial alternatives.

1.2 SITE DESCRIPTION AND HISTORY

1.2.1 Site Description and Surrounding Land Uses

The Metal Etching site, ("Site"), is a Class 2 Site listed on the NYSDEC Registry of Inactive Hazardous Waste Disposal Sites (No. 1-30-110). The

Site is located in Nassau County at 435 South Main Street, Freeport, New York, adjacent to Freeport Creek. A Site location map is presented as Figure 1-1. The Site is currently owned by Freeport Creek Associates and leased by Main Street Marine, 500 South Main Street, Freeport, New York. The Metal Etching property designation is: Section 62 Block 45 Lots 144, 145 and 158. The Site is approximately 1.05 acres, however, the area investigated in the RI was 2.06 acres. In addition to the Site, an additional 1.01 acres (Section 62 Block 45 Lots 24, 25, 54, 155 and 157), located immediately to the south and east of the Site along Freeport Creek was also investigated as part of the RI. The term "Study Area " includes the aforementioned additional properties and the Site within the Study Area boundaries are depicted on Figure 1-2.

The Study Area is currently used as a boat dealership, marina and boat storage yard. Operations at the Site are conducted in a single 2,400-square foot (sf) building located on the northeast corner of the property. A smaller 1,200-sf building, located on the western portion of the property, has been restored and is used for office space for the boat dealership. Minor boat restoration activities performed within the 2,400-sf building include, engine rebuilds, sanding and painting/varnishing. Most areas of the Site grounds are concrete or asphalt paved. Portions of the Site adjacent to Freeport Creek are covered with gravel. Soil cover was observed on a small stretch of land on the southern property beneath a two-story boat rack.

The former Metal Etching buildings at the Site were erected prior to 1954; however, the exact date of construction is unknown. These connected buildings occupied approximately 26,650 square feet of the property (approximately 60 percent of the Metal Etching portion of the property). Except for the 2,400-sf building, which was a portion of the Metal Etching quarters, the Metal Etching buildings were demolished during 2001, however the ground supports such as concrete lab/flooring/ footings remain in the ground at the Site. A six (6)-inch thick concrete slab covering an approximate area of 7,750 square feet, was the foundation of the Metal Etching plating slab and is visible to the west of the 2,400-sf building (see the areas of concern [AOCs] investigated during the RI presented in Figure 1-3).

1.2.2 *Facility History*

Prior to 1966, the Site operated as Flores Manufacturing, which processed handbags. The processing included decorative plating with nickel, chromium, and cadmium. From 1966 to 1999, Metal Etching Corporation manufactured metal nameplates, instrument panels, rulers and miscellaneous plated products. All products were etched or printed. The process of etching included anodizing, chromate conversion, and chrome/nickel plating. From 1973 to 1982 Metal Etching Co. operated under the name of Plastic Associates, as a wholly owned subsidiary. From July 1982 to June 1999 Metal Etching Co., Inc. was the entity that operated the Site. In the later years of the operation of Metal Etching Co., Inc. several of the metal coating operations were discontinued; anodizing (discontinued in 1998), chromate conversion (discontinued in 1997) and chrome plating (discontinued in 1997). All operations terminated in 1999 and Metal Etching Co., Inc. abandoned the premises during September of 1999.

The facility buildings were demolished some time around 2001. During the demolition, limited decontamination and/or investigation was performed under the oversight of NYSDEC Resource Conservation and Recovery Act (RCRA) personnel. Two (2), 4,000-gallon tanks, which formerly contained ferric chloride, were decontaminated and removed from the Site during demolition activities.

As discussed above, the former Metal Etching Facility was used primarily for plating, etching and anodizing of metals. Operations carried out at the Site included plating, etching, anodizing, degreasing, wastewater treatment, paint/powder coating, photo processing, including ink screening and printing, and metal cutting. Figure 1-3 presents the AOCs identified and investigated at the Site. Historically, sanitary and industrial wastewater was disposed of through the sanitary sewer line

1.3 SUMMARY OF REMEDIAL INVESTIGATION

ERM carried out RI field activities at the Study Area between May and November 2004. In addition, supplemental RI activities were performed in August 2004 and March 2005, including an IRM in March 2005. The scope of the RI included sub-slab vapor sampling, soil vapor sampling, a geophysical survey; soil sampling, and groundwater sampling.

The RI utilized the Triad Approach, a dynamic approach to site investigation and cleanup that is flexible and incorporates site-specific decision and data needs. The Triad Approach was developed to improve confidence in the identification of contamination at a site, reduce costs and expedite site closeout. The Triad Approach focused on management of decision uncertainty by incorporating:

- systematic Project Planning,

- dynamic Work Plan Strategies, and
- real-time measurement technologies

to accelerate site investigation and the cleanup process.

Major components of the RI included:

- site survey;
- utility survey/geophysical investigation;
- on-site soil gas survey;
- soil and groundwater investigation;
- sediment and surface water sampling;
- off-site soil gas survey;
- indoor air sampling; and
- sub-slab depressurization system installation.

The report findings indicated:

Groundwater Usage: There are currently no groundwater uses at the Study Area or in the immediate vicinity (e.g., domestic or industrial wells), and no expected future use of groundwater at the Study Area. Shallow groundwater at the Study Area is saline as a result of the proximity to Freeport Creek, and thus is unsuitable for drinking water. Based on the dissolved solids concentrations and the depth to the affected groundwater, significant use of groundwater is not expected. The nearest public supply well is approximately 6,000 ft north (upgradient) of the Study Area, and thus is not impacted by Study Area conditions.

Geophysical Results: A geophysical survey utilizing ground penetrating radar (GPR) and electromagnetics techniques (EM-61) was conducted to finalize sampling locations and guide implementation of intrusive field investigation activities. With the exception of areas occupied by boats or areas that were otherwise inaccessible, the majority of the Study Area was included in the geophysical investigation. The geophysical survey focused on the footprint of the former plating building and the adjacent areas that contained paint booths and chemical storage. The geophysical survey identified two potential underground storage tanks (USTs) at the Study Area (see Section 3.2).

Hydrogeology: The Study Area is underlain by glacial outwash deposits that generally consist of varying amounts of sand, silt, and clay. The upper three to four feet of material on the eastern portion of the Study Area is made up of a densely compacted fill material consisting mainly of gravel, debris such as brick and wood timbers. Below the fill material is a highly organic humus horizon composed of plant organics and shells. This highly organic humus and peat horizon occur between four to 11 feet below ground surface (bgs). From 11 to 30 feet bgs soil mixtures of well-sorted sands and silts are present. The "20 Foot Clay" was encountered at the Study Area in several boring locations. In each instance the top of the clay was encountered at similar depths between 30 and 35 feet bgs. The complete thickness of the clay was not determined at the Study Area; however United States Geological Survey (USGS) records that the "20–foot clay[1]" is on the order of 20-feet thick in this area.

Groundwater: The depth to water at the Study Area ranges from approximately three to five feet below grade. Average groundwater elevation determined by the tidal influence study and groundwater elevation data determined from synoptic water level measurements across the Study Area illustrate a generalized flow toward the Freeport Creek and that the Study Area is tidally influenced. Previous studies conducted in Nassau County indicate that the hydraulic conductivity of the shallow soils in the area is on the order of 250 feet/day and groundwater flow is toward the south southeast under a regional gradient of 0.00125 feet/feet and local gradient of 0.0064 feet/feet.

The following presents a summary of the major RI findings:

The five media investigated at the Study Area were soil, groundwater, surface water, sediment and soil gas. The impacts to each of these media are described below.

<u>Soil</u>

Study Area soil was characterized by the installation of 69 soil borings that resulted in 273 soil samples, which were analyzed for VOC and metals screening analyses. Approximately 20% of the screening samples, totaling 59 soil samples, were selected for confirmatory analyses. A summary of findings is presented below.

<u>*Metals*</u>

Metals in soil are found ubiquitously across the Study Area at concentrations that are above the NYSDEC TAGM No. 4046 recommended soil cleanup objectives (RSCOs). The presence of metals in the surface and subsurface soil is likely the result of the historical

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[1] Perlmutter, N.M., and Geraghty, J.J. Geology and Groundwater Conditions in Southern Nassau and Southeastern Queens Counties, Long Island, N.Y., U.S Geological Survey Water Supply Paper 1613-A1963

operational and disposal activities, airborne pollution from the facility, and from natural sources. The main inorganic constituents of potential concern (COPC) at the Study Area are chromium, copper, nickel and zinc. Isolation of the particular COPCs in soil identified hot spot areas. In general, the hot spot areas were observed at greater frequencies in the upper zero to seven feet bgs intervals. Elevated concentrations decrease in frequency of detection and in concentration with depth. Generally the concentrations of COPCs above TAGM 4046 RSCOs at the interval from 11 to 12 feet bgs become minimal, and the frequency of detections above the TAGM 4046 RSCOs also diminish.

VOCs

Twenty-five of the 273 soil samples contained measurable concentrations of several VOCs above the NYSDEC RSCOs. The constituents that exceed RSCOs include; benzene, toluene, ethylbenzene, xylene, MTBE, naphthalene, chlorobenzene, tetrachloroethene (PCE), trichloroethene (TCE), trans-1,2-dichloroethene (DCE) and vinyl chloride (VC). The distribution of VOCs in soil exceeding the TAGM 4046 RSCOs indicates that VOC contamination is present at four areas across the Study Area. Contamination at the eastern portion of the Site "Eastern Cluster" is evident in soil borings SB-02, SB-52 and SB-56. This contamination is most likely attributable to fuel spillage from boat maintenance activities attributable to current and past Site operations.

On the western portion of the Site "Western Cluster" four borings, SB-43, SB-58, SB-60 and SB-63 exhibited concentrations of naphthalene and xylenes above the RSCOs. This contamination was observed in the tank grave of the former 550-gallon UST abandoned sometime around year 1990. Delineation borings located approximately 10 feet from each of the contaminated locations (SB-43, SB-58, SB-60 and SB-63) indicated soil concentrations below the RSCOs.

A third area "Central Western Cluster" located approximately 15 feet southeast of the 1,200-sf building indicated the presence of one boring, SB-41, with TCE above the RSCO at an interval of 1.5 to 2.5 feet bgs. No further detections of TCE were observed in the deeper samples from this boring. The geophysical report indicated that an anomaly was present along the eastern wall of the 1,200-sf building. The anomaly was not confirmed during the RI, though potential locations for USTs were identified (see Section 3.2). The TCE source in soil is likely from disposal of spent solvent or spillage during product handling.

The fourth area where soil impacts were observed is at the center of Site "Central Eastern Cluster". Soil impacts above RSCOs were observed in soil borings, SB-07, SB-10, SB-11, SB-31, SB-34, SB-36, SB-37, SB-48 and SB-65. Detections of benzene, toluene, MTBE, PCE, TCE, trans-1,2-DCE and VC were detected above the RSCOs. VOC impacts in this area are likely due to the poor housekeeping observed during the historical photo review. Waste handling and spillage that may have occurred in this area would have directly impacted soil cover. Documentation review during a file review at the Nassau County Department of Health (NCDOH) indicates that Metal Etching Co, Inc. requested permission from the NCDOH to abandon a 1,500-gallon UST in place. No additional documentation recording the status of the tank abandonment was identified during the file review. These areas were identified as potential source areas in the conceptual model and were therefore targeted during the Site investigation.

Groundwater

Groundwater samples were collected from 65 soil borings installed at the Site and confirmatory samples were collected from a total of 13 locations. The groundwater samples were collected at the water table following completion of each soil boring. Groundwater samples were analyzed for VOCs and metals.

At the completion of the soil boring program a permanent groundwater monitoring well network was installed consisting of the 10 monitoring wells. The monitoring well network was installed based on the determination of groundwater flow direction and in areas where soil and groundwater impacts were observed during the soil boring program. The network consisted of shallow (S designation) water table wells and deep (D designation) wells situated on top of the "20 foot Clay".

VOCs

Sixty-five groundwater samples were collected for VOC screening analysis. Forty-seven of the 65 groundwater screening samples contained measurable concentrations of VOCs above the NYSDEC TOGS. The following constituents exceeded the NYSDEC TOGS in order of greatest frequency of detection to the least: MTBE, benzene, cis-1,2-dichlorethene, PCE, VC, xylene, ethylbenzene, toluene, TCE, chlorobenzene, naphthalene, 1,1-dichloroethene, 1,2-dichlorobenzene, and 1,4-dichlorobenzene. Confirmation of these findings were observed in groundwater collected from the permanent monitoring well network.

VOCs in groundwater detected in one or more samples in the permanent monitoring well network above the NYSDEC TOGS include six (6) compounds: benzene, MTBE, PCE, TCE, cis-1,2-DCE and VC. PCE was observed at the greatest concentration in monitoring wells and concentrations appear to migrating toward the Freeport Creek. VOCs in groundwater are attributed to former Metal Etching Co., Inc. operations and poor housekeeping which impacted soil and ultimately groundwater at the Site. The greatest VOC concentrations were observed in the Central Eastern portion of the Site. Additionally, the presence of breakdown products from PCE such as TCE, cis-1,2-DCE and VC indicates that reductive dechlorination is naturally occurring in subsurface.

Degradation of PCE, TCE and cis-1,2-DCE is enhanced in anaerobic environments. As the concentration of DO and the ORP potential decrease, subsurface conditions become favorable for the growth of anaerobes capable of degrading chlorinated hydrocarbons (CHCs) through reductive dechlorination. Environmental research has shown that bacterial degradation of CHCs proceeds in a stepwise process starting with PCE and ending with ethane/ethene. The degradation sequence is:

$$\text{PCE} \rightarrow \text{TCE} \rightarrow \text{cis-1,2-DCE} \rightarrow \text{VC} \rightarrow \text{ethane/ethene}$$

Except for ethane/ethene, which have not been analyzed for, each of the species in the degradation pathway has been observed at the Site. Low DO concentrations have been observed in each of the monitoring wells installed as part of the RI and in six of the 10 monitoring wells installed at the Site. The ORP is conducive for the reductive dechlorination of CHCs. Therefore, there is an active transformation mechanism in the subsurface at the Site that will remove/limit the migration of any PCE or TCE released during operation of the business.

Metals

Metals detected in groundwater in one or more samples in the permanent monitoring well network above the NYSDEC TOGS included seven inorganics: antimony, barium, hexavalent chromium, iron, magnesium, manganese, and sodium.

The Metal Etching Co., Inc. facility represents the likely source of many of these metals. Elevated concentration of sodium, iron, magnesium and manganese were observed and appear to be related to the local naturally occurring geochemistry and the tidally influenced groundwater regime at the Site. Groundwater samples collected during the soil boring investigation indicated the presence of dissolved metals in groundwater, however, permanent groundwater monitoring well sampling data indicated that dissolved metals are not present at the Site. In the screening groundwater samples turbidities were greater than 50 nephelometric turbidity units (NTU) during sample collection. Although the suspended solids these samples may have had time to settle prior to laboratory analysis, the suspended content is likely the reason for the elevated metals concentrations. The permanent monitoring well network was sampled using low flow methodology and turbidities in most instances were below 10 NTUs. A significant metals dissolved plume was not observed in Site monitoring wells, therefore metals in groundwater do not appear to be of concern at this time.

Surface Water

COPCs in surface water at the Site based on exceedence of the Class SC surface water quality standards and guidance include two VOCs (ethylbenzene and xylenes) and one inorganic (copper). The ethylbenzene is likely from petroleum fuels lost from boat engines.

Marinas line the western banks of the Freeport Creek. Many boat fittings, engine parts, such as propellers and fastenings are made from brass to resist corrosion from salt. Brass is an alloy of copper and zinc. Although brass is more resistant than iron or steel to the effects of salt water, it does in time corrode. Furthermore, marine antifouling paints now commonly include copper as a biocide. Copper concentrations in antifouling points can be as large as 50% and dissolve into water bodies over time (Johnsen and Engoy, 1999). Therefore, the presence of copper in surface water is not considered to be Site-related.

Sediment

Sediment in Freeport Creek is impacted by both organic contaminants and metals. The organic contaminants (principally PAHs, pesticides and PCBs) are not Site related because groundwater discharging to the Creek is not contaminated by those substances. The highest concentrations of PCBs were detected in the storm sewer sediment and the Freeport Creek sediment nearest the storm sewer. PAHs were also found in the storm sewer sediment. Freeport Creek sediment samples nearest the storm sewer and the large hotel parking lot had some of the highest PAH concentrations. It is possible that runoff from the road ways and asphalt sealer in the parking lot is a source of sediment PAHs. Metal contamination of Freeport Creek sediments is potentially related to stormwater discharge, either from the storm sewer or from non-point sources. Hydrogeochemical conditions limit the movement of metals in groundwater and metals are not transported to Freeport Creek by groundwater discharge.

Soil Gas

Soil gas contamination, from contaminated groundwater or from soil contaminants, by VOCs was detected. The soil gas contaminants are related to degreasing solvents used at the Site (and degradation products thereof) and petroleum hydrocarbons (plus oxygenates). Soil gas contamination is present beneath the on-Site buildings and extends beneath East Ray and South End Place Streets. A component of the soil gas contamination is related to Site activities, however, impacts to air quality within residential structures adjacent to the Site have not been directly observed.

Additionally, two sub-slab depressurization (SSD) systems have been installed beneath the two on-Site structures specifically underneath the 2,400-sf building (large warehouse building) and the 1,200-sf building (show room). The objective of these two venting systems was to provide a temporary means of reducing the pressures underneath the building slabs, and providing an alternative migration pathway for soil vapor. Thereby mitigating the elevated concentrations of soil vapor contaminants beneath the structures. Venting systems are currently in operation at the Site.

1.4 *SUMMARY OF THE INTERIM REMEDIAL MEASURE*

Following the soil vapor investigation, an IRM was implemented to address impacted soil vapor underneath the Site buildings. SSD systems were installed beneath the warehouse and office building to provide a means of reducing the pressure underneath the building slabs and providing an alternate migration pathway for soil vapor.

Warehouse *(2,400-sf Building)*

Two stainless steel well screens (two inches in diameter, three feet long, 0.020-inch slot size) were installed along the center line of the building, and evenly spaced. To install the screens, a hole was cored through the floor. An auger was then used to loosen the underlying soil prior to driving the screens to the necessary depth. The annular space between the screen and the floor were sealed to prevent soil vapor from migrating into the building. To allow for flow adjustment or isolation of each point, a valve was placed downstream of the well screens. Three-inch PVC Schedule 40 piping was connected to the screens and run along the ceiling to the northeast corner of the building. The piping was inserted through an existing hole in a window. The piping was connected to a hard-wired Radon America GP-501 in-line ventilation fan that was mounted in the piping on the outside of the building. A tee was installed at the inlet to the fan, and a valve was installed to allow for the fan to draw ambient air, if needed, to keep the fan motor cool. The three-inch outlet piping was attached to the side of the building and extend above the roof line. The exhaust point was covered with a rain cap.

Office Building *(1,200-sf Building)*

The office building had been recently renovated and had limited means for interior floor penetrations and piping. Therefore, the venting point consisted of stainless steel well screen (two inches in diameter with 0.020-inch slot size) driven horizontally five to ten feet underneath the building. To install the screens, an area near the building exterior was excavated to expose the building foundation. A core drill was then used to drill an approximate three-inch hole through the building foundation, at a depth of approximately 16 to 24 inches below grade. An auger was then used to loosen the soil. The well screen will be fixed with a drive point and driven underneath the building. Two, five-foot well screens were installed under the building. The annular space between the screen and the foundation was sealed.

Three-inch PVC pipe was connected to the well screen and connected to a hard-wired Radon America GP-501 in-line ventilation fan that was mounted in the piping on the outside of the building. A tee was installed at the inlet to the fan, and a valve was installed to allow the fan to draw ambient air, if needed to keep the fan motor cool. The three-inch outlet piping was attached to the side of the building and extends above the roof line. The exhaust point was be covered with a rain cap. Following completion of the venting system installation, the asphalt surfaces were restored to original condition.

2.0 *REMEDIAL GOALS AND REMEDIAL ACTION OBJECTIVES*

This section presents the remedial goals and RAOs established for the Study Area media of interest (i.e., soil, groundwater, Freeport Creek sediment, Freeport Creek surface water, storm sewer sediment and soil gas). For the purposes of this FS, the "Site" is defined as the property formerly owned by Metal Etching, Inc. The "Study Area" will refer to the entire area investigated during the RI, including the former Metal Etching property. The Study Area extends from east of the access road to south of the Metal Etching property, encompassing part of the marina and including adjacent Freeport Creek sediment and surface water. These areas are outlined in Figure 2-1. As discussed below, consistent with Division of Environmental Remediation (DER) "Draft Technical Guidance for Site Investigation and Remediation, (DER-10)", dated December 2002 (New York State Department of Environmental Conservation [NYSDEC], 2002), the remedial needs for soil gas will be evaluated in the context of the RAOs for Study Area soil and groundwater.

Remedial goals are common to all inactive hazardous waste sites on the registry and are derived from the statute (i.e., 6 New York Code of Rules and Regulations [6NYCRR] Part 375) and NYSDEC guidance. The remedial goals express the intent of the remedial actions to restore the Study Area to conditions prior to disposal within certain confines. Examples of relevant remedial goals are set forth in the DER-10.

The remedial goals for the Study Area are:

- restoration to pre-disposal/pre-release conditions, to the extent feasible and authorized by law; and,
- eliminate or mitigate all significant threats to the public health and the environment caused by Site-related operations through the proper application of scientific and engineering principles.

The remedial goals provide the broad framework in which RAOs can be defined for media that have been impacted by the Site operations.

Guidance on developing RAOs is provided in NYSDEC TAGM No. 4030 (NYSDEC, 1990) and examples of RAOs are also set forth in DER-10 (NYSDEC, 2002). The RAOs are media-specific targets that are aimed at protecting the public health and the environment. In the case of protection of human health, RAOs usually reflect the concentration of a COPC and the potential exposure route. Protection may be achieved by reducing potential exposure (e.g., use restrictions, limiting access) as well as by reducing concentrations. RAOs, which are established for protection of environmental receptors, are usually intended to preserve or restore a resource. As such, environmental RAOs are set for a media of interest and a target concentration level.

Media that are candidates for remedial evaluation are identified based on the nature and extent of contamination and applicable or relevant and appropriate Standards, Criteria and Guidelines (SCGs). The Study Area media of interest identified during the remedial investigation (RI) are soil, groundwater, Freeport Creek sediment, Freeport Creek surface water, storm sewer sediment, and soil gas. As identified in 6NYCRR375-1.10(c)(1)(ii), SCGs are provided in a guidance provided by the NYSDEC. The most recent NYSDEC guidance containing SCGs is draft DER-10 (NYSDEC, 2002).

In addition to SCGs, certain site-specific factors are considered when developing the RAOs for Study Area media of interest. These site-specific factors relate to the impacted media, types of constituents and potential routes of exposure. The factors that were considered in developing RAOs are discussed in the following subsections according to the media evaluated.

2.1 *IDENTIFICATION OF SCGS*

SCGs include promulgated standards and non-promulgated guidance, which govern activities that may affect the environment. The standards and criteria (SCs) are those cleanup standards, standards of control and other substantive requirements, criteria or limitations that are officially promulgated under federal or state law. Though guidance does not represent a legal requirement, it should be considered based on professional judgment when applicable to site conditions (NYSDEC, 2002).

Table 2-1 presents potential SCGs, which may govern remedial actions at the Study Area. This table lists: the citation; a description of the SCG; SCG type (i.e., chemical, action or location specific); and, reason the SCG is listed (e.g., remedy selection and/or remedial action) and how it applies to the remedy evaluation.

Certain SCGs are considered in the development of the Study Area media of interest RAOs. These SCGs are discussed with the remedial requirements for the media of interest in the following sections. The relevance of the SCGs to the remedial alternatives is discussed with the evaluation of each alternative in Section 4.0 (i.e., in the evaluation of the ability of each remedial action alternative to comply with the SCGs).

2.2 *MEDIA OF INTEREST*

The following Study Area media were identified during the RI and evaluated below as potential media of interest requiring RAOs: (1) soil; (2) groundwater; (3) Freeport Creek sediment; (4) Freeport Creek surface water; and (5) storm sewer sediment. Soil gas will be discussed in the context of the soil and groundwater media of interest. This is consistent with draft DER-10. A summary of the RI for these media was presented in Section 1.3 and summaries of the human health environmental exposure assessment and fish and wildlife impact assessment (FWIA) for each media are included below in their relevant subsections.

2.2.1 *Soil*

Past site operations and sources have impacted soil with organic and inorganic COPCs. There are two existing Site buildings that are used for boat repairs and sales. These buildings are a 2,400-sf building located along the northern site boundary (repairs) and a 1,200-sf building (sales) located on the western portion of the property. As shown on Figure 2-1, the majority of the western parcel is paved with either concrete or asphalt, the entire eastern portion of the property is covered in gravel and a small area of unpaved soil is located on the western parcel adjacent to Freeport Creek. Boat racks approximately 2-stories high overlie this uncovered soil area year round.

The upper three to four feet of material on the eastern portion of the Study Area is made up of a densely compacted fill material mainly comprised of gravel and debris such as brick and wood timbers. Below the fill material on the eastern side and below the concrete foundation slabs on the western side of the Study Area is sand interspersed with a highly organic humus horizon. The humus layer is present between 3 feet and 13 feet bgs. Below 13 feet bgs is an additional 17 feet of well sorted sands and silts.

A unit, believed to be the "Twenty-Foot Clay" layer, underlies the Site at a depth of approximately 31 feet bgs. The overburden glacial outwash in the area of the Study Area is approximately 100 feet thick from the surface to the underlying Magothy Aquifer, which is made up of sand and gravel with intermittent beds of clayey sands and is considered a sole source aquifer. Groundwater occurs at depths ranging from three to five feet below grade at the Study Area. A competent bulkhead is present on the southwestern portion of the Study Area and a riprap wall forms the border with the creek on its northeastern side.

In addition to the existing soil covers, Figure 2-1 also shows where former Site buildings' concrete foundation structures remain on the Metal Etching Property (Section 62, Block 45, Lots 144, 155 and 158). These concrete foundation slabs are present throughout the majority of the Site.

2.2.1.1 Remedial Requirements

The remedial requirements for Study Area soil have been determined using the SCGs, the results of the human health and environmental exposure assessment, and the results of the fate and transport analysis.

<u>SCGs</u>

Chemical specific SCGs that apply to Study Area soil are derived from the NYSDEC TAGM 4046 RSCOs and Eastern USA background concentrations listed in TAGM 4046, where site background concentrations may be used in lieu of RSCOs. The TAGM 4046 RSCOs are designated as guidance values.

Comparison of maximum soil concentrations to the TAGM 4046 RSCOs is presented in Table 2-2. In addition, Figures 2-2 and 2-3 show the location of all soil exceedences for volatile organic compounds (VOCs) and metals, respectively. As shown in these tables and figures, constituent concentrations in soil exceed a number of the RSCOs for VOCs and metals.

As discussed in the RI, background soil analyses were not carried out as part of the RI. Therefore Eastern U.S. background concentrations or New York regional background data listed in TAGM 4046 were used to supplement soil concentration comparison to guidance values. Comparison with these criteria indicated that the concentrations of seven metals (cadmium, chromium, copper, lead, nickel, selenium, and zinc) are present in the Study Area soil at concentrations above the TAGM 4046 RSCOs.

Toxicity characteristic leaching procedure (TCLP) testing conducted during the RI did not indicate that excavated soil would be characterized as hazardous waste under 6 NYCRR Parts 370 through 373 and 375 or RCRA (40CFR261.24). Thus, SCGs related to hazardous waste are not applicable.

There is no discernible and distinct free phase non-aqueous phase liquid (NAPL) at the soil/groundwater interface present within the Study Area. Only one boring, SB-34, of 69 borings indicated the presence of petroleum. At this location, black stained soils with a strong odor were observed from 2.5 to 11 feet bgs. However, the monitoring wells closest to this boring, MW-07S, MW-03S, and MW-02S, located at 38, 61.5, and 30.5 feet away from SB-34, respectively, did not exhibit NAPL on the water table.

Because a discernable free phase NAPL layer has not been observed at the Study Area, SCGs related to NAPL are not needed[2].

In conclusion, the following SCGs will be used to determine the extent of impacted Study Area soil:

- TAGM 4046 RSCOs;
- Eastern U.S. background concentrations; and
- New York regional background data.

Table 2-1 presents a summary of the soil SCGs used in this evaluation.

Results of the Human Health and Environmental Exposure Assessment and FWIA

The existing bulkheaded areas and stabilized rip-rap shoreline prevent the erosion of soil to Freeport Creek. VOCs, present in Study Area soil, are also present in Study Area groundwater at concentrations above the screening criteria. The human health and environmental exposure assessment identified five VOCs in soil (benzene, methyl tertiary butyl ether [MTBE], PCE, TCE, and VC) that have leached to groundwater. However, as also discussed in the Human Health and Environmental Exposure Assessment (HHEEA), none of the VOC COPCs detected in Study Area soil result in a significant exposure pathway via leaching to groundwater and discharge to Freeport Creek. However, until

[2] The New York State requirements for NAPL removal are described in the New York Oil Spill, Control, and Compensation Act, Article 12 of the New York State Navigation Law, as amended. Overall, Article 12 of the New York State Navigation Law and the National Contingency Plan (NCP) require that potential threats or risks posed by free phase NAPL be minimized or mitigated but do not require actions to eliminate any potential threats or risks related to free phase NAPL.

groundwater use is controlled, both on and off-Site, leaching of VOCs to groundwater is a potential exposure pathway.

In conclusion, the soil erosion and discharge of groundwater to Freeport Creek exposure pathways are not of concern. However, if there are no measures enforced to control the use of groundwater, both on-site and off-site, the leaching of VOCs to the groundwater is a potential exposure pathway.

The remaining exposure pathway is volatilization to indoor and outdoor air. VOCs in soil above the groundwater table (i.e., the upper three to six feet of soil) present the potential for volatilization into the interstitial spaces between soil particulates, and may pose a potential for migration into indoor and outdoor air. The presence of VOCs in soil gas confirms that this pathway is complete. The tidal fluctuations in groundwater are likely a driving force for the migration of these groundwater chemicals. The RI evaluated this exposure potential, and as a result mitigative measures were implemented where needed through an IRM to prevent exposure. Sampling has demonstrated that the Site-related constituents in soil vapor and indoor air has not impacted off-site residential structures.

The FWIA found that Study Area soil is not having adverse impacts to fish and wildlife resources on, adjacent to, or within a 0.5-mile radius of the Study Area.

2.2.1.2 *Remedial Action Objectives for Soil*

Based on the evaluation discussed above and draft NYSDEC guidance regarding development of RAOs in DER-10 (NYSDEC, 2002) the following RAOs have been established for the Study Area soil:

- Prevent ingestion and/or direct contact with soil that exceeds applicable SCGs.

- Prevent migration of contaminants that would result in groundwater contamination.

- Prevent inhalation of or exposure to COPCs volatilizing from impacted soil.

The following section discusses the extent of impacted Study Area soil/fill to which the above RAOs would apply.

2.2.1.3 *Extent of Impacted Soil*

The extent of impacted soil at the Study Area exhibiting VOC and inorganic concentrations above RSCOs is shown in Figures 2-2 and 2-3. Surface soil is defined as exposed (i.e., non-covered) soil located within one foot of the ground surface. Subsurface soil is defined as material deeper than one-foot bgs or material covered by asphalt or concrete. As shown on these figures, metal RSCO exceedences occur throughout the Study Area soil with more localized exceedances VOCs.

Overburden soil concentrations in excess of the RSCOs ranged in depth from surface to 33 feet bgs and extend throughout the entire Study Area. The approximate areal extent of RSCO exceedences across the entire Study Area is 90,000 square feet (sf). With the exception of limited soil exceedences at SB-24 and SB-56, all other soil exceedences of RSCOs occur between surface and 14 feet bgs. Thus, the total volume of soil exhibiting concentrations in excess of the RSCOs is approximately 46,700 cubic yards (cy) (i.e., 90,000 sf x 14 feet in thickness = 1,260,000 cubic feet (cf) x 1 cy/27 cf = 46,666 cy).

As shown in Figure 2-2, there are isolated VOC exceedences of NYSDEC RSCOs. Additionally, localized metal 'hot spot' resulting from operational impacts to the subsurface were also identified in SB-3 at 0-0.5 feet bgs (copper and zinc), SB-1 at 1.5-2.5 feet bgs (copper), SB-2 at 1.5-2.5 feet bgs (chromium and zinc), and SB-10 and SB-11 at 1.5-2.5 feet bgs (nickel and chromium). The total volume associated with these VOC and metals 'hot spots' is approximately 4,900 cy. These areas are shown on Figure 2-4 and their volume calculation is presented in Table 2-3. Average Site soil concentrations of chromium, copper, nickel and zinc both with and without the removal of the metal 'hot spots' are:

Inorganic Constituent	**Average Concentration of Metal in Site Soil (mg/kg)**	**Average Soil Concentration Excluding Metal Hot Spots (mg/kg)**
Chromium	61.4	48.8
Copper	119.3	80.1
Nickel	42.2	32.5
Zinc	113	96

Hereinafter, "hot spots" will be defined as the above referenced metal hot spots and the VOC exceedences of NYSDEC RSCO areas as shown in Figure 2-2.

2.2.2 *Groundwater*

Groundwater within the Study Area is encountered from three to five feet below grade. Groundwater generally flows to the southeast towards Freeport Creek. As discussed in the RI report, both shallow and deeper groundwater flow are, at certain periods in the tidal cycle, toward and likely discharging to Freeport Creek, which is a tidal estuary.

During the RI, shallow groundwater samples were collected from 69 soil borings. Almost all the samples were analyzed for VOCs and metals. Due to sampling limitations, the turbidity of these samples was often elevated, potentially resulting in high biased metals concentrations. As a follow-up to this groundwater sampling, ten permanent monitoring wells were installed within the Study Area. At three locations, well clusters of one shallow well (screened from 3 to 13 feet bgs) and one deeper well (screened from 20 to 30 feet bgs) were installed. At the remaining four locations, one shallow well was installed. The groundwater sampling results collected from the monitoring wells are more representative of the formation conditions and therefore have been used to determine the RAOs for Study Area groundwater. Lastly, groundwater concentrations of metals do not suggest that leaching of metals from soil to groundwater is occurring. The only chemical observed in soil above its RSCO and in groundwater above the Class GA groundwater standard was cadmium and this groundwater exceedence only occurred in two wells.

The RI results showed that chlorinated VOCs, benzene, MTBE, as well as a number of metals are present in both the shallow and deep Study Area groundwater. However, the concentrations of chlorinated VOCs in shallow groundwater, along with generally negative Oxidation Reduction Potentials (ORPs) values observed in the shallow monitoring wells, suggest that anaerobic biodegradation of chlorinated VOCs is likely occurring. It is believed that biodegradation is being fueled by the humic layer observed in the shallow soil interval at the Study Area and/or possibly the concentrations of aromatic hydrocarbons present in the shallow groundwater. These anaerobic conditions and resultant biodegradation is not observed in the deeper groundwater.

The remedial requirements for Study Area groundwater have been based on the SCGs, results of human health and environmental exposure assessment and the fate and transport analysis.

2.2.2.1 *Remedial Requirements*

<u>SCGs</u>

A comparison of maximum detected Study Area groundwater concentrations collected from monitoring wells to the Class GA standards is shown in Table 2-4. Although the chloride concentrations in monitoring wells MW-03S and MW-05 did not reach the concentration requirements for saline water classification, based on the conductivity measurements collected during groundwater sampling, it is suspected that the Study Area groundwater is saline. However, in the absence of saline groundwater standards, the Class GA standards were used to determine the remedial needs for Study Area groundwater. Due to its high sodium concentration, Study Area groundwater would not be suitable as a potable groundwater drinking water supply. Also, there are no potable wells at the Study Area or downgradient of the Study Area.

Comparison to the Class GA standards indicates that the shallow and the deeper Site groundwater exceed the Class GA standards for the following chemicals at the following frequencies:

<u>Shallow Groundwater (3-13 feet bgs)</u>
Benzene (1/7 wells)
cis-1,2-DCE (3/7)
MTBE (6/7)
PCE (2/7)
TCE (3/7)
Vinyl Chloride (3/7)
Antimony (5/7)
Barium (1/7)
Cadmium (2/7)
Iron (6/7)
Magnesium (4/7)
Manganese (4/7)
Sodium (7/7)
Hexavalent chromium (1/7 – minor exceedence)

<u>Deeper Groundwater (20-30 feet bgs)</u>
cis-1,2-DCE (1/3)
PCE (2/3)
TCE (2/3)
Antimony (2/3)
Iron (3/3)
Magnesium (3/3)
Sodium (3/3)

Results of Human Health and Environmental Exposure Assessment and the Fate and Transport Analysis and FWIA

As discussed above, the groundwater sampling results strongly suggest that anaerobic biodegradation of the chlorinated VOCs in the shallow Study Area groundwater is occurring. Groundwater is not currently used for drinking water or any purposes at the Study Area or in the Study Area vicinity, and discharge to Freeport Creek was not found to be a significant exposure pathway as part of the exposure assessment. Furthermore, based on its sodium concentrations, the Study Area groundwater cannot be used as a drinking water source. However, while there is presently no use of groundwater at the Study Area, until groundwater meets SCGs, groundwater is considered to be a potential exposure pathway.

Groundwater sampling results showed that Study Area groundwater is not impacting surface water in Freeport Creek. The only chemicals present in surface water above their standards were copper and ethylbenzene; however, neither of these chemicals is present in the Study Area groundwater.

The potential for exposure via volatilization from shallow groundwater to overlying indoor or outdoor air was identified as a potential complete exposure pathway. The tidal fluctuations in groundwater are likely a driving force for the volatilization of these groundwater chemicals. As the water table elevation increases, the pressure of the soil vapor increases, thereby increasing the volatilization rate of organic compounds. That is, as the water table elevation increases, soil gas present in the vadose zone is forced into a smaller volume, which increases the pressure. As the pressure increases with respect to the atmosphere, soil gas can escape to the surface. Similarly, as the elevation of the water table recedes, VOCs sorbed to soil from the groundwater are left in the vadose zone. Thus, there is greater VOC source to partition to soil gas and consequently greater potential for subsequent VOC volatilization. The RI evaluated this exposure potential, and as a result mitigative measures were implemented where needed through an IRM to prevent exposure. Sampling has demonstrated that the Site-related constituents in soil vapor and indoor air has not impacted off-site residential structures.

The FWIA found that Study Area groundwater is not having adverse impacts to fish and wildlife resources on, adjacent to, or within a 0.5-mile radius of the Study Area.

2.2.2.2 *Remedial Action Objectives for Groundwater*

The following RAOs have been established for Study Area groundwater:

- Prevent inhalation of VOCs volatizing from contaminated groundwater;
- Prevent discharge of Site-contaminants to surface water; and
- Remove the source of groundwater or surface water contamination (this RAO will be addressed in the context of the soil RAOs).

2.2.2.3 *Extent of Impacted Groundwater*

The extent of groundwater contamination extends throughout the entire Study Area. As discussed above, Study Area groundwater exceeds Class GA standards for a number of VOCs and metals. However, as discussed above, neither the shallow or deeper Study Area groundwater is adversely impacting surface water.

Additionally, as discussed in the RI, groundwater flowing onto the Study Area appears to be impacted by an upgradient source of benzene and MTBE. These constituents are gasoline-related and are not considered to be Site-related impacts. As discussed above, removal of the source of groundwater contamination will be addressed in the soil RAOs.

In conclusion, the exposure routes of concern for Site groundwater are groundwater use and volatilization to indoor air. The extent of impacted groundwater will be defined as the extent of the entire plume as delineated during the RI and shown in Figures 2-5 through 2-11. There are no exposure routes of concern related to metals in Site groundwater.

2.2.3 *Freeport Creek Sediment*

Six sediment samples (SED-01 to SED-05 and SED-07) were collected adjacent to the Site's shoreline and two background sediment samples (SED-06 and SED-08) were collected further into Freeport Creek approximately 82 feet offshore. Based on the tidal flow, SED-06 is considered to be the upstream sample and SED-08 is considered to be the downstream sample. Sediment sampling results for these sample locations are provided Table 2-5 and their locations are provided in Figure 1-2.

2.2.3.1 *Remedial Requirements*

The remedial requirements for Freeport Creek sediment have been determined according to the following criteria of analysis:

- SCGs; and

- results of the human health and environmental exposure assessment.

SCGs

As shown in Tables 2-5 and 2-6, sediment concentrations in the background samples as well as the samples collected adjacent to the Study Area exceeded the sediment screening levels contained in the NYSDEC Technical Guidance for Screening of Contaminated Sediment (NYSDEC, 1999). The elevated background sediment concentrations must therefore be taken into account when using the sediment standards for the purpose of making remedial decisions. In addition, the presence of non-Site related sources (e.g., surface water runoff from paved areas) must also be taken into consideration when using the sediment guidance for the purpose of making remedial decisions. Comparison of the sediment concentrations to their SCGs is presented below.

Results of the Human Health and Environmental Exposure Assessment and Fate and Transport and FWIA

The only pathway of concern for human health impacts from Freeport Creek sediment is ingestion of fish. There are no exposure concerns for this human pathway for the Site-related chemicals of concern in sediment.

Groundwater discharge to Freeport Creek is not impacting sediment quality and there is currently no erosion of Study Area soil into the creek. Current and previous discharge of residual storm sewer sediment is a suspected source of chemical discharge to Freeport Creek sediment. In addition, past erosion of soil from previously uncovered Study Area soil areas is also a suspected previous source of chemicals to Freeport Creek. Finally, discharge from off-Site properties to Freeport Creek via stormwater flow is another past and current source of chemicals to Freeport Creek sediment. This last source is demonstrated by the presence of non-Site related chemicals (e.g., polychlorinated biphenyls (PCBs), pesticides/herbicides and semi-volatile organic compounds [SVOCs]) in the Freeport Creek sediment samples. Pathways of concern for ecological receptors have been defined by the NYSDEC.

With the exception of sediments in the vicinity of SED-04, the FWIA found that Freeport Creek sediment is not having adverse impacts to fish and wildlife resources on, adjacent to, or within a 0.5-mile radius of the Study Area.

2.2.3.2 *Remedial Action Objectives for Freeport Creek Sediment*

Based on the remedial requirements discussed above, the following RAOs have been established for the Site-related creek sediment:

- Prevent surface water contamination which may result in fish advisories;
- Prevent releases of chemicals in excess of upriver values to or from sediment that would result in surface water concentrations of COPCs in excess of ambient water quality criteria and/or result in fish advisories; and
- Prevent Site-related impacts from bioaccumulation through the marine or aquatic food chain to the extent practicable, by taking upriver sediment quality and applicable SCGs into consideration.

2.2.3.3 *Extent of Impacted Freeport Creek Sediment*

To determine the remedial needs for sediment adjacent to the Site, the sediment concentrations were first compared to the upstream sample concentrations at SED-06. Following this comparison, the sediment concentrations above the background levels were compared to the specific sediment screening criteria provided in NYSDEC Technical Guidance for Screening of Contaminated Sediment (NYSDEC, 1999). Figure 2-12 presents a comparison of select constituents of concern concentrations in sediment to the Effects Range Medium (ER-M) values in this guidance for chromium, mercury, nickel, and zinc.

As presented in the RI, sediment concentrations in excess of the SED-06 background concentrations occur for a number of SVOCs, PCBs, pesticides/herbicides, calcium, chromium, mercury, nickel and zinc. The SVOCs, PCBs, pesticides/herbicides and mercury are not associated with the Site. Consequently these chemicals will be eliminated from consideration. Although calcium was observed above its background value, it is present at a concentration below its Effects Range-Low (ER-L) and therefore is not of concern. The remaining chemicals present above background concentrations and above their SCGs are nickel in excess of its ER-L at SED-01 and SED-04, chromium above its ER-L at SED-04 and zinc above its ER-M at SED-04.

Assuming a maximum impacted sediment depth of 2 feet, the approximate extent of impacted sediment around SED-01 is 39 cy and the approximate depth around SED-04 is 114 cy for a total of 153 cy of Site-related impacted Freeport Creek sediment. These areas of impacted sediment are depicted on Figure 2-13. To further refine the areal and vertical extent of Site-related impacted sediment, additional delineation sampling would be needed and will likely be undertaken as part of a pre-design study. This will include additional background samples further upstream.

2.2.4 *Freeport Creek Surface Water*

Six surface water samples (SW-01 to SW-05 and SW-07) were collected adjacent to the Study Area's shoreline and two background surface water samples (SW-06 and SW-08) were collected further into Freeport Creek approximately 82 feet offshore. Based on the tidal flow, SW-06 is considered to be the upstream sample and SW-08 is considered to be the downstream sample. The surface water sample locations are provided in Figure 1-2.

2.2.4.1 Remedial Requirements

The remedial requirements for Freeport Creek surface water have been determined according to the following criteria of analysis:

- SCGs; and
- Results of the human health and environmental exposure assessment.

<u>SCGs</u>

Freeport Creek is a Class SC surface water body. Promulgated Class SC standards are available in TOGS 1.1.1. In addition, there are also US Environmental Protection Agency (USEPA) Water Quality Criteria for the protection of human health via ingestion of fish.

As shown in Table 2-7, surface water concentrations in the background samples as well as the samples collected adjacent to the Study Area exceeded the surface water criteria. This factor (i.e., elevated background surface water concentrations) must therefore be taken into account when using the surface water standards for the purpose of making remedial decisions. In addition, the presence of non-Site related sources (e.g., surface water runoff from paved areas) must also be taken into consideration when using the surface water criteria for the purpose of making remedial decisions.

<u>Fate and Transport Analysis and Results of the Human Health Exposure Assessment</u>

Potential transport routes for chemicals to surface water include discharge of groundwater to surface water, surface water runoff from paved areas, discharge of stormwater from the stormwater outfall containing impacted storm sewer sediment and resuspension of chemicals present in sediment.

As discussed in the RI Report, the potential pathways of concern for Freeport Creek surface water are: ingestion of fish from Freeport Creek and direct contact (incidental ingestion and dermal absorption) with surface water that is expected to occur mainly as a result of secondary contact activities (fishing and recreational boating).

2.2.4.2 *Remedial Action Objectives for Freeport Creek Surface Water*

Based on the remedial requirements discussed above, the following RAOs have been established for the Site-related impacted surface water:

- Prevent ingestion of water impacted by Site-related contaminants;
- Prevent contact with contaminants from impacted water bodies;
- Prevent surface water contamination which may result in fish advisories;
- Restore surface water to ambient water quality criteria for the Site-related contaminant of concern;
- Prevent Site-related impacts to biota from ingestion/direct contact with surface water causing toxicity and impacts from bioaccumulation through the marine or aquatic food chain to the extent practicable.

2.2.4.3 *Extent of Impacted Freeport Creek Surface Water*

The extent of Site-related impacted surface water has been defined as the extent exceeding the upstream values and exceeding the Class SC standards. Comparison of the surface water concentrations to the upriver values and the Class SC standards is presented in Table 2-7. As shown in this table, surface water concentrations in excess of the SW-06 background concentrations occur for copper at two of the Site-related sample locations, SW-04 and SW-05. These concentrations are also in excess of the surface water standard for fish propagation in saline waters. The presence of copper in surface water in the vicinity of the Study Area is curious since copper is not of concern in Study Area groundwater. The only potential source of copper in surface water from the Site that has been identified is the residual sediment present in the storm sewer discharging in the vicinity of SW-01. Previous surface water runoff when the Site was unpaved may have also been a source. Isolated exceedances of the Class SC standards for ethylbenzene and xylene was also present at SW-08; however, they are not present in Study Area groundwater or storm sewer sediment. These constituents are therefore not considered to be Site-related.

The surface water immediately adjacent to the Study Area appears to be impacted by copper. These impacts are not likely associated with copper concentrations in Site soil or previous and current discharges from the contaminated storm sewer system. Additionally, copper was not identified as a COPC in Freeport Creek sediment samples. Marinas line the western banks of the Freeport Creek. Many boat fittings, engine parts, such as propellers and fastenings are made from brass to resist corrosion from salt. Brass is an alloy of copper and zinc. Although brass is more resistant than iron or steel to the effects of salt water, it does in time corrode. Furthermore, marine antifouling paints now commonly include copper as a biocide. Copper concentrations in antifouling points can be as large as 50% and dissolve into water bodies over time (Johnsen and Engoy, 1999). Therefore, the presence of copper in surface water is not considered to be Site-related.

2.2.5 *Storm Sewer Line*

As previously discussed, a storm sewer line is present in the vicinity of the Site as shown on Figure 1-2. A storm drain was sampled during the RI (SD-01) and found to contain a number of SVOCs and inorganics.

2.2.5.1 *Remedial Requirements*

There are no SCGs that directly relate to storm sewer sediment and this media was not evaluated in the HHEEA since it is not truly an environmental media. However, the FWIA found that sediment samples within the storm drain and sanitary sewer may potentially pose a risk to ecological receptors utilizing these areas. As previously mentioned, it is suspected that the residual sediment located in this line may be a source of chemicals to the Freeport Creek sediment and surface water.

2.2.5.2 *Remedial Action Objectives for Sewer Line*

Based on the evaluation discussed above, the following RAOs have been established for the storm sewer line:

- Prevent migration of storm sewer sediment that would result in surface water and sediment impacts that exceed applicable SCGs or result in fish advisories.

The following section discusses the extent of impacted storm sewer sediment to which these RAOs would apply.

2.2.5.3 *Extent of Impacted Storm Sewer Sediment*

The approximate extent of impacted storm sewer sediment was estimated assuming 25% of the storm sewer line is filled with sediment and 1 foot of sediment is present in the storm drain. Assuming a length of 98 feet for the stormwater outfall and a 2.5 feet by 1.5 feet storm drain, the total volume of impacted sediment is approximately 2.8 cy.

2.3 *SUMMARY OF RAOS*

The following summarizes the RAOs for Site-related contaminants:

<u>Soil RAOs</u>

1. Prevent ingestion and/or direct contact of/with soil that exceeds applicable SCGs.

2. Prevent migration of soil that would result in surface water, groundwater, or sediment impacts that exceed applicable SCGs or result in fish advisories.

3. Prevent inhalation of or exposure from COPCs volatilizing from soil that exceed applicable SCGs.

<u>Groundwater RAOs</u>

4. Prevent inhalation of surface VOCs volatizing from contaminated groundwater.

5. Prevent discharge of Site-contaminants to surface water; and

6. Remove the source of ground or surface water contamination (this RAO will be addressed in the context of the soil RAOs).

<u>Sediment RAOs</u>

7. Prevent surface water contamination, which may result in fish advisories.

8. Prevent releases of chemicals in excess of upriver values to or from sediment that would result in surface water concentrations of COPCs in excess of ambient water quality criteria and/or result in fish advisories; and

9. Prevent Site-related impacts from bioaccumulation through the marine or aquatic food chain to the extent practicable, by taking upriver sediment quality and applicable SCGs into consideration.

Surface Water RAOs

10. Prevent ingestion of surface water impacted by contaminants.

11. Prevent contact with contaminants from impacted water bodies.

12. Prevent surface water contamination, which may result in fish advisories.

13. Restore surface water to ambient water quality criteria for the contaminant of concern.

14. Prevent Site-related impacts to biota from ingestion/direct contact with surface water causing toxicity and impacts from bioaccumulation through the marine or aquatic food chain to the extent practicable.

3.0 IDENTIFICATION AND SCREENINGOF REMEDIAL ACTION TECHNOLOGIES, PRELIMINARY REMEDIAL ACTION ALTERNATIVES, AND DESCRIPTION OF REMEDIAL ACTION ALTERNATIVES

This section screens a variety of remedial technologies that may be employed individually or in combination to achieve the RAOs for Study Area media of interest. Remedial technologies that pass the evaluation process (Section 3.1) are organized into remedial alternatives, which are subjected to a preliminary evaluation in Section 3.2. The preliminary remedial action alternatives that are deemed applicable for the Study Area are then, together with a number of common actions, presented and evaluated as full remedial alternatives in detail in Section 3.3.

Common actions involve technologies that would be included in applicable remedial action alternatives that are evaluated in Section 3.3. These common actions are generally presumptive remedies, and as a result, the technologies included in these common actions are excluded from the evaluation process discussed in Section 3.1. The Common Actions are:

1) Existing IRM: Operation of the sub-slab depressurization (SSD) system beneath the on-Site buildings;

2) Removal of sediment from the stormwater outfall pipe;

3) UST removal; and

4) Environmental Easement

These Common Actions are comprised of selected technologies that would address certain RAOs for the Site and are discussed more fully in Section 3.2. As these technologies are proven, they are not screened in this section.

3.1 TECHNOLOGY EVALUATION

The remedial technologies considered for media of interest are general engineering approaches that would rely on ex-situ, in-situ, containment and easement types of response actions that could meet one or more of the RAOs. The considered technologies were identified through a review of NYSDEC information, USEPA guidelines, relevant literature, Site conditions, and experience in developing feasibility studies and remedial action plans for similar types of environmental conditions.

The identified technologies underwent a screening against the following criteria: the ability to protect human health and the environment, effectiveness, and implementability. Table 3-1 provides an evaluation of the potential remedial technologies screened for the Study Area. They are:

Type	Technology/Control
Environmental Easement	Access and Use Restrictions
Containment	Soil Cover Constructed Sediment Cap
In-Situ Treatment	Chemical Oxidation of Soil/Groundwater Chemical Fixation/Stabilization Reductive Dechlorination of Groundwater using Zero Valent Iron (ZVI) Enhanced Biodegradation Soil Vapor Extraction (SVE)
Ex-Situ Treatment	Soil Excavation Sediment Removal/Dredging Solidification/Stabilization (On-Site & Off-Site) Off-Site Land Disposal Incineration Groundwater Treatment (Physical/Chemical)
Natural Recovery	Groundwater Monitored Natural Attenuation (MNA) Sediment Monitored Natural Attenuation (MNR)
Others	Groundwater Discharge Groundwater Extraction Site Management Plan

Effectiveness considers how a technology would impact the Study Area in the short-term during its use and its ability to meet the RAOs in the long-term. Protection of human health and environment considers potential positive and adverse impacts that may result from the use of a particular technology. This evaluation incorporates elements of the NYSDEC guidance documents TAGM 4030 and the draft DER-10 (NYSDEC, 1990; NYSDEC, 2002) and the Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA, 1988).

Implementability focuses on institutional aspects associated with use of the remedial technology, along with constructability and operation, maintenance, and/or monitoring (OM&M) requirements. These subcategories are consistent with the approach for remedial alternative evaluation in TAGM 4030. Institutional aspects involve permits or access approvals for on-site use, off-site work, and off-site treatment, storage and disposal services. Constructability, or technical feasibility, refers to the ability to construct, reliably operate and meet technical specifications or criteria, and the availability of specific equipment and technical specialty personnel to operate necessary process units.

The evaluation of effectiveness, implementability and ability to meet the RAOs further reduced the list of remedial technologies. Those technologies exhibiting more favorable characteristics in the evaluated areas were carried forward. The remedial technologies that were kept after the effectiveness and implementability evaluation were then combined into various remedial action alternatives for preliminary evaluation in Section 3.2.

The results of this evaluation are presented in Table 3-1 and discussed in the following section.

3.1.1 Summary of Selected Remedial Technologies

As presented in Table 3-1, all of the environmental easement/containment technologies (i.e., access/use restrictions and covers/caps) will be retained. These technologies are readily constructed and would address the soil, groundwater and sediment RAOs. Their ability to protect human health and the environment is achieved by eliminating the pathway of exposure while the COPCs remain in place. Hence, the long-term effectiveness of these technologies is directly related to the performance monitoring, O&M of the engineering controls and compliance with administrative restrictions. The O&M would vary in scope with the media and require more effort for the sediment medium.

In-situ technologies retained for further evaluation in remedial action alternatives are enhanced biodegradation, SVE, and reductive dechlorination using ZVI. In-situ chemical oxidation (ISCO) of soil/groundwater and chemical fixation/stabilization will not be retained for further evaluation. These technologies were not found to be applicable for the Study Area conditions. Specifically, the degree to which the oxidant could be delivered throughout the soil, competition from other chemicals in the soil for the oxidant raised concern and a potential change in the metals equilibrium in the subsurface. The concentration of organic matter present in Study Area soil would compete for ISCO chemicals injected into the soil matrix. Consequently, this uncertainty would extend to the technology's ability to protect human health and the environment. It is not expected that the salinity of the groundwater, which ranges from 0.12 to 1.3 parts per trillion in the Study Area, would alter the effectiveness of the ZVI wall. The ZVI wall would be designed to accommodate tidal influences that affect groundwater flow velocity and direction, water level, and VOC concentrations. Appendix A provides more detail on ZVI application in tidal-influenced waters.

Ex-situ technologies carried forward for development into remedial action alternatives are soil excavation, sediment removal/dredging, off-site land disposal, and groundwater treatment (physical/chemical). Solidification/ stabilization and incineration were not retained for further evaluation because, given the site conditions, these technologies were not warranted.

In summary, 14 of the 19 proposed remedial technologies for Study Area media of interest are carried forward for preliminary remedial alternative development in Section 3.2. These technologies are:

Type	**Technology/Control**
Environmental Easement	1. Access and Use Restrictions
Containment	2. Soil Cover
In-Situ Treatment	3. Reductive Dechlorination of Groundwater using ZVI 4. Enhanced Biodegradation 5. SVE
Ex-Situ Treatment	6. Soil Excavation 7. Sediment Removal/Dredging 8. Off-Site Land Disposal 9. Groundwater Treatment (Physical/Chemical)
Natural Recovery	10. MNA for Groundwater 11. MNR for Sediment
Others	12. Groundwater Discharge 13. Groundwater Extraction 14. Site Management Plan

3.2 *DEVELOPMENT OF PRELIMINARY REMEDIAL ACTION ALTERNATIVES*

In this section, the remedial technologies retained after the evaluation in Section 3.1 are assembled into remedial action alternatives that address the Study Area media of interest. Additionally, a separate set of Common Actions, which are coupled with the remedial action alternatives to meet the RAOs, are also evaluated.

Common Action C1: Existing IRM: Operation of the SSD System Beneath On-Site Buildings

Currently, mitigation of soil gas impacts to on-Site buildings is being conducted as an IRM as discussed previously in Section 1.4. The IRM was implemented to mitigate elevated soil gas concentrations detected in soil gas samples collected from beneath the existing Site buildings. A supplemental soil gas/indoor air sampling investigation was conducted in March 2005, which determined the extent of Site-related soil gas impacts. Soil and groundwater in the vicinity of these Site buildings are both potential sources of VOCs in soil gas beneath these buildings. Although some of the remedial alternatives considered would also address these potential soil gas source areas, mitigation of the soil gas, which has already accumulated beneath the Site buildings, is included as a Common Action. Thus, the SSD described here is for a permanent remedy. Gas surveys were conducted to assess potential off-Site soil gas risks.

An environmental easement specifying access and use restrictions and OM&M of this system would be implemented (see Common Action C4). This easement, included along with alternatives addressing portions of the Study Area where VOC-impacted soil and/or groundwater remain, would also contain provisions regarding future buildings at the Study Area and the need for SSD systems as part of the building design.

This common action, i.e. the mitigation of contaminated soil gas from below existing on-Site buildings, was implemented as an IRM and included installation of horizontal slotted venting pipes beneath the Site buildings. The piping was connected to a blower that draws soil gas from beneath the building and vents it outside above the roof.

Common Action C2: Sediment Removal from the Stormwater System

As discussed in Section 2.2.5, the sediment sample collected from the storm drain (SD-01) at the west end of the storm sewer system located within the study area contained elevated concentrations of SVOCs, PCBs, pesticides/herbicides and metals. It has therefore been assumed that sediment containing similar concentrations is present in the storm sewer line emanating from the contaminated storm drain. It is suspected that this sediment is a previous and continuing source of chemicals to Freeport Creek sediment and surface water.

MH-01 is a sediment sample that was collected from a closed sanitary manhole, which would be cleaned as part of the Common Action. Under this Common Action, the sediment from both the storm sewer line and the sanitary manhole would be removed. The sediment would be removed by plugging the outfall and using a vacuum truck to collect materials at the outfall. The recovered sediment/water mixture would then be stored at the Site and allowed to separate prior to disposal off-site.

Common Action C3: UST Removal

It is believed that a closed 1,500-gallon UST may still be present at the Site, located just south and west of the 2,400-sf building. In addition, a second potential UST maybe located near the southeast corner of the 1,200 sf building. Figure 3-1 shows the general location of these potential USTs. Thus, excavation and removal of these potentially remaining USTs is included as a Common Action. Under this Common Action, overlying soils would be excavated and stockpiled on-Site (or potentially transported and disposed off-Site depending upon the selected remedial alternative for this Site) to access the USTs. The top of the USTs would be cut so that the interior may be accessed to remove any contents, which would be disposed of off-Site. The UST body or bodies would then be removed and transported off-Site for disposal. Finally, any petroleum-impacted surrounding soils would be excavated and disposed and the excavation areas would be backfilled with clean fill.

Common Action C4: Environmental Easement

An environmental easement would be implemented to control future Site/Study Area uses, depending upon the selected remedial alternative. The environmental easement may include a Site Management Plan (SMP) specifying OM&M requirements for remediation implemented at the Site and Study Area (e.g., SSD systems, groundwater monitoring, maintenance of any engineering controls, and annual certification that the controls and environmental easement requirements are in place and are effective). The environmental easement would require any owner of the property to convey to Grantee (the State) real property rights and interests that would run the land in perpetuity in order to provide an effective and enforceable means of encouraging the reuse and redevelopment of this Controlled Property at a level that has been determined to be safe for a specific use while ensuring the performance of OM&M requirements; and to ensure the potential restriction of future uses of the land that are inconsistent with the above-stated purpose.

3.2.1 PRELIMINARY REMEDIAL ACTION ALTERNATIVES

Using the technologies selected from those identified in Table 3-1, the preliminary remedial action alternatives developed for evaluation are:

Alternative P1	No Action
Alternative P2	Surface Cover, Groundwater MNA, SVE, and Sediment MNR
Alternative P3	Hot Spot Soil Excavation to the Water Table and Surface Cover, Groundwater MNA, and Sediment Removal
Alternative P4	Hot Spot Soil Excavation and Surface Cover, Groundwater MNA and Sediment Removal
Alternative P5	Hot Spot Soil Excavation and Surface Cover, Groundwater MNA with Biological Enhancements and Sediment Removal
Alternative P6	Hot Spot Soil Excavation and Surface Cover, Removal of Uncapped Soil, In-situ Groundwater Treatment Using ZVI Wall, SVE, and Sediment Removal.
Alternative P7	Full-Scale Soil Excavation, In-Situ Groundwater Treatment using ZVI Wall, and Sediment Removal.
Alternative P8	Full-Scale Soil Excavation, Groundwater Pump and Treat, and Sediment Removal

The following table summarizes the maximum depth and total volume of impacted soil removed under each preliminary alternative:

Preliminary Alternative	Maximum Depth of Soil Removed	Volume of Impacted Soil Removed
Alternative P1	Not Applicable	0 cy
Alternative P2	Not Applicable	0 cy
Alternative P3	4 feet bgs or to the water table	1,650 cy
Alternative P4	Varied depths down to 14 feet bgs	4,871 cy
Alternative P5	Varied depths down to 14 feet bgs	4,871 cy
Alternative P6	Varied depths down to 14 feet bgs	6,857 cy[3]
Alternative P7	14 feet bgs	46,667 cy
Alternative P8	14 feet bgs	46,667 cy

Alternative P1 has been included as a benchmark with which to compare the other alternatives. Alternatives P2 through P6 provide alternative

[3] In addition to removing currently delineated hot spot soil areas and uncapped soils, Alternative P6 includes for an allowance of two additional hot spot areas approximately 50 feet by 50 feet in area down to 14 feet bgs.

means to address the RAOs for the Study Area media and Alternatives P7 and P8 have been developed to address the RAOs for the Study Area media and to also address the NYSDEC goal for restoration to pre-disposal/pre-release conditions, to the extent feasible and required by law (i.e., Pre-Disposal Alternatives). Schematic figures of alternatives P2 through P8 are presented in Figures 3-2 through 3-8.

In accordance with the NYSDEC TAGM 4030, Selection of Remedial Actions at Inactive Hazardous Waste Sites (NYSDEC, 1990), Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA, 1988), Draft DER-10, Technical Guidance for Site Investigation and Remediation (NYSDEC, 2002) and the NCP, each alternative has first been evaluated for:

- overall protection of human health and the environment; and
- compliance with Standards, Criteria and Guidance (SCGs).

Table 3-2 lists the components of each of the preliminary remedial action alternatives, and the evaluation of each of the preliminary alternatives is presented in Table 3-3. Overall protection of human health and the environment is evaluated in the context of fulfillment of the RAOs for the various Site media.

As discussed above, Alternative P1 will be retained for benchmarking purposes. As demonstrated in Table 3-3, Alternative P2 would be effective in addressing the Site RAOs for soil, groundwater and sediment through implementation of engineering controls and an environmental easement, installation and operation of SSD and SVE systems, and removal of the storm sewer sediment. Through these engineering controls and environmental easement, Alternative P2 would also address all of the SCGs related to the media of interest.

In addition to the engineering controls, environmental easement and Common Actions presented in Alternative P2, Alternatives P3 through P6 also include focused soil removal. Alternative P3 includes the addition of focused soil excavation to the water table to address inorganic and VOC hot spots above the water table. Alternatives P4 and P6 include the addition of ZVI to the backfill materials below the water table emplaced after the hot spot excavation to 14 feet bgs.

Alternative P5 would provide a biological augmentation for groundwater treatment. Currently, reductive dechlorination of chlorinated VOCs is currently occurring in the shallow groundwater; thus augmentation is not needed. This degradation process is not observed in the deeper aquifer possible due to the absence of organic matter and the high ORP. In addition, due to tidal fluctuations and the high conductivity in the saturated zone, augmentations would likely be flushed out of the saturated zone before they were effective. Based on these factors, biological augmentation would not be appropriate for the Study Area groundwater and Alternative P5 has been eliminated from consideration.

Alternative P6 additionally includes installation of a ZVI wall for in-situ groundwater treatment, SVE, and removal of sediment containing chemicals in excess of the background concentrations and above Effect Range Low (ER-L) criteria. Alternatives P4 and P6 also provide for additional reductive dechlorination via ZVI backfill mixture used in the plume areas where soil hot spot removal has been conducted.

Under Alternatives P6 and P7, a treatment wall would be constructed using ZVI along the border with Freeport Creek. The wall would be approximately 170 feet long by 9 inches thick in three, 3.0-inch increments by 28 feet deep. Water passing through the wall would be treated to the Class GA standards, thus reducing groundwater concentrations entering the Creek.
As noted above, Alternatives P7 and P8 are both pre-disposal alternatives. Alternatives P7 and P8 would also include the excavation of all soil containing chemicals at concentrations in excess of the RSCOs and removal of all sediment containing chemicals in excess of the background concentrations and the ER-Ls values.

In place of a ZVI wall, Alternative P8 would utilize a groundwater pump and treat system to address the groundwater exceedances within the Study Area. Based on the hydraulic conductivity of the Study Area soil, a groundwater extraction system pumping a large water volume would be required to capture the Study Area groundwater and a groundwater treatment system would need to be installed and operated to treat this high flow rate. Discharge to the creek would be the likely alternative. However, to obtain a permit for discharge to this surface water body, groundwater would need to be treated for VOCs and metals. The options for inorganics removal include ion exchange and precipitation and removal. Both metals removal technologies generate waste streams requiring subsequent disposal. Although, hydraulic control (i.e., capture) would continue, it is uncommon for pump and treat systems to completely restore groundwater to Class GA groundwater standards. Because the Study Area groundwater is not impacting the adjacent surface water and hydraulic capture of the Site's groundwater plume is not needed, Alternative P8 will not be carried forward. Six Preliminary Alternatives P1, P2, P3, P4, P6, and P7 will be carried forward for further, detailed analysis as full Alternatives I through VI.

Groundwater Modeling

Groundwater modeling was performed to support the analysis of soil and groundwater remedial alternatives. The approach utilized simplifying assumptions and the use of basic analytical models. To support the development of the FS remedial alternatives, solute travel periods, anticipated time to reach the maximum contaminant levels (MCLs) for PCE and flushing efficiency of the aquifer with respect to the contaminant plume were calculated. Calculations were based on the assumption that the source of the contamination in soil has been removed, which would consistent with P4 through P8.

The flushing model reached a similar conclusion for two types of calculations. The first method used a literature half-life value to determine the time it will take PCE to reach the NYSDEC TOGS value of 5 ug/l. Using the 270 day half-life for PCE the anticipated time to reach the MCL is approximately 6.16 years.

The alternative method used Darcy's Law to calculate the time to flush one pore volume of PCE contaminated groundwater through the area designated to be the width and depth of the PCE plume (width of 95 feet and depth of 35 feet). A published table from HMCRI In Situ Bioremediation Short Course (December 5, 1991), calculates the fraction of contaminants remaining after flushing 1, 3, 5, 25 and 75 pore volumes of water through an aquifer. The reference table indicates that 75 pore volumes will flush nearly 100% of PCE from the aquifer (flushing efficiency for PCE). Thus by multiplying the 28.93 days for one pore volume flush by 75 pore volumes, a time of 5.95 years is obtained to reach near 100% removal of the PCE in the aquifer. This value nearly matched the time to reach MCLs calculated from the degradation rate for PCE of 6.16 years. Appendix B presents a full discussion of the groundwater model approach and results.

3.3 DESCRIPTION AND EVALUATION OF REMEDIAL ACTION ALTERNATIVES

Using the seven criteria listed below, the remedial alternatives retained after the screening in Section 3.2 are fully described and evaluated in accordance with the NYSDEC TAGM 4030, Selection of Remedial Actions at Inactive Hazardous Waste Sites (NYSDEC, 1990), Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA, 1988) and Draft DER-10. The evaluative criteria used for the evaluation are:

- overall protection of human health and the environment;

- compliance with Standards, Criteria and Guidance (SCGs);
- long-term effectiveness and permanence;
- reduction of toxicity, mobility or volume;
- short-term effectiveness;
- implementability; and
- cost.

The first two criteria, overall protection of human health and the environment and compliance with SCGs, are considered threshold criteria. Consequently, there is an expectation that each selected remedial action alternative would achieve these two criteria. This comparison, which was already conducted in Section 3.2, will be expanded in this section. The next five evaluation criteria are referred to as balancing criteria. They offer a basis to compare the remedial action alternatives as part of the decision-making process that results in a recommended remedial action alternative.

The associated costs for the alternatives are conceptual design cost estimates. Changes in the quantities of the media requiring remediation (e.g., volume of waste requiring excavation, extent of regrading, etc.), detailed engineering, as well as other factors not foreseen at the time this report was prepared, could increase costs by as much as 50 percent or decrease costs by as much as 30 percent, as defined in Section 6.2.3.7 of Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA, 1988). An inflation rate of two percent (2%) was used to determine future costs and an interest rate of five percent (5%) was used to compute the present worth of all future costs. The inflation rate is consistent with the US Department of Labor Consumer Price Index (CPI) change between 2002 and 2003 (USDOL, 2003). The assumed interest rate, which corresponds to the current interest rate for a 30-year treasury bond, was selected to "produce an amount at which the environmental liability theoretically could be settled in an arm's length transaction with a third party, or if such a rate is not readily determinable, the discount should not exceed the interest rate on "risk-free" monetary assets with maturities comparable to the environmental liability" in accordance with the US Securities and Exchange Commission (SEC) Staff Accounting Bulletin (SAB) No. 92 (SEC, 1993). SAB No. 92 provides generally accepted accounting principles for estimating and reporting environmental liability.

The six alternatives undergoing detailed evaluation are:

Full Remedial Alternative	Description	Corresponding Preliminary Alternative
Alternative I.	No Action	P1
Alternative II.	Surface Cover, Groundwater MNA, SVE, and Sediment MNR	P2
Alternative III.	Hot Spot Excavation to the Water Table and Surface Cover, Groundwater MNA, and Sediment Removal	P3
Alternative IV.	Hot Spot Soil Excavation and Surface Cover, Groundwater MNA, and Sediment Removal	P4
Alternative V.	Hot Spot Soil Excavation and Surface Cover, Removal of Uncapped Soil, ZVI Wall, SVE, and Sediment Removal	P6
Alternative VI.	Full-Scale Soil Excavation, ZVI Wall, and Sediment Removal	P7

3.3.1 ALTERNATIVE I: NO ACTION

3.3.1.1 Description

Section 300.430(e)(6) of the NCP recommends describing and evaluating a no action alternative as a measure of identifying the potential risks posed by a site if no remedial action were implemented. Pursuant to 6 NYCRR Part 375-1.10(c), a remedial program for a site listed on the Registry must not be inconsistent with the NCP. Accordingly, a No Action Alternative (Alternative I) has been developed to fulfill the NCP requirement. This alternative is evaluated in this section.

Under this Alternative, no remedial actions would be implemented at the Site.

3.3.2 ALTERNATIVE II: SURFACE COVER, GROUNDWATER MNA, SVE, AND SEDIMENT MNR

This section describes Alternative II: Surface Cover, Groundwater MNA, and Sediment MNR. Figure 3-2 shows the components of this Alternative, which are described in the below sub-sections. As with Alternatives III through VI, Alternative II includes Common Actions C1 through C4 and the following remedial tasks:

- Access/Use Restrictions

- Installation and Maintenance of Surface Covers in Uncovered Areas
- Monitored Natural Attenuation
- Monitored Natural Recovery in Freeport Creek
- Installation of an SVE System

3.3.2.1 Access/Use Restrictions

This section discusses the access and use restrictions to be implemented under the Common Action C4, Environmental Easement. Under this alternative, soil containing chemicals at concentrations above the RSCOs would remain in place under a cover. An environmental easement would be implemented to address the NYSDEC's requirement to issue a notice regarding chemicals present in Study Area soil above the RSCOs. The environmental easement (Common Action C4) would include the provision that a SSD system would be required for any new building construction at the Site and maintenance of the existing IRM SSD system.

The environmental easement would restrict the use of groundwater and use of the Site to commercial or industrial uses unless additional remediation is undertaken or residential type uses are specifically designed to address remaining issues and the designs are reviewed/approved by NYSDOH and NYSDEC.

3.3.2.2 Installation and Maintenance of Surface Covers in Uncovered Areas

As shown in Figure 2-1, a small portion exposed soil exists at the south end of the Study Area. This area is currently occupied by boat racks, approximately 2 stories in height, making access to this uncovered area limited. Nevertheless, this exposed soil area would be covered with an asphalt or ballast cover to the extent allowable under this remedial action. To facilitate drainage in this area and also to allow surface covering without movement of the boat racks, a ballast cover would likely be used and has been assumed in this cost estimate.

Under this alternative, a barrier would exist to prevent direct contact with residual chemicals in soil left in place. The Common Action C4, Environmental Easement would provide for an SMP to facilitate annual maintenance and inspection of the surface cover through an OM&M Plan to eliminate the potential exposure to chemicals present in the Study Area soil remaining after the selected remedial action is implemented. The goals of the SMP would be to ensure that: (1) disturbance of any remaining Site soil be conducted in a manner that would protect construction workers; and (2) ensure the proper management of the disturbed Site soil would be conducted.

The SMP in the environmental easement would provide for the asphalt, concrete and ballast covers to be inspected on an annual basis for a period of 30 years. If the surface cover begins to degrade or crack, repairs would be made to these areas in accordance with the SMP. The SMP would also include provisions for maintaining the access/use restrictions implemented under this alternative. For cost estimation purposes it has been assumed that the entire surface cover would require repair over a 30-year period.

3.3.2.3 *Monitored Natural Attenuation*

As previously discussed, biodegradation of chlorinated VOCs in shallow Site groundwater (i.e., 3 feet to 13 feet) is currently occurring. This upper groundwater zone, along with VOCs in soil, serves as the source for VOCs in the soil gas. Although biodegradation of chlorinated VOCs in the deeper groundwater (i.e., 20 feet to 30 feet) is not occurring, this deeper groundwater is not impacting its receptor (i.e., Freeport Creek). Thus groundwater monitoring would be conducted to confirm on-going degradation of chlorinated VOCs.

Under this remedial action, quarterly groundwater monitoring would be conducted for two years and annual monitoring for 28 years in each of the existing groundwater monitoring wells and four additionally installed wells. Samples would be analyzed for VOCs. Continued degradation of the chlorinated VOCs in the shallow groundwater would be monitored. An additional four monitoring wells would also be constructed to expand and enhance the existing monitoring network (See Figure 3-2). Although metals in groundwater do not currently pose an exposure concern, groundwater monitoring would also include metals analysis to confirm this continues to be the case.

3.3.2.4 *Monitored Natural Recovery in Freeport Creek*

Removal of sediment from the storm sewer drain in conjunction with MNR in Freeport Creek would address the limited exceedances of the background sediment concentrations and the sediment screening criteria.

Baseline studies would be conducted as part of the Remedial Design/Remedial Action (RD/RA) to determine the following information in the areas proposed for MNR:

- the topography of the sediment,
- the depth of overlying water during the tidal cycles,
- the dominant river currents;

- the layering of sediment and areas of potential sediment deposition and scouring; and
- verification and fine-tuning of the delineation of Site-related impacts to the sediment.

The studies, which would be conducted during the RD/RA process, include:

- geophysical surveys (e.g., bathymetric, multibeam); and
- current and float (i.e., current) surveys.

Following completion of the baseline studies, a MNR Monitoring Plan would be prepared. The components of this plan would be refined following completion of the baseline studies. The purpose of the MNR monitoring would be to evaluate the effectiveness of this technology and its ability to provide adequate protection of human health and the environment.

The anticipated MNR monitoring components would include:

- Seasonal current and float studies. These quarterly studies would be conducted to ensure that there is no seasonal gross sediment erosion. The results of these studies would be documented in an annual report to the NYSDEC. After three years, this study would be conducted annually. The timing of this annual study would be determined based on the results of the previous seasonal studies.
- Shallow sediment sampling. This sampling would be conducted in shallow intervals (e.g., 2 cm increments) to document whether sediment deposition is occurring at the Site. The collected samples would be submitted for analysis for metals. This sampling would be conducted every 3 years.
- Geophysical surveys. These surveys would be conducted every three- (3) years, as needed, and used along with the shallow sediment sampling to establish whether adequate sediment deposition has occurred.

A summary report would be prepared every three (3) years to document the results of the shallow sediment sampling, geophysical surveys and present an evaluation of this information.

The need for continued MNR monitoring would be re-evaluated every five years. The evaluation criteria for the five-year review would be proposed in the MNR Monitoring Plan. For cost estimation purposes a monitoring period of 30 years has been assumed.

3.3.2.5 Installation of an SVE System

SVE horizontal piping would be installed across the Site in three segments. Each segment would run from the western portion of the Site to the eastern portion of the Site, and would bend north, east, and south in areas of VOC source soil. The total length of the piping associated with the three segments would be 1300 feet. The horizontal piping would be installed at a depth of 2 feet bgs in order to treat the zone above the groundwater table. Installation of the SVE would involve minor disruptions due to trenching to install the piping, repaving of the Site after the trenching, and the construction of a shed to house the blower and various other controls.

3.3.3 ALTERNATIVE III: HOT SPOT SOIL EXCAVATION TO THE WATER TABLE AND SURFACE COVER, GROUNDWATER MNA, AND SEDIMENT REMOVAL

This section describes Alternative III: Hot Spot Soil Excavation to the Water Table and Surface Cover, Groundwater MNA, and Sediment Removal. Figure 3-3 shows the components of this Alternative, which are described in the below sub-sections. Alternative III also includes Common Actions C1 through C4 and the following remedial tasks:

- Pre-Construction Studies and Permitting
- Site Preparation and Mobilization
- Excavation of VOC and Metals Impacted Hot Spot Soil Areas to the Water Table
- Ambient Air Monitoring
- Transportation and Off-Site Disposal
- Backfill of Excavated Areas with Clean Backfill
- Site Restoration, Installation and Maintenance of Surface Covers
- Freeport Creek Sediment Removal
- Dewatering, Liquids Treatment and Discharge
- Monitored Natural Attenuation
- Access/Use Restrictions

3.3.3.1 Pre-Construction Studies and Permitting

Under this remedial alternative, excavation of impacted soils would be limited to the depth of the water table. Step back excavation would be conducted to remove hot spot soils above the water table and dewatering of soils would not be necessary.

Additional site-specific information would be collected prior to the remedial design (RD) for the sediment removal, and permitting for sediment removal would be secured prior to construction. As discussed in Section 2.2.3.3, the areal and vertical extent of Site-related impacts to sediments is currently undefined. During the RD, additional sediment sampling would be conducted to determine these limits. Sample results would be compared to ER-L values from Technical Guidance for Screening of Contaminated Sediment (NYSDEC, 1999) to determine Site-related impacts. For cost estimation purposes, it has been assumed that a maximum depth of 2 feet of impacted sediment is present and that the total areal extent of impacted sediment is 12,165 sf, which is approximately 900 bulk cubic yards (bcy). These limits would be refined during the RD studies.

Prior to implementation of the RA, a bathymetry survey would be conducted. This survey would provide a baseline for determining dredging depths and allow for design of operational parameters such as location of barges, and finalization of the dredging method(s). A tide and float (i.e., current) survey would be conducted to select the sediment control method (e.g., silt curtain) and to determine the optimum location of the sediment control measures. Following sediment removal, the area would be backfilled with materials similar in nature to removed sediments.

The sediments to be excavated are expected to be classified as non-hazardous waste. During RD, analysis would be conducted to determine the expected water content of sediments, optimal handling, dewatering requirements and dewatering techniques to allow off-Site disposal. Shallow water areas five feet deep or less may be able to be isolated by portable dams and excavated in the dry.

Dredging and removal of impacted sediments, require a number of permits and approvals. These may include: a permit under Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403), a Coastal Zone Management (CZM) Act of 1972 (16 U.S.C. section 1455b et. seq.) consistency determination, and approvals related to the State Environmental Quality Review Act (SEQRA) (NYSDEC), Wildlife (U.S. Fish and Wildlife Service), zoning ordinances (Town and County), riparian authorities, right-of-way restrictions (Town, County, and State) and floodplain/floodway construction restrictions (Town).

This task would take approximately 6 to 8 months to complete.

3.3.3.2 *Site Preparation and Mobilization*

Site preparation and mobilization would include: relocation of existing utilities; provision of temporary facilities and utilities, as needed; mobilization of equipment to the Site; set up of staging, stockpiling and dewatering areas; set up of the decontamination area; and construction of a waste transfer station. Existing fencing that may impede access in its current position would be removed and fencing to prevent unauthorized access would be installed and properly sited.

The site preparation and mobilization task would take approximately 2 to 3 months to complete.

3.3.3.3 *Excavation of VOC and Metals Impacted Hot Spot Soil Areas to the Water Table*

The VOC and metals impacted hot spot soil areas were defined in Section 2.2.1.3 (all hot spots would be addressed in this action, except those under existing buildings, i.e. SB-65) and are shown in Figure 2-4. Prior to excavation of hot spot areas, any overlying asphalt, ballast and/or concrete would be removed. The hot spot excavation depth would be limited to removal of unsaturated soils and dewatering of groundwater would not be conducted.

The impacted soil would be removed to the water table. In areas where the hot spot begins at one foot below grade, the overlying soil and cover material would be segregated and reused as backfill following the excavation of the hot spot area. Soil boring SB-65 is located under a building and is inaccessible and it would not be excavated. The Common Action SSD (C1) would address any VOC impacts or potential for exposure from this location. All excavated soil would be stockpiled, characterized and transported off-Site for disposal. Additional discussion regarding these items is provided below.

Horizontal delineation would be done before excavation via pre-excavation sampling or as a pre-design study. Post-excavation samples would be collected at a frequency of one sample per 2,500 sf of the bottom excavation. The bottom post-excavation samples would be submitted for analysis for Target Compound List (TCL) VOCs and Target Analyte List (TAL) metals.

3.3.3.4 *Ambient Air Monitoring*

During soil excavation, an ambient air-monitoring program would be implemented to measure the concentration of particulates and VOCs in ambient air in the work zone and at the perimeter of the Study Area.

Real-time VOC concentrations in ambient air would be measured using a photoionization detector (PID) equipped instrument. Real time metals concentrations in ambient air would be estimated using particulate concentrations correlated to metals concentrations.

A Community Air Monitoring Plan (CAMP) that specifies the components of this program would be developed in accordance with the NYSDOH Generic CAMP contained in Appendix 1A of the Draft DER-10 (NYSDEC, 2002).

During excavation, dust control measures such as water or foam sprays, or limiting areas of soil to be disturbed at any one time would be used if perimeter action levels established in the CAMP are exceeded. The degree to which these measures would be used would depend on particulate levels in ambient air at the perimeter of the Study Area as determined through the implementation of the CAMP.

In addition, a health and safety plan (HASP) would be prepared for the work. The HASP would include air monitoring for particulates in the work and exclusion zones. This plan would identify the level of personal protective equipment (PPE) required for the work, action levels for the work and exclusion zones, and PPE upgrades and engineering controls that correspond to action level exceedances.

Dust generation during sediment removal activities is not anticipated due to the high moisture content of the materials being handled under this alternative. However, dust may be generated during the addition of absorptive agents to reduce water content. Dust monitoring conducted under the soil alternative would be expanded to address dust monitoring needed during the sediment remedial action

3.3.3.5 *Transportation and Off-Site Disposal*

Remediation-derived waste would be transported and disposed of off-Site. Remediation-derived waste would include:

- excavated soil classified as non-hazardous waste;
- dredged sediment classified as non-hazardous waste; and
- overlying asphalt, gravel and concrete classified as construction and demolition (C&D) debris.

Assuming hydraulic dredging of the sediment is conducted in Freeport Creek, the incoming slurry would likely have a water content of approximately 80 percent by weight. For the purposes of the FS, it is estimated that settled solids would be dewatered using belt presses and a stabilization agent would be added to remove the free liquids. For cost estimation purposes, it was assumed that the addition of a stabilization agent would increase the in-situ volume of sediment by approximately 20 percent.

As discussed above, waste characterization samples for the excavated soil and sediment would be collected. For cost estimation purposes, it has been assumed that these materials would be Resources Conservation and Recover Act (RCRA) non-hazardous waste. Non-hazardous soil and sediment would be transported to and disposed of at an off-Site Subtitle D, non-hazardous waste landfill. Construction and demolition (C&D) debris would be sent to a facility permitted under 6 NYCRR Part 360-7. The spent carbon and filters used for treating the construction liquids would be characterized and sent to an appropriate disposal facility.

3.3.3.6 *Backfill of Excavated Areas with Clean Backfill*

Following soil removal, the excavated areas would be restored to their present grade. The excavation areas would be backfilled with approved fill from off-Site sources. Backfill would be defined, at a minimum, as soil containing chemicals at concentrations below the TAGM 4046 RSCOs. In accordance with *Draft* DER-10, the source of fill material would be approved by the NYSDEC DER in advance, and bills of lading would be available for NYSDEC review (NYSDEC, 2002). Excavated soil and cover material that is not from hot spot areas would be stockpiled and segregated for reuse as backfill. Approximately 1,650 cy of backfill would be installed above the water table.

3.3.3.7 *Site Restoration, Installation and Maintenance of Surface Covers*

After the hot spots above the water table have been excavated and backfilled with clean fill, the Study Area would be restored. This would include removal of temporary services, and excavation equipment. As shown in Figure 3-3, a small portion of exposed soil exists at the Site. This area is currently occupied by boat racks, approximately 2 stories in height, thus making access to this uncovered area limited. Nevertheless, this exposed soil area would be covered with an asphalt or ballast cover under this remedial action. To facilitate drainage in this area and also to allow surface covering without movement of the boat racks, a ballast cover would likely be used.

Under this alternative, a barrier would exist to prevent direct contact with residual chemicals in soil left in place. The Common Action C4, Environmental Easement would provide for a Site Management Plan (SMP) to facilitate annual maintenance and inspection of the surface cover through an OM&M Plan to eliminate the potential exposure to chemicals present in the Study Area soil remaining after the selected remedial action is implemented. The goals of the SMP would be to ensure that: (1) disturbance of any remaining Site soil be conducted in a manner that would protect construction workers; and (2) ensure the proper management of the disturbed Site soil would be conducted.

The SMP in the environmental easement would provide for the asphalt, concrete and ballast covers to be inspected on an annual basis for a period of 30 years. If the surface cover begins to degrade or crack, repairs would be made to these areas in accordance with the SMP. The SMP would also include provisions for maintaining the access/use restrictions implemented under this alternative. For cost estimation purposes it has been assumed that the entire surface cover would require repair over a 30-year period.

3.3.3.8 Freeport Creek Sediment Removal

Site-related impacted sediment would be removed in this task. As discussed in above, additional delineation sampling would be conducted during the RD to determine the horizontal and vertical delineation of Site-related impacted sediment. For cost estimation purposes, hydraulic dredging of Freeport Creek sediment was assumed. The final sediment removal methods would be refined during the RD.

It is estimated that approximately 900 bcy of Site-related impacted sediment would be removed. During the RD, the dredging rates and sediment treatment rates would be matched to the available size of the staging and dewatering areas. This task would take approximately one month to complete.

3.3.3.9 Dewatering, Liquids Treatment and Discharge

Dewatering of sediments would be necessary prior to disposal. Lime additives and/or filter presses may be used to dewater sediment. A temporary water treatment system may be needed to treat water prior to discharging back to the creek. For this task, discharge to the creek has been assumed.

Treatment of liquids would consist of dewatering suspended solids, sedimentation, and removal and liquid carbon media filtering to remove organics if determined to be needed. Dewatering liquids would be treated to meet the appropriate permit limits.

3.3.3.10 *Monitored Natural Attenuation*

As previously discussed, biodegradation of chlorinated VOCs in shallow Site groundwater (i.e., 3 feet to 13 feet) is currently occurring. This upper groundwater zone, along with VOCs in soil, serves as the source for VOCs in the soil gas. Although biodegradation of chlorinated VOCs in the deeper groundwater (i.e., 20 feet to 30 feet) is not occurring, this deeper groundwater is not impacting its receptor (i.e., Freeport Creek). Thus groundwater monitoring would be conducted to confirm on-going degradation of chlorinated VOCs.

Under this remedial action, quarterly groundwater monitoring would be conducted for two years and annual monitoring for 28 years in each of the existing groundwater monitoring wells[4] and four additionally installed wells. Samples would be analyzed for VOCs. Continued degradation of the chlorinated VOCs in the shallow groundwater would be monitored. An additional four monitoring wells would also be constructed to expand and enhance the existing monitoring network. At least four of the existing monitoring wells fall within hot spot excavation areas (see Figure 3-3) and would need to be replaced and four additional new wells would also be constructed to expand and enhance the existing monitoring network. Although metals in groundwater do not currently pose an exposure concern, groundwater monitoring would also include metals analysis to confirm this continues to be the case.

3.3.3.11 *Access/Use Restrictions*

This section discusses the access and use restrictions to be implemented under the Common Action C4, Environmental Easement. Under this alternative, soil containing chemicals at concentrations above the RSCOs would remain in place under a cover. An environmental easement would be implemented to address the NYSDEC's requirement to issue a notice regarding chemicals present in Study Area soil above the RSCOs. The environmental easement (Common Action C4) would include the provision that SSD systems would be required for any new building construction at the Site and operation and maintenance of the existing IRM SSD system.

The environmental easement would restrict the use of groundwater and use of the Site to commercial or industrial uses unless additional

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[4] Any existing monitoring wells that fall within hot spot excavation areas would be replaced subsequent to remedial action implementation.

remediation is undertaken or residential type uses are specifically designed to address remaining issues and the designs are reviewed/approved by NYSDOH and NYSDEC.

3.3.4 *ALTERNATIVE IV: HOT SPOT SOIL EXCAVATION AND SURFACE COVER, GROUNDWATER MNA AND SEDIMENT REMOVAL*

This section describes Alternative IV: Hot Spot Soil Excavation and Surface Cover, Groundwater MNA, and Sediment Removal. Figure 3-4 shows the components of this Alternative, which are described in the below sub-sections. Alternative IV also includes Common Actions C1 through C4 and the following remedial tasks:

- Pre-Construction Studies and Permitting
- Site Preparation and Mobilization
- Installation of Sheeting
- Excavation of VOC and Metals Impacted Hot Spot Soil Areas
- Ambient Air Monitoring
- Transportation and Off-Site Disposal
- Backfill of Excavated Areas with Clean Backfill and ZVI
- Freeport Creek Sediment Removal
- Dewatering, Liquids Treatment and Discharge
- Site Restoration, Installation, and Maintenance of Surface Covers
- Monitored Natural Attenuation
- Access/Use Restrictions

3.3.4.1 *Pre-Construction Studies and Permitting*

As discussed below, under this alternative installation of watertight sheeting has been assumed in the FS to allow soil excavation and to minimize groundwater infiltration into the excavation area. Alternative supplemental excavation control technologies, such as slurry walls with stepped-back excavation and possibly ground freezing, would be evaluated during the RD.

Additional soil sampling would be conducted to define the horizontal and vertical limits of hot spot excavations. An allowance for analysis of up to 20 samples for VOCs, SVOCs, and TAL metals has been included in the cost estimate for this work.

Additional site-specific information would be collected prior to the RD for the sediment removal, and permitting for sediment removal would be secured prior to construction. As discussed in Section 2.2.3.3, the areal and vertical extent of Site-related impacts to sediments is currently undefined. During the RD, additional sediment sampling would be conducted to determine these limits. Sample results would be compared to ER-L values from Technical Guidance for Screening of Contaminated Sediment (NYSDEC, 1999) to determine Site-related impacts. For cost estimation purposes, it has been assumed that a maximum depth of 2 feet of impacted sediment is present and that the total areal extent of impacted sediment is 12,165 sf, which is approximately 900 bcy. These limits would be refined during the RD studies.

Prior to implementation of the RA, a bathymetry survey would be conducted. This survey would provide a baseline for determining dredging depths and allow for design of operational parameters such as location of barges, and finalization of the dredging method(s). A tide and float (i.e., current) survey would be conducted to select the sediment control method (e.g., silt curtain) and to determine the optimum location of the sediment control measures. Following sediment removal, the area would be backfilled with materials similar in nature to removed sediments.

The sediments to be excavated are expected to be classified as non-hazardous waste. During RD, analysis would be conducted to determine the expected water content of sediments, optimal handling, dewatering requirements and dewatering techniques to allow off-Site disposal. The system used to treat the construction fluids generated during soil excavation would also be used to treat the dewatering liquids from the sediment dredging.

Dredging and removal of impacted sediments, require a number of permits and approvals. These may include: a permit under Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403), a Coastal Zone Management (CZM) Act of 1972 (16 U.S.C. section 1455b et. seq.) consistency determination, and approvals related to the State Environmental Quality Review Act (SEQRA) (NYSDEC), Wildlife (U.S. Fish and Wildlife Service), zoning ordinances (Town and County), riparian authorities, right-of-way restrictions (Town, County, and State) and floodplain/floodway construction restrictions (Town).

This task would take approximately 6 to 12 months to complete.

3.3.4.2 *Site Preparation and Mobilization*

Site preparation and mobilization would include: relocation of existing utilities; provision of temporary facilities and utilities, as needed; mobilization of equipment to the Site; set up of staging, stockpiling and dewatering areas; set up of the decontamination area; and construction of a waste transfer station. Existing fencing that may impede access in its current position would be removed and fencing to prevent unauthorized access would be installed and properly sited.

The site preparation and mobilization task would take approximately 3 to 6 months to complete.

3.3.4.3 *Installation of Sheeting*

Geotechnical measures would be needed to allow deep excavation and prevent migration of groundwater into the excavated areas. For FS cost estimation purposes, it has been assumed that watertight interlocking sheeting would be installed to allow excavation and to prevent vertical migration of groundwater into the excavation area. This evaluation would rely on additional information collected during the RD studies to determine the need for alternative/ supplemental geotechnical and dewatering controls. For cost estimation purposes, it has been assumed that the sheeting would be installed around the perimeter of each hot spot area.

3.3.4.4 *Excavation of VOC and Metals Impacted Hot Spot Soil Areas*

The VOC and metals impacted hot spot soil areas were defined in Section 2.2.1.3 (all hot spots would be addressed in this action, except those under existing buildings, i.e. SB-65) and are shown in Figure 2-4. Prior to excavation of hot spot areas, any overlying asphalt, ballast and/or concrete would be removed. Based on the maximum depth of hot spot excavation (i.e., 14 feet) and the depth of groundwater in the vicinity of these hot spots, some dewatering would be needed.

The impacted soil would be removed to a maximum depth of 14 feet below grade. In areas where the hot spot does not begin at the soil surface, the overlying soil would be segregated and reused as backfill following the excavation of the hot spot area. Soil boring SB-65 is located under a building and is inaccessible and it would not be excavated. The Common Action SSD would address any VOC impacts or potential for exposure from this location. All excavated soil would be stockpiled, characterized and transported off-Site for disposal. Additional discussion regarding these items is provided below.

Horizontal delineation would be done before excavation via pre-excavation sampling or as a pre-design study. Post-excavation samples would be collected at a frequency of one sample per 2,500 sf of the bottom excavation. The bottom post-excavation samples would be submitted for analysis for TCL VOCs and TAL metals.

3.3.4.5 Ambient Air Monitoring

During soil excavation, an ambient air-monitoring program would be implemented to measure the concentration of particulates and VOCs in ambient air in the work zone and at the perimeter of the Study Area. Real-time VOC concentrations in ambient air would be measured using a photoionization detector (PID) equipped instrument. Real time metals concentrations in ambient air would be estimated using particulate concentrations correlated to metals concentrations.

A CAMP that specifies the components of this program would be developed in accordance with the NYSDOH Generic CAMP contained in Appendix 1A of the Draft DER-10 (NYSDEC, 2002).

During excavation, dust control measures such as water or foam sprays, or limiting areas of soil to be disturbed at any one time would be used if perimeter action levels established in the CAMP are exceeded. The degree to which these measures would be used would depend on particulate levels in ambient air at the perimeter of the Study Area as determined through the implementation of the CAMP.

In addition, a HASP would be prepared for the work. The HASP would include air monitoring for particulates in the work and exclusion zones. This plan would identify the level of PPE required for the work, action levels for the work and exclusion zones, and PPE upgrades and engineering controls that correspond to action level exceedances.

Dust generation during sediment removal activities is not anticipated due to the high moisture content of the materials being handled under this alternative. However, dust may be generated during the addition of absorptive agents to reduce water content. Dust monitoring conducted under the soil alternative would be expanded to address dust monitoring needed during the sediment remedial action

3.3.4.6 Transportation and Off-Site Disposal

Remediation-derived waste would be transported and disposed of off-Site. Remediation-derived waste would include:

- excavated soil classified as non-hazardous waste

- dredged sediment classified as non-hazardous waste
- overlying asphalt, gravel and concrete classified as construction and demolition (C&D) debris
- spent carbon and filters from construction liquid treatment

Prior to disposal, the excavated soil would be dewatered. Stockpiled soil would be gravity dewatered. Following gravity dewatering, a stabilization agent would be added to the soil to remove excess moisture. For cost estimation purposes, a 20 percent increase in the soil volume was assumed from the additional of stabilization agent.

Assuming hydraulic dredging of the sediment is conducted in Freeport Creek, the incoming slurry would likely have a water content of approximately 80 percent by weight. For the purposes of the FS, it is estimated that settled solids would be dewatered using belt presses and a stabilization agent would be added to remove the free liquids. For cost estimation purposes, it was assumed that the addition of a stabilization agent would increase the in-situ volume of sediment by approximately 20 percent.

As discussed above, waste characterization samples for the excavated soil and sediment would be collected. For cost estimation purposes, it has been assumed that these materials would be RCRA non-hazardous waste. Non-hazardous soil and sediment would be transported to and disposed of at an off-Site Subtitle D, non-hazardous waste landfill. C&D debris would be sent to a facility permitted under 6 NYCRR Part 360-7. The spent carbon and filters used for treating the construction liquids would be characterized and sent to an appropriate disposal facility.

3.3.4.7 *Backfill of Excavated Areas with Clean Backfill and ZVI*

Following soil removal, the excavated areas would be restored to their present grade. The excavation areas would be backfilled with approved fill from off-Site sources. Backfill would be defined, at a minimum, as soil containing chemicals at concentrations below the TAGM 4046 RSCOs. In accordance with Draft DER-10, the source of fill material would be approved by the NYSDEC DER in advance, and bills of lading would be available for NYSDEC review (NYSDEC, 2002). Excavated soil and cover material that is not from hot spot areas would be stockpiled and segregated for reuse as backfill. The backfill that is installed below the groundwater table would be mixed with ZVI. ZVI works to abiotically degrade chlorinated compounds into safe end products (carbon dioxide and water). Also, metals are immobilized and removed from the groundwater by precipitation. For cost estimation purposes, it has been assumed that approximately 348 tons of ZVI would be added to the 3,100 cy of backfill installed beneath the water table. The actual quantity of ZVI would be determined during the RD. An additional 1,650 cy of backfill would be installed above the water table.

3.3.4.8 Freeport Creek Sediment Removal

Site-related impacted sediment would be removed in this task. As discussed in above, additional delineation sampling would be conducted during the RD to determine the horizontal and vertical delineation of Site-related impacted sediment. For cost estimation purposes, hydraulic dredging of Freeport Creek sediment was assumed. The final sediment removal methods would be refined during the RD.

It is estimated that approximately 900 bcy of Site-related impacted sediment would be removed. During the RD, the dredging rates and sediment treatment rates would be matched to the available size of the staging and dewatering areas.

This task would take approximately 1 month to complete.

3.3.4.9 Dewatering, Liquids Treatment and Discharge

The shallow groundwater table and the proximity of the creek suggest that dewatering would be needed to facilitate soil excavation. Dewatering wells would extend approximately 14 feet below grade and would be installed, removed and reinstalled progressively along with the excavation sequence. Approximately 217,978 gallons of water are contained within the pore volume of the deep excavation area. This is based on the following assumptions:

Saturated Thickness = Excavation depth(14 feet) – 3.5 feet (i.e. minimum depth to groundwater) = 10.5 feet for 14 feet excavation, 5.5 feet for 9 feet excavation.

Volume = Saturated Thickness x Excavation Area x Porosity 0.25) x 7.48 gal/cf

= 220,000 gallons

In addition, upward groundwater seepage is expected to contribute some amount of groundwater to be treated and discharged. The upward groundwater seepage volume, as well as the seepage volumes through the sheeting and its contribution to the above pore water, would be confirmed during the RD studies.

The three potential options for discharge of extracted groundwater are: discharge to the Freeport Creek under a State Pollutant Discharge Elimination System (SPDES) permit, discharge to the Publicly Owned Treatment Works (POTW) or recharge to groundwater. Due the shallow depth of groundwater at the Site, recharge of groundwater outside of the excavation area would not be possible. POTWs are often reluctant to accept remediation groundwater. Discharge to the creek has therefore been assumed.

Evidence of potential NAPL was observed at SB-34. This material may therefore be encountered during dewatering. Consequently, treatment of the construction liquids would also consist of separating any free phase NAPL recovered using an oil/water separator, along with suspended solids sedimentation and removal, and liquid carbon media filtering to remove organics. Construction liquids would be treated to meet the appropriate permit limits.

This system would also manage the water generated during dewatering of the excavated soil, dredged Freeport Creek sediments and removed storm sewer sediments. Dewatering and treatment of construction liquids would be conducted on an on-going basis during excavation and dredging activities.

3.3.4.10 Site Restoration, Installation, and Maintenance of Surface Covers

After the hot spots above the water table have been excavated and backfilled with clean fill, the Study Area would be restored. This would include removal of temporary services, and excavation equipment. As shown in Figure 3-4, a small portion of exposed soil exists at the Site. This area is currently occupied by boat racks, approximately 2 stories in height, thus making access to this uncovered area limited. Nevertheless, this exposed soil area would be covered with an asphalt or ballast cover under this remedial action. To facilitate drainage in this area and also to allow surface covering without movement of the boat racks, a ballast cover would likely be used.

Under this alternative, a barrier would exist to prevent direct contact with residual chemicals in soil left in place. The Common Action C4, Environmental Easement would provide for an SMP to facilitate annual maintenance and inspection of the surface cover through an OM&M Plan to eliminate the potential exposure to chemicals present in the Study Area soil remaining after the selected remedial action is implemented. The goals of the SMP would be to ensure that: (1) disturbance of any remaining Site soil be conducted in a manner that would protect construction workers; and (2) ensure the proper management of the disturbed Site soil would be conducted.

The SMP in the environmental easement would provide for the asphalt, concrete and ballast covers to be inspected on an annual basis for a period of 30 years. If the surface cover begins to degrade or crack, repairs would be made to these areas in accordance with the SMP. The SMP would also include provisions for maintaining the access/use restrictions implemented under this alternative. For cost estimation purposes it has been assumed that the entire surface cover would require repair over a 30-year period.

3.3.4.11 Monitored Natural Attenuation

As previously discussed, biodegradation of chlorinated VOCs in shallow Site groundwater (i.e., 3 feet to 13 feet) is currently occurring. This upper groundwater zone, along with the Site soil, serves as the source for VOCs in the soil gas. Although biodegradation of chlorinated VOCs in the deeper groundwater (i.e., 20 feet to 30 feet) is not occurring, this deeper groundwater is not impacting its receptor (i.e., Freeport Creek). Thus groundwater monitoring would be conducted to confirm on-going degradation of chlorinated VOCs.

Under this remedial action, quarterly groundwater monitoring would be conducted for two years and annual monitoring for 28 years in each of the existing groundwater monitoring wells[5] and four additionally installed wells. Samples would be analyzed for VOCs. Continued degradation of the chlorinated VOCs in the shallow groundwater would be monitored. An additional four monitoring wells would also be constructed to expand and enhance the existing monitoring network. At least six of the monitoring wells fall within hot spot excavation areas (see Figure 3-4) and would need to be replaced and four additional new wells would also be constructed to expand and enhance the existing monitoring network. Although metals in groundwater do not currently pose an exposure concern, groundwater monitoring would also include metals analysis to confirm this continues to be the case. It should be noted that groundwater modeling shows that once the source of VOCs are removed, groundwater concentrations would reduce to below the groundwater standard for PCE in six years. Thus, monitoring frequency may be reduced after the first six years or eliminated entirely.

[5] Any existing monitoring wells that fall within hot spot excavation areas would be replaced subsequent to remedial action implementation.

3.3.4.12 *Access/Use Restrictions*

This section discusses the access and use restrictions to be implemented under the Common Action C4, Environmental Easement. Under this alternative, soil containing chemicals at concentrations above the RSCOs would remain in place under a cover. An environmental easement would be implemented to address the NYSDEC's requirement to issue a notice regarding chemicals present in Site media above the RSCOs. The environmental easement (Common Action C4) would include the provision that SSD systems would be required for any new building construction at the Site and operation and maintenance of the existing IRM SSD system.

The environmental easement would restrict the use of groundwater and use of the Site to commercial or industrial uses unless additional remediation is undertaken or residential type uses are specifically designed to address remaining issues and the designs are reviewed/approved by NYSDOH and NYSDEC.

3.3.5 *ALTERNATIVE V: HOT SPOT EXCAVATION AND SURFACE COVER, REMOVAL OF UNCAPPED SOILS, ZVI WALL, SVE, AND SEDIMENT REMOVAL*

This section describes Alternative V: Hot Spot Soil Excavation and Surface Cover, Removal of Uncapped Soils, ZVI Wall, SVE, and Sediment Removal. Figure 3-6 shows the components of this Alternative, which are described in the below sub-sections. Alternative V also includes Common Actions C1 through C4 and the following remedial tasks:

- Conduct Pre-Design Studies and Obtain Permits
- Site Preparation and Mobilization
- Installation of Sheeting
- Hot Spot Soil Excavation and Removal of Top Six Inches of Uncovered Soils
- Ambient Air Monitoring
- Transportation and Off-Site Disposal
- Backfill of Excavated Areas
- Freeport Creek Sediment Removal
- Dewatering, Liquids Treatment and Discharge
- Installation of a ZVI Wall
- Installation of a SVE System
- Site Restoration, Installation and Maintenance of Surface Covers

- Access/Use Restrictions
- Groundwater Monitoring

3.3.5.1 *Conduct Pre-Design Studies and Obtain Permits*

As discussed below, installation of water tight sheeting has been assumed in the FS to allow soil excavation and to minimize groundwater infiltration into the excavation area. Alternative/supplemental excavation control technologies, such as slurry walls with stepped back excavation and possibly ground freezing, would be evaluated during the RD. Additionally, the exact placement of the ZVI wall would be designed as part of the RD (see Section 3.3.5.10).

Additional soil sampling would be conducted to define the horizontal and vertical limits of hot spot excavations. An allowance for analysis of up to 20 samples for VOCs, SVOCs, and TAL metals has been included in the cost estimate for this work.

Additional Site-specific information would be collected prior to the RD to better define the area of sediment to be removed and permitting for sediment removal would be secured prior to construction. As discussed in Section 2.2.3.3, the areal and vertical extent of Site-related sediment impacts is currently undefined. During the RD, additional sediment sampling would be conducted to determine these limits. Sample results would be compared to ER-L values from Technical Guidance for Screening of Contaminated Sediment (NYSDEC, 1999) to determine Site-related impacts. For cost estimation purposes, it has been assumed that a maximum depth of 2 feet of impacted sediment is present and that the total areal extent of impacted sediment is 12,165 sf. These limits would be refined during the RD studies.

Prior to implementation of the RA, a bathymetry survey would be conducted. This survey would provide a baseline for determining dredging depths and allow for design of operational parameters such as location of barges, and finalization of the dredging method(s). A tide and float (i.e., current) survey would be conducted to select the sediment control method (e.g., silt curtain) and to determine the optimum location of the sediment control measures. Following sediment removal, the area would be backfilled with materials similar in nature to removed sediments.

The sediments to be excavated are expected to be classified as non-hazardous waste. During RD, analysis would be conducted to determine the expected water content of sediments, optimal handling, dewatering requirements and dewatering techniques to allow off-Site disposal. The system used to treat the construction fluids generated during soil excavation would also be used to treat the dewatering liquids from the sediment dredging.

Dredging and removal of impacted sediments would require a number of permits and approvals. These may include: a permit under Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403), a CZM Act of 1972 (16 U.S.C. section 1455b et. seq.) consistency determination, and approvals related to the SEQRA (NYSDEC), Wildlife (U.S. Fish and Wildlife Service), zoning ordinances (Town and County), riparian authorities, right-of-way restrictions (Town, County, and State) and floodplain/floodway construction restrictions (Town).

This task would take approximately 6 to 12 months to complete.

3.3.5.2 Site Preparation and Mobilization

Site preparation and mobilization would include: relocation of existing utilities; provision of temporary facilities and utilities, as needed; mobilization of equipment to the Site; set up of staging, stockpiling and dewatering areas; set up of the decontamination area; and construction of a waste transfer station. Existing fencing that may impede Site access in its current position would be removed and fencing to prevent unauthorized access would be installed and properly sited.

The preparation and mobilization task would take approximately 3 to 6 months to complete.

3.3.5.3 Installation of Sheeting

Geotechnical measures are needed to allow deep soil excavation and prevent migration of groundwater and surface water into the excavated areas. For FS cost estimation purposes, it has been assumed that water-tight interlocking sheeting would be installed to allow deep excavation and to prevent vertical migration of groundwater and creek water into the excavation area. This evaluation would rely on additional information collected during the RD studies to determine excavation depth feasibility and the use of alternative/ supplemental geotechnical controls.

3.3.5.4 Hot Spot Soil Excavation and Removal of Top Six Inches of Uncovered Soils

The VOC and metals impacted hot spot soil areas were defined in Section 2.2.1.3 (all hot spots would be addressed in this action, except those under existing buildings, i.e. SB-65) and are shown in Figure 2-4. Prior to excavation of the hot spot areas, any overlying asphalt, ballast and/or concrete would be removed. The top six inches of exposed soils would then be excavated for disposal. Based on the maximum depth of hot spot excavation (i.e., 14 feet) and the depth of the groundwater in the vicinity of these hot spots, some dewatering would be needed.

After the top six inches of soil is removed for disposal, excavation of hot spots would occur. In areas where the hot spot does not occur at the soil surface, the overlying soil (with the exception of the top six inches, which would be disposed) would be segregated and reused as backfill following excavation of the hot spot area. Soil boring SB-65 is located under a building and is inaccessible and it would not be excavated. The Common Action SSD would address any VOC impacts or potential exposure at this location. All excavated soil would be stockpiled, characterized, and transported off-site for disposal. This alternative assumes an allowance for up to two additional hot spot areas, each 2,500 square feet, to be excavated to the depth of 14 feet for off-site disposal, and the top six inches of the gravel area would be replaced with clean gravel backfill. The remediated areas would be graded such that the runoff is diverted away from the creek.

Post- excavation samples would be collected at a frequency of one sample per 2,500 sf of the bottom excavation. The bottom post-excavation samples would be submitted for analysis for TCL VOCs and TAL metals.

3.3.5.5 Ambient Air Monitoring

During soil excavation an ambient air monitoring program would be implemented to measure the concentration of particulates and VOCs in ambient air in the work zone and at the perimeter of the Site. Real-time VOC concentrations in ambient air would be measured using a PID. Real time metals concentrations in ambient air would be estimated using particulate concentrations correlated to metals concentrations.

A CAMP that specifies the components of this program would be developed in accordance with the NYSDOH Generic CAMP contained in Appendix 1A of the Draft DER-10 (NYSDEC, 2002).

During excavation, if perimeter action levels established in the CAMP are exceeded, dust control measures such as water or foam sprays, or limiting areas of soil to be disturbed at any one time would be used at the Site. The degree to which these measures would be used would depend on particulate levels in ambient air as determined through the implementation of the CAMP.

In addition, a HASP would be prepared for Site work. The HASP would include air monitoring for particulates in the work and exclusion zones. This plan would identify the level of PPE required for Site work, action levels for the work and exclusion zones, and PPE upgrades and engineering controls that correspond to action level exceedances.

Dust generation during sediment removal activities is not anticipated due to the high moisture content of the materials being handled under this alternative. However, dust may be generated during the addition of absorptive agents to reduce water content. Dust monitoring conducted under the soil alternative would be expanded to address dust monitoring needed during the sediment remedial action

3.3.5.6 Transportation and Off-Site Disposal

The remediation-derived waste would be transported and disposed of off-Site. Remediation derived waste would include:

- Excavated soil classified as non-hazardous waste
- Dredged sediment classified as non-hazardous waste
- Overlying asphalt, gravel and concrete classified as construction and demolition (C&D) debris
- Spent carbon and filters from construction liquid treatment

Prior to disposal, the excavated soil and sediment would be dewatered. Soil would be gravity dewatered. Following gravity dewatering, a stabilization agent would be added to the soil to remove excess moisture. For cost estimation purposes, a 20 percent increase in the soil volume was assumed from the additional of stabilization agent.

Assuming hydraulic dredging of the sediment is conducted, the incoming slurry would likely have a water content of approximately 80 percent by weight. For the purposes of the FS, it is estimated that settled solids would be dewatered using belt presses and a stabilization agent would be added to remove the free liquids. For cost estimation purposes, it was assumed that the addition of a stabilization agent would increase the in-situ volume of sediment by approximately 20 percent.

As discussed above, waste characterization samples for the excavated soil and sediment would be collected. For cost estimation purposes, it has been assumed that these materials would be RCRA non-hazardous waste. Non-hazardous soil and sediment would be transported to and disposed of at an off-Site Subtitle D, non-hazardous waste landfill. C&D debris would be sent to a facility permitted under 6 NYCRR Part 360-7. The spent carbon and filters used for treating the construction liquids would be characterized and sent to an appropriate disposal facility.

3.3.5.7 *Backfill of Excavated Areas*

Following soil removal, the Site would be restored to its present grade. The excavation areas would be backfilled with approved fill from off-Site sources. Backfill would be defined, at a minimum, as soil containing chemicals at concentrations below the TAGM 4046 RSCOs. In accordance with Draft DER-10, the source of fill material would be approved by DER in advance, and bills of lading would be available for Department review. Since Alternative V includes a ZVI wall for groundwater treatment, it would not be added as fill for the hot spot excavation areas.

3.3.5.8 *Freeport Creek Sediment Removal*

Under this remedial action, the Site-related impacted sediment would be removed. As discussed in above, additional delineation sampling would be conducted during the RD to determine the horizontal and vertical limits of Site-related impacted sediment. For cost estimation purposes, hydraulic dredging of Freeport Creek sediment was also assumed. If needed, absorptive agents would be added to materials that have too high of a water content for disposal. The final sediment removal methods would be refined during the RD.

Approximately 900 bcy of Site-related impacted sediment would be removed. During the RD, the dredging rates and sediment treatment rates would be matched to the available size of the staging and dewatering areas.

This task would take approximately 1 month to complete.

3.3.5.9 *Dewatering, Liquids Treatment and Discharge*

The shallow depth of the groundwater and the proximity of the creek indicate that dewatering would be needed to facilitate soil excavation. Dewatering wells would extend 14 feet below grade and would be installed, removed and reinstalled progressively along with the excavation sequence. Approximately 316,153 gallons of water are contained within the pore volume of the deep excavation area. This is based on the following assumptions:

Saturated Thickness = Excavation depth (14 feet) – 3.5 feet (i.e. minimum depth to groundwater) = 10.5 feet for 14 feet excavation, 5.5 feet for 9 feet excavation.

Volume = Saturated Thickness x Excavation Area x Porosity (0.25) x 7.48 gal/cf

= 317,000 gal

In addition, upward groundwater seepage is expected to contribute to some additional amount of groundwater requiring treatment and discharge. The upward groundwater seepage volume, as well as the seepage volumes through the sheeting and its contribution to the above pore water, would be confirmed during the RD studies.

The three potential options for discharge of extracted groundwater are: discharge to the Freeport Creek under a SPDES permit, discharge to the POTW or recharge to groundwater. Due the shallow depth of groundwater at the Site, recharge of groundwater outside of the excavation area would not be possible. POTWs are often reluctant to accept remediation groundwater. Discharge to the creek has therefore been assumed.

Evidence of petroleum impacts was observed at SB-34. Concentrations detected suggest that a NAPL could be present. This material could therefore be encountered during dewatering. Consequently, treatment of the construction liquids would also consist of separating free phase NAPL potentially encountered using an oil/water separator, along with suspended solids sedimentation and removal, and liquid carbon media filtering to remove organics. Construction liquids would be treated to meet the appropriate permit limits.

This system would also manage the water generated during dewatering of the excavated soil, dredged Freeport Creek sediments and removed storm sewer sediments. Dewatering and treatment of construction liquids would be conducted on an on-going basis during excavation and dredging activities.

3.3.5.10 Installation of a ZVI Wall

To treat groundwater, a iron permeable reactive barrier (PRB) would be installed in-situ at the downgradient boundary of the Site. ZVI works to abiotically degrade chlorinated compounds into safe end products (carbon dioxide and water). Metals are immobilized and removed from the groundwater by precipitation. Iron PRB technology has been used at many sites to provide a long-term solution to groundwater remediation and can have an effective life of greater than thirty years. The PRB wall design assumed a hydraulic conductivity of 250 feet/day. The design would utilize three PRBs with the following dimensions: each PRB would be 170′ in length; 28′ of vertical height; and 3.0″ thick. Three PRBS are required to allow sufficient residence time for the PRBs to effectively treat the contaminants present due to the high hydraulic conductivity assumed and because of the shallow depth of the wall. The actual PRB configurations could be revised based on slug tests to precisely determine the Site-specific hydraulic conductivity. Additionally, the minimal depth we that iron could be injected would be 5-feet bgs, so the upper section of the wall may need to be installed by trenching. The wall would be designed to treat both shallow and deep groundwater down to 30 feet bgs, and could be placed at the downgradient Site boundary or along the creek to intercept groundwater just before exiting the Study Area.

An RD investigation would be performed to help fine-tune the placement design specifics. A Treatability Study on site-specific groundwater to confirm the degradation curves for verifying and designing the appropriate horizontal thickness. The exact final placement for the PRBs would be based on current round(s) of groundwater samples from the site.

3.3.5.11 Installation of a SVE System

SVE horizontal piping would be installed across the Site in three segments. Each segment would run from the western portion of the Site to the eastern portion, and would bend north, east, and south to address VOC source areas. The total length of the piping associated with the three segments would be 1300 feet. The horizontal piping would be installed at a depth of 2 feet bgs in order to treat the zone above the groundwater table. Installation of the SVE would involve minor disruptions due to trenching to install the piping, repaving of the Site after the trenching, and the construction of a shed to house the blower and various other controls.

3.3.5.12 Site Restoration, Installation and Maintenance of Surface Covers

After the hot spots above the water table have been excavated and backfilled with clean fill, the Study Area would be restored. This would include removal of temporary services, and excavation equipment. As shown in Figure 3-6, a small portion of exposed soil exists at the Site. This area is currently occupied by boat racks, approximately 2 stories in height, thus making access to this uncovered area limited. Nevertheless, this exposed soil area would be covered with an asphalt or ballast cover under this remedial action. To facilitate drainage in this area and also to allow surface covering without movement of the boat racks, a ballast cover would likely be used.

Under this alternative, a barrier would exist to prevent direct contact with residual chemicals in soil left in place. The Common Action C4, Environmental Easement would provide for an SMP to facilitate annual maintenance and inspection of the surface cover through an OM&M Plan to eliminate the potential exposure to chemicals present in the Study Area soil remaining after the selected remedial action is implemented. The goals of the SMP would be to ensure that: (1) disturbance of any remaining Site soil be conducted in a manner that would protect construction workers; and (2) ensure the proper management of the disturbed Site soil would be conducted.

The SMP in the environmental easement would provide for the asphalt, concrete and ballast covers to be inspected on an annual basis for a period of 30 years. If the surface cover begins to degrade or crack, repairs would be made to these areas in accordance with the SMP. The SMP would also include provisions for maintaining the access/use restrictions implemented under this alternative. For cost estimation purposes it has been assumed that the entire surface cover would require repair over a 30-year period.

3.3.5.13 Access/Use Restrictions

This section discusses the access and use restrictions to be implemented under the Common Action C4, Environmental Easement. Under this alternative, soil containing chemicals at concentrations above the RSCOs would remain in place under a cover. An environmental easement would be implemented to address the NYSDEC's requirement to issue a notice regarding chemicals present in Study Area soil above the RSCOs. The environmental easement (Common Action C4) would include the provision that SSD systems would be required for any new building construction at the Site and operation and maintenance of the existing IRM SSD system.

The environmental easement would restrict the use of groundwater and use of the Site to commercial or industrial uses unless additional remediation is undertaken or residential type uses are specifically designed to address remaining issues and the designs are reviewed/approved by NYSDOH and NYSDEC.

3.3.5.14 Groundwater Monitoring

Groundwater concentrations in the shallow and deeper groundwater zones would be monitored to determine the effectiveness of the soil excavation and ZVI treatments wall on the groundwater quality in the shallow and deeper groundwater zones. The progress of this activity would be monitored through annual groundwater monitoring of the remaining existing groundwater monitoring wells, six replacement monitoring wells, and six additional new monitoring wells to be installed to monitor performance of the PRB. One well would be located to the east, another well to the west, two upgradient of the wall, and two downgradient of the wall. All samples would also be analyzed for VOCs and TAL metals. Quarterly for two years and annual monitoring for 28 years has conservatively been assumed. It should be noted that groundwater modeling shows that once the source of VOCs are removed, groundwater concentrations would reduce to below the groundwater standard for PCE in six years. Thus, monitoring frequency may be reduced after the first six years or eliminated entirely.

3.3.6 ALTERNATIVE VI: FULL-SCALE SOIL EXCAVATION, ZVI WALL, AND SEDIMENT REMOVAL

This section describes Alternative VI: Full-Scale Soil Excavation, ZVI Wall, and Sediment Removal. Figure 3-7 shows the components of this Alternative, which are described in the below sub-sections. Alternative VI also includes Common Actions C1 through C4.

3.3.6.1 Description

As discussed in Section 2.0, returning the entire Study Area to pre-disposal conditions, to the extent feasible and authorized by law, is a remedial goal. This is the overall goal of the Inactive Hazardous Waste Site (IHWS) program as identified in 6NYCRR Part 375. Alternative VI has been developed to evaluate satisfaction of this goal for the Study Area soil, groundwater and sediment. Under Alternative VI, all of the Study Area soil to a depth of at least 14 feet below grade would be removed (see Figure 3-7), the groundwater would be treated using a ZVI wall prior to its discharge to the creek and all Site-related impacted sediment would be removed.

This alternative would include the following remedial tasks and incorporate the Common Actions C2 through C4[6]:

- Conduct Pre-Construction Studies
- Site Preparation and Mobilization

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[6] Common Action C1, the IRM SSD, would remain in place until building demolition is conducted. Following remedial action, the continued need for SSD systems for newly constructed buildings post-remediation would be evaluated through soil gas sampling.

- Demolition of Site Buildings
- Installation of Sheeting
- Soil Excavation to RSCOs
- Sediment Removal
- Dewatering, Liquids Treatment and Discharge
- Ambient Air Monitoring
- Transportation and Off-Site Disposal
- Backfill of Excavated Areas
- Installation of a ZVI Wall
- Site Restoration
- Groundwater Monitoring
- Sediment Removal for the Storm sewer (Common Action C2)
- UST Removal (Common Action C3)
- Environmental Easement (Common Action C4)

The time to complete this alternative has been estimated to be approximately 2 years following NYSDEC approval of the RD. An environmental easement specifying groundwater monitoring and access and use restrictions would continue beyond this period.

Descriptions of the common actions considered for this were provided in Section 3.2. Evaluation of these common actions is included along with the other tasks of this alternative.

3.3.6.2 *Conduct Pre-Design Studies and Obtain Permits*

As discussed below, installation of water tight sheeting has been assumed in the FS to allow soil excavation and to minimize groundwater infiltration into the excavation area. Alternative/supplemental excavation control technologies, such as slurry walls with stepped back excavation and possibly ground freezing, would be evaluated during the RD. Additionally the exact placement of the ZVI wall would be designed as part of the RD (See Section 3.3.6.12).

Additional soil sampling would be conducted to define the horizontal and vertical limits of hot spot excavations. An allowance for analysis of up to 20 samples for VOCs, SVOCs, and TAL metals has been included in the cost estimate for this work.

Additional site-specific information would be collected prior to the RD to implement the sediment removal and permitting for sediment removal would be secured prior to construction. As discussed in Section 2.2.3.3, the areal and vertical extent of Site-related sediment impacts is currently undefined. During the RD, additional sediment sampling would be conducted to determine these limits. Sample results would be compared to ER-L values from Technical Guidance for Screening of Contaminated Sediment (NYSDEC, 1999) to determine Site-related impacts. For cost estimation purposes, it has been assumed that a maximum depth of 2 feet of impacted sediment is present and that the total areal extent of impacted sediment is 12,165 sf. These limits would be refined during the RD studies.

Prior to implementation of the RA, a bathymetry survey would be conducted. This survey would provide a baseline for determining dredging depths and allow for design of operational parameters such as location of barges, and finalization of the dredging method(s). A tide and float (i.e., current) survey would be conducted to select the sediment control method (e.g., silt curtain) and to determine the optimum location of the sediment control measures. Following sediment removal, the area would be backfilled with materials similar in nature to removed sediments.

The sediments to be excavated are expected to be classified as non-hazardous waste. During RD, analysis would be conducted to determine the expected water content of sediments, optimal handling, dewatering requirements and dewatering techniques to allow off-Site disposal. The system used to treat the construction fluids generated during soil excavation would also be used to treat the dewatering liquids from the sediment dredging.

Dredging and removal of impacted sediments would require a number of permits and approvals. These may include: a permit under Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403), a CZM Act of 1972 (16 U.S.C. section 1455b et. seq.) consistency determination, and approvals related to the SEQRA (NYSDEC), Wildlife (U.S. Fish and Wildlife Service), zoning ordinances (Town and County), riparian authorities, right-of-way restrictions (Town, County, and State) and floodplain/floodway construction restrictions (Town).

This task would take approximately 6 to 12 months to complete.

3.3.6.3 *Site Preparation and Mobilization*

Site preparation and mobilization would include: relocation of existing utilities; provision of temporary facilities and utilities, as needed; mobilization of equipment; set up of staging, stockpiling and dewatering areas; set up of the decontamination area; and construction of a waste transfer station. Existing fencing that may impede access to work areas in its current position would be removed and fencing to prevent unauthorized access would be installed and properly sited.

The Site preparation and mobilization task would take approximately 3 to 6 months to complete.

3.3.6.4 *Demolition of Site Buildings*

During site preparation, the two buildings currently at the Site would be demolished. These buildings would be demolished to access the soil beneath them. This task would be conducted concurrently with site preparation.

3.3.6.5 *Installation of Sheeting*

Geotechnical measures are needed to allow deep soil excavation and prevent migration of groundwater and surface water into the excavated areas. For FS cost estimation purposes, it has been assumed that water-tight interlocking sheeting would be installed to allow deep excavation and to prevent vertical migration of groundwater and creek water into the excavation area. This evaluation would rely on additional information collected during the RD studies to determine excavation depth feasibility and the use of alternative/ supplemental geotechnical controls.

The largest perimeter of excavation under this alternative is approximately 1,476 feet, and the surface area is approximately 90,000 sf (see Figure 3-7). For cost estimation purposes, it has also been assumed that the sheeting would be installed around the perimeter of the excavation area. During the remedial action, sheeting may be installed in smaller sub-excavation areas within the overall footprint rather than around the entire excavation perimeter. As discussed above, the final selection of the excavation control technique would be made during RD.

The duration of sheeting installation would depend upon whether the entire area is sheeted or smaller areas are sheeted along with excavation.

3.3.6.6 *Soil Excavation to the RSCOs*

All Study Area soil containing COPCs at concentrations in excess of the TAGM 4046 RSCOs would be removed. This would require excavation of approximately 46,667 cy of soil. Excavation would proceed in a staged approach. Overlying asphalt, gravel and/or concrete would first be removed from each excavation area cell. Soil would be stockpiled in roll-offs. The stockpiled soil would be sampled for waste disposal characterization. This information would be used to confirm the disposal requirements for the excavated materials. Any debris encountered would be separated out for bulk landfilling.

Post-excavation samples would be collected at a frequency of one sample per 2,500 sf of the bottom excavation. The post-excavation samples would be submitted for analysis for TCL VOCs and TAL metals.

3.3.6.7 *Freeport Creek Sediment Removal*

Under this remedial action, the Site-related impacted sediment would be removed. As discussed in above, additional delineation sampling would be conducted during the RD to determine the horizontal and vertical delineation of Site-related impacted sediment. For cost estimation purposes, hydraulic dredging of Freeport Creek sediment was assumed. The final sediment removal methods would be refined during the RD.

Approximately 900 bcy of Site-related impacted sediment would be removed. During the RD, the dredging rates and sediment treatment rates would be matched to the available size of the staging and dewatering areas.

This task would take approximately 1 month to complete.

3.3.6.8 *Dewatering, Liquids Treatment and Discharge*

Due to the depth of the groundwater table and the proximity of the creek, dewatering would be needed to facilitate soil excavation. Dewatering wells would extend 14 feet below grade and would be installed, removed and reinstalled progressively along with the excavation sequence. Approximately 1.8 million gallons of water are contained within the pore volume of the deep excavation area. This is based on the following assumptions:

Saturated Thickness = Excavation depth (14 feet) – 3 feet (i.e. minimum depth to groundwater) = 10.5 feet

Volume = Saturated Thickness x Excavation Area x Porosity (0.25) x 7.48 gal/cf

= 1,800,000 gal

In addition, upward groundwater seepage is expected to contribute some amount of groundwater to be treated and discharged. The upward groundwater seepage volume, as well as the seepage volumes through the sheeting and its contribution to the above pore water, would be confirmed during the RD studies.

The three potential options for discharge of extracted groundwater are: discharge to the Freeport Creek under a SPDES permit, discharge to the POTW or recharge to groundwater. Due the shallow depth of groundwater at the Site, recharge of groundwater outside of the excavation area would not be possible. POTWs are often reluctant to accept remediation groundwater. Discharge to the creek has therefore been assumed.

Evidence of potential NAPL was observed at SB-34. This material may therefore be encountered during dewatering. Consequently, treatment of the construction liquids would also consist of separating free phase NAPL potentially encountered using an oil/water separator, along with suspended solids sedimentation and removal, and liquid carbon media filtering to remove organics. Construction liquids would be treated to meet the appropriate permit limits.

This system would also manage the water generated during dewatering of the excavated soil, dredged Freeport Creek sediments and removed storm sewer sediments. Dewatering and treatment of construction liquids would be conducted on an on-going basis during excavation and dredging activities.

3.3.6.9 *Ambient Air Monitoring*

During soil excavation, an ambient air monitoring program would be implemented to measure the concentration of particulates and VOCs in ambient air in the work zone and at the perimeter of the Site. Real-time VOC concentrations in ambient air would be measured using a PID. Real time metals concentrations in ambient air would be estimated using particulate concentrations correlated to metals concentrations.

A CAMP that specifies the components of this program would be developed in accordance with the NYSDOH Generic CAMP contained in Appendix 1A of the Draft DER-10 (NYSDEC, 2002).

During excavation, dust control measures such as water or foam sprays, or limiting areas of soil to be disturbed at any one time would be used at the work area if perimeter action levels established in the CAMP are exceeded. The degree to which these measures would be used would depend on particulate levels in ambient air at the perimeter of the work area as determined through the implementation of the CAMP.

In addition, a HASP would be prepared for the work. The HASP would include air monitoring for particulates in the work and exclusion zones. This plan would identify the level of PPE required for the work, action levels for the work and exclusion zones, and PPE upgrades and engineering controls that correspond to action level exceedances.

Dust generation during sediment removal activities is not anticipated due to the high moisture content of the materials being handled under this alternative. However, dust may be generated during the addition of absorptive agents to reduce water content. Dust monitoring conducted under the soil alternative would be expanded to address dust monitoring needed during the sediment remedial action

3.3.6.10 Transportation and Off-Site Disposal

The remediation-derived waste would be transported and disposed of off-Site. Remediation derived waste would include:

- Excavated soil classified as non-hazardous waste
- Dredged sediment classified as non-hazardous waste
- Overlying asphalt, gravel and concrete classified as construction and demolition (C&D) debris
- Spent carbon and filters from construction liquid treatment

Prior to disposal, the excavated soil and sediment would be dewatered. Soil would be gravity dewatered. Following gravity dewatering, a stabilization agent would be added to the soil to remove excess moisture. For cost estimation purposes, a 20 percent increase in the soil volume was assumed from the additional of stabilization agent.

Assuming hydraulic dredging of the sediment is conducted, the incoming slurry would likely have a water content of approximately 80 percent by weight. For the purposes of the FS, it is estimated that settled solids would be dewatered using belt presses and a stabilization agent would be added to remove the free liquids. For cost estimation purposes, it was assumed that the addition of a stabilization agent would increase the in-situ volume of sediment by approximately 20 percent.

As discussed above, waste characterization samples for the excavated soil and sediment would be collected. For cost estimation purposes, it has been assumed that these materials would be RCRA non-hazardous waste. Non-hazardous soil and sediment would be transported to and disposed of at an off-Site Subtitle D, non-hazardous waste landfill. C&D debris would be sent to a facility permitted under 6 NYCRR Part 360-7. The spent carbon and filters used for treating the construction liquids would be characterized and sent to an appropriate disposal facility.

3.3.6.11 Backfill of Excavated Areas

Following soil removal, the Study Area would be restored to its present grade. Backfill would be defined, at a minimum, as soil containing chemicals at concentrations below the TAGM 4046 RSCOs. In accordance with Draft DER-10, the source of fill material would be approved by DER in advance, and bills of lading would be available for Department review.

3.3.6.12 Installation of a ZVI Wall

To treat groundwater, a PRB would be installed in-situ at the downgradient boundary of the Site. ZVI works to abiotically degrade chlorinated compounds into safe end products (carbon dioxide and water). Metals are immobilized and removed from the groundwater by precipitation. Iron PRB technology has been used at many sites to provide a long-term solution to groundwater remediation and can have an effective life of greater than thirty years. The PRB wall design assumed a hydraulic conductivity of 250 feet/day. The design would utilize three PRBs with the following dimensions: each PRB would be 170′ in length; 28′ of vertical height; and 3.0″ thick. Three PRBS are required to allow sufficient residence time for the PRBs to effectively treat the contaminants present due to the high hydraulic conductivity assumed and because of the shallow depth of the wall. The actual PRB configurations could be revised based on slug tests to precisely determine the Site-specific hydraulic conductivity. Additionally, the minimal depth we that iron could be injected would be 5-feet bgs, so the upper section of the wall may need to be installed by trenching. The wall would be designed to treat both shallow and deep groundwater down to 30 feet bgs, and could be placed at the downgradient Site boundary or along the Creek to intercept groundwater just before exiting the Study Area.

An RD investigation would be performed to help fine-tune the placement design specifics. A Treatability Study on site-specific groundwater to confirm the degradation curves for verifying and designing the appropriate horizontal thickness. The exact final placement for the PRBs would be based on current round(s) of groundwater samples from the

Study Area. The ZVI wall would be configured such that at least one monitoring well at a minimum could be downgradient of the wall between the wall and Freeport Creek.

3.3.6.13 Site Restoration

After the Site soil has been excavated and backfilled, the Site would be restored. This would include removal of dewatering equipment, temporary services, and surplus fencing.

3.3.6.14 Groundwater Monitoring

Groundwater concentrations in the shallow and deeper groundwater zones would be monitored to determine the effectiveness of the full-scale soil excavation and ZVI treatment walls on the groundwater quality in the shallow and deeper groundwater zones. The progress of this activity would be monitored through annual groundwater monitoring of a total of six new groundwater monitoring wells. One well would be located to the east, another well to the west, up to two downgradient of the wall, and up to two downgradient of the wall. All samples would also be analyzed annually for VOCs and TAL metals. A monitoring period of 30 years has conservatively been assumed. It should be noted that groundwater modeling shows that once the source of VOCs are removed, groundwater concentrations would reduce to below the groundwater standard for PCE in six years. Thus, monitoring frequency may be reduced after the first six years or eliminated entirely.

4.0 EVALUATION OF REMEDIAL ACTION ALTERNATIVES

Section 4.1 evaluates each of the individual remedial action alternatives for the following seven criteria:

- Overall Protection of Human Health and the Environment
- Compliance with SCGs
- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility or Volume
- Short-Term Effectiveness
- Implementability
- Cost

After evaluation of each alternative individually, Section 4.2 compares the six alternatives against one another for the seven criteria.

4.1 ANALYSIS OF INDIVIDUAL ALTERNATIVES

4.1.1 ALTERNATIVE I: NO ACTION

4.1.1.1 *Overall Protection of Human Health and the Environment*

Alternative I would not be protective of human health and the environment. This alternative would not meet the NYSDEC's overall Site remedial goals for the soil, groundwater, surface water, or sediment RAOs.

4.1.1.2 *Compliance with SCGs*

A summary of the applicable SCGs for the soil, groundwater, surface water and sediment is presented in Table 4-1. Since no remedial actions would be conducted under this alternative, none of the location specific and a limited number of the action specific SCGs are applicable to this alternative. The alternative would not comply with the applicable action or chemical specific SCGs.

4.1.1.3 *Long Term Effectiveness and Permanence*

Since this alternative does not provide for the maintenance of the existing covers, confirmation that natural attenuation of groundwater continues to occur and does not provide for the removal of the storm sewer sediment or SSD, it would not provide long-term effectiveness or permanence.

4.1.1.4 Reduction of Toxicity, Mobility or Volume

Through the biodegradation of chlorinated solvents that is currently occurring in shallow groundwater, this alternative would result in a decrease in the toxicity, mobility and volume of these chemicals in shallow groundwater. However, this alternative provides no means to confirm that natural attenuation will continue to occur and hence there is an overall reduction in VOC concentrations at this site. There would be no reduction of toxicity, mobility or volume for chemicals in Study Area soil, Site-related impacted sediment or surface water under this alternative.

4.1.1.5 Short-Term Effectiveness

There are no short-term effects associated with this alternative since there are no actions included with this alternative.

4.1.1.6 Implementability

As there are no specific actions related to this alternative, it would be readily implementable.

4.1.1.7 Cost

There are no actions taken under this alternative. As such, there are no costs associated with the implementation of Alternative I.

4.1.2 ALTERNATIVE II: SURFACE COVER, GROUNDWATER MNA, SVE, AND SEDIMENT MNR

4.1.2.1 Overall Protection of Human Health and the Environment

This alternative would provide adequate protection of human health and the environment for the soil, groundwater, and Site-related impacted surface water and sediment. The surface covers and environmental easement requirements would prevent direct contact with soil and the SSD systems would address the inhalation risks posed by VOCs in soil and groundwater. Because the Study Area groundwater is not impacting the surface water body and there are no groundwater supply wells at the Site and inhalation risks posed by groundwater are being address through SSD systems, this alternative would provide adequate protection of human health and environment for groundwater. Due to the isolated locations of sediment criteria exceedances above background levels, this alternative is expected to provide adequate protection of human health and environment for Site-related impacted sediment and surface water.

The chlorinated VOCs in shallow groundwater would continue to naturally degrade through reductive dechlorination, which would be confirmed through MNA monitoring. In addition, as discussed previously, metals are also present in Site groundwater at concentrations above the Class GA groundwater standards. However, the only receptor for metals discharging in groundwater is Freeport Creek and currently groundwater discharge does not result in unacceptable surface water concentrations.

Finally, sediment removal from the storm sewer system along with Freeport Creek sediment removal would eliminate exposure to Site-related impacted sediment and is expected to improve surface water quality.

Thus, collectively, this alternative would provide adequate protection of human health and environment.

4.1.2.2 *Compliance with SCGs*

A summary of the applicable SCGs that apply to this alternative is presented in Table 4-1. As shown in this table, this alternative would address the chemical-specific SCGs through surface covers, SSD systems, environmental easement, and natural sediment deposition.

4.1.2.3 *Long-Term Effectiveness and Permanence*

This alternative would be effective in the long term, and its continued effectiveness would be mandated through the environmental easement. This alternative provides for the maintenance of the existing surface covers, confirmation that the degradation of chlorinated VOCs continues to occur, confirmation that adequate sediment deposition is occurring, removal of the storm sewer sediment, SSD beneath all buildings, and installation and operation of an SVE system.

4.1.2.4 *Reduction of Toxicity, Mobility or Volume*

Through natural attenuation, this alternative would result in a decrease in the toxicity, mobility and volume of the net chemicals in shallow groundwater. This reduction would be confirmed via groundwater monitoring. However, natural attenuation could result in short-term increase in toxicity due to the potential for generation of vinyl chloride.

Additionally, the mass of individual VOCs could increase temporarily as natural attenuation progresses. Reduction in toxicity, mobility and volume of VOCs in Site soil would occur through the SVE system. Some reduction in the mobility and volume of Site-related impacted sediment and surface water is anticipated under this alternative since the suspected source of chemicals to sediment and surface water (i.e., storm sewer sediment) would be removed under Common Action C2 of this alternative.

4.1.2.5 Short-Term Effectiveness

There would be minimal short-term impacts associated with this alternative.

4.1.2.6 Implementability

The main components of this alternative could be completed within six months of NYSDEC approval of the RD for this project. Groundwater monitoring, environmental easement, MNR monitoring and limited annual OM&M activities would continue beyond this time frame. All activities associated with this alternative are readily implementable.

4.1.2.7 Cost

The capital and OM&M costs for this alternative are provided in Table 4-2.

4.1.3 ALTERNATIVE III: HOT SPOT SOIL EXCAVATION TO THE WATER TABLE AND SURFACE COVER, GROUNDWATER MNA, AND SEDIMENT REMOVAL

4.1.3.1 Overall Protection of Human Health and the Environment

This alternative would provide adequate protection of human health and the environment for the soil, groundwater, and Site-related impacted surface water and sediment. The hot spot soil removal to the water table, surface covers, and environmental easement requirements would prevent direct contact with soil; and the hot spot removal would mitigate leaching of VOCs to groundwater from the vadose zone and reduce the overall concentrations of select metals in soil. The SSD systems would address the inhalation risks posed by the remaining VOCs in soil and groundwater. Because the Study Area groundwater is not impacting the surface water body and there are no groundwater supply wells at the Site and inhalation risks posed by groundwater are being address through SSD systems, this alternative would provide adequate protection of human health and environment for groundwater. Due to the isolated locations of sediment criteria exceedances above background levels, this alternative is expected to provide adequate protection of human health and environment for Site-related impacted sediment and surface water.

The chlorinated VOCs in shallow groundwater would continue to naturally degrade through reductive dechlorination, which would be confirmed through MNA monitoring. In addition, as discussed previously, metals are also present in Site groundwater at concentrations above the Class GA groundwater standards. However, the only receptor for metals discharging in groundwater is Freeport Creek and currently groundwater discharge does not result in unacceptable surface water concentrations.

Finally, sediment removal from the storm sewer system along with Freeport Creek sediment removal would eliminate exposure to Site-related impacted sediment and is expected to improve surface water quality.

Thus, collectively, this alternative would provide adequate protection of human health and environment.

4.1.3.2 *Compliance with SCGs*

A summary of the applicable SCGs that apply to this alternative is presented in Table 4-1. As shown in this table, this alternative would address the chemical-specific SCGs through surface covers, hot spot soil excavation to the water table, SSD systems, environmental easement, and Freeport Creek sediment removal.

4.1.3.3 *Long-Term Effectiveness and Permanence*

This alternative would be effective in the long term, and its continued effectiveness would be mandated through the environmental easement. This alternative provides for the soil excavation of hot spot areas to the water table, maintenance of the existing and new surface covers, confirmation that the degradation of chlorinated VOCs continues to occur, Freeport Creek sediment removal, removal of the storm sewer sediment, and SSD.

4.1.3.4 *Reduction of Toxicity, Mobility or Volume*

Through natural attenuation, this alternative would result in a decrease in the toxicity, mobility and volume of the net chemicals in shallow groundwater. This reduction would be confirmed via groundwater monitoring. However, natural attenuation could result in short-term increase in toxicity due to the potential for generation of vinyl chloride. Additionally, the mass of individual VOCs could increase temporarily as natural attenuation progresses. Through excavation of hot spot areas to the water table, sediment removal from the storm sewer system and Freeport Creek sediment removal, this alternative would result in a decrease in the toxicity, mobility and volume of chemicals in soil, shallow groundwater, Site-related impacted sediment and Site-related impacted surface water.

4.1.3.5 *Short-Term Effectiveness*

It is estimated that the time to complete excavation and trucking off-site of the soil would be approximately one month. During this time, potential impacts to remedial contractors, during earthwork activities would be addressed in accordance with the HASP and CAMP. The potential for a temporary increase of risk to the community and workers due to particulate emissions (dust) during soil excavation would be controlled, if needed, by the use of dust control measures, such as water or foam sprays. The degree to which these measures would be used would depend upon particulate and VOC levels in ambient air at the property boundary as determined through the CAMP. Workers would also be protected by respirators (if needed) and protective clothing.

Potential short-term risks to the community would be posed by transportation of excavated soil to off-Site landfill disposal facilities. Potential exposure of spilled material to the community and the environment along the transportation route, as well as truck related injuries and increased emissions from trucks would be potential concerns. Because approximately 55 truckloads would be required to transport excavated soil/fill waste to an off-Site landfill disposal facility; there are some potential short-term risks associated with the transportation of excavated materials from the Site to an off-Site landfill.

4.1.3.6 *Implementability*

The main components of this alternative could be completed within 9 months of NYSDEC approval of the RD for this project. Groundwater monitoring, environmental easement, and limited annual OM&M activities would continue beyond this time frame. All activities associated with this alternative are readily implementable.

4.1.3.7 *Cost*

The capital and OM&M costs for this alternative are provided in Table 4-3.

4.1.4 ALTERNATIVE IV: HOT SPOT SOIL EXCAVATION AND SURFACE COVER, GROUNDWATER MNA, AND SEDIMENT REMOVAL

4.1.4.1 Overall Protection of Human Health and the Environment

This alternative would provide adequate protection of human health and the environment for the soil, groundwater and Site-related impacted surface water and sediment. The hot spot soil removal to depths below the water table, surface covers, and environmental easements would prevent direct contact with soil; and the hot spot removal and backfill with clean fill/ZVI mixture would mitigate leaching of VOCs to groundwater and reduce the overall concentrations of select metals in soil. The SSD systems would address the inhalation risks posed by the remaining VOCs in soil and groundwater.

The chlorinated VOCs in shallow groundwater would degrade upon contact with the ZVI installed along with the backfill in the excavated areas. Further, the chlorinated VOCs in shallow groundwater would continue to naturally degrade through reductive dechlorination, which would be confirmed through MNA monitoring. In addition, as discussed previously, metals are also present in Site groundwater at concentrations above the Class GA groundwater standards. However, the only receptor for metals discharging in groundwater is Freeport Creek and currently groundwater discharge does not result in unacceptable surface water concentrations. Nevertheless, antimony, cadmium and magnesium can be reduced and bound as iron oxyhydroxies when in contact with ZVI and manganese and hexavalent chromium can be reduced and precipitated upon contact with ZVI. These mechanisms would serve to reduce the dissolved concentrations of these constituents. The only metals not affected would be barium, which was only detected above the Class GA standards in one of the seven shallow wells, and iron and manganese, both of which have groundwater standards based on aesthetics. In conclusion, the addition of ZVI to the backfill would serve to reduce the resultant groundwater concentrations of chlorinated VOCs and metals migrating to the creek. Due to the isolated locations of sediment criteria exceedances above background levels, this alternative is expected to provide adequate protection of human health and environment for Site-related impacted sediment and surface water.

Finally, sediment removal from the storm sewer system along with Freeport Creek sediment removal would eliminate exposure to Site-related impacted sediment and is expected to improve surface water quality.

Thus, collectively, this alternative would provide adequate protection of human health and environment.

4.1.4.2 Compliance with SCGs

A summary of the applicable SCGs that apply to this alternative is presented in Table 4-1. As shown in this table, this alternative would address the chemical-specific SCGs through surface covers, hot spot soil excavation, SSD systems, environmental easement, and Freeport Creek sediment removal.

4.1.4.3 Long-Term Effectiveness and Permanence

This alternative would be effective in the long term, and its continued effectiveness would be mandated through the environmental easement. This alternative provides for the soil excavation of hot spot areas, maintenance of the existing and new surface covers, ZVI application, confirmation that the degradation of chlorinated VOCs continues to occur, Freeport Creek sediment removal, removal of the storm sewer sediment, and SSD.

4.1.4.4 Reduction of Toxicity, Mobility or Volume

Through natural attenuation and ZVI application, this alternative would result in a decrease in the toxicity, mobility and volume of the net chemicals in shallow groundwater. This reduction would be confirmed via groundwater monitoring. However, natural attenuation could result in short-term increase in toxicity due to the potential for generation of vinyl chloride. Additionally, the mass of individual VOCs could increase temporarily as natural attenuation progresses. Through excavation of hot spot areas, shallow groundwater treatment through application of ZVI, sediment removal from the storm sewer system and Freeport Creek sediment removal, this alternative would result in a decrease in the toxicity, mobility and volume of chemicals in soil, shallow groundwater, Site-related impacted sediment and Site-related impacted surface water.

4.1.4.5 Short-Term Effectiveness

It is estimated that the time to complete sheeting, excavation and trucking off-site of the soil would be approximately three months. During this time, potential impacts to remedial contractors, during earthwork activities would be addressed in accordance with the HASP and CAMP. Excavation stability potentially poses safety concerns; therefore, the depth of safe excavation would be defined in RD studies.

The potential for a temporary increase of risk to the community and workers due to particulate emissions (dust) during soil excavation would be controlled, if needed, by the use of dust control measures, such as water or foam sprays. The degree to which these measures would be used would depend upon particulate and VOC levels in ambient air at the property boundary as determined through the CAMP. Workers would also be protected by respirators (if needed) and protective clothing.

Potential short-term risks to the community would be posed by transportation of excavated soil to off-Site landfill disposal facilities. Potential exposure of spilled material to the community and the environment along the transportation route, as well as truck related injuries and increased emissions from trucks would be potential concerns. Because approximately 162 truckloads would be required to transport excavated soil/fill waste to an off-Site landfill disposal facility; there are some potential short-term risks associated with the transportation of excavated materials from the Site to an off-Site landfill. Barging of materials may be considered during the RD in lieu of truck transport.

Excavation to depths greater than 3 feet to 5 feet would also require dewatering and treatment and discharge of dewatering fluids. Short-term impacts to the Freeport Creek are also possible.

4.1.4.6 Implementability

The main components of this alternative could be completed within 1 year of NYSDEC approval of the RD for this project. Groundwater monitoring, environmental easement, and limited annual OM&M activities would continue beyond this time frame.

This alternative would require RD studies to evaluate possible excavation constraints and, if appropriate, stabilization options. Furthermore, the volume of construction liquid generated would need to be addressed appropriately and may pose administrative concerns. Because of the shallow groundwater elevation at the Site and large quantity of construction liquid, recharging the construction liquid would not be possible. As previously discussed, a SPDES permit would need to be obtained. In either case, the discharge limits to be determined by NYSDEC would govern the treatment requirements. Under either scenario, considerable testing of the effluent and OM&M would be required.

4.1.4.7 Cost

The capital and O&M costs for this alternative are provided in Table 4-4.

4.1.5 *ALTERNATIVE V: HOT SPOT SOIL EXCAVATION AND SURFACE COVER, REMOVAL OF UNCAPPED SOILS, ZVI WALL, SVE, AND SEDIMENT REMOVAL*

4.1.5.1 Overall Protection of Human Health and the Environment

This alternative would provide adequate protection of human health and the environment for the soil, groundwater and Site-related impacted surface water and sediment. The hot spot soil removal, surface covers, and environmental easements would prevent direct contact with soil and mitigate leaching of VOCs to groundwater, and would reduce the overall concentrations of select metals in soils. The SSD systems would address the inhalation risks posed by the remaining VOCs in soil and groundwater. Removal of the top six inches of uncovered soil would prevent direct contact exposures as well.

The chlorinated VOCs in groundwater would degrade upon contact with the ZVI wall, thus reducing the potential for migration of VOCs to soil gas downgradient of the wall. Further, the chlorinated VOCs in shallow groundwater would continue to naturally degrade through reductive dechlorination, which would be confirmed through groundwater monitoring. In addition, as discussed previously, metals are also present in Site groundwater at concentrations above the Class GA groundwater standards. However, the only receptor for metals in groundwater is Freeport Creek and these constituents do not pose an unacceptable risk to surface water. Nevertheless, antimony, cadmium and magnesium can be reduced and bound as iron oxyhydroxides when in contact with ZVI and manganese and hexavalent chromium can be reduced and precipitated upon contact with ZVI. These mechanisms would serve to reduce dissolved metals concentrations. The only metals not affected would be barium, which was only detected above the Class GA standards in one of the seven shallow wells, and iron and manganese, both of which have groundwater standards based on aesthetics. In conclusion, the ZVI wall would serve to reduce the resultant groundwater concentrations of chlorinated VOCs and metals migrating to the creek. The groundwater monitoring would serve to confirm that metals are not being mobilized and leaching to groundwater.

Due to the isolated locations of sediment criteria exceedances above background levels, this alternative is expected to provide adequate protection of human health and environment for Site-related impacted sediment and surface water. Finally, sediment removal from the storm sewer system along with Freeport Creek sediment removal would eliminate exposure to Site-related impacted sediment and is expected to improve surface water quality.

Thus, collectively, this alternative would provide adequate protection of human health and environment.

4.1.5.2 *Compliance with SCGs*

A summary of the applicable SCGs that apply to this alternative is presented in Table 4-1. As shown in this table, this alternative would address the chemical specific SCGs through surface covers, hot spot soil excavation, SSD and SVE systems, groundwater treatment, environmental easement, and Freeport Creek sediment removal.

4.1.5.3 *Long-Term Effectiveness and Permanence*

This alternative would be effective in the long term and would be considered a permanent remedy. This alternative provides for hot spot soil excavation, installation of a ZVI treatment wall, groundwater monitoring, Freeport Creek sediment removal, SVE, removal of the storm sewer sediment and SSD.

4.1.5.4 *Reduction of Toxicity, Mobility or Volume*

Hot spot soil excavation, the ZVI wall, SVE system, groundwater treatment and Site-related Freeport Creek sediment removal would result in a decrease in the toxicity, mobility and volume of COPCs in soil, groundwater, sediment and surface water.

4.1.5.5 *Short-Term Effectiveness*

It is estimated that the time to complete sheeting, excavation and trucking off-site of the soil would be approximately three months. During this time, potential impacts to remedial contractors, during earthwork activities would be addressed in accordance with the HASP and CAMP. Excavation stability potentially poses safety concerns; therefore, the depth of safe excavation would be defined in RD studies.

The potential for a temporary increase of risk to the community and workers due to particulate emissions (dust) during soil excavation would be controlled, if needed, by the use of dust control measures, such as water or foam sprays. The degree to which these measures would be used would depend upon particulate and VOC levels in ambient air at the property boundary as determined through the CAMP. Workers would also be protected by respirators (if needed) and protective clothing.

Potential short-term risks to the community would also be posed by this alternative from transportation of excavated soil to off-Site landfill disposal facilities. Potential exposure of spilled material to the community and the environment along the transportation route, as well as truck related injuries and increased emissions from trucks would be potential concerns. Because approximately 266 truckloads would be required to transport excavated soil/fill waste to an off-Site landfill disposal facility; there are significant potential short-term risks associated with the transportation of excavated materials from the Site to an off-Site landfill. Barging of materials may be considered during the RD in lieu of truck transport.

Excavation to depths greater than 3 feet to 5 feet would also require dewatering and treatment and discharge of dewatering fluids. Short-term impacts to the Freeport Creek are also possible.

4.1.5.6 *Implementability*

The main components of this alternative could be completed within one year of NYSDEC approval of the RD for this project. Groundwater monitoring, environmental easement, and limited annual OM&M activities would continue beyond this time frame.

This alternative would require RD studies to evaluate possible excavation constraints and, if appropriate, stabilization options. Furthermore, the volume of construction liquid generated would need to be addressed appropriately and may pose administrative concerns. Because of the shallow groundwater elevation at the Site and large quantity of construction liquid, recharging the construction liquid would not be possible. As previously discussed, a SPDES permit would need to be obtained from the NYSDEC. In either case, the discharge limits to be determined by NYSDEC would govern the treatment requirements. Under either scenario, considerable testing of the effluent and OM&M would be required.

4.1.5.7 *Cost*

The capital and O&M costs for this alternative are provided in Table 4-5.

4.1.6 *ALTERNATIVE VI: FULL-SCALE SOIL EXCAVATION, ZVI WALL, AND SEDIMENT REMOVAL*

4.1.6.1 *Overall Protection of Human Health and the Environment*

This alternative would provide adequate protection of human health and the environment for the soil, groundwater and Site-related impacted surface water and sediment. Full-scale soil removal would prevent direct contact exposures with chemicals in the Study Area soil and eliminate leaching of VOCs to groundwater.

The chlorinated VOCs in groundwater would degrade upon contact with the ZVI wall thus reducing the potential for migration of VOCs to soil gas downgradient of the wall. Further, the chlorinated VOCs in shallow groundwater would likely continue to naturally degrade through reductive dechlorination, which would be confirmed through groundwater monitoring. In addition, as discussed previously, metals are also present in Site groundwater at concentrations above the Class GA groundwater standards. However, the only receptor for metals in groundwater is Freeport Creek and these constituents do not pose an unacceptable risk to surface water. Antimony, cadmium and magnesium would be reduced and bound as iron oxyhydroxides when in contact with ZVI and manganese and hexavalent chromium can be reduced and precipitated upon contact with ZVI. These mechanisms would serve to reduce dissolved metal concentrations. The only metals not affected would be barium, which was only detected above the Class GA standards in one of the seven shallow wells, and iron and manganese, both of which have groundwater standards based on aesthetics. In conclusion, the ZVI wall would serve to reduce the resultant groundwater concentrations of chlorinated VOCs and metals migrating to the creek. The groundwater monitoring would serve to confirm that metals are not being mobilized and leaching to groundwater.

Due to the isolated locations of sediment criteria exceedances above background levels, this alternative is expected to provide adequate protection of human health and environment for Site-related impacted sediment and surface water. Finally, sediment removal from the storm sewer system along with Freeport Creek sediment removal would eliminate exposure to Site-related impacted sediment and is expected to improve surface water quality. Thus, collectively, this alternative would provide adequate protection of human health and environment.

4.1.6.2 Compliance with SCGs

A summary of the applicable SCGs that apply to this alternative is presented in Table 4-1. As shown in this table, this alternative would address the chemical specific SCGs through soil excavation, SSD system(s) if determined to be needed, groundwater treatment, environmental easement, and Freeport Creek sediment removal.

4.1.6.3 *Long-Term Effectiveness and Permanence*

This alternative would be effective in the long term and would be considered a permanent remedy. This alternative provides for the full-scale soil excavation, installation of a ZVI treatment wall, groundwater monitoring, Freeport Creek sediment removal, removal of the storm sewer sediment and SSD.

4.1.6.4 *Reduction of Toxicity, Mobility or Volume*

Through full-scale soil excavation, groundwater treatment and Site-related Freeport Creek sediment removal, this alternative would result in a decrease in the toxicity, mobility and volume of COPCs in soil, groundwater, sediment and surface water.

4.1.6.5 *Short-Term Effectiveness*

It is estimated that the time to complete sheeting, excavation and trucking off-site of the soil would be approximately one year. During this time, potential impacts to remedial contractors during earthwork activities would be addressed in accordance with the HASP and CAMP. Furthermore, since excavation stability poses significant safety concerns, the depth of safe excavation would need to be defined in RD studies.

The potential for a temporary increase of risk to the community and workers due to particulate emissions (dust) during soil excavation would be controlled, if needed, by the use of dust control measures, such as water or foam sprays. The degree to which these measures would be used would depend upon particulate and VOC levels in ambient air at the property boundary as determined through the CAMP. Workers would also be protected by respirators (if needed) and protective clothing.

Potential short-term risks to the community would also be posed by this alternative from transportation of excavated soil to off-Site landfill disposal facilities. Potential exposure of spilled material to the community and the environment along the transportation route, as well as truck related injuries and increased emissions from trucks would be potential concerns. Because approximately 1,556 truckloads would be required to transport excavated soil/fill waste to an off-Site landfill disposal facility; there are significant potential short-term risks associated with the transportation of excavated materials from the Site to an off-Site landfill. Barging of materials may be considered during the RD in lieu of truck transport.

Excavation would require dewatering and treatment and discharge of dewatering fluids. Short-term impacts to the Freeport Creek depending upon the discharge scenario selected.

4.1.6.6 *Implementability*

The main components of this alternative could be completed within two years of NYSDEC approval of the RD for this project. Groundwater monitoring, environmental easement, and limited annual OM&M activities may continue beyond this time frame.

This alternative would require RD studies to evaluate possible excavation constraints and, if appropriate, stabilization options. Furthermore, the volume of construction liquid generated would need to be addressed appropriately and may pose significant administrative concerns. Because of the shallow groundwater elevation at the Site and large quantity of construction liquid, recharging the construction liquid would not be possible. As previously discussed, a SPDES permit would need to be obtained from the NYSDEC. In either case, the discharge limits determined by NYSDEC would govern the treatment requirements. Under either scenario, considerable testing of the effluent and O&M would be required.

The duration of this alternative would increase the potential for adverse weather conditions to pose problems during implementation. For example, asphalt can only be installed during warm months.

4.1.6.7 *Cost*

The capital and O&M costs for this alternative are provided in Table 4-6.

4.2 *COMPARATIVE EVALUATION OF REMEDIAL ACTION ALTERNATIVES*

Overall Protection of Human Health and the Environment

Since Alternative I employs no action, contaminated soil will remain in place, providing no protection for potential future exposure. Alternatives II, III, IV, V and VI provide more protection of human health and the environment; each to a different degree of protectiveness. By providing surface covers to prevent direct contact exposures in Alternative II and restricting groundwater usage, potential direct human exposure pathways would be eliminated as well as reducing vertical migration of contamination by minimizing rainwater infiltration. An environmental easement must be implemented to maintain protection of human health and the environment. Alternatives III, IV, V, and VI provide a greater degree of protection than Alternative II because the contaminated soils would be excavated and properly disposed of off-site. There are no human or environmental receptors for impacted groundwater. Though, the subsequent volatilization to soil vapor and indoor air may be a pathway for exposure. Although there are no receptors of contamination, Alternative I will not prevent possible future exposures. Alternatives II through VI include an environmental easement and monitoring programs to minimize potential future exposures to contaminants. SSD systems are included in all Alternatives except Alternative I[7], and thus are protective of human health and the environment. Alternatives IV, V and VI employ active treatment through ZVI either via ZVI backfill in the saturated zone or installation of a ZVI wall to eliminate the groundwater contamination, providing the greatest degree of protectiveness.

Compliance with SCGs

Chlorinated VOCs concentrations in groundwater are expected to decrease over time due to natural attenuation, and for Alternatives IV, V, and VI, would be actively degraded by ZVI. Inorganics and VOCs will remain above SCGs in soil at some depth under a surface cover for all alternatives except Alternative VI. Therefore, Alternatives I through V do not comply with SCGs because contaminated soils would remain on site, to varying degrees. Alternative VI complies with SCGs since soil contamination will be removed and properly disposed of off-Site. NYSDEC Class GA groundwater standards comprise the chemical-specific SCGs for groundwater at the Study Area. Alternatives I through VI do not comply with the SCGs. Although Alternatives IV, V and VI provide active treatment to eliminate chlorinated VOCs in groundwater.

Long-term Effectiveness and Performance

Since Alternative I employs no action, contaminated soil would remain in place, providing no protection for potential future exposure. Alternative II would be effective in the long term provided proper inspection and routine maintenance is performed and the environmental easement is enforced. Alternatives III, IV, and V have a higher degree of long-term effectiveness than Alternative II because impacted soils would be removed and properly disposed of off-Site. Alternative VI would provide

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[7] Alternative VI includes SSD until building demolition and soil removal would be conducted. Following remedial action, the continued need for SSD systems for newly constructed buildings post-remediation would be evaluated through soil gas sampling.

for the greatest protection since all contaminated soils would be removed from the Site. Under all Alternatives, concentrations of chlorinated VOCs in groundwater are expected to decrease over time. The environmental easement restricting groundwater usage combined with monitoring for natural attenuation in Alternative II and III provide effective long-term mechanisms to protect human health and the environment. Alternatives IV, V, and VI further the decrease in groundwater concentrations through the use of ZVI and provides treatment for contaminated groundwater, which would increase protectiveness.

Reduction in Toxicity, Mobility, or Volume through Treatment

Reduction in toxicity, mobility, or volume through treatment would be achieved through Alternatives III through VI via soil removal, though the materials would just be transferred to a controlled landfill location. Alternatives II through VI would also achieve reduction in toxicity, mobility, and volume through natural attenuation, and for Alternatives IV, V, and VI, through degradation via ZVI.

Short-Term Effectiveness

Alternative I is the only alternative without any short-term effects since no

remediation activities will take place. Alternative II would also have little to no short-term effects. Short-term impacts may affect the surrounding community during remedy implementation for Alternatives III through VI such as noise, dust, and potential spills during off-Site transport of contaminated soil. It is anticipated that the remedial construction duration for Alternatives III through V would be less than Alternatives VI due to the limited excavated soil volumes associated with these alternatives. Noise impacts are associated with all excavation activities, therefore occurring during implementation of Alternatives III through VI.

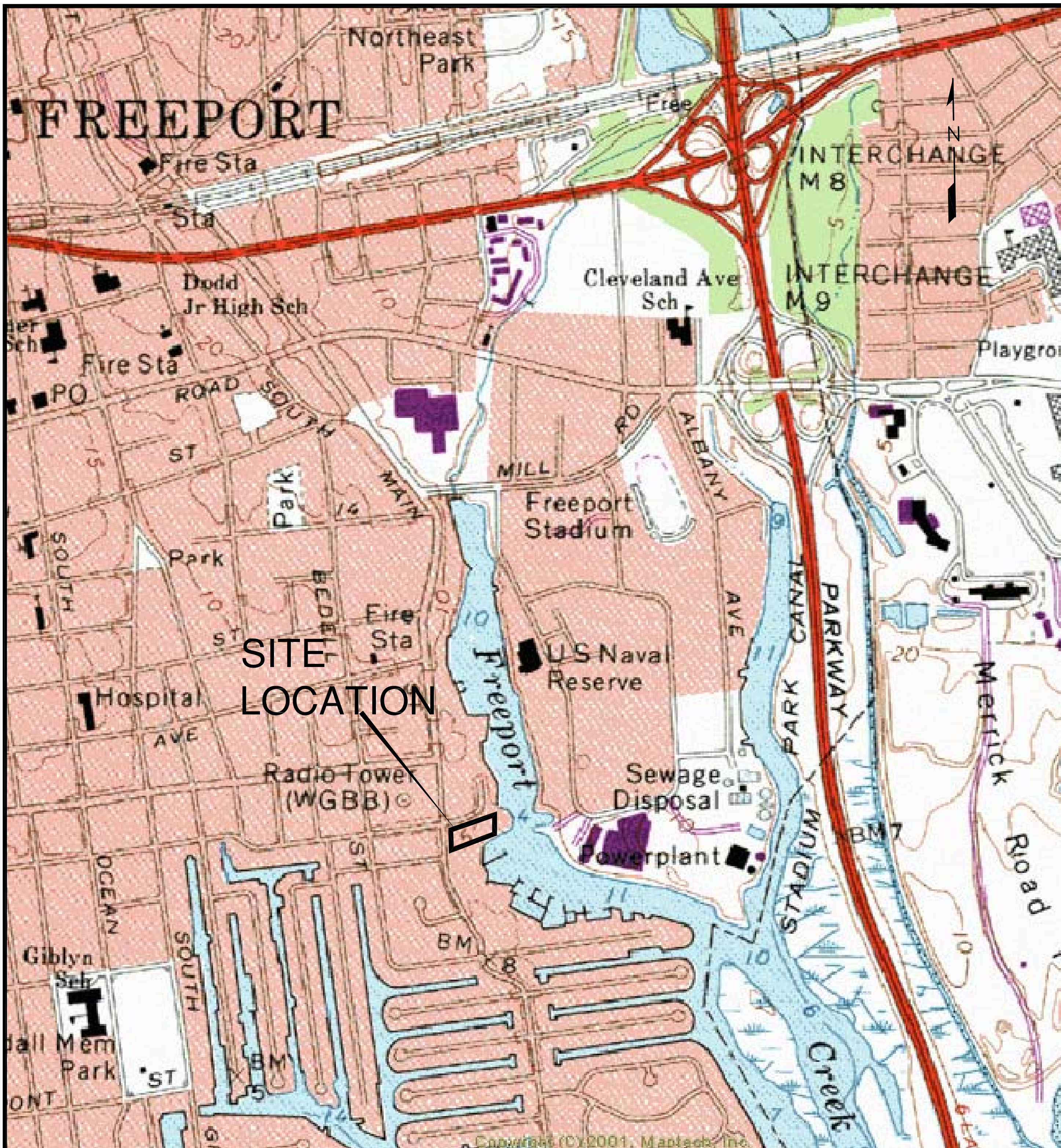
Implementability

There are not any actions to implement for Alternative I. Alternatives II through V are readily implemented using standard construction means and methods. Alternative VI would be difficult to implement given the shallow depth of groundwater, extensive excavation of the whole study area, and proximity to Freeport Creek.

Cost

Alternative I is no action, and does not have any associated cost. Alternative II has a lower total capital cost than Alternative III, but a significantly larger OM&M cost due to the continued MNR costs (Alternative II total cost is $2,168,945 and Alternative III total cost is $2,209,080). However, Alternative III is more effective at removing contaminants from the Study Area. Alternatives IV and V increase in cost as compared to Alternative II because both remove more soil, and also Alternative V includes a ZVI wall and SVE (Alternative IV is $4,750,005 and Alternative V is $8,384,717). Finally, Alternative VI is the most expensive alternative ($26,292,211) because it removes all soil at the Study Area down to 14 feet bgs.

FIGURES



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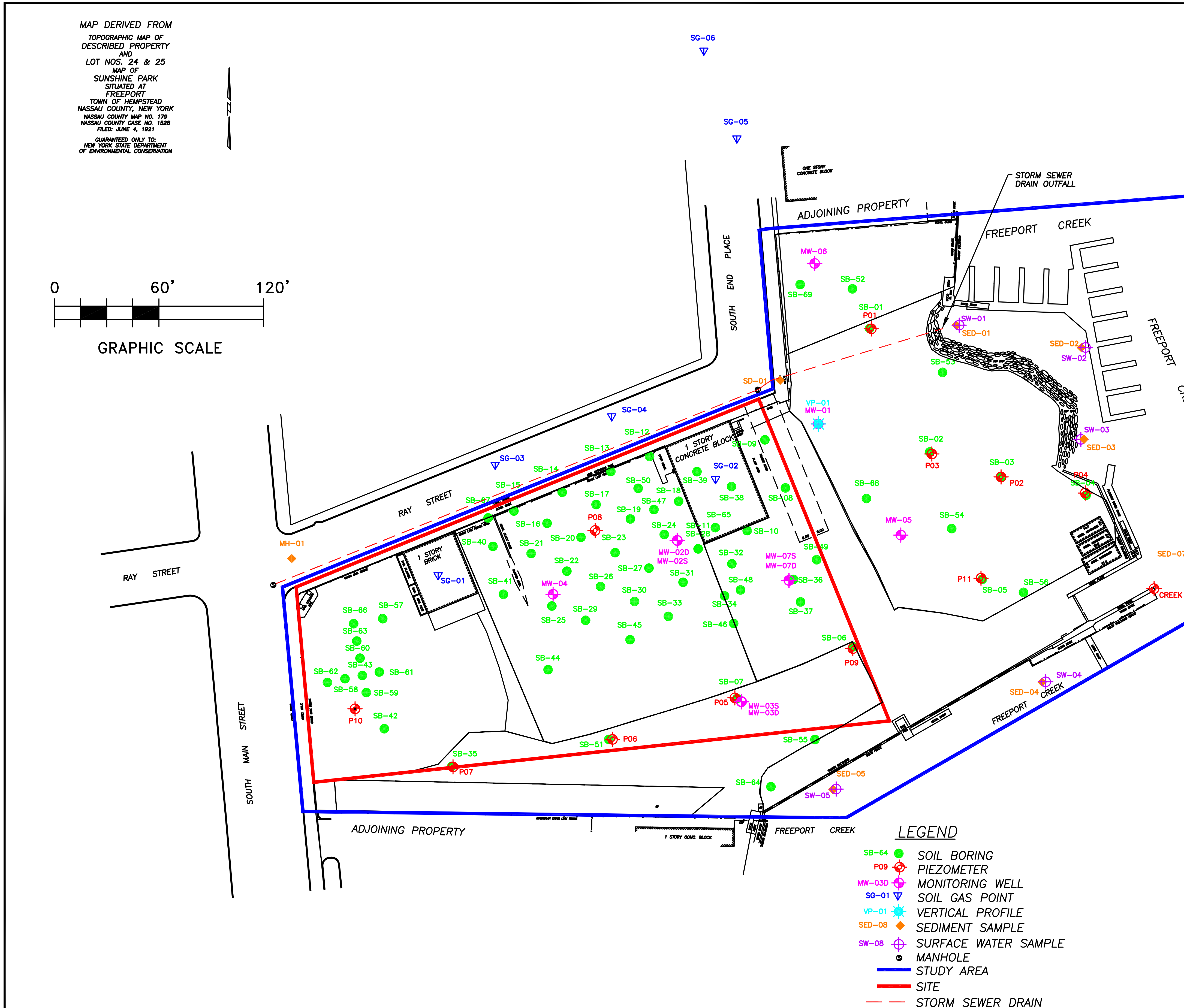
GRAPHIC SCALE IN FEET

SOURCE: USGS QUADRANGLE MAP, FREEPORT, NY, 1979

TITLE				
SITE LOCATION MAP METAL ETCHING FREEPORT, NEW YORK				
PREPARED FOR: NYSDEC				
ERM Environmental Resources Management			SCALE: GRAPHIC	FIGURE: 1-1
DRAWN: MFM	JOB NO.: 0011475	FILE NAME: 0011475.004a	DATE: 12/06/04	



TITLE

SITE AND STUDY AREA BOUNDARIES AND SAMPLE LOCATIONS
METAL ETCHING SITE
FREEPORT, NEW YORK

PREPARED FOR

NYSDEC

ERM Environmental Resources Management

DRAWN:	JOB NO.:	FILE NAME:	SCALE	FIGURE
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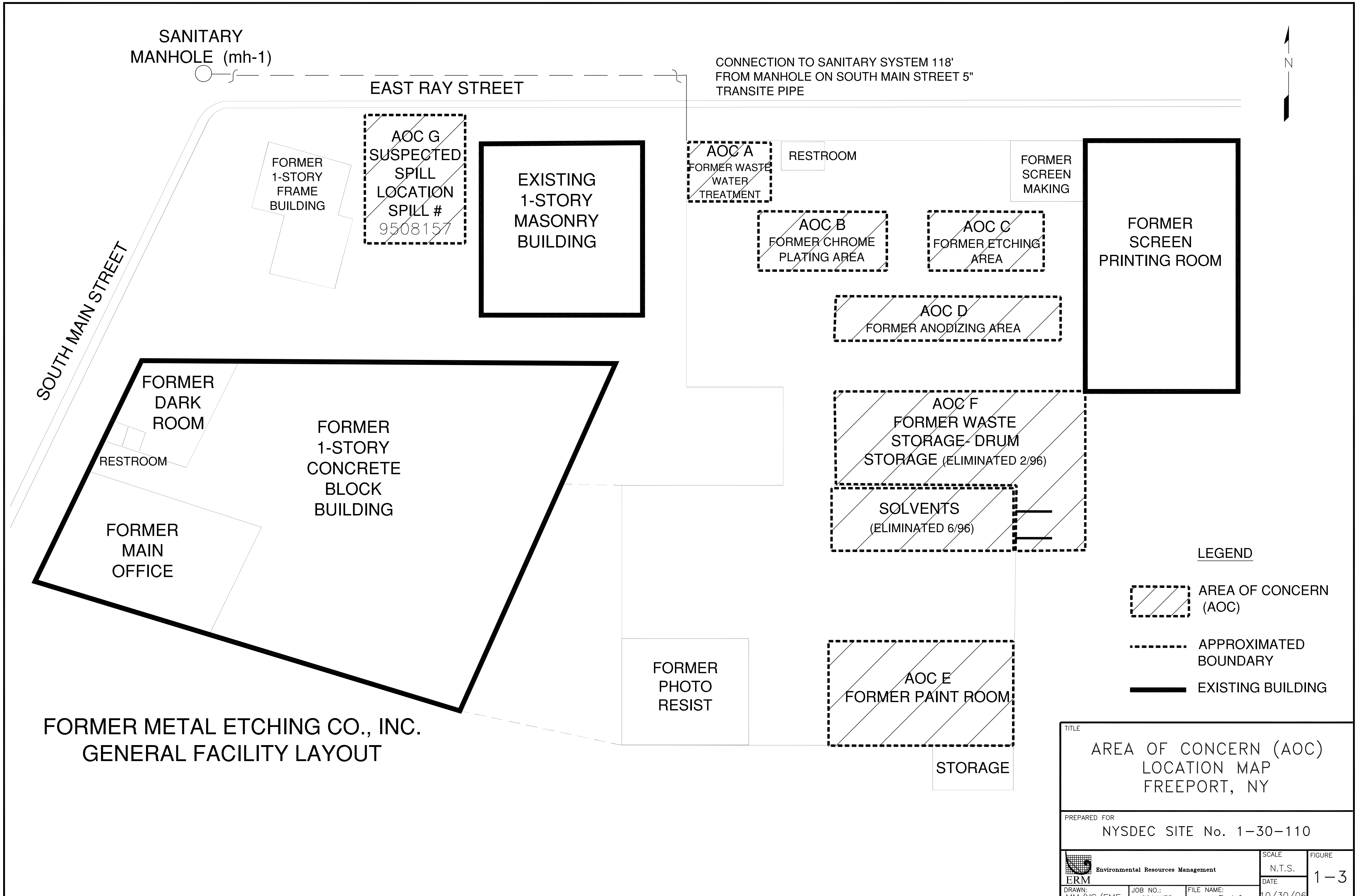
			DATE: 10/30/06	


SANITARY
MANHOLE (mh-1)
EAST RAY STREET
CONNECTION TO SANITARY SYSTEM 118'
FROM MANHOLE ON SOUTH MAIN STREET 5"
TRANSITE PIPE
N
SOUTH MAIN STREET
FORMER
1-STORY
FRAME
BUILDING
AOC G
SUSPECTED
SPILL
LOCATION
SPILL #
9508157
EXISTING
1-STORY
MASONRY
BUILDING
AOC A
FORMER WASTE
WATER
TREATMENT
RESTROOM
FORMER
SCREEN
MAKING
AOC B
FORMER CHROME
PLATING AREA
AOC C
FORMER ETCHING
AREA
FORMER
SCREEN
PRINTING ROOM
AOC D
FORMER ANODIZING AREA
FORMER
DARK
ROOM
RESTROOM
FORMER
1-STORY
CONCRETE
BLOCK
BUILDING
FORMER
MAIN
OFFICE
AOC F
FORMER WASTE
STORAGE- DRUM
STORAGE (ELIMINATED 2/96)
SOLVENTS
(ELIMINATED 6/96)
LEGEND
AREA OF CONCERN
(AOC)
APPROXIMATED
BOUNDARY
EXISTING BUILDING
FORMER
PHOTO
RESIST
AOC E
FORMER PAINT ROOM
STORAGE
FORMER METAL ETCHING CO., INC.
GENERAL FACILITY LAYOUT
TITLE
AREA OF CONCERN (AOC)
LOCATION MAP
FREEPORT, NY
PREPARED FOR
NYSDEC SITE No. 1-30-110
ERM
Environmental Resources Management
SCALE
N.T.S.
FIGURE
1-3
DATE
10/30/06
DRAWN:
MM/YS/EMF
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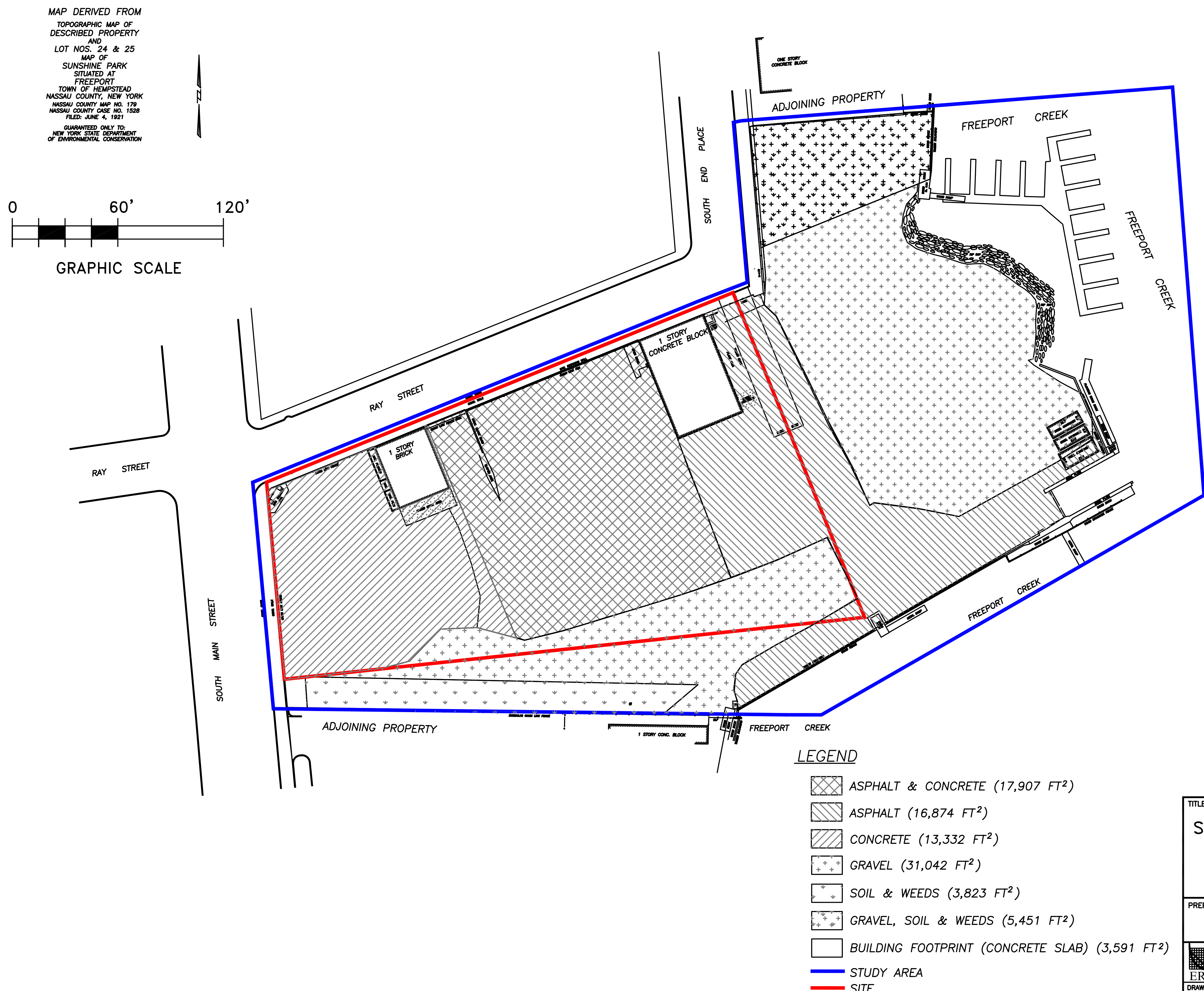
0011475
FILE NAME:
Fig 1-2



TITLE

SITE OVERLYING COVER MATERIALS
METAL ETCHING SITE
FREEPORT, NEW YORK

PREPARED FOR

NYSDEC

ERM Environmental Resources Management

DRAWN:	JOB NO.:	FILE NAME:	SCALE	FIGURE
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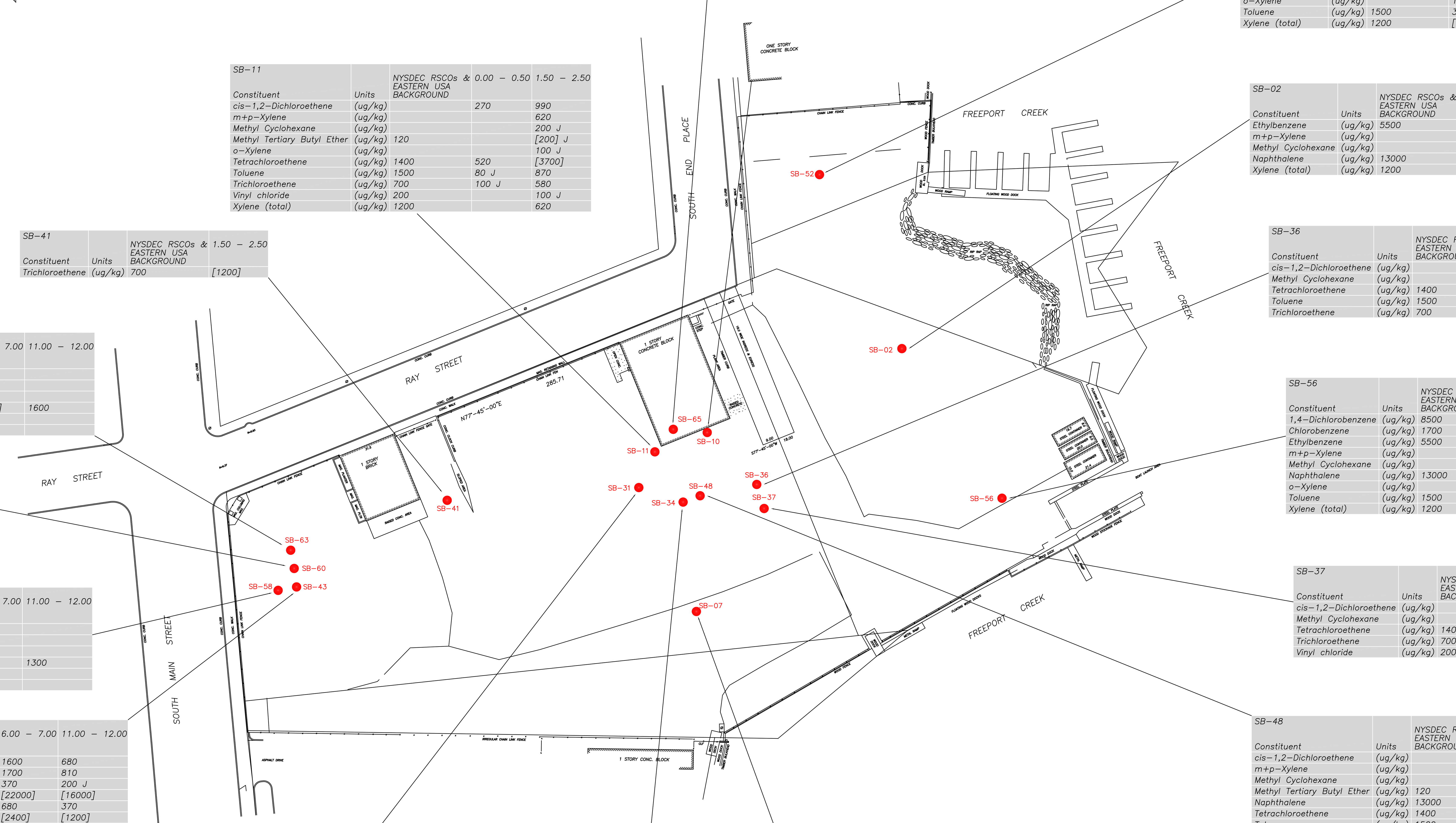
			DATE: 10/17/06	



SB-65 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	0.00 – 0.50	1.50 – 2.50	11.00 – 12.00
cis-1,2-Dichloroethene	(ug/kg)		1700		200 J
Tetrachloroethene	(ug/kg)	1400	200 J		
Trichloroethene	(ug/kg)	700	[10000]	100 J	[1100]

SB-10 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	0.00 – 0.50	1.50 – 2.50	6.00 – 7.00
cis-1,2-Dichloroethene	(ug/kg)		70 J	200 J	70 J
Methyl Cyclohexane	(ug/kg)		200 J		
Tetrachloroethene	(ug/kg)	1400		200 J	
Toluene	(ug/kg)	1500	60 J		90 J
Trichloroethene	(ug/kg)	700	100 J	[1700]	

SB-52 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	6.00 – 7.00	11.00 – 12.00
Ethylbenzene	(ug/kg)	5500	5200	1500
m+p-Xylene	(ug/kg)		3000	1400
Methyl Cyclohexane	(ug/kg)		42000	21000
Naphthalene	(ug/kg)	13000	6700	2800
o-Xylene	(ug/kg)		1000	290
Toluene	(ug/kg)	1500	360	80 J
Xylene (total)	(ug/kg)	1200	[4000]	[1700]

SB-11 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	0.00 – 0.50	1.50 – 2.50
cis-1,2-Dichloroethene	(ug/kg)		270	990
m+p-Xylene	(ug/kg)			620
Methyl Cyclohexane	(ug/kg)			200 J
Methyl Tertiary Butyl Ether	(ug/kg)	120		[200] J
o-Xylene	(ug/kg)			100 J
Tetrachloroethene	(ug/kg)	1400	520	[3700]
Toluene	(ug/kg)	1500	80 J	870
Trichloroethene	(ug/kg)	700	100 J	580
Vinyl chloride	(ug/kg)	200		100 J
Xylene (total)	(ug/kg)	1200		620

SB-02 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	0.00 – 0.50	1.50 – 2.50	6.00 – 7.00	11.00 – 12.00
Ethylbenzene	(ug/kg)	5500		1600	200 J	
m+p-Xylene	(ug/kg)			2000	60 J	
Methyl Cyclohexane	(ug/kg)		1400	54000 J	42000 J	590
Naphthalene	(ug/kg)	13000		1200	3800	350
Xylene (total)	(ug/kg)	1200		[2000]	60 J	

SB-41 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	1.50 – 2.50
Trichloroethene	(ug/kg)	700	[1200]

SB-36 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	0.00 – 0.50	1.50 – 2.50	6.00 – 7.00	11.00 – 12.00
cis-1,2-Dichloroethene	(ug/kg)		470	200 J	300	
Methyl Cyclohexane	(ug/kg)		27000	750	420	250
Tetrachloroethene	(ug/kg)	1400	80 J		100 J	
Toluene	(ug/kg)	1500	[2800]			
Trichloroethene	(ug/kg)	700	560		[1000]	

SB-63 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	0.00 – 0.50	1.50 – 2.50	6.00 – 7.00	11.00 – 12.00
Ethylbenzene	(ug/kg)	5500			1600	
m+p-Xylene	(ug/kg)				2600	
Methyl Cyclohexane	(ug/kg)				970	
Naphthalene	(ug/kg)	13000	200 J	80 J	[19000]	1600
o-Xylene	(ug/kg)				480	
Xylene (total)	(ug/kg)	1200			[3100]	

SB-56 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	4.00 – 8.00	10.00 – 14.00	20.00 – 24.00
1,4-Dichlorobenzene	(ug/kg)	8500	4800	200 J	
Chlorobenzene	(ug/kg)	1700	[3700]	90 J	
Ethylbenzene	(ug/kg)	5500	[14000]	280	
m+p-Xylene	(ug/kg)		15000	320	
Methyl Cyclohexane	(ug/kg)		34000	950	
Naphthalene	(ug/kg)	13000	11000	1200	60 J
o-Xylene	(ug/kg)		470		
Toluene	(ug/kg)	1500	270		
Xylene (total)	(ug/kg)	1200	[15000]	320	

SB-60 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	6.00 – 7.00	11.00 – 12.00
Ethylbenzene	(ug/kg)	5500	3600	80 J
m+p-Xylene	(ug/kg)		9100	200 J
Methyl Cyclohexane	(ug/kg)		1300	
Naphthalene	(ug/kg)	13000	[25000]	4500
o-Xylene	(ug/kg)		1400	
Xylene (total)	(ug/kg)	1200	[11000]	200 J

SB-37 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	0.00 – 0.50	1.50 – 2.50	6.00 – 7.00	11.00 – 12.00
cis-1,2-Dichloroethene	(ug/kg)		12000	300 J	100 J	100 J
Methyl Cyclohexane	(ug/kg)		200 J	200 J	100 J	100 J
Tetrachloroethene	(ug/kg)	1400	[4300]	200 J	100 J	100 J
Trichloroethene	(ug/kg)	700	[2700]	80 J		70 J
Vinyl chloride	(ug/kg)	200	[1800]			

SB-58 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	6.00 – 7.00	11.00 – 12.00
Ethylbenzene	(ug/kg)	5500	420	
m+p-Xylene	(ug/kg)		2000	
Methyl Cyclohexane	(ug/kg)		100 J	
Naphthalene	(ug/kg)	13000	10000	1300
o-Xylene	(ug/kg)		2000	
Xylene (total)	(ug/kg)	1200	[4000]	

SB-48 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	11.00 – 12.00	0.00 – 0.50	1.50 – 2.50	6.00 – 7.00
cis-1,2-Dichloroethene	(ug/kg)		60 J			70 J
m+p-Xylene	(ug/kg)					80 J
Methyl Cyclohexane	(ug/kg)		1100	200 J	1000	740
Methyl Tertiary Butyl Ether	(ug/kg)	120	[450]		60 J	
Naphthalene	(ug/kg)	13000	100 J		200 J	640
Tetrachloroethene	(ug/kg)	1400				200 J
Toluene	(ug/kg)	1500				60 J
Trichloroethene	(ug/kg)	700	200 J		80 J	[730]
Xylene (total)	(ug/kg)	1200				80 J

SB-43 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	6.00 – 7.00	11.00 – 12.00
Ethylbenzene	(ug/kg)	5500	1600	680
m+p-Xylene	(ug/kg)		1700	810
Methyl Cyclohexane	(ug/kg)		370	200 J
Naphthalene	(ug/kg)	13000	[22000]	[16000]
o-Xylene	(ug/kg)		680	370
Xylene (total)	(ug/kg)	1200	[2400]	[1200]

SB-07 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	0.00 – 0.50	6.00 – 7.00	11.00 – 12.00	1.50 – 2.50
Benzene	(ug/kg)	60		[480]		[1400]
Ethylbenzene	(ug/kg)	5500		70 J		200 J
m+p-Xylene	(ug/kg)		80 J	370		1000
Methyl Cyclohexane	(ug/kg)		1700			170000 J
Naphthalene	(ug/kg)	13000	200 J	2600	310	8300
o-Xylene	(ug/kg)			100 J		100 J
Toluene	(ug/kg)	1500		350		1100
Xylene (total)	(ug/kg)	1200	80 J	370		1000

SB-31 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	0.00 – 0.50	1.50 – 2.50	6.00 – 7.00	11.00 – 12.00
Methyl Cyclohexane	(ug/kg)				100 J	
Methyl Tertiary Butyl Ether	(ug/kg)	120			[280]	70 J
Tetrachloroethene	(ug/kg)	1400	710			60 J
Toluene	(ug/kg)	1500		60 J		70 J

SB-34 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	0.00 – 0.50	6.00 – 7.00	11.00 – 12.00	7.00 – 8.00
Ethylbenzene	(ug/kg)	5500		200 J		200 J
m+p-Xylene	(ug/kg)			410		470
Methyl Cyclohexane	(ug/kg)		17000	170000	4200	350000
Methyl Tertiary Butyl Ether	(ug/kg)	120	[370]	[1500]		
Naphthalene	(ug/kg)	13000	370	1300		680
Toluene	(ug/kg)	1500	100 J	[35000]	200 J	[78000]
Xylene (total)	(ug/kg)	1200		410		470

LEGEND

SB-63 ● SOIL BORING LOCATION WITH VOLATILE ORGANIC COMPOUND CONCENTRATIONS ABOVE NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION (NYSDEC) TECHNICAL AND ADMINISTRATIVE GUIDANCE MEMORANDUM (TAGM) #4046 RECOMMENDED SOIL CLEANUP OBJECTIVE (RSCO)

[ ] DETECTED SOIL CONCENTRATION IS ABOVE NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION (NYSDEC) TECHNICAL AND ADMINISTRATIVE GUIDANCE MEMORANDUM (TAGM) #4046 RECOMMENDED SOIL CLEANUP OBJECTIVE (RSCO)

J ESTIMATED VALUE

MAP DERIVED FROM
TOPOGRAPHIC MAP OF DESCRIBED PROPERTY AND LOT NOS. 24 & 25 MAP OF SUNSHINE PARK SITUATED AT FREEPORT TOWN OF HEMPSTEAD NASSAU COUNTY, NEW YORK
NASSAU COUNTY MAP NO. 179
NASSAU COUNTY CASE NO. 1528
FILED: JUNE 4, 1921
GUARANTEED ONLY TO: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

0 30' 60'
GRAPHIC SCALE

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

NYSDEC

ERM Environmental Resources Management

CHECKED	DATE
DESIGN ENGINEER	
PROJECT ENGINEER	
PROJECT MANAGER	MFM
APPROVED	
APPROVED	

VOC DETECTIONS IN SOIL ABOVE TAGM RSCO
METAL ETCHING SITE NO. 1-30-110
FREEPORT, NEW YORK

DRAWN	DATE	REVISED DATE
MFM/EMF	10/24/06	
SCALE	JOB NO.	FILE NAME
GRAPHIC	0011475.1	0011475-01-033

DRAWING NO. 2-2
REV. NO.
SHEET OF

SB-23 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	3.9	[52]	[1500]	[120]
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	4	4.3	[130]	10
Nickel	13	4.5 U	4.5 U	[33]	4.4 U
Zinc	20	7.3	4.5 U	[40]	4.4 U

SB-24 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00	16.00	20.00	24.00	33.00
Chromium	50	29	29	[190]	[140]	43	35	[58]	38
Chromium(Hexavalent)	NA	NA	NA	6.52	NA	NA	NA	NA	NA
Copper	25	2.8 U	2.7 U	[25]	13	7.4	7.1	5.1	[25]
Nickel	13	4.6 U	4.5 U	4.1 U	5.1 U	5.2 U	<4.7 U	<4.9 U	[19]
Zinc	20	4.6 U	4.5 U	4.7	5.1 U	5.2 U	<4.7 U	<4.9 U	[51]

SB-18 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	[120]	3.3	33	23
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[30]	2.8 U	[37]	6.6
Nickel	13	[46]	4.6 U	[16]	3.7 U
Zinc	20	[81]	6.4	[77]	4.9

SB-39 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	3.5	10	3.1	2 U
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	5.6	20	2.8 U	2.9 U
Nickel	13	4.8 U	7.6	4.6 U	4.9 U
Zinc	20	8.2	[41]	19	4.9 U

SB-69 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	6.7	3	2.8	3.5
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	9.7	3.6	3.5	4.1
Nickel	13	4.5	2.2 U	2.3 U	2.2 U
Zinc	20	[23]	4.8	4.5	3.2

SB-38 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	9.5	3.7	1.7	1.8
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	4.9	7.1	2.5 U	2.5
Nickel	13	4.2 U	5.2 U	4.2 U	3.8 U
Zinc	20	6	[33]	4.2 U	3.8 U

SB-20 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	39	4.7	23	[98]
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	16	3.6	4.3	6.9
Nickel	13	8.5	7.3	5.3 U	12
Zinc	20	18	6.8	6.6	5.1

SB-19 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	5.7	2.9	[51]	[85]
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	5	3.9	12	14
Nickel	13	5.2 U	4.5 U	4.4 U	6.2
Zinc	20	8	5.4	7.4	12

SB-12 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	[220]	[640]	[500]	28
Chromium(Hexavalent)	NA	88.9	NA	218	NA
Copper	25	3.2	2.8	2.7	4.1
Nickel	13	4.2	3.6	8.1	[25]
Zinc	20	3.6	4.1	3.7	3.6

SB-65 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	3.9	9.9	2.5	6
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	3.6	[65]	2	20
Nickel	13	2.2 U	11	2 U	3.8
Zinc	20	6.2	[29]	3.1	[20]

SB-09 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	10	2.5	2.3	2.1
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	18	2.8 U	3.4	3.3
Nickel	13	6	4.7 U	4.7 U	9.9
Zinc	20	[37]	[27]	[33]	[31]

SB-52 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	[100]	34	7	7
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[100]	[180]	5.3	[45]
Nickel	13	6.2	[21]	3.7 U	4.1 U
Zinc	20	[48]	[1200]	[350]	[150]

SB-16 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00	16.00	20.00	37.00
Chromium	50	[120]	[1100]	[180]	[80]	48	37	2
Chromium(Hexavalent)	NA	4.26 U	19.4	5.94	NA	NA	NA	NA
Copper	25	[40]	[49]	13	3	5.2	7	<2.6 U
Nickel	13	2.3 U	2.2 U	5	4.3	4.5 U	<3.9 U	<4.4 U
Zinc	20	4.9	2.2	7.3	2.9	4.5 U	6.4	<4.4 U

SB-17 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00	0.50
Chromium	50	[470]	[160]	17	20	
Chromium(Hexavalent)	NA	NA	NA	NA	NA	4.58 U
Copper	25	16	12	5.1	5.8	
Nickel	13	4.5 U	5.2 U	4.6 U	3.7 U	
Zinc	20	4.5 U	5.2 U	4.6 U	3.7 U	

SB-11 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	6.9	36	5.2	2.8
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[100]	[130]	6.3	2.9
Nickel	13	[440]	[1300]	9.6	4.2 U
Zinc	20	[180]	[290]	7.3	4.2 U

SB-32 Constituent	NYSDEC RSCOs	7.00	12.00
Chromium	50	4.3	2.1
Chromium(Hexavalent)	NA	NA	NA
Copper	25	6.6	2.9 U
Nickel	13	11	4.8 U
Zinc	20	8.4	4.8 U

SB-01 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	14	13	14	3.4
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[530]	[5700]	[220]	15
Nickel	13	9	9.3	6.9	5 U
Zinc	20	[140]	[790]	[170]	5 U

SB-67 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	[310]	[68]	10	[76]
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[890]	[31]	10	13
Nickel	13	[280]	8.4	5.5	4.1
Zinc	20	[160]	7.1	14	9.1

SB-15 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	9.7	4.7	38	36
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[110]	9.5	3.5	2.7
Nickel	13	[13]	2.8	2.2	2.2 U
Zinc	20	[58]	[44]	3.9	3

SB-14 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	13	4.4	9.1	15
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[64]	4.6	3.1	3.3
Nickel	13	[170]	2.4	3.2	2.4 U
Zinc	20	[67]	[21]	8.9	4

SB-47 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	31	2.5	[57]	22
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[55]	3.5	7.6	7.9
Nickel	13	[24]	3.5 U	5.4 U	4.4 U
Zinc	20	[25]	4.5	5.4 U	4.4 U

SB-53 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	27	18	6.1	6.6
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[85]	[66]	12	5
Nickel	13	[15]	[14]	4.7 U	4.9 U
Zinc	20	[130]	[95]	[26]	13

SB-40 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	5.6	35	36	25
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	20	9.6	3.8	5.3
Nickel	13	5.5	10	5.2	4.7 U
Zinc	20	[81]	[26]	4.8 U	5.1

SB-21 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	4.3	[170]	[59]	[73]
Chromium(Hexavalent)	NA	NA	NA	7.21	NA
Copper	25	5.6	[110]	7.5	3.4
Nickel	13	5 U	9.8	8.7	5
Zinc	20	6.8	[32]	7.6	4.8 U

SB-31 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	[150]	21	3.9	4.1
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[330]	24	2.7 U	5.3
Nickel	13	[13]	[15]	4.5 U	4.4 U
Zinc	20	[140]	[140]	9.5	12

SB-50 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	[50]	18	[75]	49
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	9.5	[110]	8.4	2.6
Nickel	13	4.5 U	[320]	4.5 U	3.6 U
Zinc	20	5.8	[78]	4.5 U	3.6 U

SB-68 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	42	7.3	3.4	5.5
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[540]	[35]	[160]	24
Nickel	13	10	4.4	2.2 U	3
Zinc	20	[200]	[110]	[31]	[160]

SB-27 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	6.7	8.3	3.1	5.5
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[58]	[43]	[92]	5.3
Nickel	13	4.8 U	4.7 U	9.3	11
Zinc	20	[100]	[120]	9.6	[24]

SB-13 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	15	10	9.5	8
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[310]	6.2	[44]	3.3
Nickel	13	[140]	[53]	[380]	2.4 U
Zinc	20	[310]	8.8	[47]	2.9

SB-02 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	7	[1200]	13	9.5
Chromium(Hexavalent)	NA	NA	24.3	NA	NA
Copper	25	[30]	[1600]	[93]	[44]
Nickel	13	9.1	[19]	[24]	7.8
Zinc	20	[110]	[1200]	[130]	[42]

SB-26 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	9	12	[82]	[120]
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[210]	[310]	7.5	9.6
Nickel	13	11	[13]	4.4 U	4.5 U
Zinc	20	[640]	[810]	4.5	4.9

SB-22 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	4	3.5	36	2.4
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	3	4.1	10	3
Nickel	13	4.7 U	4.7 U	4.8	4.2 U
Zinc	20	6.7	9.3	4.5 U	9.8

SB-03 Constituent	NYSDEC RSCOs	7.00	0.50	2.50	12.00
Chromium	50	22	[57]	13	15
Chromium(Hexavalent)	NA	NA	4.56 U	NA	NA
Copper	25	[640]	[2000]	[180]	11
Nickel	13	[20]	[71]	[13]	5.2 U
Zinc	20	[360]	[1600]	[240]	13

SB-41 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	6.4	6.9	3	3.3
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[31]	[29]	6.9	3.6
Nickel	13	[220]	9.8	5.7	3.8 U
Zinc	20	[46]	[320]	13	6

SB-25 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	43	11	5.3	3
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[960]	[290]	6.9	12
Nickel	13	[240]	[32]	[13]	5 U
Zinc	20	[3600]	[910]	[24]	7.9

SB-04 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	14	5.7	22	22
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[39]	[40]	[100]	10
Nickel	13	5 U	5 U	[15]	9.9
Zinc	20	[22]	[20]	[160]	[31]

SB-57 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	8.5	7.3	2.5	7.9
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	14	5.3	4	5.5
Nickel	13	4.7 U	4.3	4.9 U	5 U
Zinc	20	[34]	11	4.9 U	12

SB-54 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	3.9	9.9	24	14
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	16	15	[170]	4.4
Nickel	13	5.1 U	9.9	[15]	4.7
Zinc	20	14	[94]	[260]	17

SB-61 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	5.1	8.4	3.2	2.7
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	14	4.9	3.1 U	2.9 U
Nickel	13	4.8 U	5.4	5.2 U	4.8 U
Zinc	20	[69]	14	5.2 U	4.8 U

SB-60 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	4.6	6.1	1.9	4.9
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	8	5.3	2.4	4.3
Nickel	13	4.2 U	4.8 U	3.8 U	5.4 U
Zinc	20	[63]	13	3.8 U	5.4 U

SB-56 Constituent	NYSDEC RSCOs	8.00	14.00	24.00	38.00
Chromium	50	14	2.2 U	31	5.9
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[57]	3.3 U	[69]	3.5
Nickel	13	[16]	5.6 U	5 U	4.3
Zinc	20	[150]	5.6 U	5 U	13

SB-66 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	13	6.4	1.8	6.6
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[26]	6.4	2.5	3.2
Nickel	13	6.4	4.3	2.7	2.3 U
Zinc	20	[110]	11	6.5	10

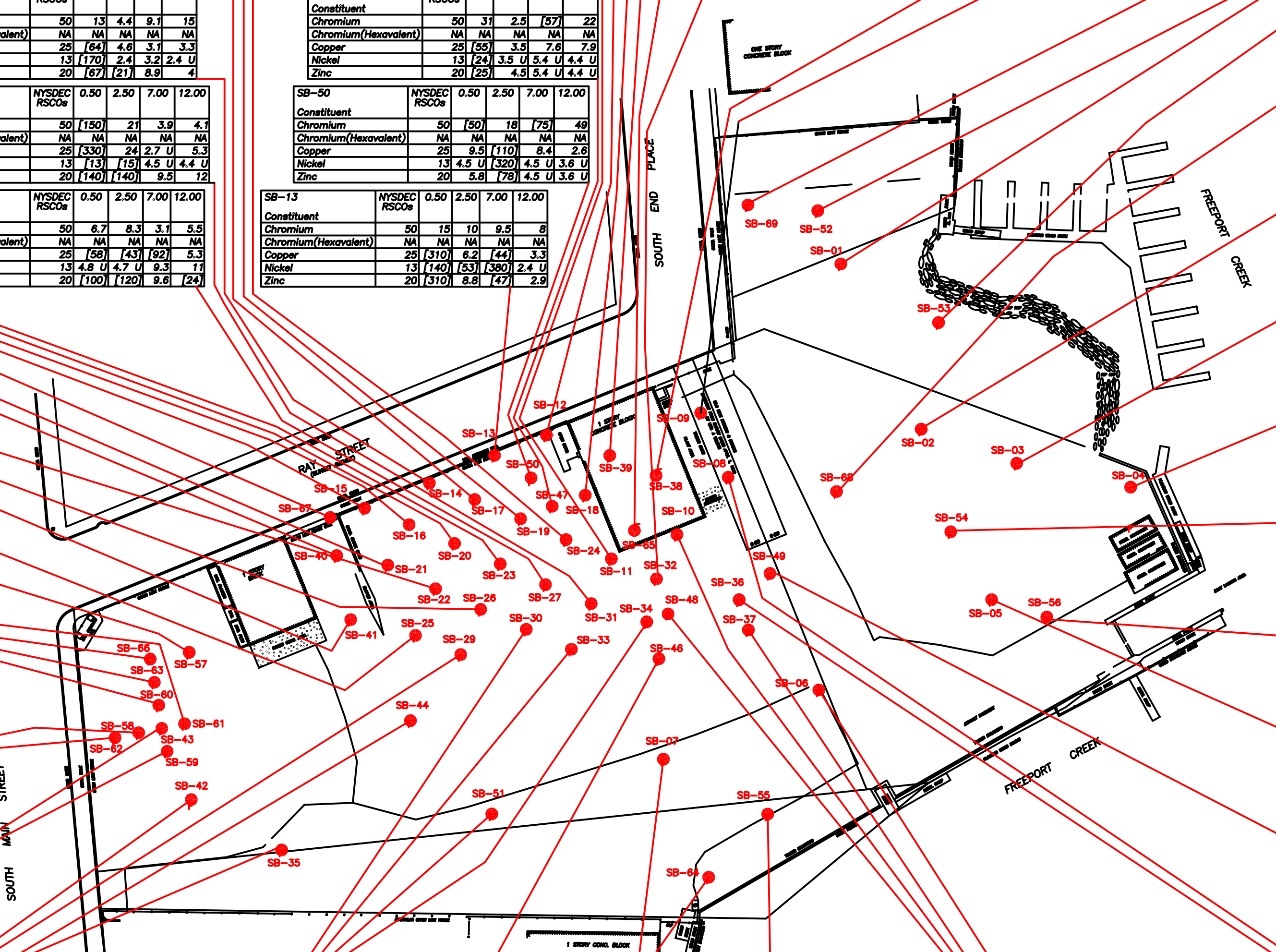
SB-62 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	6.7	8.6	3.8	3.5
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	2.5 U	4.2	2.8	3.2 U
Nickel	13	4.2	5.2 U	4 U	5.3 U
Zinc	20	13	13	6.2	5.3 U

SB-05 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	30	11	8.8	1.9
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[87]	[69]	9.6	2.9
Nickel	13	9.3	7.7	5 U	4.2 U
Zinc	20	[70]	[87]	[34]	4.2 U

SB-63 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	34	5.8	2.6	2.8
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[68]	6.3	2.9	3
Nickel	13	[18]	3.1	2.4 U	2.2 U
Zinc	20	[210]	[24]	2.7	2.5

SB-59 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	3.5	5.8	2.2	6.6
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	11	4.1	3.6	3.5
Nickel	13	4.5 U	4.2 U	4 U	4.5 U
Zinc	20	[46]	11	5.3	4.5 U

SB-49 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	14	9.5	16	11
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[32]	17	[25]	[37]
Nickel	13	7	4.9	9.8	5.5
Zinc	20	[73]	[160]	[84]	[54]



SB-58 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	15	7.4	4.9	2.1 U
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	21	6.3	4.7	3.1 U
Nickel	13	4.2 U	5.2 U	3.6 U	5.2 U
Zinc	20	[70]	13	6	5.2 U

SB-29 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	4.6	5.4	2.2 U	4.9
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	9.6	8.7	3.3 U	6.8
Nickel	13	5.4 U	5.1 U	5.6 U	5 U
Zinc	20	[22]	[37]	13	[67]

SB-30 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	12	13	2.4	1.7
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[31]	[48]	2.7 U	2.1 U
Nickel	13	11	6.1	4.5 U	3.5
Zinc	20	[62]	[49]	4.5 U	4.6

SB-46 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	44	6.9	20	5.8
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[140]	15	[130]	5.3
Nickel	13	[18]	4.9 U	6.1	4.5 U
Zinc	20	[100]	[23]	[52]	5.6

SB-55 Constituent	NYSDEC RSCOs	8.00	14.00	24.00	34.00
Chromium	50	12	13	32	19
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	21	[140]	7.7	7.9
Nickel	13	5 U	4.7	4.2 U	4.7 U
Zinc	20	[59]	[87]	4.2 U	4.7 U

SB-06 Constituent	NYSDEC RSCOs	2.50	0.50	7.00	12.00
Chromium	50	7.1	35	3.6	9
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[90]	[31]	9.1	2.7 U
Nickel	13	9.4	6	4.7 U	4.5 U
Zinc	20	[130]	[83]	[50]	4.5 U

SB-08 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	18	12	3.1	3.4
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[81]	13	3.1 U	2.7
Nickel	13	[34]	6.7	5.2 U	4.5 U
Zinc	20	[110]	[46]	5.2 U	4.5 U

SB-43 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	4	8.6	2.9	5.9
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	8.9	3.8	3.4	2.9
Nickel	13	4.3 U	5.6	3.9 U	4.8 U
Zinc	20	[36]	17	5	8.8

SB-44 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	27	6	2	3.1
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[240]	14	3.5	4.1
Nickel	13	11	4.6	4.2 U	5.4 U
Zinc	20	[81]	[39]	18	5.4 U

SB-33 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	4.4	10	3.4	2.7
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[25]	5.4	2.9 U	3
Nickel	13	4.5 U	6.5	4.8 U	4.5 U
Zinc	20	15	15	9	4.5 U

SB-07 Constituent	NYSDEC RSCOs	0.50	7.00	12.00	2.50	0.50
Chromium	50	[740]	[690]	3.9	[320]	
Chromium(Hexavalent)	NA	NA	9.93	NA	13.6	4.39 U
Copper	25	[260]	[84]	2.4 U	[130]	
Nickel	13	[37]	[240]	4 U	[45]	
Zinc	20	[280]	[99]	4 U	[180]	

SB-48 Constituent	NYSDEC RSCOs	12.00	0.50	2.50	7.00
Chromium	50	8.1	26	5.3	24
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	5.3	[180]	[43]	[150]
Nickel	13	6.2	[99]	[21]	[49]
Zinc	20	10	[240]	[26]	[85]

SB-37 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	[74]	8.5	3.6	7.7
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[3600]	[110]	22	[83]
Nickel	13	[23]	[20]	4.6 U	5 U
Zinc	20	[470]	[79]	[24]	[130]

SB-36 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	23	6	12	3.1
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[65]	9.6	[64]	2.2 U
Nickel	13	[20]	4.9 U	9.9	3.7 U
Zinc	20	[420]	[32]	[140]	3.7 U

SB-42 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	1.8 U	3.9	2.3	2 U
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	6.2	10	2.9	2.9 U
Nickel	13	4.5 U	5.3 U	4.8 U	4.9 U
Zinc	20	7.6	[28]	5.6	4.9 U

SB-35 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	4.6	9.8	2.9	3.7
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	13	[35]	3.6	3.1
Nickel	13	5 U	4.8 U	4.9 U	4.7 U
Zinc	20	[32]	[55]	13	4.7 U

SB-51 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	15	18	29	3.4
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[35]	[47]	[1300]	12
Nickel	13	10	5.8	7.5	5 U
Zinc	20	[170]	[38]	[69]	7.3

SB-34 Constituent	NYSDEC RSCOs	0.50	7.00	12.00	0.50	8.00
Chromium	50	[230]	14	2.7		44
Chromium(Hexavalent)	NA	NA	NA	NA	7.09	NA
Copper	25	[290]	[28]	3.3		[51]
Nickel	13	[48]	4.7 U	5.4		[16]
Zinc	20	[140]	17	[35]		[27]

SB-10 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	[390]	[2200]	16	3.2
Chromium(Hexavalent)	NA	19.2	14.3	NA	NA
Copper	25	[500]	[370]	15	21
Nickel	13	[40]	[13]	[50]	4.7 U
Zinc	20	[150]	[69]	[500]	[20]

SB-64 Constituent	NYSDEC RSCOs	0.50	2.50	7.00	12.00
Chromium	50	13	44	16	0.92 U
Chromium(Hexavalent)	NA	NA	NA	NA	NA
Copper	25	[1300]	[77]	[44]	4
Nickel	13	[17]	[28]	9.4	2.3 U
Zinc	20	[600]	[250]	[57]	2.3 U

MAP DERIVED FROM
TOPOGRAPHIC MAP OF
DESCRIBED PROPERTY
AND
LOT NOS. 24 & 25
MAP OF
SUNSHINE PARK
SITUATED AT
FREEPORT
TOWN OF HEMPSTEAD
NASSAU COUNTY, NEW YORK
NASSAU COUNTY MAP NO. 179
NASSAU COUNTY CASE NO. 1526
FILED JUNE 4, 1921
GUARANTEED ONLY TO:
NEW YORK STATE DEPARTMENT
OF ENVIRONMENTAL CONSERVATION

0 30' 60'
GRAPHIC SCALE

LEGEND

SB-57 ● SOIL BORING LOCATION
CONCENTRATIONS OF CONSTITUENTS ARE SHOWN IN MILLIGRAM PER KILOGRAM (mg/kg)

[ ] DETECTED SOIL CONCENTRATION IS ABOVE NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION (NYSDEC) TECHNICAL AND ADMINISTRATIVE GUIDANCE MEMORANDUM RECOMMENDED SOIL CLEANUP OBJECTIVE (RSCO)

U NOT DETECTED AT INDICATED DETECTION LIMIT

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

NYSDEC

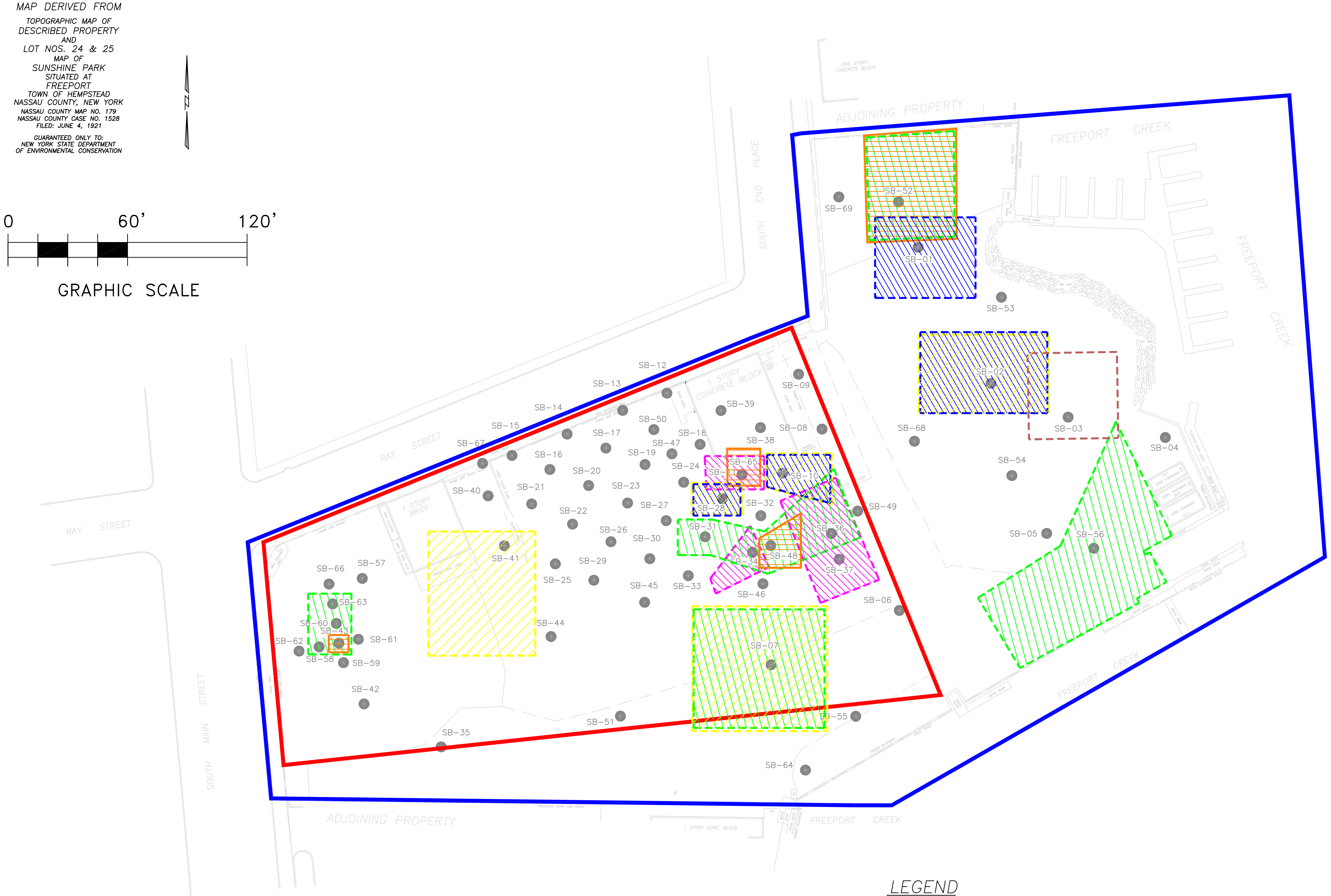
ERM Environmental Resources Management

CHECKED	DATE
DESIGN ENGINEER	
PROJECT ENGINEER	
PROJECT MANAGER	
APPROVED	
APPROVED	

METALS DETECTIONS IN SOIL ABOVE TAGM RSCO
METAL ETCHING SITE NO. 1-30-110
FREEPORT, NEW YORK

DRAWN	MFM/EMF		10/24/06	REVISED DATE	
SCALE	GRAPHIC	JOB NO.	0011475.2	FILE NAME	0011475-00-040

DRAWING NO. 2-3
REV. NO.
SHEET OF



LEGEND

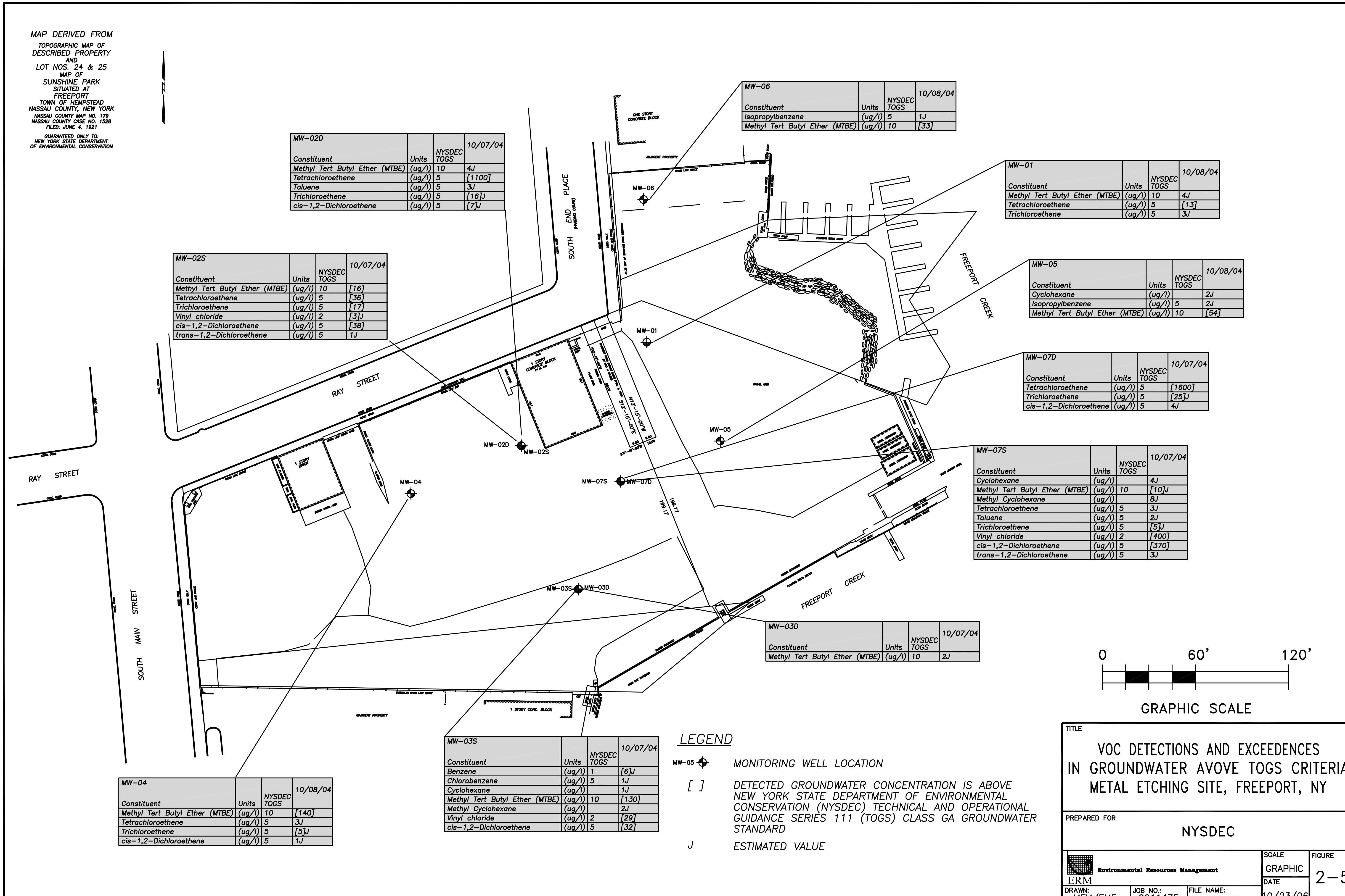
- SB-64 SOIL BORING
- STUDY AREA
- SITE
- SOIL EXCEEDING VOC SCGs FROM 0–1' BELOW GRADE (2,653 FT²)
- SOIL EXCEEDING VOC SCGs FROM 1'–4' BELOW GRADE (11,267 FT²)
- SOIL EXCEEDING VOC SCGs FROM 4'–9' BELOW GRADE (14,069 FT²)
- SOIL EXCEEDING VOC SCGs FROM 9'–14' BELOW GRADE (3,323 FT²)
- HOT SPOT SOIL FOR INORGANICS FROM 0–1' BELOW GRADE (1,938 FT²)
- HOT SPOT SOIL FOR INORGANICS FROM 1'–4' BELOW GRADE (5,646 FT²)

TITLE
HOT SPOT SOIL FOR INORGANICS AND SOIL EXCEEDING VOC TAGM RSCOs
METAL ETCHING SITE
FREEPORT, NEW YORK

PREPARED FOR
NYSDEC

ERM Environmental Resources Management

DRAWN:	JOB NO.:	FILE NAME:	SCALE	DATE	FIGURE
MFM/EMF	0011475	0011475-01-024	GRAPHIC	10/25/06	2-4



MW-06			
Constituent	Units	NYSDEC TOGS	10/08/04
Isopropylbenzene	(ug/l)	5	1J
Methyl Tert Butyl Ether (MTBE)	(ug/l)	10	[33]

MW-02D			
Constituent	Units	NYSDEC TOGS	10/07/04
Methyl Tert Butyl Ether (MTBE)	(ug/l)	10	4J
Tetrachloroethene	(ug/l)	5	[1100]
Toluene	(ug/l)	5	3J
Trichloroethene	(ug/l)	5	[16]J
cis-1,2-Dichloroethene	(ug/l)	5	[7]J

MW-01			
Constituent	Units	NYSDEC TOGS	10/08/04
Methyl Tert Butyl Ether (MTBE)	(ug/l)	10	4J
Tetrachloroethene	(ug/l)	5	[13]
Trichloroethene	(ug/l)	5	3J

MW-02S			
Constituent	Units	NYSDEC TOGS	10/07/04
Methyl Tert Butyl Ether (MTBE)	(ug/l)	10	[16]
Tetrachloroethene	(ug/l)	5	[36]
Trichloroethene	(ug/l)	5	[17]
Vinyl chloride	(ug/l)	2	[3]J
cis-1,2-Dichloroethene	(ug/l)	5	[38]
trans-1,2-Dichloroethene	(ug/l)	5	1J

MW-05			
Constituent	Units	NYSDEC TOGS	10/08/04
Cyclohexane	(ug/l)		2J
Isopropylbenzene	(ug/l)	5	2J
Methyl Tert Butyl Ether (MTBE)	(ug/l)	10	[54]

MW-07D			
Constituent	Units	NYSDEC TOGS	10/07/04
Tetrachloroethene	(ug/l)	5	[1600]
Trichloroethene	(ug/l)	5	[25]J
cis-1,2-Dichloroethene	(ug/l)	5	4J

MW-07S			
Constituent	Units	NYSDEC TOGS	10/07/04
Cyclohexane	(ug/l)		4J
Methyl Tert Butyl Ether (MTBE)	(ug/l)	10	[10]J
Methyl Cyclohexane	(ug/l)		8J
Tetrachloroethene	(ug/l)	5	3J
Toluene	(ug/l)	5	2J
Trichloroethene	(ug/l)	5	[5]J
Vinyl chloride	(ug/l)	2	[400]
cis-1,2-Dichloroethene	(ug/l)	5	[370]
trans-1,2-Dichloroethene	(ug/l)	5	3J

MW-03D			
Constituent	Units	NYSDEC TOGS	10/07/04
Methyl Tert Butyl Ether (MTBE)	(ug/l)	10	2J

MW-03S			
Constituent	Units	NYSDEC TOGS	10/07/04
Benzene	(ug/l)	1	[6]J
Chlorobenzene	(ug/l)	5	1J
Cyclohexane	(ug/l)		1J
Methyl Tert Butyl Ether (MTBE)	(ug/l)	10	[130]
Methyl Cyclohexane	(ug/l)		2J
Vinyl chloride	(ug/l)	2	[29]
cis-1,2-Dichloroethene	(ug/l)	5	[32]

MW-04			
Constituent	Units	NYSDEC TOGS	10/08/04
Methyl Tert Butyl Ether (MTBE)	(ug/l)	10	[140]
Tetrachloroethene	(ug/l)	5	3J
Trichloroethene	(ug/l)	5	[5]J
cis-1,2-Dichloroethene	(ug/l)	5	1J

LEGEND

MW-05 — MONITORING WELL LOCATION

[ ] — DETECTED GROUNDWATER CONCENTRATION IS ABOVE NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION (NYSDEC) TECHNICAL AND OPERATIONAL GUIDANCE SERIES 111 (TOGS) CLASS GA GROUNDWATER STANDARD

J — ESTIMATED VALUE

TITLE

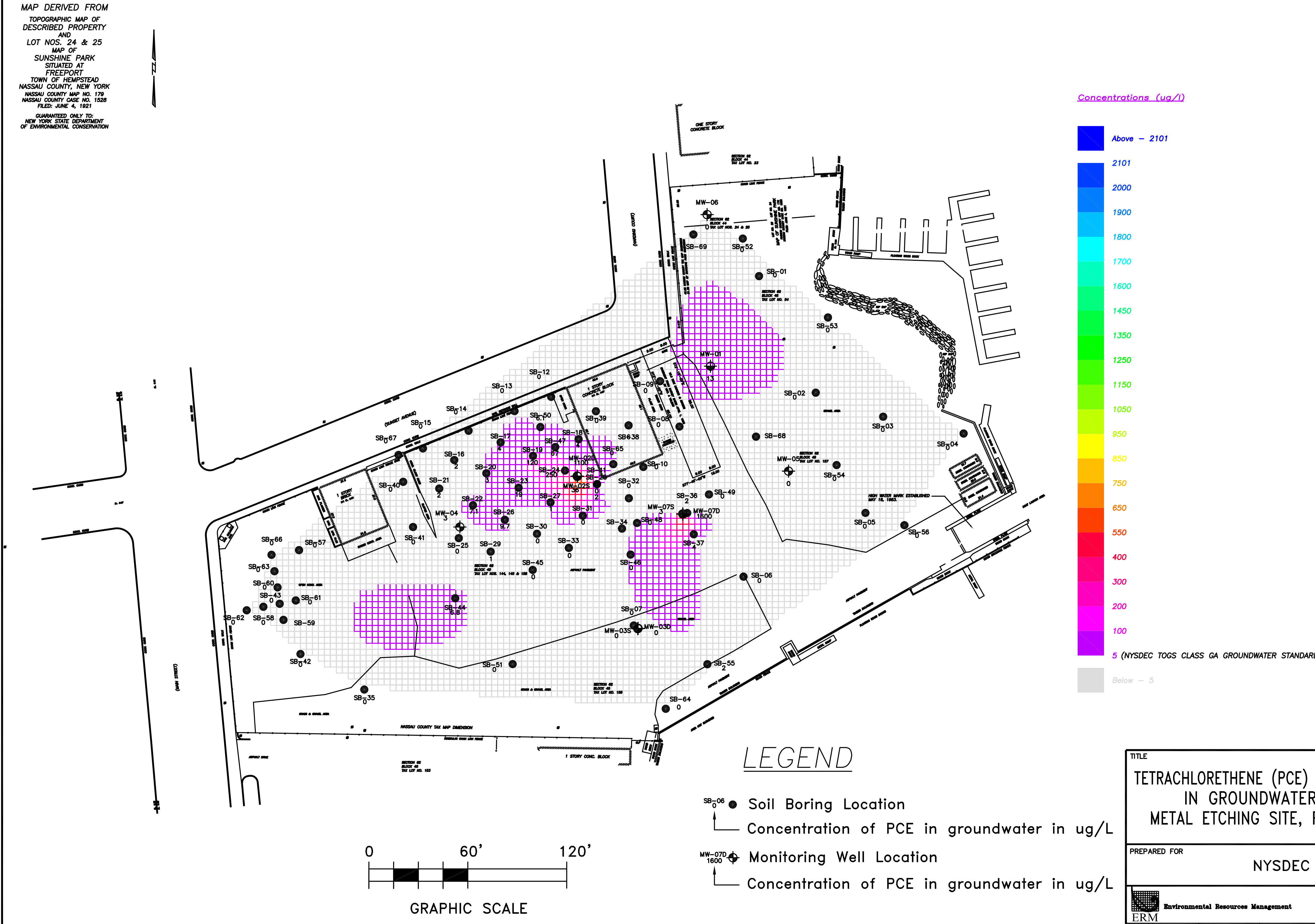
VOC DETECTIONS AND EXCEEDENCES IN GROUNDWATER AVOVE TOGS CRITERIA METAL ETCHING SITE, FREEPORT, NY

PREPARED FOR

NYSDEC

ERM Environmental Resources Management

DRAWN:	JOB NO.:	FILE NAME:	SCALE	FIGURE
MFM/EMF	0011475	0011475-00-041	GRAPHIC	2-5
			DATE	
			10/23/06	



TITLE

TETRACHLORETHENE (PCE) CONCENTRATIONS IN GROUNDWATER (UG/L) METAL ETCHING SITE, FREEPORT, NY

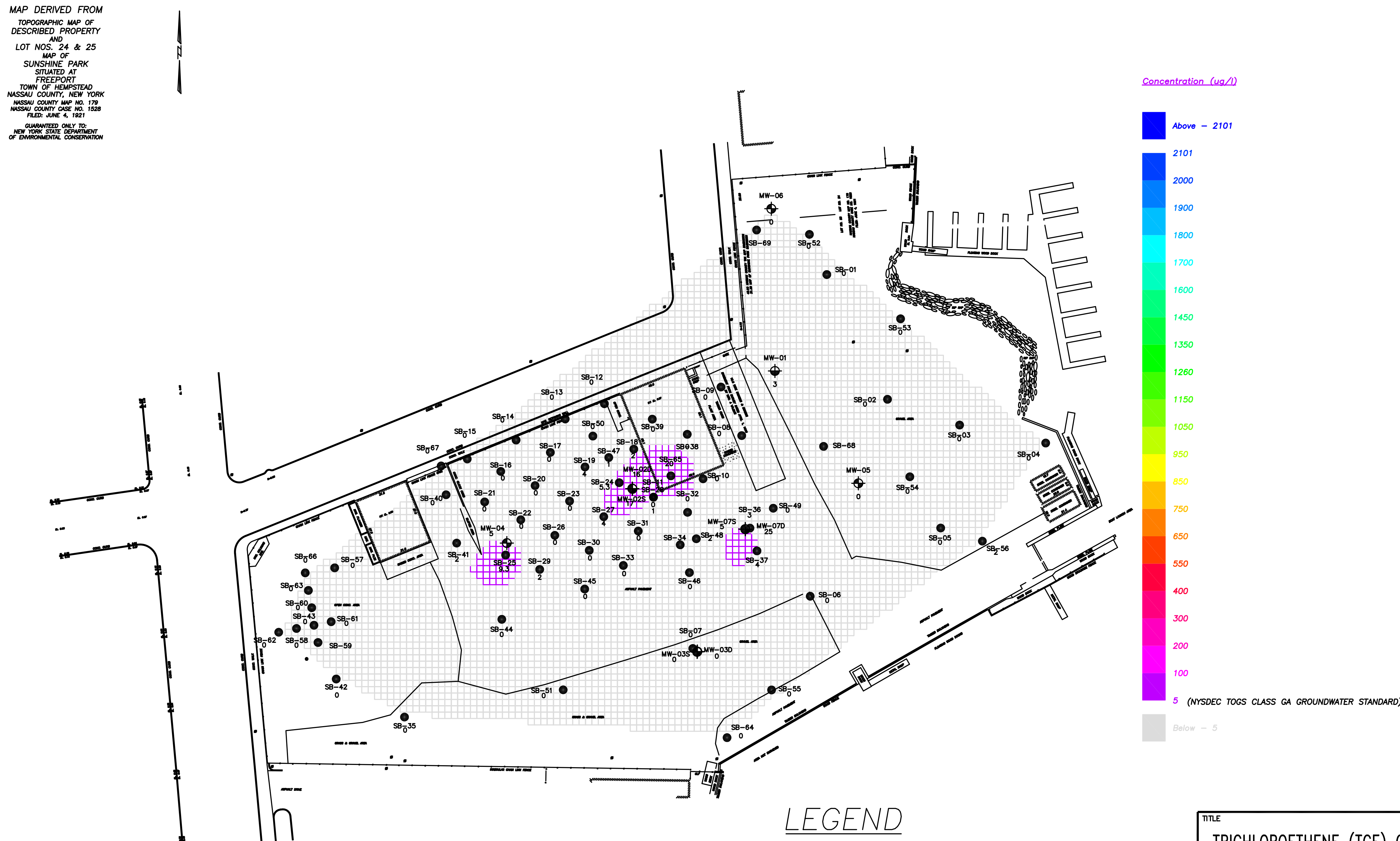
PREPARED FOR

NYSDEC

ERM Environmental Resources Management

SCALE	FIGURE
GRAPHIC	2–6
DATE	
11/1/06	

DRAWN: MFM/EMF | JOB NO.: 0011475 | FILE NAME: 0011475-00-043



LEGEND

SB-06 0 ● Soil Boring Location
└── Concentration of TCE in groundwater in ug/L

MW-07D 2.5 ⊕ Monitoring Well Location
└── Concentration of TCE in groundwater in ug/L

0 60' 120'

GRAPHIC SCALE

TITLE

TRICHLOROETHENE (TCE) CONCENTRATIONS IN GROUNDWATER (UG/L) METAL ETCHING SITE, FREEPORT, NY

PREPARED FOR

NYSDEC

ERM Environmental Resources Management

DRAWN:	JOB NO.:	FILE NAME:	SCALE	FIGURE
MFM/EMF	0011475	0011475-00-044	GRAPHIC	2-7
			DATE 11/1/06	

LEGEND

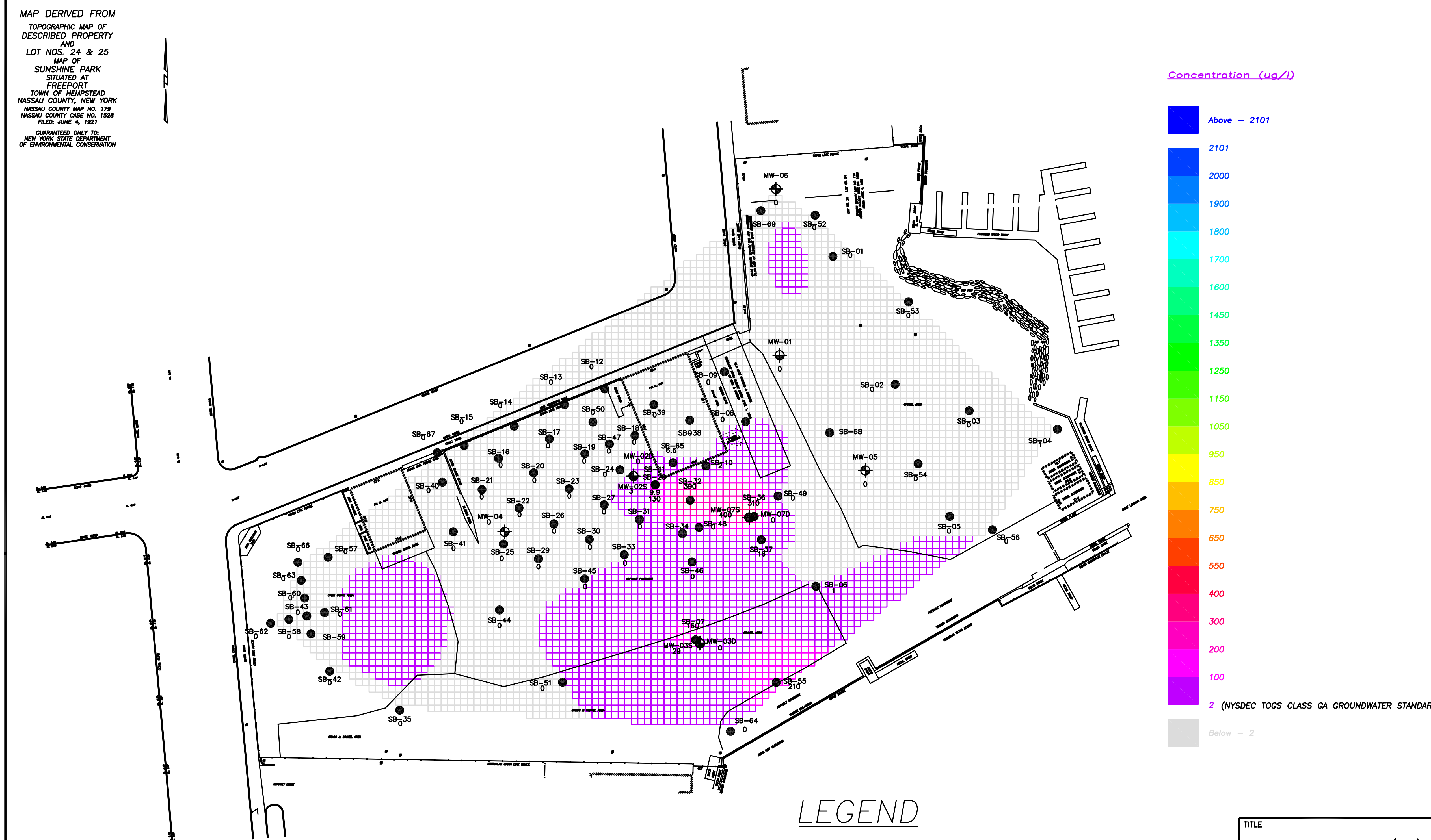
SB-06 0 ● Soil Boring Location

Concentration of CIS-1,2-Dichloroethene in groundwater in ug/L

MW-07D 4 ⌖ Monitoring Well Location

Concentration of CIS-1,2-Dichloroethene in groundwater in ug/L

TITLE	CIS-1,2-DICHLOROETHENE CONCENTRATIONS IN GROUNDWATER (UG/L) METAL ETCHING SITE, FREEPORT, NY
PREPARED FOR	NYSDEC
ERM Environmental Resources Management	SCALE: GRAPHIC; DATE: 11/1/06; FIGURE: 2-8
DRAWN: MFM/EMF	JOB NO.: 0011475; FILE NAME: 0011475-00-045



LEGEND

SB-06 ● Soil Boring Location
0 — Concentration of VC in groundwater in ug/L

MW-07D ⊕ Monitoring Well Location
400 — Concentration of VC in groundwater in ug/L

0 60' 120'

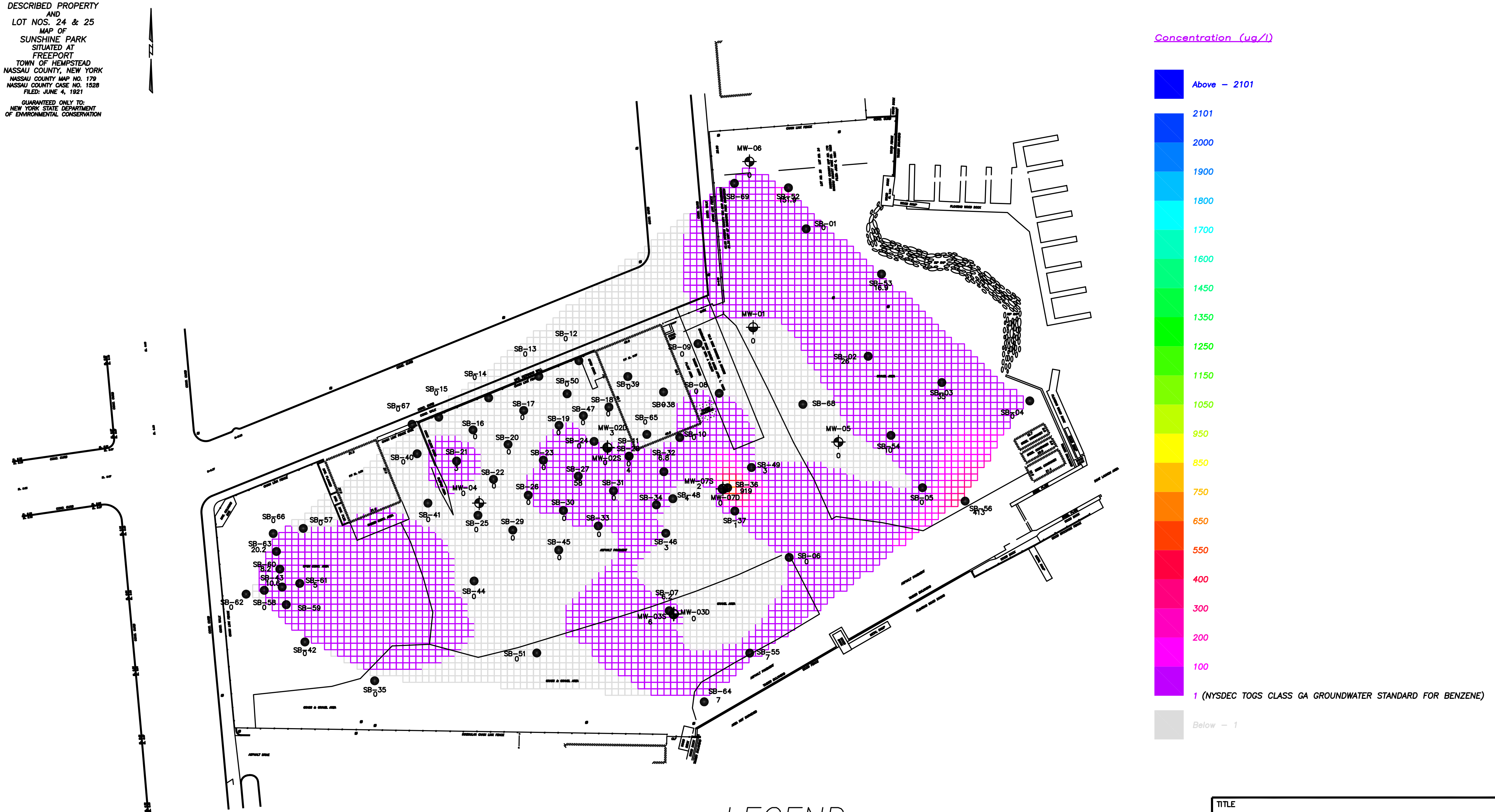
GRAPHIC SCALE

TITLE	VINYL CHLORIDE (VC) CONCENTRATIONS IN GROUNDWATER (UG/L) METAL ETCHING SITE, FREEPORT, NY
PREPARED FOR	NYSDEC

ERM Environmental Resources Management			SCALE: GRAPHIC	FIGURE: 2-9
DRAWN: MFM/EMF	JOB NO.: 0011475	FILE NAME: 0011475-00-046	DATE: 11/1/06	

MAP DERIVED FROM
TOPOGRAPHIC MAP OF
DESCRIBED PROPERTY
AND
LOT NOS. 24 & 25
MAP OF
SUNSHINE PARK
SITUATED AT
FREEPORT
TOWN OF HEMPSTEAD
NASSAU COUNTY, NEW YORK
NASSAU COUNTY MAP NO. 179
NASSAU COUNTY CASE NO. 1528
FILED: JUNE 4, 1921

GUARANTEED ONLY TO:
NEW YORK STATE DEPARTMENT
OF ENVIRONMENTAL CONSERVATION



LEGEND

SB-06 0 ● Soil Boring Location
Concentration of Total BTEX in groundwater in ug/L

MW-07D 2.5 ⌖ Monitoring Well Location
Concentration of Total BTEX in groundwater in ug/L

0 60' 120'
GRAPHIC SCALE

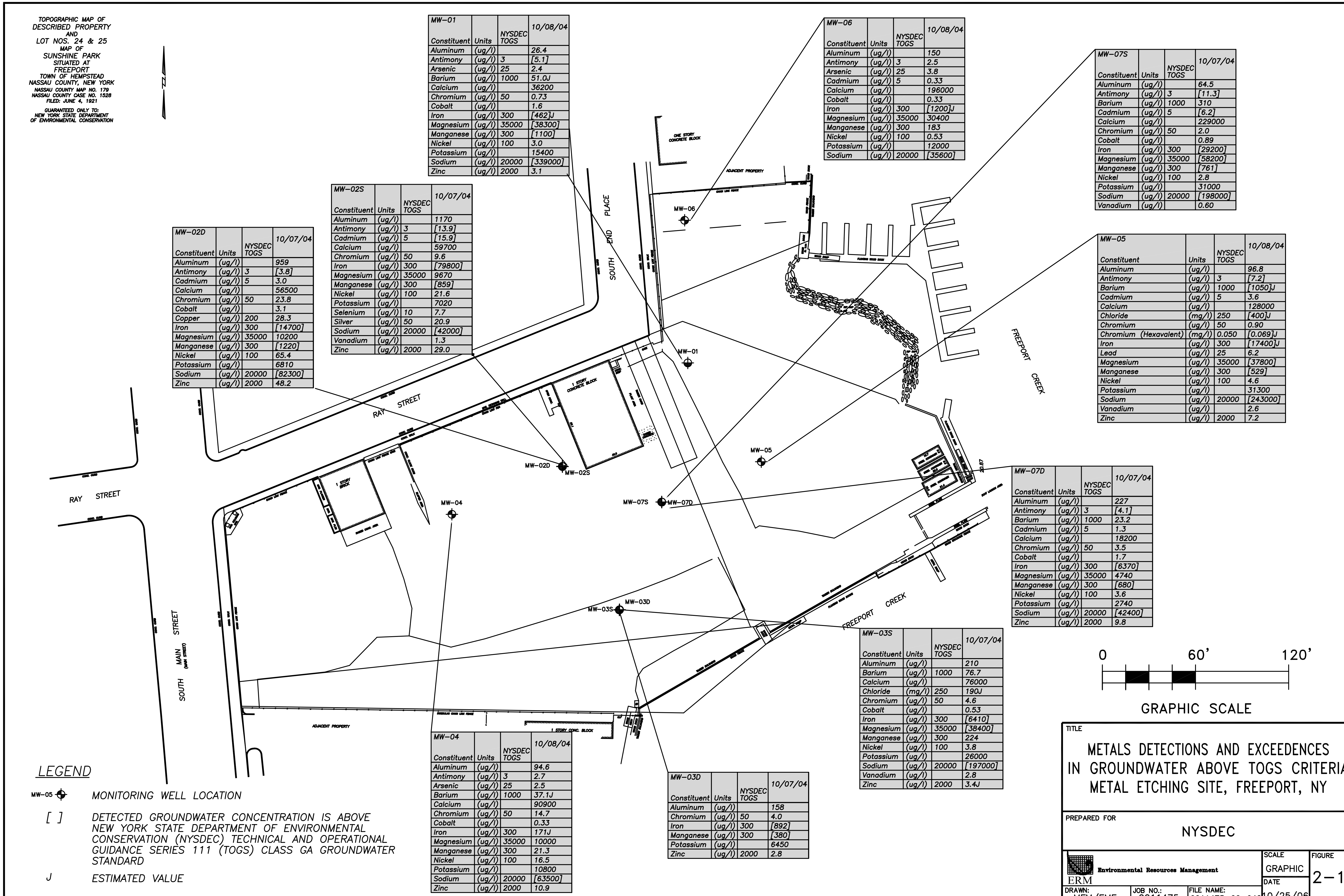
TITLE
TOTAL BENZENE, ETHYLBENZENE, TOLUENE & XYLENE (BTEX) COMPOUNDS IN GROUNDWATER (UG/L) METAL ETCHING SITE, FREEPORT, NY

PREPARED FOR
NYSDEC

ERM Environmental Resources Management

SCALE	FIGURE
GRAPHIC	2-10
DATE 11/1/06	

DRAWN:	JOB NO.:	FILE NAME:
MFM/EMF	0011475	0011475-00-047



MW-01			
Constituent	Units	NYSDEC TOGS	10/08/04
Aluminum	(ug/l)		26.4
Antimony	(ug/l)	3	[5.1]
Arsenic	(ug/l)	25	2.4
Barium	(ug/l)	1000	51.0J
Calcium	(ug/l)		36200
Chromium	(ug/l)	50	0.73
Cobalt	(ug/l)		1.6
Iron	(ug/l)	300	[462]J
Magnesium	(ug/l)	35000	[38300]
Manganese	(ug/l)	300	[1100]
Nickel	(ug/l)	100	3.0
Potassium	(ug/l)		15400
Sodium	(ug/l)	20000	[339000]
Zinc	(ug/l)	2000	3.1

MW-06			
Constituent	Units	NYSDEC TOGS	10/08/04
Aluminum	(ug/l)		150
Antimony	(ug/l)	3	2.5
Arsenic	(ug/l)	25	3.8
Cadmium	(ug/l)	5	0.33
Calcium	(ug/l)		196000
Cobalt	(ug/l)		0.33
Iron	(ug/l)	300	[1200]J
Magnesium	(ug/l)	35000	30400
Manganese	(ug/l)	300	183
Nickel	(ug/l)	100	0.53
Potassium	(ug/l)		12000
Sodium	(ug/l)	20000	[35600]

MW-07S			
Constituent	Units	NYSDEC TOGS	10/07/04
Aluminum	(ug/l)		64.5
Antimony	(ug/l)	3	[11.3]
Barium	(ug/l)	1000	310
Cadmium	(ug/l)	5	[6.2]
Calcium	(ug/l)		229000
Chromium	(ug/l)	50	2.0
Cobalt	(ug/l)		0.89
Iron	(ug/l)	300	[29200]
Magnesium	(ug/l)	35000	[58200]
Manganese	(ug/l)	300	[761]
Nickel	(ug/l)	100	2.8
Potassium	(ug/l)		31000
Sodium	(ug/l)	20000	[198000]
Vanadium	(ug/l)		0.60

MW-02S			
Constituent	Units	NYSDEC TOGS	10/07/04
Aluminum	(ug/l)		1170
Antimony	(ug/l)	3	[13.9]
Cadmium	(ug/l)	5	[15.9]
Calcium	(ug/l)		59700
Chromium	(ug/l)	50	9.6
Iron	(ug/l)	300	[79800]
Magnesium	(ug/l)	35000	9670
Manganese	(ug/l)	300	[859]
Nickel	(ug/l)	100	21.6
Potassium	(ug/l)		7020
Selenium	(ug/l)	10	7.7
Silver	(ug/l)	50	20.9
Sodium	(ug/l)	20000	[42000]
Vanadium	(ug/l)		1.3
Zinc	(ug/l)	2000	29.0

MW-02D			
Constituent	Units	NYSDEC TOGS	10/07/04
Aluminum	(ug/l)		959
Antimony	(ug/l)	3	[3.8]
Cadmium	(ug/l)	5	3.0
Calcium	(ug/l)		56500
Chromium	(ug/l)	50	23.8
Cobalt	(ug/l)		3.1
Copper	(ug/l)	200	28.3
Iron	(ug/l)	300	[14700]
Magnesium	(ug/l)	35000	10200
Manganese	(ug/l)	300	[1220]
Nickel	(ug/l)	100	65.4
Potassium	(ug/l)		6810
Sodium	(ug/l)	20000	[82300]
Zinc	(ug/l)	2000	48.2

MW-05			
Constituent	Units	NYSDEC TOGS	10/08/04
Aluminum	(ug/l)		96.8
Antimony	(ug/l)	3	[7.2]
Barium	(ug/l)	1000	[1050]J
Cadmium	(ug/l)	5	3.6
Calcium	(ug/l)		128000
Chloride	(mg/l)	250	[400]J
Chromium	(ug/l)	50	0.90
Chromium (Hexavalent)	(mg/l)	0.050	[0.069]J
Iron	(ug/l)	300	[17400]J
Lead	(ug/l)	25	6.2
Magnesium	(ug/l)	35000	[37800]
Manganese	(ug/l)	300	[529]
Nickel	(ug/l)	100	4.6
Potassium	(ug/l)		31300
Sodium	(ug/l)	20000	[243000]
Vanadium	(ug/l)		2.6
Zinc	(ug/l)	2000	7.2

MW-07D			
Constituent	Units	NYSDEC TOGS	10/07/04
Aluminum	(ug/l)		227
Antimony	(ug/l)	3	[4.1]
Barium	(ug/l)	1000	23.2
Cadmium	(ug/l)	5	1.3
Calcium	(ug/l)		18200
Chromium	(ug/l)	50	3.5
Cobalt	(ug/l)		1.7
Iron	(ug/l)	300	[6370]
Magnesium	(ug/l)	35000	4740
Manganese	(ug/l)	300	[680]
Nickel	(ug/l)	100	3.6
Potassium	(ug/l)		2740
Sodium	(ug/l)	20000	[42400]
Zinc	(ug/l)	2000	9.8

MW-03S			
Constituent	Units	NYSDEC TOGS	10/07/04
Aluminum	(ug/l)		210
Barium	(ug/l)	1000	76.7
Calcium	(ug/l)		76000
Chloride	(mg/l)	250	190J
Chromium	(ug/l)	50	4.6
Cobalt	(ug/l)		0.53
Iron	(ug/l)	300	[6410]
Magnesium	(ug/l)	35000	[38400]
Manganese	(ug/l)	300	224
Nickel	(ug/l)	100	3.8
Potassium	(ug/l)		26000
Sodium	(ug/l)	20000	[197000]
Vanadium	(ug/l)		2.8
Zinc	(ug/l)	2000	3.4J

MW-04			
Constituent	Units	NYSDEC TOGS	10/08/04
Aluminum	(ug/l)		94.6
Antimony	(ug/l)	3	2.7
Arsenic	(ug/l)	25	2.5
Barium	(ug/l)	1000	37.1J
Calcium	(ug/l)		90900
Chromium	(ug/l)	50	14.7
Cobalt	(ug/l)		0.33
Iron	(ug/l)	300	171J
Magnesium	(ug/l)	35000	10000
Manganese	(ug/l)	300	21.3
Nickel	(ug/l)	100	16.5
Potassium	(ug/l)		10800
Sodium	(ug/l)	20000	[63500]
Zinc	(ug/l)	2000	10.9

MW-03D			
Constituent	Units	NYSDEC TOGS	10/07/04
Aluminum	(ug/l)		158
Chromium	(ug/l)	50	4.0
Iron	(ug/l)	300	[892]
Manganese	(ug/l)	300	[380]
Potassium	(ug/l)		6450
Zinc	(ug/l)	2000	2.8

LEGEND

MW-05 ⊕ MONITORING WELL LOCATION

[ ] DETECTED GROUNDWATER CONCENTRATION IS ABOVE NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION (NYSDEC) TECHNICAL AND OPERATIONAL GUIDANCE SERIES 111 (TOGS) CLASS GA GROUNDWATER STANDARD

J ESTIMATED VALUE

TITLE

METALS DETECTIONS AND EXCEEDENCES IN GROUNDWATER ABOVE TOGS CRITERIA METAL ETCHING SITE, FREEPORT, NY

PREPARED FOR

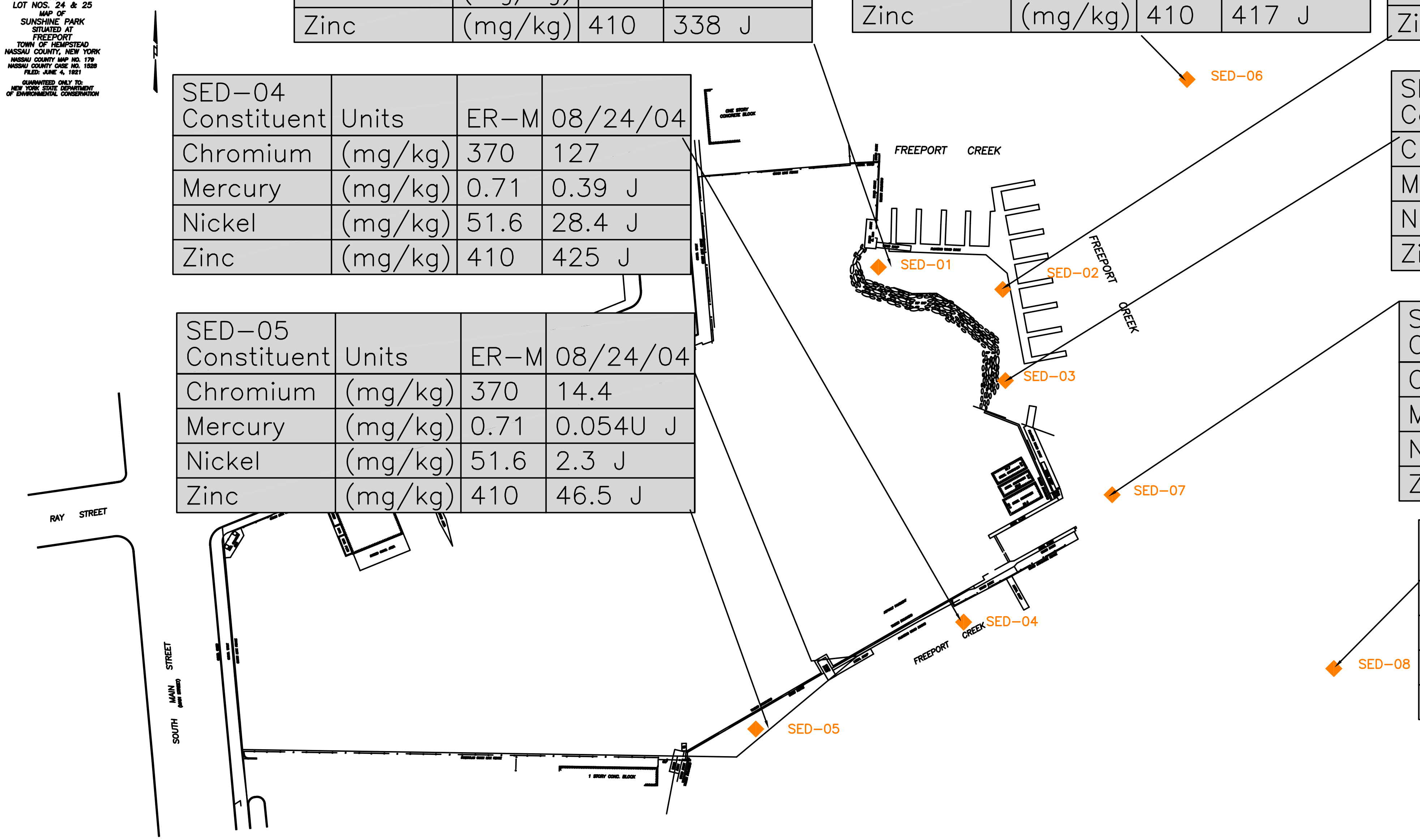
NYSDEC

Environmental Resources Management
ERM

DRAWN:	JOB NO.:	FILE NAME:	SCALE	FIGURE
MFM/EMF	0011475	0011475-00-042	GRAPHIC	2-11
			DATE 10/25/06	

TOPOGRAPHIC MAP OF
DESCRIBED PROPERTY
AND
LOT NOS. 24 & 25
MAP OF
SUNSHINE PARK
SITUATED AT
FREEPORT
TOWN OF HEMPSTEAD
NASSAU COUNTY, NEW YORK
NASSAU COUNTY MAP NO. 179
NASSAU COUNTY CASE NO. 1528
FILED: JUNE 4, 1921

GUARANTEED ONLY TO:
NEW YORK STATE DEPARTMENT
OF ENVIRONMENTAL CONSERVATION



SED–01 Constituent	Units	ER–M	08/24/04
Chromium	(mg/kg)	370	34.7
Mercury	(mg/kg)	0.71	2.5 J
Nickel	(mg/kg)	51.6	15.4 J
Zinc	(mg/kg)	410	338 J

SED–06 Constituent	Units	ER–M	08/24/04
Chromium	(mg/kg)	370	89.2 J
Mercury	(mg/kg)	0.71	0.61 J
Nickel	(mg/kg)	51.6	26.8 J
Zinc	(mg/kg)	410	417 J

SED–02 Constituent	Units	ER–M	08/24/04
Chromium	(mg/kg)	370	16.0
Mercury	(mg/kg)	0.71	0.065 J
Nickel	(mg/kg)	51.6	8.8 J
Zinc	(mg/kg)	410	93.2 J

SED–04 Constituent	Units	ER–M	08/24/04
Chromium	(mg/kg)	370	127
Mercury	(mg/kg)	0.71	0.39 J
Nickel	(mg/kg)	51.6	28.4 J
Zinc	(mg/kg)	410	425 J

SED–03 Constituent	Units	ER–M	08/24/04
Chromium	(mg/kg)	370	3.3
Mercury	(mg/kg)	0.71	0.059U J
Nickel	(mg/kg)	51.6	3.2 J
Zinc	(mg/kg)	410	59.7 J

SED–05 Constituent	Units	ER–M	08/24/04
Chromium	(mg/kg)	370	14.4
Mercury	(mg/kg)	0.71	0.054U J
Nickel	(mg/kg)	51.6	2.3 J
Zinc	(mg/kg)	410	46.5 J

SED–07 Constituent	Units	ER–M	08/24/04
Chromium	(mg/kg)	370	3.4
Mercury	(mg/kg)	0.71	0.047U J
Nickel	(mg/kg)	51.6	1.4 J
Zinc	(mg/kg)	410	16.5 J

SED–08 Constituent	Units	ER–M	08/24/04
Chromium	(mg/kg)	370	6.5
Mercury	(mg/kg)	0.71	0.089 J
Nickel	(mg/kg)	51.6	2.6 J
Zinc	(mg/kg)	410	26.5 J

LEGEND

◆ SED–07 SEDIMENT SAMPLE LOCATION

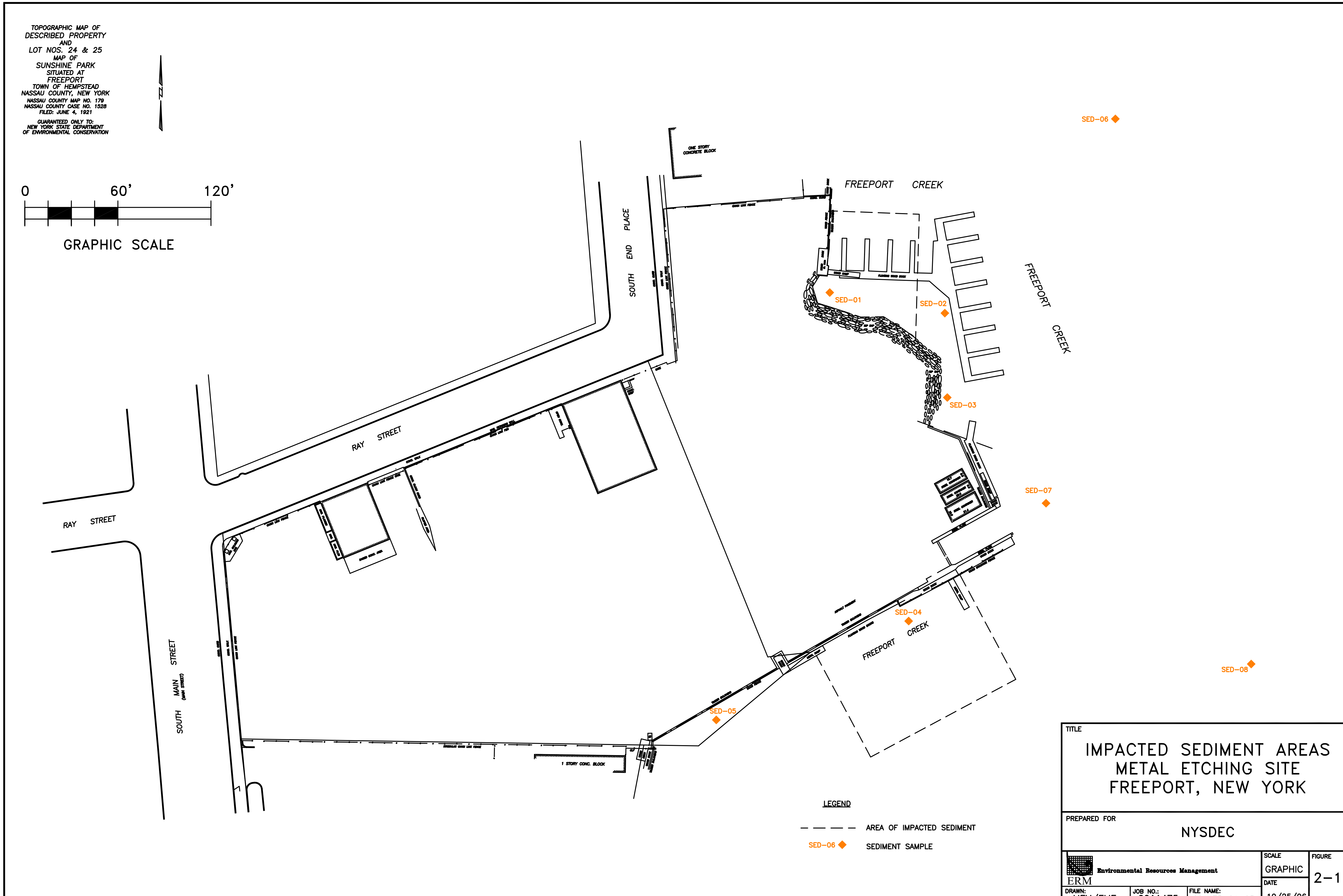
ER–M EFFECTS RANGE – MEDIUM

NOTE: ER–M VALUES DERIVED FROM NYSDEC TECHNICAL GUIDANCE FOR SCREENING CONTAMINANTED SEDIMENTS (NYSDEC 1999)

0 80' 160'

GRAPHIC SCALE

TITLE	CONSTITUENTS OF CONCERN IN SEDIMENT AGAINST ER–Ms METAL ETCHING SITE FREEPORT, NEW YORK
PREPARED FOR	NYSDEC SITE NO: 1–30–110
ERM Environmental Resources Management	SCALE: GRAPHIC; DATE: 1/9/07; FIGURE: 2–12
DRAWN: MFM/EMF	JOB NO.: 0011475; FILE NAME: 0011475–01–057



TITLE

IMPACTED SEDIMENT AREAS
METAL ETCHING SITE
FREEPORT, NEW YORK

PREPARED FOR

NYSDEC

ERM Environmental Resources Management

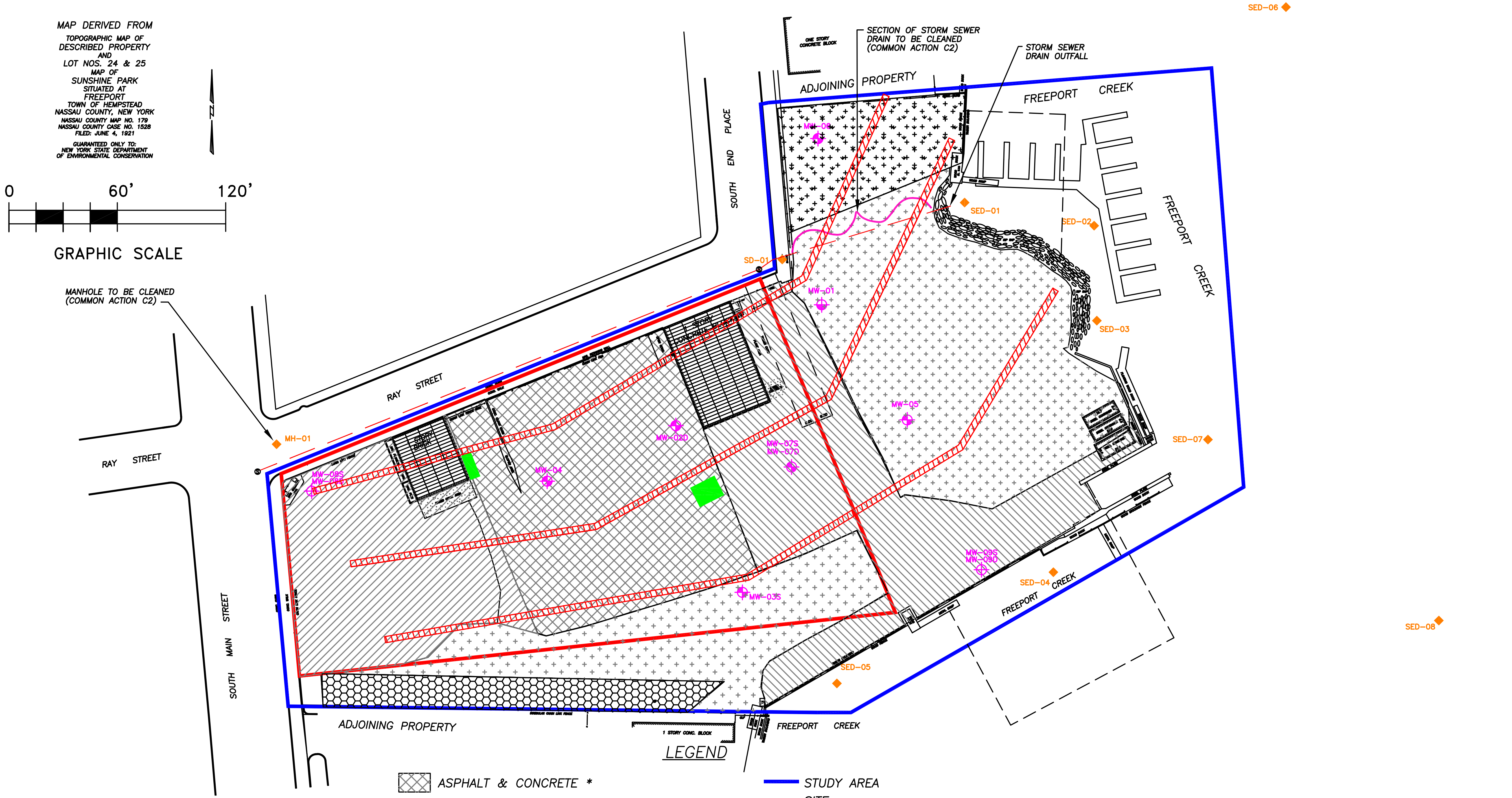
DRAWN:	JOB NO.:	FILE NAME:	SCALE	DATE	FIGURE
MFM/EMF	0011475	001475-01-031	GRAPHIC	10/25/06	2-13

LEGEND

- STUDY AREA
- SITE
- POTENTIAL UST LOCATION

UST= UNDERGROUND STORAGE TANK

TITLE GENERAL LOCATION OF POTENTIAL USTs METAL ETCHING SITE FREEPORT, NEW YORK				
PREPARED FOR NYSDEC				
ERM Environmental Resources Management			SCALE GRAPHIC	FIGURE 3-1
DRAWN: MFM/EMF	JOB NO.: 0011475	FILE NAME: 0011475-01-030	DATE 10/17/06	



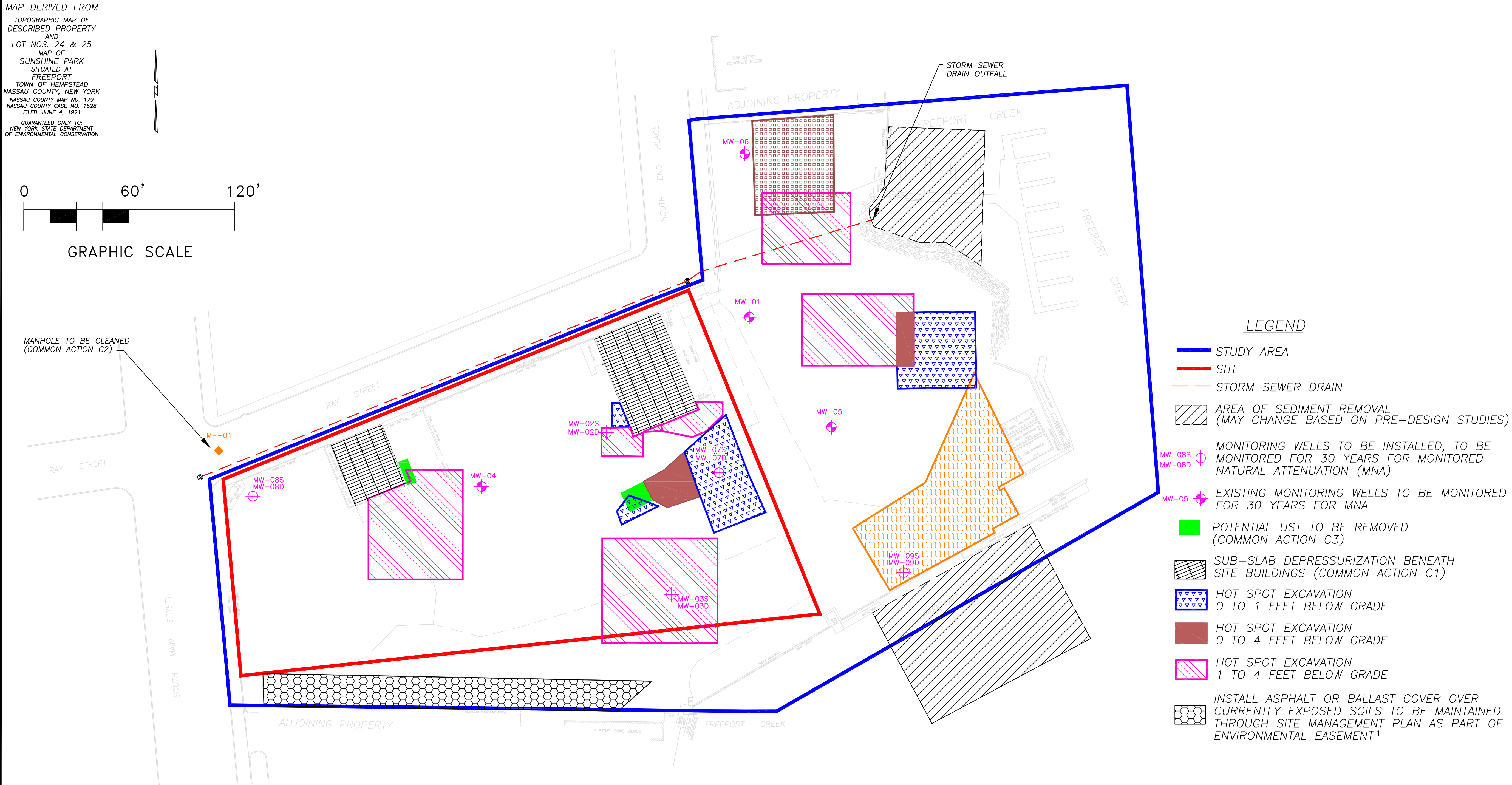
LEGEND

- ASPHALT & CONCRETE *
- ASPHALT *
- CONCRETE *
- GRAVEL *
- INSTALL ASPHALT OR BALLAST COVER OVER CURRENTLY EXPOSED SOILS *
- GRAVEL, SOIL & WEEDS *
- SUB-SLAB DEPRESSURIZATIN BENEATH SITE BUILDINGS (COMMON ACTION C1)
- STUDY AREA
- SITE
- STORM SEWER DRAIN
- AREA OF IMPACTED SEDIMENT TO BE MONITORED THROUGH MONITORED NATURAL RECOVERY (MNR) (MAY CHANGE BASED ON PRE-DESIGN STUDIES)
- SED-08 SEDIMENT SAMPLE
- MW-08S MW-08D MONITORING WELLS TO BE INSTALLED, TO BE MONITORED FOR 30 YEARS FOR MONITORED NATURAL ATTENUATION (MNA)
- MW-07S MW-07D EXISTING MONITORING WELLS TO BE MONITORED FOR 30 YEARS FOR MONITORED NATURAL ATTENUATION (MNA)
- POTENTIAL UST TO BE REMOVED (COMMON ACTION C3)
- PIPING FOR SOIL VAPOR EXTRACTION SYSTEM

NOTE:

* TO BE MAINTAINED THROUGH SITE MANAGEMENT PLAN AS PART OF ENVIROMENTAL EASEMENT (COMMON ACTION C4)

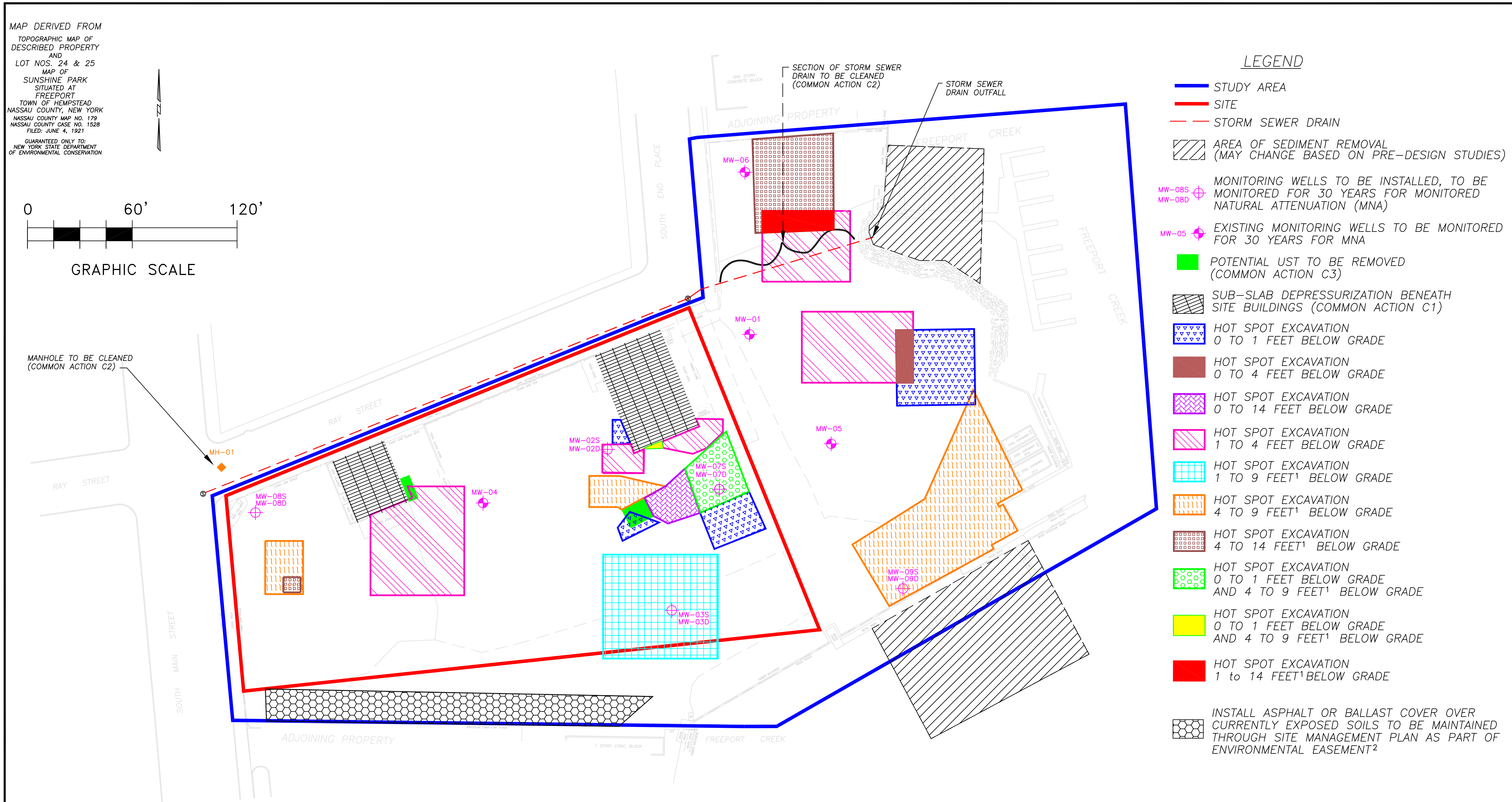
TITLE	ALTERNATIVE P2 AND II: SOIL COVER, GROUNDWATER MNA, SVE, AND SEDIMENT MNR METAL ETCHING SITE FREEPORT, NEW YORK
PREPARED FOR	NYSDEC
	ERM Environmental Resources Management
SCALE	GRAPHIC
DATE	11/1/06
FIGURE	3-2
DRAWN:	MFM/EMF
JOB NO.:	0011475
FILE NAME:	0011475-01-038



NOTE:

1. REFER TO FIGURE 2-1 FOR SURFACE COVERS TO BE MAINTAINED THROUGH SITE MANAGEMENT PLAN AS PART OF ENVIRONMENTAL EASEMENT (COMMON ACTION C4)

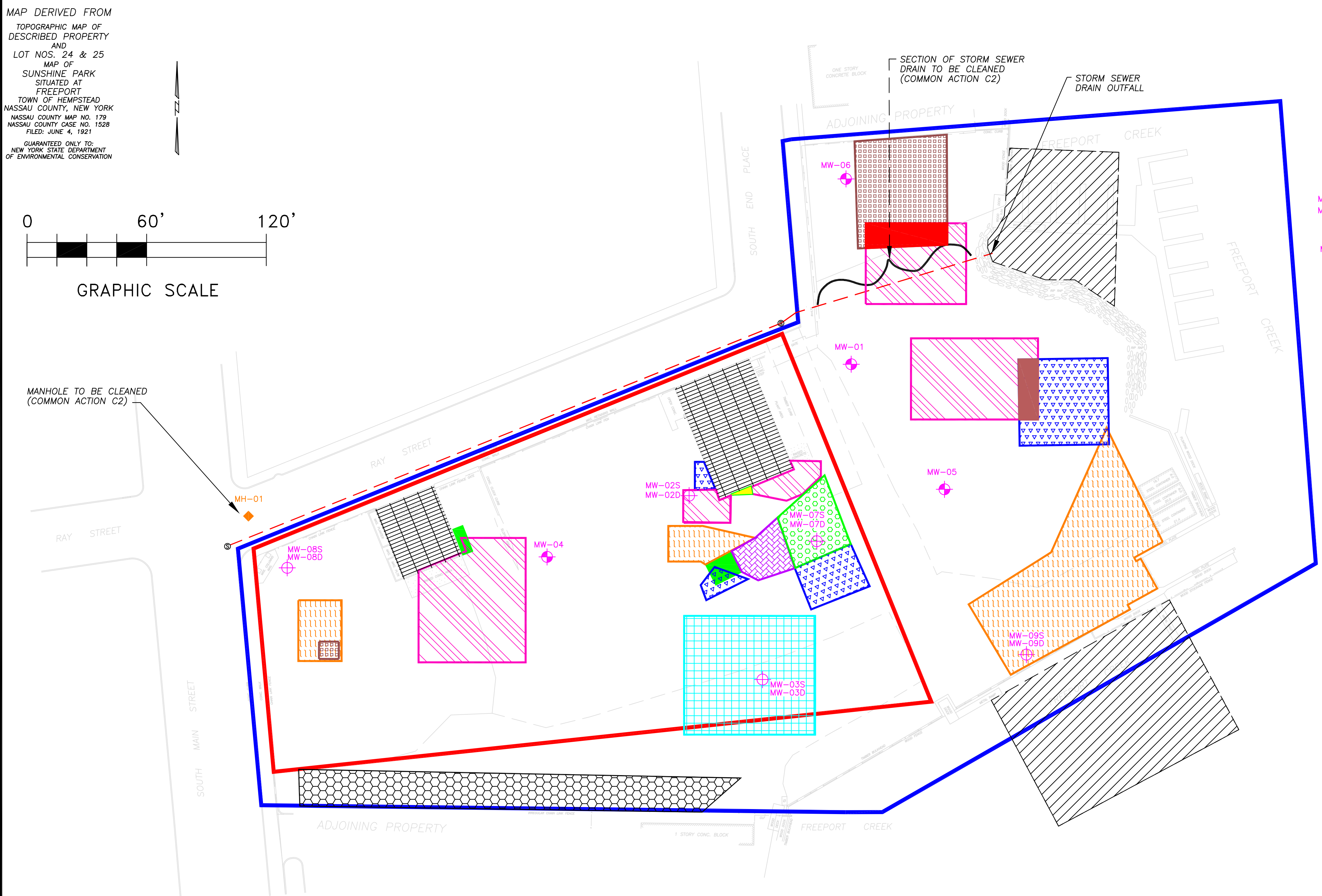
TITLE	ALTERNATIVE P3 AND III: HOT SPOT SOIL EXCAVATION TO THE WATER TABLE, AND SURFACE COVER GROUNDWATER MNA AND SEDIMENT REMOVAL METAL ETCHING SITE FREEPORT, NEW YORK
PREPARED FOR	NYSDEC
ERM Environmental Resources Management	SCALE: GRAPHIC; DATE: 11/1/06; FIGURE: 3-3
DRAWN: MFM/EMF	JOB NO.: 0011475; FILE NAME: 0011475-01-056



NOTE:

1. HOT SPOT EXCAVATION INTERVALS DEEPER THAN 4 FEET BELOW GRADE ARE TO BE BACKFILLED WITH CLEAN FILL AND ZERO VALENT IRON MIXTURE.
2. REFER TO FIGURE 2-1 FOR SURFACE COVERS TO BE MAINTAINED THROUGH SITE MANAGEMENT PLAN AS PART OF ENVIRONMENTAL EASEMENT (COMMON ACTION C4)

TITLE			
ALTERNATIVE P4 AND IV: HOT SPOT SOIL EXCAVATION, SURFACE COVER GROUNDWATER MNA AND SEDIMENT REMOVAL METAL ETCHING SITE FREEPORT, NEW YORK			
PREPARED FOR: NYSDEC			
ERM Environmental Resources Management		SCALE: GRAPHIC; DATE: 11/1/06	FIGURE 3-4
DRAWN: MFM/EMF	JOB NO.: 0011475	FILE NAME: 0011475-01-039	



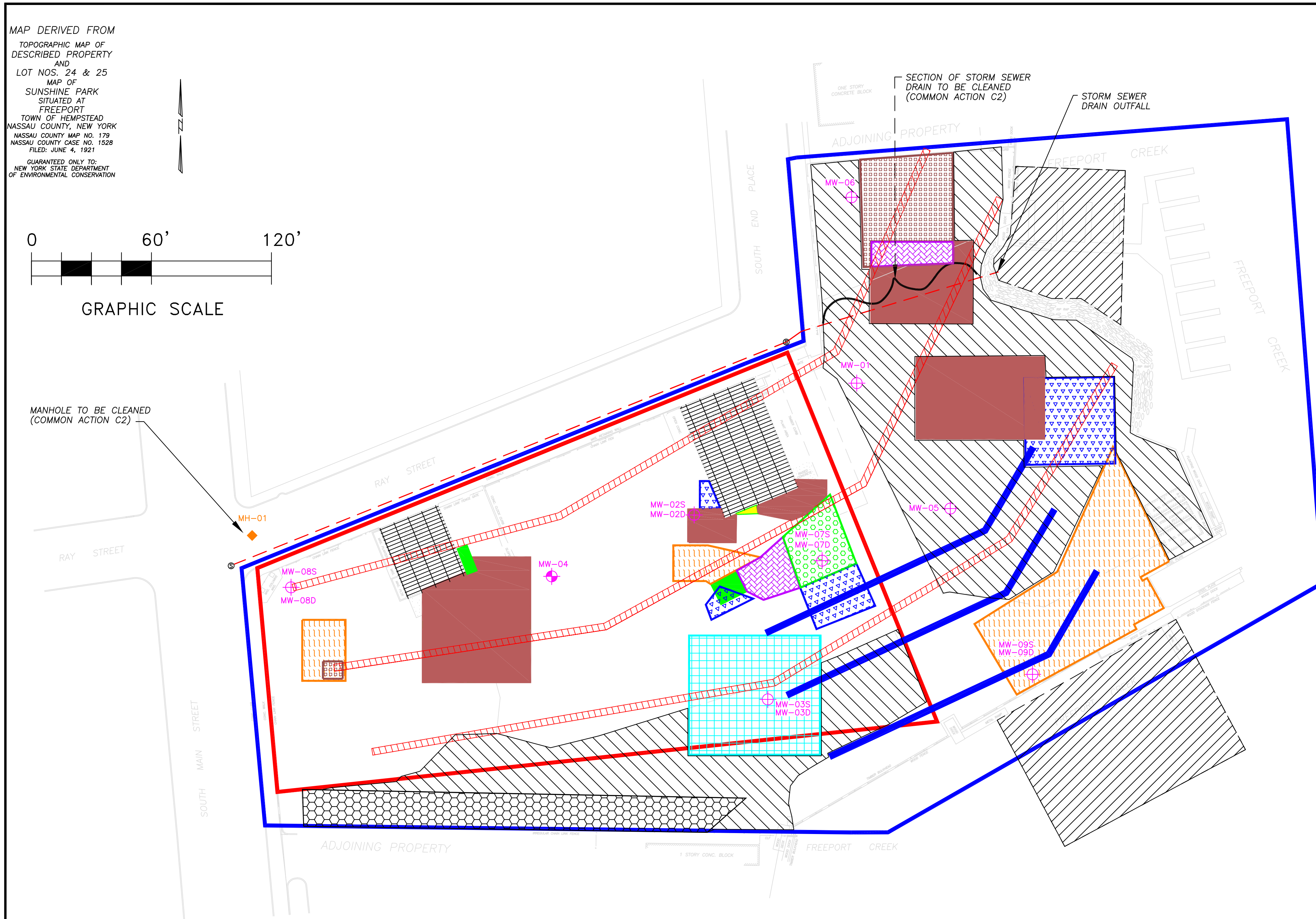
LEGEND

- STUDY AREA
- SITE
- STORM SEWER DRAIN
- AREA OF SEDIMENT REMOVAL (MAY CHANGE BASED ON PRE-DESIGN STUDIES)
- MW-08S / MW-08D — MONITORING WELLS[2] TO BE INSTALLED, TO BE MONITORED FOR 30 YEARS FOR MONITORED NATURAL ATTENUATION (MNA)
- MW-05 — EXISTING MONITORING WELLS[2] TO BE MONITORED FOR 30 YEARS FOR MNA
- POTENTIAL UST TO BE REMOVED (COMMON ACTION C3)
- SUB-SLAB DEPRESSURIZATION BENEATH SITE BUILDINGS (COMMON ACTION C1)
- HOT SPOT EXCAVATION 0 TO 1 FEET BELOW GRADE
- HOT SPOT EXCAVATION 0 TO 4 FEET BELOW GRADE
- HOT SPOT EXCAVATION 0 TO 14 FEET BELOW GRADE
- HOT SPOT EXCAVATION 1 TO 4 FEET BELOW GRADE
- HOT SPOT EXCAVATION 1 TO 9 FEET BELOW GRADE
- HOT SPOT EXCAVATION 4 TO 9 FEET BELOW GRADE
- HOT SPOT EXCAVATION 4 TO 14 FEET BELOW GRADE
- HOT SPOT EXCAVATION 0 TO 1 FEET BELOW GRADE AND 4 TO 9 FEET BELOW GRADE
- HOT SPOT EXCAVATION 0 TO 1 FEET BELOW GRADE AND 4 TO 9 FEET BELOW GRADE
- HOT SPOT EXCAVATION 1 to 14 FEET BELOW GRADE
- INSTALL ASPHALT OR BALLAST COVER OVER CURRENTLY EXPOSED SOILS TO BE MAINTAINED THROUGH SITE MANAGEMENT PLAN AS PART OF ENVIRONMENTAL EASEMENT[1]

NOTE:

1. REFER TO FIGURE 2–1 FOR SURFACE COVERS TO BE MAINTAINED THROUGH SITE MANAGEMENT PLAN AS PART OF ENVIRONMENTAL EASEMENT (COMMON ACTION C4)
2. BIOLOGICAL ENHANCEMENTS TO BE INJECTED INTO GROUNDWATER MONITORING WELLS.

TITLE	ALTERNATIVE P5: HOT SPOT SOIL EXCAVATION AND SURFACE COVER GROUNDWATER MNA WITH BIOLOGICAL ENHAMCEMENTS, AND SEDIMENT REMOVAL METAL ETCHING SITE FREEPORT, NEW YORK
PREPARED FOR	NYSDEC
ERM Environmental Resources Management	SCALE: GRAPHIC; DATE: 11/1/06; FIGURE: 3–5
DRAWN: MFM/EMF	JOB NO.: 0011475; FILE NAME: 0011475-01-052



LEGEND

- STUDY AREA
- SITE
- STORM SEWER DRAIN
- AREA OF SEDIMENT REMOVAL (MAY CHANGE BASED ON PRE-DESIGN STUDIES)
- MW-08S / MW-08D — MONITORING WELLS TO BE INSTALLED, TO BE MONITORED FOR 30 YEARS FOR MONITORED NATURAL ATTENUATION (MNA)
- MW-05 — EXISTING MONITORING WELLS TO BE MONITORED FOR 30 YEARS FOR MNA
- POTENTIAL UST TO BE REMOVED (COMMON ACTION C3)
- SUB-SLAB DEPRESSURIZATION BENEATH SITE BUILDINGS (COMMON ACTION C1)
- HOT SPOT EXCAVATION 0 TO 1 FEET BELOW GRADE
- HOT SPOT EXCAVATION 0 TO 4 FEET BELOW GRADE
- HOT SPOT EXCAVATION 0 TO 14 FEET BELOW GRADE
- HOT SPOT EXCAVATION 0 TO 9 FEET BELOW GRADE
- HOT SPOT EXCAVATION 0 TO 6 INCHES AND 4 TO 9 FEET BELOW GRADE
- HOT SPOT EXCAVATION 0 TO 6 INCHES AND 4 TO 14 FEET BELOW GRADE
- HOT SPOT EXCAVATION 0 TO 1 FEET BELOW GRADE AND 4 TO 9 FEET BELOW GRADE
- HOT SPOT EXCAVATION 0 TO 1 FEET BELOW GRADE AND 4 TO 9 FEET BELOW GRADE
- REMOVAL OF UNCAPPED SOILS 0 TO 6 INCHES BELOW GRADE
- INSTALL ASPHALT OR BALLAST COVER OVER CURRENTLY EXPOSED SOILS TO BE MAINTAINED THROUGH SITE MANAGEMENT PLAN AS PART OF ENVIRONMENTAL EASEMENT[1]
- PIPING FOR SOIL VAPOR EXTRACTION SYSTEM
- ZERO VALENT IRON WALL

NOTE:

1. REFER TO FIGURE 2-1 FOR SURFACE COVERS TO BE MAINTAINED THROUGH SITE MANAGEMENT PLAN AS PART OF ENVIRONMENTAL EASEMENT (COMMON ACTION C4)

TITLE

ALTERNATIVE P6 & V:
HOT SPOT SOIL EXCAVATION AND SURFACE COVER, REMOVAL OF UNCAPPED SOIL, ZVI WALL, SVE, AND SEDIMENT REMOVAL
METAL ETCHING SITE
FREEPORT, NEW YORK

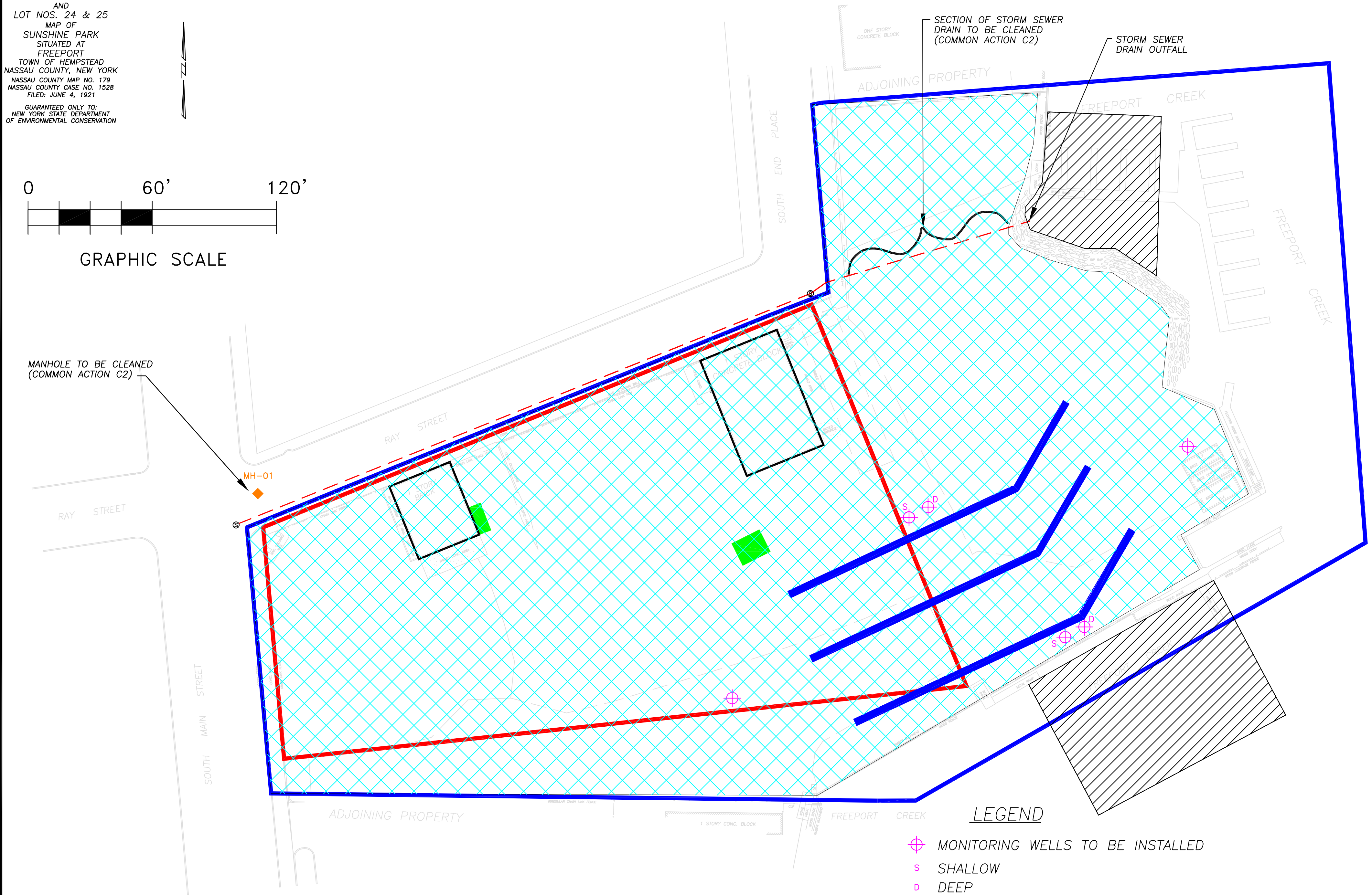
PREPARED FOR

NYSDEC

ERM Environmental Resources Management		SCALE: GRAPHIC	FIGURE
DRAWN: MFM/EMF	JOB NO.: 0011475	FILE NAME: 0011475-01-053	DATE: 11/1/06	3-6

MAP DERIVED FROM
TOPOGRAPHIC MAP OF DESCRIBED PROPERTY AND LOT NOS. 24 & 25 MAP OF SUNSHINE PARK SITUATED AT FREEPORT TOWN OF HEMPSTEAD NASSAU COUNTY, NEW YORK
NASSAU COUNTY MAP NO. 179
NASSAU COUNTY CASE NO. 1528
FILED: JUNE 4, 1921

GUARANTEED ONLY TO: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION



LEGEND

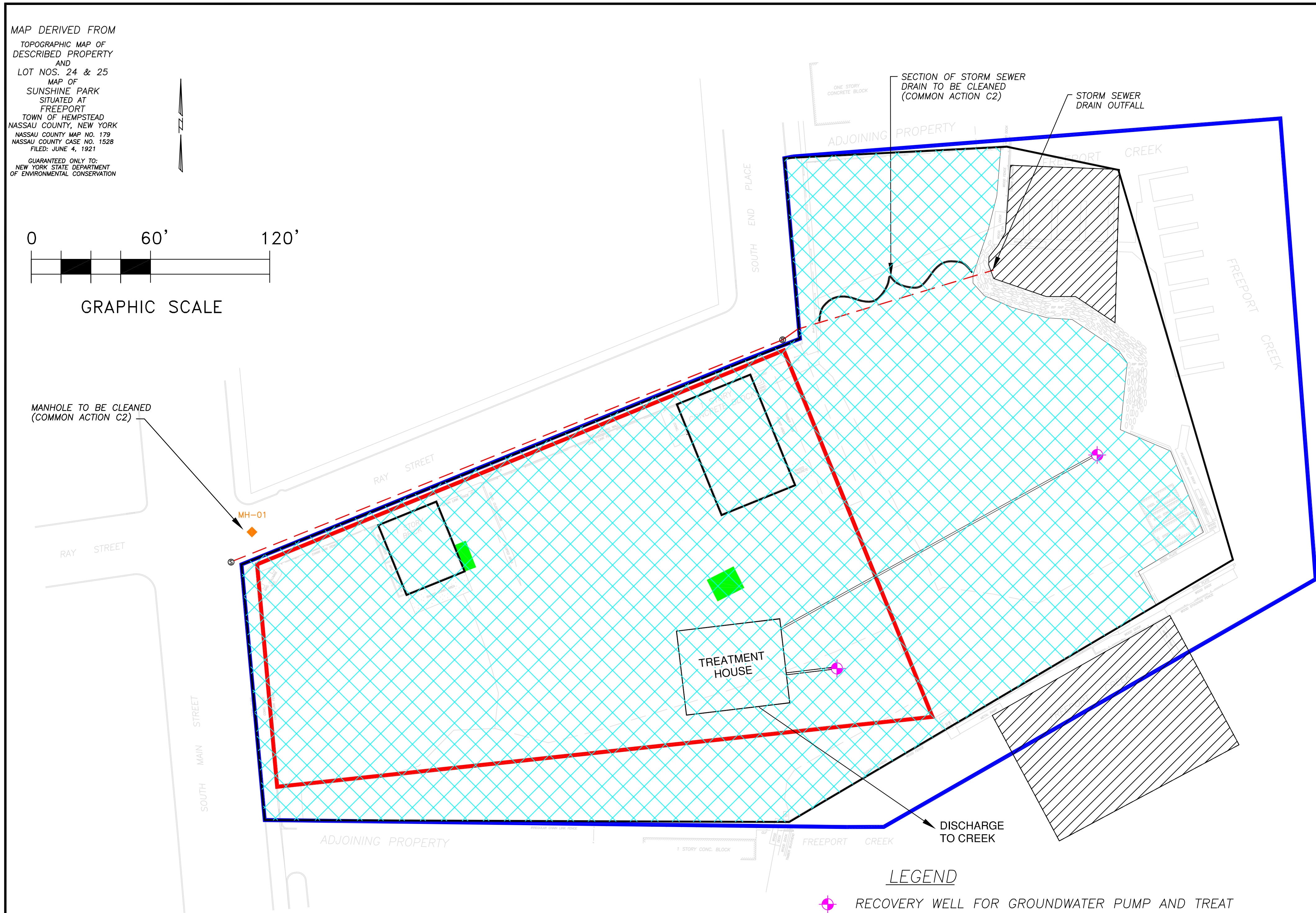
- MONITORING WELLS TO BE INSTALLED
- S SHALLOW
- D DEEP
- STUDY AREA
- SITE
- STORM SEWER DRAIN
- AREA OF SEDIMENT REMOVAL (MAY CHANGE BASED ON PRE-DESIGN STUDIES)
- POTENTIAL UST TO BE REMOVED (COMMON ACTION C3)
- EXCAVATION OF SOILS EXCEEDING VOC AND METALS SCGs TO 14' BELOW GRADE
- BUILDING TO BE DEMOLISHED PRIOR TO SOIL EXCAVATION
- ZERO VALENT IRON WALL

NOTE:

1. THE NEED FOR SUB-SLAB DEPRESSURIZATION (COMMON ACTION C1) FOR NEW BUILDINGS CONSTRUCTED POST-REMEDIATION WOULD BE EVALUATED THROUGH SOIL GAS SAMPING FOLLOWING REMEDIAL ACTION IMPLEMENTATION.

2. ENVIRONMENTAL EASEMENT (COMMON ACTION C4) WOULD BE IMPLEMENTED TO RESTRICT GROUNDWATER USE.

TITLE			
ALTERNATIVE P7 AND VI: FULL SCALE SOIL EXCAVATION, ZVI WALL AND SEDIMENT REMOVAL METAL ETCHING SITE FREEPORT, NEW YORK			
PREPARED FOR: NYSDEC			
ERM Environmental Resources Management		SCALE: GRAPHIC	FIGURE: 3-7
DRAWN: MFM/EMF	JOB NO.: 0011475	FILE NAME: 0011475-01-054	DATE: 11/1/06



NOTE:

1. THE NEED FOR SUB-SLAB DEPRESSURIZATION (COMMON ACTION C1) FOR NEW BUILDINGS CONSTRUCTED POST-REMEDIATION WOULD BE EVALUATED THROUGH SOIL GAS SAMPING FOLLOWING REMEDIAL ACTION IMPLEMENTATION.
2. ENVIRONMENTAL EASEMENT (COMMON ACTION C4) WOULD BE IMPLEMENTED TO RESTRICT GROUNDWATER USE.

LEGEND

- RECOVERY WELL FOR GROUNDWATER PUMP AND TREAT
- STUDY AREA
- SITE
- STORM SEWER DRAIN
- PIPING FOR GROUNDWATER EXTRACTION
- AREA OF SEDIMENT REMOVAL (MAY CHANGE BASED ON PRE-DESIGN STUDIES)
- POTENTIAL UST TO BE REMOVED (COMMON ACTION C3)
- EXCAVATION OF SOILS TO 14' BELOW GRADE EXCEEDING VOC AND METALS SCGs
- BUILDING TO BE DEMOLISHED

TITLE	ALTERNATIVE P8: FULL SCALE SOIL EXCAVATION, GROUNDWATER PUMP AND TREAT, AND SEDIMENT REMOVAL METAL ETCHING SITE FREEPORT, NEW YORK
PREPARED FOR	NYSDEC
ERM Environmental Resources Management	SCALE: GRAPHIC; FIGURE: 3-8
DRAWN: MFM/EMF	JOB NO.: 0011475
FILE NAME: 0011475-01-055	DATE: 11/1/06

TABLES

TABLE 2-1
POTENTIAL NEW YORK STATE STANDARDS, CRITERIA AND GUIDELINES (SCGS)
METAL ETCHING
FREEPORT, NEW YORK

CITATION	DESCRIPTION	TYPE	POTENTIAL APPLICABILITY TO DEVELOPING REMEDIAL ACTION OBJECTIVES	POTENTIAL APPLICABILITY TO EVALUATING REMEDIAL ACTION ALTERNATIVES
STANDARDS AND CRITERIA [(1)]				
6 NYCRR Part 364	Waste Transporter Permits	Action	Not applicable	This standard would relate to alternatives that involve waste removal.
6 NYCRR Part 375	Inactive Hazardous Waste Disposal Site Remedial Program	Action	This statute would be used to determine remedial requirements for at the Site.	This standard relates to all Site remedial activities (i.e. remedy selection and remedial action).
6 NYCRR Part 611	Environmental Priorities and Procedures in Petroleum Cleanup and Removal	Action	Not applicable.	May relate to management of NAPL that is recovered during remedial action.
6 NYCRR Part 608 (Environmental Conservation Law (ECL) Article 15 Title 5 Protection of Waters)	Use & Protection of Waters	Action, Location	Not applicable.	If remedial actions include any of the following activities, a permit may be required under this regulation: • disturbance of the bed and banks of the Creek; • excavation or placement of fill in navigable waters and contiguous wetlands; • water quality certification; and • construction, reconstruction, repair or expansion of dams, docking and/or mooring structures.

TABLE 2-1
POTENTIAL NEW YORK STATE STANDARDS, CRITERIA AND GUIDELINES (SCGS)
METAL ETCHING
FREEPORT, NEW YORK

CITATION	DESCRIPTION	TYPE	POTENTIAL APPLICABILITY TO DEVELOPING REMEDIAL ACTION OBJECTIVES	POTENTIAL APPLICABILITY TO EVALUATING REMEDIAL ACTION ALTERNATIVES
6 NYCRR Part 703.5	NYSDEC Water Quality Standards, Surface Water and Ground Water	Action, Chemical	This standard provides promulgated numeric standards that would be applicable to the development of remedial requirements for Site ground water and sediment.	This standard would relate to alternatives that include: discharge of removed excavation fluids to surface water bodies; and/or ground water monitoring.
6 NYCRR Part 661	Tidal Wetlands Land Use and Regulation	Action, Location	Not applicable.	Any remedial action activities performed along the Freeport Creek in areas designated as tidal wetlands would require a permit.
Clean Water Act [Federal Water Pollution Control Act, as amended] Section 304(a)	Federal ambient water quality criteria	Chemical	This standard provides promulgated numeric standards that would be directly applicable to water quality in the Freeport Creek (provided NY State standards are not more restrictive). Environmental media RAOs would need to ensure that surface water complies with these numeric standards.	This standard could relate to alternatives that include: discharge of removed excavation fluids to surface water bodies. Remedial activities need to ensure compliance with applicable numeric criteria.
6 NYCRR Part 257	Air Quality Standards	Action	Not applicable.	May relate to remedial action activities
Article 12 of the NYS Navigation Law (New York Oil Spill, Control and Compensation Act	Requires Cleanup and Removal of Petroleum Discharges to the Environment	Action, Chemical	Free phase petroleum was not identified at the Study Area, so it is not applicable.	May relate if found during remedial action.

TABLE 2-1
POTENTIAL NEW YORK STATE STANDARDS, CRITERIA AND GUIDELINES (SCGS)
METAL ETCHING
FREEPORT, NEW YORK

CITATION	DESCRIPTION	TYPE	POTENTIAL APPLICABILITY TO DEVELOPING REMEDIAL ACTION OBJECTIVES	POTENTIAL APPLICABILITY TO EVALUATING REMEDIAL ACTION ALTERNATIVES
6 NYCRR Part 750	State Discharge Elimination System (SPDES) Permits	Action	Not applicable.	This standard would relate to alternatives that include: discharge of removed excavation fluids to surface water bodies.
OSHA; 29 CFR 1910	Guidelines/Requirements for Workers at Hazardous Waste Sites (Subpart 120) and Standards for Air Contaminants (Subpart 1).	Action	Not applicable.	May relate to certain remedial action activities
OSHA; 29 CFR 1926	Safety and Health Regulations for Construction	Action	Not applicable	May relate to certain remedial action activities
6 NYCRR 613	Handling and Storage of Petroleum	Action	Applies to closure requirements for out of service tanks.	Relates to closure of out of service aboveground storage tanks.
Guidelines [(1)]				
TAGM HWR-90-4030	Selection of Remedial Actions at Inactive Hazardous Waste Sites	Action	Guidance is applicable to developing the remedial action objectives.	May relate to selection of remedial action.
TAGM HWR-94-4046	Determination of Soil Cleanup Objectives and Cleanup Levels	Chemical	Guidance is applicable for the development of remedial action objectives for Site soil.	Guidance is applicable for evaluating the effectiveness of a remedial alternative.

TABLE 2-1
POTENTIAL NEW YORK STATE STANDARDS, CRITERIA AND GUIDELINES (SCGS)
METAL ETCHING
FREEPORT, NEW YORK

CITATION	*DESCRIPTION*	*TYPE*	*POTENTIAL APPLICABILITY TO DEVELOPING REMEDIAL ACTION OBJECTIVES*	*POTENTIAL APPLICABILITY TO EVALUATING REMEDIAL ACTION ALTERNATIVES*
NYSDOH Community Air Monitoring Plan for Intrusive Activities	Requirements real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust)	Action, Chemical	Not applicable.	Would relate to any intrusive remedial activities.
NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York	Provides guidance for addressing subsurface VOC impacted soil vapor and indoor air.	Chemical, Action	Guidance relates to development of remedial action objectives through outlining guidance values for soil vapor and indoor air for chemicals.	Relates to potential technologies that may be used to remediate soil vapor.
NYSDEC TOGS 1.1.1	Ambient Water Quality Standards and Guidance Values	Action, Chemical	Guidance would be applicable for development of groundwater RAOs for; indirectly relate to developing RAOs for Site soil and sediment.	Guidance would be applicable for remedial action alternatives that involve work associated with Site ground water or the Freeport Creek.
NYSDEC Technical Guidance for Screening of Contaminated Sediment	Sediment screening guidance document	Chemical	Guidance relates to development of remedial action objectives for sediment. Methodology presented in this guidance would apply to the development of ecologically risk-based sediment RAOs.	Guidance would be applicable for developing alternative RAOs for evaluating remedial action alternatives that involve work associated with Site sediment in Freeport Creek.
TO BE CONSIDERED (TBCS) [(2)]				
NYS DOS, Policy 8 Coastal Management Program	Pollutants – Protection of fish and wildlife resources	Location	Not applicable.	This program is not likely to directly influence the evaluation of remedial action alternatives; however, remedial action outcomes should be consistent with the goals of the program.

TABLE 2-1
POTENTIAL NEW YORK STATE STANDARDS, CRITERIA AND GUIDELINES (SCGS)
METAL ETCHING
FREEPORT, NEW YORK

CITATION	*DESCRIPTION*	*TYPE*	*POTENTIAL APPLICABILITY TO DEVELOPING REMEDIAL ACTION OBJECTIVES*	*POTENTIAL APPLICABILITY TO EVALUATING REMEDIAL ACTION ALTERNATIVES*
NYSDEC *Draft* DER-10	Technical Guidance for Site Investigation and Remediation	Action	Draft guidance relates to development of remedial action objectives.	Relates to all Site remedial action activities.
Section 10, Rivers and Harbors Act 33 *U.S.C.* § 403	Pertains to activities in navigable waters	Action, Location	Not applicable	U.S. Army Corps of Engineers approval is generally required to excavate or fill, or in any manner to alter or modify the course, location, condition, or capacity of the channel of any navigable water of the United States.

GLOSSARY OF ACRONYMS

CFR	Code of Federal Regulations
NYSDEC	New York State Department of Environmental Conservation
NYCRR	New York Code of Rules and Regulations
OSHA	Occupational Safety and Health
SCG	Standards, Criteria and Guidance
TBC	To Be Considered Information
USEPA	U. S. Environmental Protection Agency
DER	Division of Environmental Remediation

Notes:
(1) Standards and Criteria were obtained from NYSDEC Draft DER-10, Technical Guidance for Site Investigation and Remediation, December 2002.
(2) Guidelines were obtained from NYSDEC Draft DER-10, Technical Guidance for Site Investigation and Remediation, December 2002.
(3) TBCs are defined in this report as regulations and guidance documents that are not identified NYSDEC Draft DER-10, Technical Guidance for Site Investigation and Remediation, December 2002.

TABLE 2-2
COMPARISON OF MAXIMUM DETECTED SOIL CONCENTRATIONS TO SCGs
METAL ETCHING
FREEPORT, NY

CONSTITUENT	UNITS	NYSDEC TAGM 4046 RSCO	Maximum Detected Screening Soil Boring Concentration
VOCs			
Acetone	(ug/kg)	200	[247]
Benzene	(ug/kg)	60	[1400]
Benzene, 1-methylethyl-	(ug/kg)	--	1.89 J
Chlorobenzene	(ug/kg)	1700	[3700]
cis-1,2-Dichloroethylene	(ug/kg)	--	12000
Ethene, 1,2-dichloro-, (E)-	(ug/kg)	300	[300]
Ethylbenzene	(ug/kg)	5500	[14000]
m+p-Xylene	(ug/kg)	--	15000
Methyl ethyl ketone	(ug/kg)	300	64
Methylcyclohexane	(ug/kg)	--	350000
Methyltert-butylether	(ug/kg)	120	[1500]
Naphthalene	(ug/kg)	13000	[25000]
o-Xylene	(ug/kg)	--	1400
p-Dichlorobenzene	(ug/kg)	8500	4800
Tetrachloroethylene	(ug/kg)	1400	[4300]
Toluene	(ug/kg)	1500	[78000]
Trichloroethylene	(ug/kg)	700	[10000]
Vinyl chloride	(ug/kg)	200	[1800]
Xylene (total)	(ug/kg)	1200	[15000]
SVOCs			
2-Methylnaphthalene	(ug/kg)	36000	90.6 J
Acenaphthene	(ug/kg)	50000	151 J
Acenaphthylene	(ug/kg)	41000	94.1 J
Anthracene	(ug/kg)	50000	373 J
Benzo(a)anthracene	(ug/kg)	224	[1190]
Benzo(a)pyrene	(ug/kg)	61	[1180]
Benzo(b)fluoranthene	(ug/kg)	1100	[1390]
Benzo(ghi)perylene	(ug/kg)	50000	336 J
Benzo(k)fluoranthene	(ug/kg)	1100	[1400]
Benzoic acid	(ug/kg)	2700	468 J
Bis(2-ethylhexyl)phthalate (BEH	(ug/kg)	50000	97 J
Carbazole	(ug/kg)	--	271 J
Chrysene	(ug/kg)	400	[1320]
Dibenzo(a,h)anthracene	(ug/kg)	14	[138] J
Dibenzofuran	(ug/kg)	6200	75.2 J
Fluoranthene	(ug/kg)	50000	3140
Fluorene	(ug/kg)	50000	160 J
Indeno(1,2,3-cd)pyrene	(ug/kg)	3200	203 J
Naphthalene	(ug/kg)	13000	70.1 J
Phenanthrene	(ug/kg)	50000	1740
Pyrene	(ug/kg)	50000	2060
INORGANICS			
Aluminum	(mg/kg)	33000	28400
Antimony	(mg/kg)	--	37
Arsenic	(mg/kg)	7.5	[29]
Barium	(mg/kg)	300	220
Beryllium	(mg/kg)	0.16	[1]
Cadmium	(mg/kg)	10*	[78]
Calcium	(mg/kg)	35000	[72000]
Chromium	(mg/kg)	50*	[2200]
Chromium (Hexavalent)	(mg/kg)	50*	[218]
Cobalt	(mg/kg)	30	[91]
Copper	(mg/kg)	25	[5700]
Iron	(mg/kg)	2000	[43000]
Lead	(mg/kg)	500*	[3900]
Magnesium	(mg/kg)	5000	[22000]
Manganese	(mg/kg)	5000	509
Mercury	(mg/kg)	0.1	[0.162]
Nickel	(mg/kg)	13	[1300]
Selenium	(mg/kg)	2	[6.7]
Silver	(mg/kg)	--	5.5
Sodium	(mg/kg)	--	481
Thallium	(mg/kg)	--	3.2
Vanadium	(mg/kg)	150	59
Zinc	(mg/kg)	20	[3600]

NYSDEC TAGM 4046 RSCO = New York State Department of Environmental Conservation (NYSDEC) Technical and Administrative Guidance Memorandum (TAGM) #4046 Recommended Soil Cleanup Objective (RSCO) dated January 24, 1994.
* Interim NYSDEC TAGM 4046 RSCO currently being used by the Department is listed
[ ] Indicates detected concentration is above the NYSDEC TAGM 4046 RSCO
J = Estimated value
ug/kg = microgram per kilogram
mg/kg = milligram per kilogram
-- = No NYSDEC TAGM 4046 RSCO exists

TABLE 2-3
HOT SPOT SOIL FOR INORGANICS AND VOCs SOIL CONCENTRATIONS ABOVE RSCOs: SOIL VOLUME CALCULATION
METAL ETCHING
FREEPORT, NY

Depth Interval (ft)	Area (ft^2)	Soil Volume (ft^3)	Soil Volume (BCY)
0-1	4,501	4,501	167
1-4	13,348[1]	40,044	1,483
4-9	14,069	70,345	2,605
9-14	3,323	16,615	615
		Total:	**4,871**

1. The area for the 1-4 interval does not add to the sum of the inorganic and VOC hot spot areas shown in Figure 2-2 because there are areas for both inorganic and VOC hot spot that coincide with another.
BCY = bank cubic yards (material as it lies in its natural state)
ft = feet
ft^2 = square feet
ft^3 = cubic feet

TABLE 2-4
COMPARISON OF MAXIMUM DETECTED MONITOR WELL GROUNDWATER CONCENTRATIONS TO SCGs
METAL ETCHING
FREEPORT, NY

CONSTITUENT	UNITS	NYSDEC TOGS	Maximum Detected Monitor Well Groundwater Concentration
VOCs			
Benzene	(ug/l)	1	[6] J
Benzene, 1-methylethyl-	(ug/l)	5	2 J
Bromoform	(ug/l)	50	2 J
Chlorobenzene	(ug/l)	5	1 J
cis-1,2-Dichloroethylene	(ug/l)	5	[370]
Cyclohexane	(ug/l)	--	4 J
1,2-dichloroethene	(ug/l)	5	3 J
Methylcyclohexane	(ug/l)	--	2 J
Methyltert-butylether	(ug/l)	10	[140]
Tetrachloroethylene	(ug/l)	5	[1600]
Toluene	(ug/l)	5	3 J
Trichloroethylene	(ug/l)	5	[25]
Vinyl chloride	(ug/l)	2	[400]
SVOCs			
2-Methylnaphthalene	(ug/l)	--	1J
Acenaphthene	(ug/l)	20	3J
Bis(2-ethylhexyl)phthalate	(ug/l)	5	1J
Carbazole	(ug/l)	--	1J
Dibenzofuran	(ug/l)	--	1J
Fluorene	(ug/l)	50	3J
Naphthalene	(ug/l)	10	6J
N-Nitrosodiphenylamine	(ug/l)	50	15
Phenanthrene	(ug/l)	50	
Pesticides/PCBs			
Endrin ketone	(ug/l)	5	0.079 J
Metals			
Aluminum	(ug/l)	--	1170
Antimony	(ug/l)	3	[13.9]
Arsenic	(ug/l)	25	3.8
Barium	(ug/l)	1000	[1050] J
Cadmium	(ug/l)	5	[15.9]
Calcium	(ug/l)	--	229000
Chloride	(mg/l)	250	[400] J
Chromium	(ug/l)	50	23.8
Chromium (Hexavalent)	(mg/l)	0.05	[0.069] J
Cobalt	(ug/l)	--	3.1
Copper	(ug/l)	200	28.3
Iron	(ug/l)	300	[79800]
Lead	(ug/l)	25	6.2
Magnesium	(ug/l)	35000	[58200]
Manganese	(ug/l)	300	[1220]
Nickel	(ug/l)	100	65.4
Potassium	(ug/l)	--	31300
Selenium	(ug/l)	10	7.7
Silver	(ug/l)	50	20.9
Sodium	(ug/l)	20000	[339000]
Vanadium	(ug/l)	--	2.8
Zinc	(ug/l)	2000	48.2

TOGS = New York State Department of Environmental Conservation (NYSDEC) TOGS No. 1.1.1 "Ambient Water Quality Standards and Guidance Values" (1998) (NYSDEC TOGS).
[ ] Indicates detected concentration is above the TOGS Class GA Groundwater Standard
J = Estimated value
ug/l = microgram per liter
-- = No TOGS Class GA Groundwater Standard exists

TABLE 2-5
COMPARISON OF SEDIMENT SAMPLES ANALYTICAL RESULTS TO ER-Ls and ER-Ms
METAL ETCHING
FREEPORT, NY

	ER-L mg/kg (Metals); ug/kg (PCBs, VOCs, SVOCs)	ER-M mg/kg (Metals); ug/kg (PCBs, VOCs, SVOCs)	SED-01 C1024-01 8/24/2004 Primary	SED-01 C1024-09 8/24/2004 Duplicate	SED-02 C1024-02 8/24/2004 Primary	SED-03 C1024-03 8/24/2004 Primary	SED-04 C1024-04 8/24/2004 Primary	SED-05 C1024-05 8/24/2004 Primary	SED-07 C1024-07 8/24/2004 Primary	Background Locations SED-06 C1024-06 8/24/2004 Primary	SED-08 C1024-08 8/24/2004 Primary
VOCs (ug/kg)											
Acetone	NA	NA	24	17	18	13 U	36	13 U	7	560	17
Carbon disulfide	NA	NA	14 U	12 U	13 U	13 U	7	13 U	12 U	87	13 U
Methylene chloride	NA	NA	14 U	12 U	10	13 U	19 U	13 U	12 U	19	10
Methyl-tert-butyl-ether	NA	NA	14 U	12 U	13 U	13 U	19 U	3	13 U	42 U	12 U
Sum of Constituents			***24***	***17***	***28***	***0***	***43***	***3***	***7***	***751***	***27***
SVOCs (ug/kg)											
2-Methylnaphthalene	70	670	480 U	400 U	410 U	430 U	610 U	430 U	390 U	1400 U	430 U
4-Methylphenol	NA	NA	480 U	400 U	86	430 U	610 U	430 U	390 U	1400 U	430 U
Acenaphthene	16	500	110	80	410 U	430 U	610 U	260	390 U	1400 U	430 U
Acetophenone	NA	NA	480 U	42	410 U	66	610 U	430 U	390 U	1400 U	430 U
Anthracene	85.3	1100	280	260	97	430 U	610 U	660	390 U	1400 U	430 U
Benzaldehyde	NA	NA	130	69	410 U	430 U	610 U	430 U	390 U	1400 U	430 U
Benzo(a)anthracene	261	1600	1100	930	340	61	410	3000	390 U	350	430 U
Benzo(a)pyrene	430	1600	1200	940	380	64	250	3000	390 U	410	430 U
Benzo(b)fluoranthene	NA	NA	2200	1600	620	95	490	4000	43	750	76
Benzo(ghi)perylene	NA	NA	290	260	110	430 U	610 U	690	390 U	250	430 U
Benzo(k)fluoranthene	NA	NA	740	570	250	46	160	2000	390 U	280	430 U
Bis(2-ethylhexyl)phthalate	NA	NA	6000	1700	690	100	1000	270	160	1400	240
Butyl benzyl phthalate	NA	NA	810	400	120	430 U	610 U	430 U	390 U	1400 U	430 U
Carbazole	NA	NA	200	140	50	430 U	610 U	390	390 U	1400 U	430 U
Chrysene	384	2800	1400	1500	430	79	350	3400	390 U	550	58
Dibenzo(a,h)anthracene	63.4	260	180	150	69	430 U	610 U	460	390 U	1400 U	430 U
Dibenzofuran	NA	NA	65	51	410 U	430 U	610 U	130	390 U	1400 U	430 U
Dimethyl phthalate	NA	NA	140	93	410 U	430 U	610 U	430 U	390 U	1400 U	430 U
Di-n-butyl phthalate	NA	NA	310	250	410 U	430 U	610 U	430 U	390 U	1400 U	430 U
Di-n-octyl phthalate	NA	NA	91	53	410 U	430 U	610 U	430 U	390 U	1400 U	430 U
Fluoranthene	600	5100	2500	1900	650	110	510	5100	390 U	470	61
Fluorene	19	540	130	140	410 U	430 U	610 U	270	390 U	1400 U	430 U
Indeno(1,2,3-cd)pyrene	NA	NA	740	570	240	430 U	610 U	1700	390 U	330	430 U
Naphthalene	160	2100	480 U	400 U	410 U	430 U	610 U	50	390 U	1400 U	430 U
Pentachlorophenol	NA	NA	1200 U	73	1000 U	1100 U	1500 U	1100 U	970 U	3500 U	1100 U
Phenanthrene	240	1500	1600	1400	410	58	610 U	3200	390 U	160	430 U
Pyrene	665	2600	3100	2300	910	130	3000	5200	42	930	75
Sum of Constituents			***23316***	***15471***	***5452***	***809***	***6170***	***33780***	***245***	***5880***	***510***

TABLE 2-5
COMPARISON OF SEDIMENT SAMPLES ANALYTICAL RESULTS TO ER-Ls and ER-Ms
METAL ETCHING
FREEPORT, NY

										Background Locations	
			SED-01	SED-01	SED-02	SED-03	SED-04	SED-05	SED-07	SED-06	SED-08
			C1024-01	C1024-09	C1024-02	C1024-03	C1024-04	C1024-05	C1024-07	C1024-06	C1024-08
	ER-L	ER-M	8/24/2004	8/24/2004	8/24/2004	8/24/2004	8/24/2004	8/24/2004	8/24/2004	8/24/2004	8/24/2004
Pest/PCBs (ug/kg)											
4,4'-DDD	NA	NA	4.1	10	4.1 U	3.7	6.1 U	4.3 U	3.9 U	14 U	4.3 U
4,4'-DDE	2.2	27	2.3	19	4.1 U	4.2	4.3	4.3 U	3.9 U	14 U	4.3 U
4,4'-DDT	1.58	46.1	4.8 U	8.2	4.1 U	4.3 U	6.1 U	4.3 U	3.9 U	14 U	4.3 U
Aldrin	NA	NA	2.5 U	2 U	2.1 U	2.2 U	3.1 U	2.2 U	2 U	7.1 U	2.2 U
alpha-BHC	NA	NA	2.5 U	2 U	2.1 U	2.2 U	3.1 U	2.2 U	2 U	7.1 U	2.2 U
alpha-Chlordane	0.5	6	2.5 U	2 U	2.7	1.9	3.1 U	1.2	2 U	7.1 U	2.2 U
Dieldrin	0.02	8	4.8 U	4 U	4.1 U	4.3 U	6.1 U	4.3 U	3.9 U	14 U	4.3 U
Endosulfan I	NA	NA	2.5 U	2 U	2.1 U	2.2 U	3.1 U	2.2 U	2 U	7.1 U	2.2 U
Endosulfan sulfate	NA	NA	4.8 U	4 U	4.1 U	4.3 U	6.1 U	4.3 U	3.9 U	14 U	4.3 U
Endrin aldehyde	NA	NA	4.8 U	17	4.1 U	4.3 U	6.9	4.3 U	3.9 U	14 U	4.3 U
Endrin ketone	0.02	45	4.8 U	4 U	4.1 U	4.3 U	8.9	4.3 U	3.9 U	14 U	4.3 U
gamma-Chlordane	0.5	6	1.7	12	2.5	2.3	3.1 U	2.2 U	2 U	7.1 U	2.2 U
Heptachlor epoxide	NA	NA	2.5 U	2 U	2.1 U	2.2 U	3.1 U	2.2 U	2 U	7.1 U	2.2 U
Methoxychlor	NA	NA	25 U	14	21 U	22 U	12	22 U	20 U	71 U	22 U
Aroclor 1254	22.7	180	96	2300	70	86	170	43 U	39 U	140 U	43 U
Metals (mg/kg)											
Aluminum	NA	NA	3560	5120	2950	1310	8200	1670	1050	17800	1740
Arsenic	8.2	70	6.3	5.6	5.2	2.7	15	5.1	0.77	26	1.6
Barium	NA	NA	23.5	18.6	8	5	52.8	7.6	3.6	67.5	6.4
Beryllium	NA	NA	0.39	0.35	0.34	0.12	0.79	0.15	0.077	1.5	0.15
Cadmium	1.2	9.6	0.42	0.64	0.18	1.1 UJ	1	0.93 UJ	0.96	1	0.096
Calcium	NA	NA	16700	9050	11000	2090	2230	329	1680	12900	12700
Chromium	81	370	34.7	84.9	16	3.3	127	14.4	3.4	89.2	6.5
Cobalt	NA	NA	2.6	3	1.8	0.43	5.6	1	0.3	6.7	0.7
Copper	34	270	285	261	52.3	30.1	290	57.8	39	338	17.5
Iron [1]	2%	4%	11000	10500	6040	4840	21400	7100	1910	39300	3210
Lead	46.7	218	63.8	105	98.6	17.1	134	19	6	154	15.2
Magnesium	NA	NA	11400	8590	1430	2200	3880	553	529	11500	994
Manganese [1]	460	1100	64.3	83.6	36.5	32.5	116	38.9	13.1	268	25.6
Mercury	0.15	0.71	2.5	0.083	0.065	0.12 UJ	0.39	0.11 UJ	0.094 UJ	0.61	0.089
Nickel	20.9	51.6	15.4	40.4	8.8	3.2	28.4	2.3	1.4	26.8	2.6
Potassium	NA	NA	627	585	450	230	1850	358	284	5730	479
Silver	1	3.7	0.67	0.69	0.33	0.22	1.8	0.39		3.4	0.13
Sodium	NA	NA	4990	3940	2680	1700	6200	473	1580	33300	3260
Thallium	NA	NA	1.8	1.1	0.63	2.1 UJ	2.1	1.9 UJ	1.9 UJ	4.8	0.76
Vanadium	NA	NA	31.5	20.6	10.6	9.4	40.7	7.5	3.4	81.7	5.9
Zinc	150	410	338	315	93.2	59.7	425	46.5	16.5	417	26.5

(Yellow) Above ER-L and above SED-06 and SED-08
(Orange) Above ER-M and above SED-06 and SED-08
NA Not applicable
U : Chemical was not detected at indicated chemical limit.
UJ: Chemical was undetected but estimated to be at indicated level.

1. Persaud, D., Jaagumagi, R., and A. Hayton, 1992. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. Ontario Ministry of the Environment, Queen's Printer for Ontario.

TABLE 2-6
COMPARISON OF SURFACE WATER SAMPLE ANALYTICAL RESULTS TO TOGS 1.1.1 CRITERIA
METAL ETCHING
FREEPORT, NY

				Adjacent to Site				Downstream	Background Locations/Upstream			
	SW-01 C1024-13 8/24/2004 Primary	SW-01 C1024-10 8/24/2004 Duplicate	SW-02 C1024-14 8/24/2004 Primary	SW-03 C1024-15 8/24/2004 Primary	SW-04 C1024-16 8/24/2004 Primary	SW-05 C1024-17 8/24/2004 Primary	SW-07 C1024-19 8/24/2004 Primary	SW-08 C1024-20 8/24/2004 Primary	SW-06 C1024-18 8/24/2004 Primary	Class	Type	TOGS 1.1.1 Criteria mg/L
VOCs (ug/l)												
Benzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	7J	10 U	SC	Human Consumption of Fish (Saline Waters)	10
	10 U	10 U	10 U	10 U	10 U	10 U	10 U	7J	10 U	SC	Fish Propagation (Saline Waters)	190*
	10 U	10 U	10 U	10 U	10 U	10 U	10 U	7J	10 U	SC	Fish Survival (Saline Waters)	670*
Ethylbenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10	10 U	SC	Fish Propagation (Saline Waters)	4.5*
	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10	10 U	SC	Fish Survival (Saline Waters)	41*
Methyl-tert-butyl-ether	2J	1J	2J	10 U	1J	1J	10U	7J	10U	SC	ON PARTIAL LIST OF SUBSTANCES NOT REGULATED BY THE PRINCIPAL ORGANIC CONTAMINANT (POC) GROUNDWATER STANDARD	No standard or guidance value for groundwater is available for these substances as of the date of this document (1998)
Toluene	10 U	10 U	1J	10 U	10 U	10 U	1J	77J	1J	SC	Human Consumption of Fish (Saline Waters)	6000
	10 U	10 U	1J	10 U	10 U	10 U	1J	77J	1J	SC	Fish Propagation (Saline Waters)	92*
	10 U	10 U	1J	10 U	10 U	10 U	1J	77J	1J	SC	Fish Survival (Saline Waters)	430*
Xylenes (total)	10 U	10 U	10 U	10 U	10 U	10 U	10 U	58	10 U	SC, 1,2 Xylene	Fish Propagation (Saline Waters)	19*
	10 U	10 U	10 U	10 U	10 U	10 U	10 U	58	10 U	SC, 1,2 Xylene	Fish Survival (Saline Waters)	170*
	10 U	10 U	10 U	10 U	10 U	10 U	10 U	58	10 U	SC, 1,3 Xylene	Fish Propagation (Saline Waters)	19*
	10 U	10 U	10 U	10 U	10 U	10 U	10 U	58	10 U	SC, 1,3 Xylene	Fish Survival (Saline Waters)	170*
	10 U	10 U	10 U	10 U	10 U	10 U	10 U	58	10 U	SC, 1,4 Xylene	Fish Propagation (Saline Waters)	19*
	10 U	10 U	10 U	10 U	10 U	10 U	10 U	58	10 U	SC, 1,4 Xylene	Fish Survival (Saline Waters)	170*
Sum of Constituents	***2***	***1***	***3***	***0***	***1***	***1***	***1***	***159***	***1***			
SVOCs (ug/l)												
2,4-Dimethylphenol	10 U	6J	10 U	10 U	10 U	10 U	10 U	10 U	10 U	SC	Human Consumption of Fish (Saline Waters)	1000
2-Methylphenol	10 U	3J	10 U	10 U	10 U	10 U	10 U	10 U	10 U	Chemical not found	Chemical not found	Chemical not found
4-Methylphenol	10 U	2J	10 U	10 U	10 U	10 U	10 U	10 U	10 U	Chemical not found	Chemical not found	Chemical not found
Di-n-butyl phthalate	10UJ	1UJ	10UJ	2J	10 U	10 U	10 U	1J	10 U	Class not found	Class not found	Class not found
Di-n-octyl phthalate	10 U	2	10 U	10 U	10 U	4J	10 U	10 U	10 U	Class not found	Class not found	Class not found
Fluoranthene	10 U	10 U	10 U	10 U	10 U	2J	10 U	10 U	10 U	Class not found	Class not found	Class not found
Pyrene	10 U	10 U	10 U	10 U	10 U	2J	10 U	10 U	10 U	Class not found	Class not found	Class not found
Sum of Constituents	***0***	***14***	***0***	***2***	***0***	***8***	***0***	***1***	***0***			

TABLE 2-6
COMPARISON OF SURFACE WATER SAMPLE ANALYTICAL RESULTS TO TOGS 1.1.1 CRITERIA
METAL ETCHING
FREEPORT, NY

	Adjacent to Site							Downstream	Background Locations/Upstream			
	SW-01 C1024-13 8/24/2004 Primary	SW-01 C1024-10 8/24/2004 Duplicate	SW-02 C1024-14 8/24/2004 Primary	SW-03 C1024-15 8/24/2004 Primary	SW-04 C1024-16 8/24/2004 Primary	SW-05 C1024-17 8/24/2004 Primary	SW-07 C1024-19 8/24/2004 Primary	SW-08 C1024-20 8/24/2004 Primary	SW-06 C1024-18 8/24/2004 Primary	Class	Type	TOGS 1.1.1 Criteria mg/L
Pest/PCBs (ug/l)												
None												
Metals (ug/l)												
Aluminum	229	259	212	227	226	235	221	261	231	Class not found	Class not found	Class not found
Antimony	26	24	26	24.8	23.6	22.5	24.5	25.1	24.9	Class not found	Class not found	Class not found
Calcium	302000	300000	298000	299000	289000	255000	297000	303000	294000	Chemical not found	Chemical not found	Chemical not found
Copper	7.4 U	10.5 U	3.8 U	2.8 U	19.5	46.5	11.8 U	3.6U	0.6 U	SC	Fish Propagation (Saline Waters)	3.4**
	7.4 U	10.5 U	3.8 U	2.8 U	19.5	46.5	11.8 U	3.6U	0.6 U	SC	Fish Survival (Saline Waters)	4.8 ***
Iron	126 U	130 U	103 U	94.5 U	115 U	388	108 U	119 U	118 U	Class not found	Class not found	Class not found
Lead	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	1.4 J	0.5 UJ	0.5 UJ	0.5 UJ	SC	Fish Propagation (Saline Waters)	8
	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	1.4 J	0.5 UJ	0.5 UJ	0.5 UJ	SC	Fish Survival (Saline Waters)	204
Magnesium	970000	945000	937000	923000	866000	785000	876000	903000	902000	Class not found	Class not found	Class not found
Manganese	25.9	21.4	21.3	19.4	26.1	55	23.3	24.9	29.8	Class not found	Class not found	Class not found
Potassium	310000	294000	307000	306000	293000	255000	302000	304000	307000	Chemical not found	Chemical not found	Chemical not found
Sodium	14000000 J	12800000 J	12800000 J	13300000 J	12900000 J	11700000 J	12700000 J	13900000 J	12000000 J	Class not found	Class not found	Class not found
Vanadium	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.49	0.4 U	0.4 U	0.4 U	Class not found	Class not found	Class not found

* Guidance values derived according to scientific procedures that are in regulation (6 NYCRR Part 702).
** Standard is 3.4 ug/L except in New York/New Jersey Harbor where it is 5.6 ug/L.
*** Standard is 4.8 ug/L except in New York/New Jersey Harbor where it is 7.9 ug/L. Aquatic Type standards apply to dissolved form.
U : Chemical was not detected at indicated chemical limit.
UJ: Chemical was undetected but estimated to be at indicated level.
(highlighted) Above TOGS Standards and above SW-06

TABLE 3-1
TECHNOLOGY SCREENING AND SELECTION
METAL ETCHING
FREEPORT, NEW YORK

Technology	*Description*	*Ability to Meet the RAOs**	*Effectiveness*	*Implementability*	*Technology Carried Forward?*
Access/Use Restrictions via Environmental Easement	An environmental easement would specify access/use restrictions to prohibit access to areas of the Study Area and restrict current and future use of the Site. Examples include: deed restrictions, construction work limitations, notification regarding residual contamination through a deed notice, fencing, etc. Access and use restrictions would be implemented through an environmental easement.	This technology would help meet the following RAOs: 1,4	This technology would need to be used in conjunction with other technologies to be effective.	This technology is readily implementable.	Yes.
Surface Cover/Cap Sediment Monitored Natural Recovery (MNR)	A cover/cap can be constructed over impacted soil or impacted sediment to prevent direct contact with underlying materials. A cover/cap for impacted soil can include: soil, ballast, asphalt, concrete or more impermeable materials, such as those used for a Subtitle C cover. A cover/cap for sediment may include granular material consisting of sand, gravel, or other appropriate material. In addition, a cover/cap may be able to accumulate naturally over sediments in a subtidal environment, a process referred to as monitored naturally recovery (MNR).	Surface and sediment covers (either constructed caps or caps via natural recovery) would address the following RAOs: 1,2,7,8,9	Surface covers and constructed sediment caps are effective provided that they are properly maintained. Sediment covers via MNR are effective provided that adequate sediment deposition is occurring and potential future discharge sources are eliminated.	Surface covers are routinely constructed and readily accepted by the regulators. Sediment covers via natural recovery have also been accepted by regulators; however, there is little demonstrated acceptance of constructed sediment caps by the regulators and long-term performance information.	Yes for surface covers and MNR. No for constructed sediment caps.
Monitored Natural Attenuation (MNA)	Relies on natural processes to breakdown groundwater contaminants. Natural attenuation processes include physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce mass, toxicity, mobility, volume, or concentration of contaminants in groundwater. These processes include biodegradation, dispersion, dilution, sorption, volatilization, and chemical or biological stabilization, transformation, or destruction of contaminants. Groundwater samples are collected to track contaminant trends and breakdown byproducts to monitor progress and nutrients.	MNA would meet the following RAOs: 4,5	MNA is effective at remediation of groundwater for VOC plumes proven to be stable or shrinking. Natural attenuation is currently occurring in the shallow groundwater through anaerobic biodegradation of the chlorinated VOCs.	MNA is readily implementable. Requires significant sampling frequency and parameters. Administrative implementability depends upon the regulatory approval.	Yes.
In-situ Chemical Oxidation	Chemical oxidants are introduced into a contaminated soil or groundwater matrix using a variety of reagent injection and mixing apparatus. The oxidants interact with organic contaminants and degrade them in-situ into innocuous end products. The oxidizing agents most commonly used are ozone, hydrogen peroxide, hypochlorites, chlorine, permanganates, and chlorine dioxide.	ISCO would meet the following RAOs: 1,2,3,4,5	Low ORP and low dissolved oxygen values have been measured in the groundwater. These conditions are key indicators of on-going biodegradation of PCE in groundwater. Thus, ISCO would not be effective due to the Study Area groundwater chemistry. Also, the presence of significant humus and organic matter in the Study Area soils would create significant competition for oxidant chemicals in the soil matrix.	Design of an effective treatment program would be impractical due to the groundwater chemistry present at the Study Area. Competition from chemicals in soil may limit the degree to which this technology can be implemented.	No. Given the Study Area conditions, ISCO is not applicable to the Site.

* RAOs are listed on the last page of the table.

TABLE 3-1
TECHNOLOGY SCREENING AND SELECTION
METAL ETCHING
FREEPORT, NEW YORK

Technology	*Description*	*Ability to Meet the RAOs**	*Effectiveness*	*Implementability*	*Technology Carried Forward?*
In-Situ Chemical Fixation/ Stabilization	Contaminants in the soil are physically bound or enclosed within a stabilized mass (solidification), or chemical reactions are induced between the stabilizing agent and contaminants reduce their mobility.	Since leaching of metals to groundwater is not occurring, there are no RAOs that this technology would address.	Leaching to groundwater is not a threat; stabilization of this media is not needed.	This technology would be implementable.	No. Given the site conditions, soil stabilization is not needed.
Groundwater Reductive Dechlorination Groundwater using Zero Valent Iron (ZVI)	ZVI is placed in-situ and promotes abiotic degradation of chlorinated compounds by effecting breakdown.	ZVI would meet the following RAOs: 4,5	This technology would be effective at treating groundwater prior to discharging to Freeport Creek.	This technology would be implementable.	Yes.
Enhanced Biodegradation	Biodegradation is a process in which indigenous micro-organisms (e.g., fungi, bacteria, and other microbes) breakdown organic contaminants found in soil and/or groundwater, converting them to innocuous end products. Under enhanced biodegradation, nutrients, oxygen, or other amendments are added to enhance bioremediation and contaminant desorption from subsurface materials.	This technology would meet the following RAOs: 4,5	Biodegradation is currently occurring in the shallow groundwater, but not occurring in the deeper groundwater likely due to the absence of organic matter. Enhancement of the naturally occurring bio-degradation would not be possible due to the high hydraulic gradient and the tidal influence. In addition, the ORP of the deeper groundwater is too high to support anaerobic biodegradation.	Injection/application may be affected by subsurface structures. Preferential flow paths may limit contact between injected fluids and contaminants. There is the potential for electron acceptor limitations. High concentrations of contaminants may be toxic to microorganisms. High hydraulic conductivity reduces the residence time of injected biological enhancements.	No.
Excavation	Contaminated soil is removed. Disposal options for excavated soil are presented below.	This technology would meet the RAOs: 1,2,3	This technology would be effective at removing impacted soils from the Study Area.	This technology would be implementable with significant dewatering and engineered measures for soil beneath the water table. Additionally, the former building foundations may impact the design for excavation.	Yes.
Sediment Removal/ Dredging	Using conventional removal techniques such as hydraulic and mechanical dredging along with suction/vacuum pumping to remove impacted sediments. The selected removal method would be based on access constraints.	This technology would meet the RAOs: 7,8,9	Effective in the long term in removing COPCs from the Site-related sediment. Short-term effects to biota and marine life expected to occur. Potential effects to the estuarine environment expected to recover over time.	Implementability concerns associated with water diversion and dewatering. Also, may affect Freeport Creek boating activities. Administrative approvals would be required. Excavated materials that are managed aboveground during implementation may be subject to administrative requirement.	Yes.

* RAOs are listed on the last page of the table.

Technology	*Description*	*Ability to Meet the RAOs**	*Effectiveness*	*Implementability*	*Technology Carried Forward?*
Ex-Situ Solidification/ Stabilization	Contaminated soil or sediment is removed. Contaminants are then physically bound or enclosed within a stabilized mass (solidification), or chemical reactions are induced between the stabilizing agent and contaminants to reduce their mobility (stabilization). Once treated, the soil and/or sediment may then be replaced as backfill.	Since leaching of metals to groundwater is not occurring, there are no RAOs that this technology would address.	Chemicals in soil or sediment are not leaching groundwater so stabilization of the these media is not needed. Neither the soil nor sediment is expected to be classified as a RCRA char-acteristic hazardous waste; thus, stabilization would not be needed prior to off-site land disposal.	This technology would be implementable.	No. Given the site conditions, soil stabilization is not needed.
Off-Site Land Disposal	Contaminated soil and/or sediment are transported off-Site for disposal at an appropriately permitted landfill.	This technology would help meet the following RAOs: 1,2,3,4,5,6,7,8,9	Removes COPCs from the Study Area permanently. Transfers chemicals to landfill.	This approach is readily implementable.	Yes.
Groundwater Treatment (Physical/ Chemical)	Physical or chemical treatment processes are applied to groundwater following extraction. As part of this technology, piping is needed to convey recovered groundwater to a treatment location. Also, a treatment building would be necessary. Chemical additives are used to react with groundwater contaminants to reduce concentrations prior to discharge or filtration methods combined with liquid phase carbon absorption may be used.	This technology would help meet the following RAOs: 4,5,6	This technology has been effective at reducing groundwater contaminant concentrations at other sites. However, often times groundwater standards are not met as asymptotic concentration levels are reached over time.	Multiple contaminants can affect process performance. High suspended solids and oil and grease may cause fouling of the carbon and may require frequent media changeouts or pretreatment. Highly water-soluble compounds and small molecules are not adsorbed well. Spent carbon needs to be properly disposed.	Yes.
Incineration	High temperatures, 871 – 1,204 °C (1,600 – 2,200°F) are used to combust (in the presence of oxygen) organic constituents in excavated soil.	This technology would help meet the following RAOs: 1,2,3	Effective to remediate soils contaminated with explosives and hazardous wastes, particularly chlorinated hydrocarbons, PCBs, and dioxins.	Specific feed size and materials handling requirements may impact applicability or cost. Heavy metals may produce a bottom ash requiring stabilization. Volatile heavy metals, including lead, cadmium, mercury, and arsenic, require special handling measures. Metals can react with other elements in the feed stream, (i.e., chlorine or sulfur) to form more volatile and toxic compounds than the source material.	No. Levels of contaminants at Site do not warrant this technology.

* RAOs are listed on the last page of the table.

Technology	*Description*	*Ability to Meet the RAOs**	*Effectiveness*	*Implementability*	*Technology Carried Forward?*
Groundwater Extraction	This technology employs pumping of groundwater to withdraw water and its dissolved and entrained constituents from the aquifer. This pumping can be used to contain, reduce, remove, divert, or prevent development of chemical plumes. The use of extraction wells is most effective when the targeted chemicals of concern are miscible and move readily with the groundwater and the hydraulic conductivity is high. Groundwater extraction must be used in conjunction with other technologies (i.e., treatment and/or disposal methods) in order to manage the extracted groundwater.	This technology would help meet the following RAOs: 4,5,6	Groundwater extraction is effective at removing aqueous media from the ground.	The equipment and materials for extraction wells are readily available. Very high pumping rates would be needed to overcome the hydraulic gradient at the Site.	Yes.
Groundwater Discharge 1. Reinjection Well 2. POTW 3. Recharge Basin 4. Freeport Creek	1. Water is injected below the water table. Groundwater flows across the site to the southeast, and the plume of VOCs extends across the Study Area. Treated groundwater would need to be returned to the aquifer at an upgradient location (northwest boundary of site). 2.Discharge treated groundwater to the sanitary sewer for conveyance to the local publicly-owned treatment works (POTW). 3.This technology entails the discharge of treated groundwater to a local recharge basin (i.e., a sump) for subsequent groundwater recharge. Conveyance to the recharge basin may be accomplished via a storm sewer, or a separate pipe may need to be installed from the treatment plant to the recharge basin. Operation of this technology may include periodic clean out of the recharge basin due to the precipitation of metals. The presence of these metals in the treated effluent will depend on the selected groundwater treatment technology. 4. Discharge of treated groundwater to Freeport Creek.	This technology would help meet the following RAOs: 4,5,6	Discharge to a recharge basin is routinely conducted on Long Island for stormwater management and has been used for the discharge of treated groundwater from remediation sites. Discharging to the local POTW would require an evaluation of the ability of the local sanitary sewer piping, and the POTW, to handle the significant increase in flow. Although a reinjection well could be designed to handle the volume of water requiring discharge, there are some concerns regarding potential fouling of the formation around the injection well. Discharge to Freeport Creek is also an effective option.	Depends upon the selected option. All four options are technically implementable. However, there are significant concerns over the administrative implementability of each option.	Yes.
Soil Vapor Extraction	This technology involves the installation of piping in the unsaturated zone in order to treat chemicals adsorbed to soil in the vadose zone. A vacuum is applied inside the pipes to volatilize the chemicals from the soil to vapor inside the pipes. The vapors are then transferred to the atmosphere and may be treated by vapor phase carbon prior to discharge. The SVE system utilizes a blower and controls in order to create the vacuum.	This technology would help meet the following RAOs: 3, 4	SVE is effective in mitigating vapor risks associated with contaminants adsorbed to soil in the vadose region.	This option is implementable across the site with the use of horizontal pipes. Excavation and repaving, as well as construction of a shed to house controls and blowers will be necessary.	Yes.

* RAOs are listed on the last page of the table.

TABLE 3-1
TECHNOLOGY SCREENING AND SELECTION
METAL ETCHING
FREEPORT, NEW YORK

Technology	*Description*	*Ability to Meet the RAOs**	*Effectiveness*	*Implementability*	*Technology Carried Forward?*
Site Management Plan	A Site Management Plan (SMP) would specify required operation, monitoring and maintenance for any implemented remedial technologies such as: inspection and maintenance of surface covers implemented to prevent direct contact with soils above NYSDEC RSCOs, on-going OM&M for an SVE system, groundwater monitoring, or other activities requiring continued follow-up depending upon the selected remedial action. An SMP would be implemented through an environmental easement.	This technology would help meet the following RAOs: 1,2,3,4,5,7,8,	This technology would need to be used in conjunction with other technologies to be effective.	This technology is readily implementable.	Yes.

Specific technology descriptions obtained from Federal Remediation Technologies Roundtable, www.frtr.gov.

Key of Remedial Action Objectives

<u>Soil RAOs</u>
1. Prevent ingestion and/or direct contact of/with soil that exceeds applicable SCGs.
2. Prevent migration of soil that would result in surface water, groundwater, or sediment impacts that exceed applicable SCGs or result in fish advisories.
3. Prevent inhalation of or exposure from COPCs volatilizing from soil that exceed applicable SCGs.

<u>Groundwater RAOs</u>
4. Prevent inhalation of VOCs volatizing from contaminated groundwater.
5. Prevent discharge of Site-contaminants to surface water.
6. Remove the source of ground or surface water contamination (this RAO will be addressed in the context of the soil RAOs).

<u>Sediment RAOs</u>
7. Prevent surface water contamination which may result in fish advisories.
8. Prevent releases of chemicals in excess of upriver values to or from sediment that would result in surface water concentrations of COPCs in excess of ambient water quality criteria and/or result in fish advisories;
9. Prevent Site-related impacts from bioaccumulation through the marine or aquatic food chain to the extent practicable, by taking upriver sediment quality and applicable SCGs into consideration

<u>Surface Water RAOs</u>
10. Prevent ingestion of surface water impacted by contaminants.
11. Prevent contact with contaminants from impacted water bodies.
12. Prevent surface water contamination which may result in fish advisories.
13. Restore surface water to ambient water quality criteria for the contaminant of concern.
14. Prevent Site-related impacts to biota from ingestion/direct contact with surface water causing toxicity and impacts from bioaccumulation through the marine or aquatic food chain to the extent practicable.

* RAOs are listed on the last page of the table.

TABLE 3-2
COMPONENTS OF THE PRELIMINARY REMEDIAL ACTION ALTERNATIVES
METAL ETCHING
FREEPORT, NEW YORK

Alternative	Components
P1: No Action	None
P2: Surface Cover, Groundwater Monitored Natural Attenuation, Soil Vapor Extraction (SVE), and Sediment Monitored Natural Recovery	• Access and Use Restrictions via Environmental Easement • Installation of a Surface Cover in Uncovered Areas • Surface Cover Inspections and Maintenance • MNA of Groundwater • Freeport Creek Sediment MNR • SVE • Existing IRM: Operation of the Sub-slab Depressurization (SSD) System Beneath Existing Site Buildings (Common Action C1) • Sediment Removal from the Storm Sewer System (Common Action C2) • Underground Storage Tank (UST) Removal (Common Action C3) • Environmental Easement (Common Action C4)
P3: Hot Spot Soil Excavation to the Water Table and Surface Cover, Groundwater MNA and Sediment Removal	• Access and Use Restrictions via Environmental Easement • Excavation of Volatile Organic Compound (VOC) and Metals Hot Spots to the Water Table with Off-Site Disposal • Installation of a Surface Cover in Uncovered Areas • Surface Cover Inspections and Maintenance • MNA of Groundwater • Freeport Creek Sediment Removal • Existing IRM: Operation of the Sub-slab Depressurization (SSD) System Beneath Existing Site Buildings (Common Action C1) • Sediment Removal from the Storm Sewer System (Common Action C2) • UST Removal (Common Action C3) • Environmental Easement (Common Action C4)
P4: Hot Spot Soil Excavation and Surface Cover, Groundwater MNA and Sediment Removal	• Access and Use Restrictions via Environmental Easement • Excavation of VOC and Metals Hot Spots to the Water Table with Off-Site Disposal • Backfill of Excavated Areas with Clean with Clean Backfill / Zero Valent Iron (ZVI) Mixture below the Water Table • Installation of a Surface Cover in Uncovered Areas • Surface Cover Inspections and Maintenance • MNA of Groundwater • Freeport Creek Sediment Removal • Existing IRM: Operation of the Sub-slab Depressurization (SSD) System Beneath Existing Site Buildings (Common Action C1) • Sediment Removal from the Storm Sewer System (Common Action C2) • UST Removal (Common Action C3) • Environmental Easement (Common Action C4)
P5: Hot Spot Soil Excavation and Surface Cover, Groundwater MNA with Biological Enhancements, and Sediment Removal	• Access and Use Restrictions via Environmental Easement • Excavation of VOC and Metals Hot Spots with Off-Site Disposal • MNA of Groundwater along with Injection of Biological Enhancements • Installation of a Surface Cover in Uncovered Areas • Surface Cover Inspections and Maintenance • Freeport Creek Sediment Removal • Existing IRM: Operation of the Sub-slab Depressurization (SSD) System Beneath Existing Site Buildings (Common Action C1) • Sediment Removal from the Storm Sewer System (Common Action C2) • UST Removal (Common Action C3) • Environmental Easement (Common Action C4)

TABLE 3-2
COMPONENTS OF THE PRELIMINARY REMEDIAL ACTION ALTERNATIVES
METAL ETCHING
FREEPORT, NEW YORK

P6: Hot Spot Soil Excavation and Surface Cover, Removal of Uncapped Soil, In-situ Groundwater Treatment Using ZVI Wall, SVE, and Sediment Removal	• Access and Use Restrictions via Environmental Easement • Excavation of VOC and Metals Hot Spots with Off-Site Disposal • Installation of a Surface Cover in Uncovered Areas • Surface Cover Inspection and Maintenance • Freeport Creek Sediment Removal • Installation of a ZVI Treatment Wall Adjacent to the Creek at the Downgradient Site Boundary • Groundwater Monitoring • Installing an SVE System to Treat Unsaturated VOC Source Soil • Removal of Top Six Inches of Uncapped Soil • Existing IRM: Operation of the Sub-slab Depressurization (SSD) System Beneath Existing Site Buildings (Common Action C1) • Sediment Removal from the Storm Sewer System (Common Action C2) • UST Removal (Common Action C3) • Environmental Easement (Common Action C4)
P7: Full-Scale Soil Excavation, ZVI Application, In-Situ Groundwater Treatment Using ZVI Wall and Sediment Removal	• Excavation of all Study Area Soil with Concentrations above RSCOs to 14 Feet Below Grade • Access and Use Restrictions for Groundwater • Freeport Creek Sediment Removal • Installation of a ZVI Treatment Wall Adjacent to the Creek at the Downgradient Site Boundary • Groundwater Monitoring • Existing IRM: Operation of SSD Beneath Existing Site Buildings and Evaluate the Need for SSD for Future Site Buildings (Common Action C1)[1] • Sediment Removal from the Storm Sewer System (Common Action C2) • UST Removal (Common Action C3) • Environmental Easement (Common Action C4)
P8: Full-Scale Soil Excavation, Groundwater Pump and Treat, Sediment Removal	• Excavation of all Study Area Soil with Concentrations above RSCOs to 14 Feet Below Grade • Access and Use Restrictions for Groundwater • Freeport Creek Sediment Removal • Installation and Operation of a Groundwater Pump and Treat System with Discharge to Freeport Creek • Ground Water Monitoring • Existing IRM: Operation of SSD Beneath Existing Site Buildings and Evaluate the Need for SSD for Future Site Buildings (Common Action C1)[1] • Sediment Removal from the Storm Sewer System (Common Action C2) • UST Removal (Common Action C3) • Environmental Easement (Common Action C4)

[1] Common Action C1, the IRM SSD, would remain in place until building demolition is conducted. Following remedial action, the continued need for SSD systems for newly constructed buildings post-remediation would be evaluated through soil gas sampling.

TABLE 3-3
SCREENING OF THE PRELIMINARY REMEDIAL ACTION ALTERNATIVES
METAL ETCHING
FREEPORT, NEW YORK

	Overall Protection of Human Health and the Environment						
Preliminary Remedial Action Alternative	**Prevent ingestion, direct contact, and/or inhalation of/with soil**	**Prevent inhalation of or exposure from COPCs volatilizing from soil and/or groundwater**	**Prevent migration of contaminants from soil that would result in groundwater contamination**	**Prevent contact with VOCs in groundwater that exceed applicable SCGs**	**Sediment RAOs**	**Surface water RAOs**	**Compliance with SCGs**
P1: No Action	Although the majority of the Site is currently covered, this alternative does not provide for the maintenance of these covers. Therefore, this RAO will not be met in the future.	This alternative would not address this RAO.	This alternative would not address this RAO.	This alternative would not address this RAO.	This alternative would not address this RAO.	This alternative would not address this RAO.	Would not meet the chemical specific SCGs. Since no action, a number of the action and location specific SCGs would not be applicable.
P2: Surface Cover, Ground Water Monitored Natural Attenuation (MNA) and Sediment Monitored Natural Recovery (MNR)	Through installation of additional covers and continued maintenance of existing covers, this RAO would be met.	Through the interim remedial measure (IRM) sub-slab depressurization (SSD) beneath the existing buildings and the requirement for installation of SSD systems in all future buildings (to be facilitated through an environmental easement), this RAO would be met. In addition, the anaerobic biodegradation that is currently occurring would also serve to mitigate this RAO.	Installation and maintenance of surface covers (i.e., ballast, asphalt and concrete) will address this RAO.	The environmental easement specifying access and use restrictions and providing for monitoring of groundwater included in this alternative would address this RAO.	Removal of sediment from the storm sewer in conjunction with sediment MNR is expected to address the sediment RAOs.	Removal of sediment from the storm sewer is expected to address the surface water RAOs.	Would address the applicable chemical, action and location specific SCGs. Would not meet the pre-disposal goal.
P3: Hot Spot Soil Excavation to the Water Table and Surface Cover, Groundwater MNA and Sediment Removal	Through installation of additional covers, continued maintenance of existing covers and hot spot soil removal to the water table, this RAO would be met.	Through the SSD IRM beneath the existing buildings, the requirement for installation of SSD systems in all future buildings (to be facilitated through an environmental easement), and hot spot soil removal to the water table, this RAO would be met. In addition, the anaerobic biodegradation that is currently occurring would also serve to mitigate this RAO.	Installation and maintenance of surface covers (i.e., ballast, asphalt and concrete) along with hot spot soil excavation to the water table will address this RAO.	The environmental easement specifying access and use restrictions and providing for monitoring of groundwater included in this alternative would address this RAO.	Removal of sediment from the storm sewer in conjunction and sediment removal from Freeport Creek is expected to address the sediment RAOs.	Removal of sediment from the storm sewer is expected to address the surface water RAOs.	Would address the applicable chemical, action and location specific SCGs. Would not meet the pre-disposal goal.
P4: Hot Spot Soil Excavation and Surface Cover, Groundwater MNA and Sediment Removal	Through installation of additional covers, continued maintenance of existing covers and hot spot soil removal, this RAO would be met.	Through the SSD IRM beneath the existing buildings, the requirement for installation of SSD systems in all future buildings (to be facilitated through an environmental easement), and hot spot soil removal, this RAO would be met. In addition, the anaerobic biodegradation that is currently occurring would also serve to mitigate this RAO. Additionally, ZVI application with backfill below the water table would further the breakdown of chlorinated VOCs in groundwater, thereby reducing groundwater concentrations and subsequent soil vapor concentrations.	Installation and maintenance of surface covers (i.e., ballast, asphalt and concrete) along with hot spot soil excavation will address this RAO.	The environmental easement specifying access and use restrictions and providing for monitoring of groundwater included in this alternative would address this RAO.	Removal of sediment from the storm sewer in conjunction and sediment removal from Freeport Creek is expected to address the sediment RAOs.	Removal of sediment from the storm sewer is expected to address the surface water RAOs.	Would address the applicable chemical, action and location specific SCGs. Would not meet the pre-disposal goal.
P5: Hot Spot Soil Excavation and Surface Cover, Groundwater MNA with Biological Enhancements, and Sediment Removal	Through installation of additional covers, continued maintenance of existing covers and hot spot soil removal, this RAO would be met.	Through the SSD IRM beneath the existing buildings, the requirement for installation of SSD systems in all future buildings (to be facilitated through an environmental easement), and hot spot soil removal, this RAO would be met. In addition, the anaerobic biodegradation that is currently occurring would also serve to mitigate this RAO. However, reductive dechlorination of chlorinated VOCs is currently occurring in the shallow groundwater and does not require augmentation.	Installation and maintenance of surface covers (i.e., ballast, asphalt and concrete) along with hot spot soil excavation will address this RAO.	The environmental easement specifying access and use restrictions and providing for monitoring of groundwater included in this alternative would address this RAO.	Removal of sediment from the storm sewer in conjunction with sediment removal would address the sediment RAOs.	Removal of sediment from the storm sewer in conjunction with sediment removal would address the sediment RAOs.	Would address the applicable chemical, action and location specific SCGs. Would not meet the pre-disposal goal.

TABLE 3-3
SCREENING OF THE PRELIMINARY REMEDIAL ACTION ALTERNATIVES
METAL ETCHING
FREEPORT, NEW YORK

	Overall Protection of Human Health and the Environment						
Preliminary Remedial Action Alternative	**Prevent ingestion, direct contact, and/or inhalation of/with soil**	**Prevent inhalation of or exposure from COPCs volatilizing from soil and/or groundwater**	**Prevent migration of contaminants from soil that would result in groundwater contamination**	**Prevent contact with VOCs in groundwater that exceed applicable SCGs**	**Sediment RAOs**	**Surface water RAOs**	**Compliance with SCGs**
P6: Hot Spot Soil Excavation and Surface Cover, Removal of Uncapped Soil, In-Situ Groundwater Treatment Using ZVI Wall, and Sediment Removal	Through installation of additional covers, continued maintenance of existing covers and hot spot soil removal, this RAO would be met.	Through the SSD IRM beneath the existing buildings, the requirement for installation of SSD systems in all future buildings (to be facilitated through an environmental easement), and hot spot soil removal, this RAO would be met. In addition, the anaerobic biodegradation that is currently occurring would also serve to mitigate this RAO. Additionally, a ZVI application would further the breakdown of chlorinated VOCs in groundwater, thereby reducing groundwater concentrations and subsequent soil vapor concentrations.	Installation and maintenance of surface covers (i.e., ballast, asphalt and concrete) along with hot spot soil excavation will address this RAO.	The environmental easement specifying access and use restrictions and providing for monitoring of groundwater included in this alternative would address this RAO.	Removal of sediment from the storm sewer in conjunction with sediment removal would address the sediment RAOs.	Removal of sediment from the storm sewer in conjunction with sediment removal would address the sediment RAOs.	Would address the applicable chemical, action and location specific SCGs. Would not meet the pre-disposal goal.
P7: Full-Scale Soil Excavation, ZVI Application, In-Situ Groundwater Treatment Using ZVI Wall and Sediment Removal	Through full scale soil removal, this RAO would be met.	Through the SSD IRM beneath the existing buildings, the requirement for installation of SSD systems in all future buildings (access and use restrictions), and full scale soil removal, this RAO would be met.[1]	Through full scale soil removal, this RAO would be met.	The environmental easement specifying access and use restrictions and providing for monitoring of groundwater included in this alternative would address this RAO.	Removal of sediment from the storm sewer in conjunction with sediment removal would address the sediment RAOs.	Removal of sediment from the storm sewer in conjunction with sediment removal would address the sediment RAOs.	Would address the applicable chemical, action and location specific SCGs. Would meet the pre-disposal goal.
P8: Full-Scale Soil Excavation, Groundwater Pump and Treat, Sediment Removal	Through full scale soil removal, this RAO would be met.	Through SSD beneath the existing buildings, groundwater treatment via pump and treat, the requirement for installation of SSD in all future buildings (access and use restrictions), and full scale soil removal, this RAO would be met.	Through full scale soil removal and SVE, this RAO would be met.	The environmental easement specifying access and use restrictions and providing for monitoring of groundwater included in this alternative would address this RAO.	Removal of sediment from the storm sewer in conjunction with sediment removal would address the sediment RAOs.	Removal of sediment from the storm sewer in conjunction with sediment removal would address the sediment RAOs.	Would address the applicable chemical, action and location specific SCGs. Would meet the pre-disposal goal.

1. The existing IRM would remain in place until building demolition is conducted. Following remedial action, the continued need for an SSD system for newly constructed buildings would be evaluated through soil gas sampling.

TABLE 4-1
COMPLIANCE WITH APPICABLE SCGs
METAL ETCHING
FREEPORT, NEW YORK

CITATION	DESCRIPTION	TYPE	ALTERNATIVES						MANNER OF COMPLIANCE
			I	II	III	IV	V	VI	
STANDARDS AND CRITERIA (1)									
6 NYCRR Part 375	Inactive Hazardous Waste Disposal Site Remedial Program								
	- restore Site to pre-disposal conditions, to the extent feasible and authorized by law (goal)	Action	NC	NC	NC	NC	NC	✓	Alternative VI in its entirety and the sediment portion of Alternatives III, IV, and V would meet the intent of this goal.
	- eliminate or mitigate all significant threats to the public health and the environment	Action	NC	✓	✓	✓	✓	✓	Alternatives II through VI would eliminate or mitigate significant threats to public health and the environment. Additional discussion regarding this matter is contained in the protection of human health and the environment discussion within each of the alternatives.
6 NYCRR Part 598	Handling and Storage of Hazardous	Action	--	--	✓	✓	✓	✓	Hazardous substances, in the form of stabilization agents, would be stored under Alternatives V and VI.
6 NYCRR Part 611	Environmental Priorities and Procedures in Petroleum Cleanup and Removal	Action	--	--	✓	✓	✓	✓	Under the soil excavation alternatives, NAPL may be encountered during excavation. Booms, physical barriers or other equipment will be deployed to protect areas of environmental value, to contain any discharge and/or to protect human life, health or safety. All cleanup and removal procedures will follow the guidelines contained in chapter 300 of the "New York State Water Quality Accident Contingency Plan and Handbook".
6 NYCRR Part 608	Use & Protection of Waters	Action, Location	--	✓	✓	✓	✓	✓	This statute requires that a NYSDEC permit be obtained before modifying or disturbing any protected stream, its bed or banks or removing from its bed or banks sand, gravel or other material. The permit would have to be obtained prior to constructing, reconstructing, modifying, repairing or changing the use of any dock, pier, wharf, platform, breakwater or other structure in, on or above the navigable waters of the state. This SCG would therefore apply to sediment removal (Alternatives III, IV, V and VI). These alternatives would comply with this SCG.
6 NYCRR Part 182 Endangered Species	Endangered and Threatened Species	Action, Chemical, Location	--	✓	✓	✓	✓	✓	This statute relates to remedial action activities performed in/along the Freeport Creek and may trigger special timing considerations. As such, this SCG may relate to Alternatives III, IV, V, and VI. The Remedial Design of these alternatives would address this SCG to the extent required.
6 NYCRR Part 703.5	NYSDEC Water Quality Standards, Surface Water and Groundwater	Action, Chemical	NC	✓	✓	✓	✓	✓	Soil, groundwater, sediment and surface water RAOs address the requirement not to pose an impact to surface water. Alternatives II through VI include components that address these RAOs.
6 NYCRR Part 661	Tidal Wetlands Land Use and Regulation	Action, Location	--	✓	✓	✓	✓	✓	As part of the Remedial Design for the sediment alternatives, wetlands mitigation plan will be developed, as appropriate, to limit impacts and to preserve and protect tidal wetlands, and to prevent their despoliation and destruction. A permit would also be obtained.
Clean Water Act [Federal Water Pollution Control Act, as amended] Section 304(a)	Federal ambient water quality criteria	Chemical	NC	✓	✓	✓	✓	✓	See 6 NYCRR Part 703.5 manner of compliance.

TABLE 4-1
COMPLIANCE WITH APPICABLE SCGs
METAL ETCHING
FREEPORT, NEW YORK

CITATION	DESCRIPTION	TYPE	ALTERNATIVES						MANNER OF COMPLIANCE
			I	II	III	IV	V	VI	
6 NYCRR Part 257	Air Quality Standards	Action	--	✓	✓	✓	✓	✓	Air monitoring will be conducted, as needed during all intrusive activities, to ensure that these standards are not contravened.
Article 12 of the NYS Navigation Law (New York Oil Spill, Control and Compensation Act	Requires Cleanup and Removal of Petroleum Discharges to the Environment	Action, Chemical	--	--	✓	✓	✓	✓	Under the soil excavation alternatives, NAPL may be encountered during excavation. Free phase NAPL is not present at the Site under non-excavation conditions. In accordance with this article, NAPL encountered during excavation activities would be removed to the extent practical.
6 NYCRR Part 750	State Discharge Elimination System (SPDES) Permits	Action	--	--	✓	✓	✓	✓	Soil excavation and sediment removal alternatives may require discharge of construction liquids via a SPDES permit to the Freeport Creek (Alternatives III, IV, VI, and VI). The remedial requirements would therefore address this regulation.
OSHA; 29 CFR 1910	Guidelines/Requirements for Workers at Hazardous Waste Sites (Subpart 120) and Standards for Air Contaminants (Subpart 1)	Action	--	✓	✓	✓	✓	✓	All alternatives (except for No Action) will include preparation and implementation of a HASP that will address the requirement of this regulation.
OSHA; 29 CFR 1926	Safety and Health Regulations for Construction	Action	--	✓	✓	✓	✓	✓	The HASP prepared for the alternatives will include provisions for construction safety.
Guidelines (1)									
TAGM HWR-90-4030	Selection of Remedial Actions at Inactive Hazardous Waste Sites	Action	✓	✓	✓	✓	✓	✓	The remedy selection for implementation considered the hierarchy of remedial technologies presented in TAGM 4030.
TAGM HWR-94-4046	Determination of Soil Cleanup Objectives and Cleanup Levels	Chemical	NC	NC	✓*	✓*	✓*	✓	Alternatives III, IV, and V will meet some, but not all of the recommended soil cleanup criteria. Alternative 4 will meet all of the RSCOs.
NYSDOH Community Air Monitoring Plan for Intrusive Activities	Requirements real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust)	Action, Chemical	--	✓	✓	✓	✓	✓	Air monitoring conducted during intrusive activities will address the requirements of this document. Fugitive dust and particulate suppression controls will be employed, if necessary.
NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York	Provides guidance for addressing subsurface VOC impacted soil vapor and indoor air.	Action, Chemical	NC	✓	✓	✓	✓	✓	All alternatives (except for No Action) include sub-slab depressurization to address soil vapor intrusion at the Study Area and fulfill the recommendations in this guidance. Alternatives II and V also include soil vapor extraction.
NYSDEC TOGS 1.1.1	Ambient Water Quality Standards and Guidance Values	Action, Chemical	NC	✓	✓	✓	✓	✓	See 6 NYCRR Part 703.5 manner of compliance.
NYSDEC Technical Guidance for Screening of Contaminated Sediment	Sediment screening guidance document	Chemical	--	✓*	✓*	✓*	✓*	✓*	Alternatives II through VI will meet some, but not all of the sediment screening criteria. However, since there are upriver impacts, this guidance document is not directly applicable. Additional discussion regarding compliance with this SCG is provided in the evaluation of each of the alternatives.
NYSDEC Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites	Ecological assessment guidance document.	Action, Chemical	--	✓	✓	✓	✓	✓	Selection of the sediment remedy will take this document into account.
TO BE CONSIDERED									
(TBCS) (2)									
NYS DOS, Policy 7, Coastal Management Program	Significant Habitats - Protection	Location	--	--	--	--	--	--	Outcome of the alternative would be consistent with the goals of the program and ensure the protection, preservation and restoration of the Freeport Creek.
NYS DOS, Policy 8, Coastal Management Program	Pollutants – Protection of fish and wildlife resources	Location	--	✓	✓	✓	✓	✓	Outcome of the alternative would be consistent with the goals of the program.

TABLE 4-1
COMPLIANCE WITH APPICABLE SCGs
METAL ETCHING
FREEPORT, NEW YORK

CITATION	DESCRIPTION	TYPE	ALTERNATIVES						MANNER OF COMPLIANCE
			I	II	III	IV	V	VI	
NYSDEC Draft DER-10	Technical Guidance for Site Investigation and Remediation	Action	✓	✓	✓	✓	✓	✓	Development of remedial goals, objectives and alternatives conducted in accordance with this draft document, remedial design and O&M would address the requirements of this document once finalized.
Section 10, Rivers and Harbors Act 33 U.S.C. § 403	Pertains to activities in navigable waters	Action, Location	--	--	✓	✓	✓	✓	U.S. Army Corps of Engineers approval is generally required to excavate or fill, or in any manner to alter or modify the course, location, condition, or capacity of the channel of any navigable water of the United States. Alternatives III through VI would comply with this requirement to the extent applicable.

Notes:
Alternative I: No Action
Alternative II: Surface Cover, Groundwater MNA, SVE, and Sediment MNR
Alternative III: Hot Spot Soil Excavation to the Water Table and Surface Cover, Groundwater MNA, and Sediment Removal
Alternative IV: Hot Spot Soil Excavation and Surface Cover, Groundwater MNA, and Sediment Removal
Alternative V: Hot Spot Soil Excavation and Surface Cover, Removal of Uncapped Soils, ZVI Wall, SVE, and Sediment Removal
Alternative VI: Full-Scale Soil Excavation, ZVI Wall, and Sediment Removal

(1) Standards and Criteria were obtained from NYSDEC Draft DER-10, Technical Guidance for Site Investigation and Remediation, December 2002.
(2) Guidance were obtained from NYSDEC Draft DER-10, Technical Guidance for Site Investigation and Remediation, December 2002.
(3) TBCs are defined in this report as regulations and guidance documents that are not identified NYSDEC Draft DER-10, Technical Guidance for Site Investigation and Remediation, December 2002.
✓ Alternative complies with this SCG.
✓* Alternative complies with this SCG in most aspects. See manner of compliance column and FS text for additional detail.
NC Alternative does not comply with this SCG.
-- SCG is not applicable to this alternative.

GLOSSARY OF ACRONYMS

CFR	Code of Federal Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYCRR	New York Code of Rules and Regulations
OSHA	Occupational Safety and Health
SCG	Standards, Criteria and Guidance
TBC	To Be Considered Information
USEPA	U. S. Environmental Protection Agency
DER	Division of Environmental Remediation

TABLE 4-2
REMEDIAL ACTION ALTERNATIVE II: SOIL COVER, GROUNDWATER MNA, SVE, AND SEDIMENT MNR
METAL ETCHING
FREEPORT, NEW YORK

Item Description	Unit	Unit Cost	Quantity	Total Cost
<u>CAPITAL COSTS</u>				
Common Actions				
C1: Sub-Slab Depressurization	sf	$4.10	3,600	$14,760
C2: Storm Sewer Cleaning				
Storm Sewer Cleaning	day	$2,500	2	$5,000
Disposal of Sediment and Addition of Kiln Dust	drum	$120	40	$4,800
C3: Tank Removal	ls	$30,000	1	$30,000
C4: Environmental Easement	ls	$20,000	1	$20,000
Preparation of Site Management Plan	ls	$10,000	1	$10,000
		Subtotal, Common Actions		**$84,560**
Soil Vapor Extraction				
Install 4"-dia PVC Well screens	lf	$24.99	1,300	$3,749
Install 4"-dia Polyethylene Horizontal Well Casing	lf	$16.92	1,300	$2,538
Install filter pack	cf	$0.84	340.17	$32.97
Install plug	each	$43.37	3	$130.11
Connection piping	lf	$8.21	1,300	$1,232
Manifold piping	lf	$8.21	75	$616
Install vacuum port & sample ports	each	$200	3	$600
Install flow control valves	each	$250	3	$750
Install vacuum monitoring points	each	$300	3	$900
Misc. pipe fittings, etc.	ls	$5,000	1	$5,000
Control system	each	$5,000	1	$5,000
Shed for blower and controls	each	$8,000	1	$8,000
Install blower	each	$5,221	1	$5,221
Install condensate tank and pump	each	$5,000	1	$5,000
		Subtotal, Soil Vapor Extraction		**$28,547**
Groundwater Monitoring Wells				
Install Groundwater Monitoring Wells	well	$1,500	4	$6,000
	Subtotal, Groundwater Monitoring Well Installation			**$6,000**
Surface Cover Installation				
Supply and Install 6" Gravel Base in Southern Soil/Weeded Area	cy	$30	78	$2,340
Health and Safety Plan	ls	$5,000	1	$5,000
			Subtotal, Cover	**$7,340**
Sediment Monitored Natural Recovery Baseline Studies and Workplan				
Preparation of Baseline Study Workplan	ls	$5,000	1	$5,000
Baseline Sampling and Testing	ls	$19,000	1	$19,000
Preparation of MNR Monitoring Plan	ls	$3,000	1	$3,000
	Subtotal, Baseline Studies, Modeling, and Workplan			**$27,000**
				<u>**Remedial Action Cost Estimate**</u>
		Subtotal Remedial Action Capital Cost		$154,447
			Contingency (25%)	$38,612
		Mobilization/Demobilization (5%)		$7,722
			Remedial Design (15%)	$23,167
			Project Management (8%)	$12,356
		Construction Management (10%)		$15,445
		Total Remedial Action Capital Cost		**$251,748**

TABLE 4-2
REMEDIAL ACTION ALTERNATIVE II: SOIL COVER, GROUNDWATER MNA, SVE, AND SEDIMENT MNR
METAL ETCHING
FREEPORT, NEW YORK

Item Description	Unit	Unit Cost	Quantity	Total Cost
OPERATIONS, MAINTENANCE, AND MONITORING (OM&M) COSTS				
Annual Certification for OM&M	ls	$1,000	1	$1,000
	Subtotal, Annual Certification Present Value			**$15,372**
Cover Maintenance				
Net present value for repair and replacement of 1/3 of the surface cover over 2.06 acres of Site every 10 years ($1.70/sf x 30,000 sf = $51,000 in 2006 dollars for 1/3 the site, factoring for a 2% inflation rate and a 5% discount factor for years 10, 20 and 30)	ls	$88,103	1	**$88,103**
SVE Maintenance (annual costs)				
Equipment maintenance and parts	month	$500	12	$6,000
Electrical usage	97,985	kilowatt hour	0.14	$13,718
O&M manpower	week	$600.00	52	$31,200
Management, engineering, oversight	month	$2,500.00	12	$30,000
Carbon changeout (cost for freight and forklift rental)	event	$2,500.00	2	$5,000
Carbon refill	lb	$1.50	4000	$6,000
Sampling manpower	day	$600.00	4	$2,400
Quarterly laboratory analysis of extracted vapors	sample	$350.00	8	$2,800
Field air monitoring with photoionization detector (PID)	day	$75.00	56	$4,200
	Subtotal, Annual Cost in 2006 Dollars			$101,318
	Net Present Value, 6 Years OM&M			**$514,258**
Groundwater Monitored Natural Attenuation				
Net present value for Sampling 14 wells: Quarterly Monitoring for two years for VOCs, natural attenuation parameters, and metals ($74,130 per year, 2% inflation, 5% discount factor) Annual Monitoring for 28 years for VOCs, natural attenuation parameters, and metals ($18,530 per year, 2% inflation, 5% discount factor)	ls	$ 472,485	1	$472,485
Implement Site Management Plan				
Conduct SMP work in Years 3, 15 and 30 ($20,000 in 2006 dollars for Year 3 effort & $10,000 in 2006 dollars for subsequent efforts, 2% inflation, 5% discount factor)	ls	$28,999	1	$28,999
Sediment Monitored Natural Recovery				
Post-Baseline MNR (average annual)				
Quarterly Flow Monitoring & Reporting	ls	$4,000	1	$4,000
Subtotal, Annual O&M (Yr. 1- 3)				$4,000
Float Survey & Reporting (3 yrs beginning after 3rd year)	event	$7,000	1	$7,000
Sediment Sampling (3 yrs)	event	$11,980	1	$11,980
Multibeam Survey (3 years)	event	$14,500	1	$14,500
Subtotal, 3 Year O&M (Yr. 1- 30)				$33,480
5 Year Review	yr	$10,000	1	$10,000
Subtotal, 5-Year O&M (Yr. 1- 30)				$10,000
	Subtotal, MNR Present Value			**$505,525**
	Total OM&M Costs			$1,624,743
	Project Management Costs (8%)			$129,979
	Contingency (10%)			$162,474
Total Present Worth of Annual Operations and Maintenance Costs				**$1,917,197**
TOTAL PRESENT WORTH OF COSTS				**$2,168,945**

TABLE 4-3
REMEDIAL ACTION ALTERNATIVE III: HOT SPOT EXCAVATION TO THE WATER TABLE AND SURFACE COVER, GROUNDWATER MNA AND SEDIMENT REMOVAL
METAL ETCHING
FREEPORT, NEW YORK

Item Description	Unit	Unit Cost	Quantity	Total Cost
<u>**CAPITAL COSTS**</u>				
Common Actions				
C1: Sub-Slab Depressurization	sf	$4.10	3,600	$14,760
C2: Storm Sewer Cleaning				
Storm Sewer Cleaning	day	$2,500	2	$5,000
Disposal of Sediment and Addition of Kiln Dust	drum	$120	40	$4,800
C3: Tank Removal	ls	$30,000	1	$30,000
C4: Environmental Easement	ls	$20,000	1	$20,000
Preparation of Site Management Plan	ls	$10,000	1	$10,000
		Subtotal, Common Actions		**$84,560**
Soil Excavation				
Pre-Excavation Delineation	sample	$420	20	$8,400
Excavate Hot Spot Soil for Disposal	cy	$8	1,650	$13,199
Excavate Overlying Soils to Access Hot Spot Soil	cy	$8	150	$1,200
Excavate Overlying Asphalt, Concrete and Gravel	cy	$8	237	$1,897
Stockpile Soil, Asphalt and Concrete	cy	$4	2,037	$8,148
Post Excavation Sampling	sample	$420	7	$3,007
Install Snow Fencing for Demarcation	sf	$0.16	21,479	$3,437
Develop and Implement a Perimeter Air Monitoring Plan	ls	$26,000	1	$26,000
Waste Characterization Sampling - 1/750 cy	sample	$1,000	2	$2,200
Health and Safety Plan	ls	$5,000	1	$5,000
		Subtotal, Excavation		**$64,087**
Surface Covers				
Supply and Install 6" Gravel Base in Southern Soil/Weeded Area	cy	$30	78	$2,340
		Subtotal, Cover		**$2,340**
Soil Treatment and Disposal				
Load Soil for Disposal (accounts for volume increase of dewatering agent)	cy	$2	2,160	$4,320
Dispose Non-hazardous soil	ton	$73	3,888	$283,793
Dispose Cover Material (Concrete and Asphalt)	cy	$25	237	$5,929
		Subtotal, Disposal		**$294,041**
Site Restoration for Soil Removal				
Supply Backfill	cy	$29	2,037	$59,071
Install Backfill	cy	$4	2,037	$8,148
Install Post-Remedial Groundwater Monitoring Wells	well	$1,500	8	$12,000
		Subtotal, Site Restoration		**$79,219**
Sediment Removal				
<u>**Baseline Studies, Design, and Permitting**</u>				
Design Support Testing	of total	$333,625	10%	$33,362
Evaluation of RD/RA Studies & Additional Design Work	of total	$333,625	20%	$66,725
Health and Safety Plan	ls	$5,000	1	$5,000
Permitting	ls	$25,000	1	$25,000
	Subtotal, Study, Design, and Permitting:			**$130,087**

TABLE 4-3
REMEDIAL ACTION ALTERNATIVE III: HOT SPOT EXCAVATION TO THE WATER TABLE AND SURFACE COVER, GROUNDWATER MNA AND SEDIMENT REMOVAL
METAL ETCHING
FREEPORT, NEW YORK

Sediment Removal (continued)

Dredging for Sediment Removal				
Site Prep and Facility Construction	of	$351,184	5%	$17,559
Contractor Work Plans	LS	$5,000	1	$5,000
Health & Safety	LS	$5,000	1	$5,000
Silt Curtain	SF	$28	1,820	$50,960
Sediment Processing Area	BCY	$5	900	$4,501
Dredging	BCY	$40	900	$36,008
Dewatering	BCY	$52	900	$46,810
Stabilization (portland cement 10%)	BCY	$30	90	$2,701
Testing and Monitoring (during remediation)	days	$2,000	7	$14,000
Testing for Sediment Disposal - 1/500 cy	sample	$1,595	2	$2,872
Transportation and Disposal	ton	$56.29	1,980	$111,479
Water Treatment	ls	$31,795	1	$31,795
Construction Monitoring (in addition to construction oversight)	mo.	$30,000	0.75	$22,500
	Subtotal Construction and Disposal:			**$351,184**
Site Restoration for Sediment Removal				
Backfilling (assume 100% of removed)	cy	$41.65	450	$18,747
	Subtotal, Site Restoration			**$18,747**

Remedial Action Cost Estimate

Subtotal Remedial Action Capital Cost	$1,024,265
Contingency (25%)	$256,066
Mobilization/Demobilization (5%)	$51,213
Remedial Design (8%)	$81,941
Project Management (5%)	$51,213
Construction Management (6%)	$61,456
Total Remedial Action Capital Cost	**$1,526,155**

TABLE 4-3
REMEDIAL ACTION ALTERNATIVE III: HOT SPOT EXCAVATION TO THE WATER TABLE AND SURFACE COVER, GROUNDWATER MNA AND SEDIMENT REMOVAL
METAL ETCHING
FREEPORT, NEW YORK

OPERATIONS, MAINTENANCE, AND MONITORING (OM&M) COSTS

Annual Certification for OM&M	ls	$1,000	1	$1,000
Subtotal, Annual Certification Present Value				**$15,372**
Cover Maintenance				
Repair and replacement of 1/3 of the surface cover, excluding hot spot locations, over 2.06 acres of Site every 10 years ($1.70/sf with a 2% inflation rate and a 5% discount factor)	ls	$71,872	1	$71,872
Groundwater Monitored Natural Attenuation				
Net present value for Sampling 14 wells: Quarterly Monitoring for two years for VOCs, natural attenuation parameters, and metals ($74,130 per year, 2% inflation, 5% discount factor) Annual Monitoring for 28 years for VOCs, natural attenuation parameters, and metals ($18,530 per year, 2% inflation, 5% discount factor)	ls	$ 472,485	1	$472,485
Implement Site Management Plan				
Conduct SMP work in Years 3, 15 and 30 ($20,000 in 2006 dollars for Year 3 effort & $10,000 in 2006 dollars for subsequent efforts, 2% inflation, 5% discount factor)	ls	$28,999	1	$28,999
Total O&M Costs				$588,728
Project Management Costs (6%)				$35,324
Contingency (10%)				$58,873
Total Present Worth of Annual Operations and Maintenance Costs				**$682,925**

TOTAL PRESENT WORTH OF COSTS **$2,209,080**

TABLE 4-4
REMEDIAL ACTION ALTERNATIVE IV: HOT SPOT EXCAVATION AND SURFACE COVER, GROUNDWATER MNA AND SEDIMENT REMOVAL
METAL ETCHING
FREEPORT, NEW YORK

Item Description	Unit	Unit Cost	Quantity	Total Cost
<u>CAPITAL COSTS</u>				
Common Actions				
C1: Sub-Slab Depressurization	sf	$4.10	3,600	$14,760
C2: Storm Sewer Cleaning				
Storm Sewer Cleaning	day	$2,500	2	$5,000
Disposal of Sediment and Addition of Kiln Dust	drum	$120	40	$4,800
C3: Tank Removal	ls	$30,000	1	$30,000
C4: Environmental Easement	ls	$20,000	1	$20,000
Preparation of Site Management Plan	ls	$10,000	1	$10,000
		Subtotal, Common Actions		**$84,560**
Soil Excavation				
Pre-Excavation Delineation	sample	420	20	$8,400
Install Sheeting	sf	$25	21,470	$536,739
Excavate Hot Spot Soil for Disposal	cy	$8	4,871	$38,964
Excavate Overlying Soils for Reuse as Backfill to Access Hot Spot Soil	cy	$8	1,107	$8,854
Excavate Overlying Asphalt, Concrete and Gravel	cy	$8	397	$3,176
Stockpile Dry Soil, Asphalt and Concrete	cy	$4	3,279	$13,115
Stockpile and Dewater Excavated Hot Spot Soil from Below Water Table	cy	$15	3,715	$55,720
Stockpile and Dewater Soil for Reuse as Backfill	cy	$15	1,328	$19,922
Post Excavation Sampling	sample	$420	45	$18,896
Install Snow Fencing for Demarcation	sf	$0.16	39,225	$6,276
Develop and Implement a Perimeter Air Monitoring Plan	ls	$58,000	1	$58,000
Waste Characterization Sampling - 1/750 cy	sample	$1,000	6	$6,494
Health and Safety Plan	ls	$10,000	1	$10,000
		Subtotal, Excavation		**$776,156**
Dewatering for Hot Spot Excavation Below Water Table - based on 50 gpm				
Install Groundwater Dewatering System	ls	$16,000	1	$16,000
Operate Dewatering System	week	$5,000	5	$25,000
Install Groundwater Treatment System	ls	$28,000	1	$28,000
Operate Treatment System, Including Media Replacement	week	$7,500	5	$37,500
Disposal of Spent Treatment Media	month	$7,000	2	$14,000
<u>SPDES Permit</u>				
Obtain SPDES Permit	ls	$20,000	1	$20,000
Analyze for VOCs, SVOC, TSS, BOD, pH, Fecal Coliform, Oil and Grease, Metals	event	$795	6	$4,770
Clay Anthracite Vessel, capable 50 gpm flow, 1,500 lbs clay	vessel	$7,550	1	$7,550
		Subtotal, Dewatering		**$152,820**
Surface Covers				
Supply and Install 6" Gravel Base in Southern Soil/Weeded Area	cy	$30	78	$2,340
		Subtotal, Cover		**$2,340**
Soil Treatment and Disposal				
Load Soil for Disposal (accounts for volume increase of dewatering agent)	cy	$2	5,364	$10,729
Dispose Non-hazardous soil	ton	$73	9,656	$704,891
Dispose Cover Material (Concrete and Asphalt)	cy	$25	397	$9,925
		Subtotal, Disposal		**$725,546**
Site Restoration				
Supply Backfill	cy	$29	4,922	$142,738
Install Backfill and Reuse Soils	cy	$4	6,029	$24,116
Supply ZVI - 10% of Backfill Volume below the Water Table	tons	$800	366	$292,947
ZVI Licensing Fee	of	$168,000	12%	$20,160
Install ZVI	cy	$8	345	$2,762
Install Post-Remedial Groundwater Monitoring Wells	well	$1,500	8	$12,000
		Subtotal, Site Restoration		**$494,723**

TABLE 4-4
REMEDIAL ACTION ALTERNATIVE IV: HOT SPOT EXCAVATION AND SURFACE COVER, GROUNDWATER MNA AND SEDIMENT REMOVAL
METAL ETCHING
FREEPORT, NEW YORK

Sediment Removal

Baseline Studies, Design, and Permitting				
Design Support Testing	of total	$333,625	10%	$33,362
Evaluation of RD/RA Studies & Additional Design Work	of total	$333,625	20%	$66,725
Health and Safety Plan	ls	$5,000	1	$5,000
Permitting	ls	$25,000	1	$25,000
	Subtotal, Study, Design, and Permitting:			**$130,087**
Dredging for Sediment Removal				
Site Prep and Facility Construction	of	$351,184	5%	$17,559
Contractor Work Plans	LS	$5,000	1	$5,000
Health & Safety	LS	$5,000	1	$5,000
Silt Curtain	SF	$28	1,820	$50,960
Sediment Processing Area	BCY	$5	900	$4,501
Dredging	BCY	$40	900	$36,008
Dewatering	BCY	$52	900	$46,810
Stabilization (portland cement 10%)	BCY	$30	90	$2,701
Testing and Monitoring (during remediation)	days	$2,000	7	$14,000
Testing for Sediment Disposal - 1/500 cy	sample	$1,595	2	$2,872
Transportation and Disposal	ton	$56.29	1,980	$111,479
Water Treatment	ls	$31,795	1	$31,795
Construction Monitoring (in addition to construction oversight)	mo.	$30,000	0.75	$22,500
	Subtotal Construction and Disposal:			**$351,184**
Site Restoration for Sediment Removal				
Backfilling (assume 100% of removed)	cy	$41.65	450	$18,747
	Subtotal, Site Restoration			**$18,747**

Remedial Action Cost Estimate

Subtotal Remedial Action Capital Cost	$2,736,163
Contingency (25%)	$684,041
Mobilization/Demobilization (5%)	$136,808
Remedial Design (8%)	$218,893
Project Management (5%)	$136,808
Construction Management (6%)	$164,170
Total Remedial Action Capital Cost	**$4,076,883**

TABLE 4-4
REMEDIAL ACTION ALTERNATIVE IV: HOT SPOT EXCAVATION AND SURFACE COVER, GROUNDWATER MNA AND SEDIMENT REMOVAL
METAL ETCHING
FREEPORT, NEW YORK

OPERATIONS, MAINTENANCE, AND MONITORING (OM&M) COSTS

Annual Certification for OM&M	ls	$1,000	1	$1,000
	Subtotal, Annual Certification Present Value			**$15,372**
Cover Maintenance				
Repair and replacement of 1/3 of the surface cover, excluding hot spot locations, over 2.06 acres of Site every 10 years ($1.70/sf with a 2% inflation rate and a 5% discount factor)	ls	$63,421	1	$63,421
Groundwater Monitored Natural Attenuation				
Net present value for Sampling 14 wells: Quarterly Monitoring for two years for VOCs, natural attenuation parameters, and metals ($74,130 per year, 2% inflation, 5% discount factor) Annual Monitoring for 28 years for VOCs, natural attenuation parameters, and metals ($18,530 per year, 2% inflation, 5% discount factor)	ls	$ 472,485	1	$472,485
Implement Site Management Plan				
Conduct SMP work in Years 3, 15 and 30 ($20,000 in 2006 dollars for Year 3 effort & $10,000 in 2006 dollars for subsequent efforts, 2% inflation, 5% discount factor)	ls	$28,999	1	$28,999
	Total O&M Costs			$580,277
	Project Management Costs (6%)			$34,817
	Contingency (10%)			$58,028
	Total Present Worth of Annual Operations and Maintenance Costs			**$673,122**

TOTAL PRESENT WORTH OF COSTS	**$4,750,005**

TABLE 4-5
REMEDIAL ACTION ALTERNATIVE V: HOT SPOT EXCAVATION AND SURFACE COVER, REMOVAL OF UNCAPPED SOILS, ZVI WALL, SVE AND SEDIMENT REMOVAL
METAL ETCHING
FREEPORT, NEW YORK

Item Description	Unit	Unit Cost	Quantity	Total Cost
CAPITAL COSTS				
Common Actions				
C1: Sub-Slab Depressurization	sf	$4.10	3,600	$14,760
C2: Storm Sewer Cleaning				
Storm Sewer Cleaning	day	$2,500	2	$5,000
Disposal of Sediment and Addition of Kiln Dust	drum	$120	40	$4,800
C3: Tank Removal	ls	$30,000	1	$30,000
C4: Environmental Easement	ls	$20,000	1	$20,000
Preparation of Site Management Plan	ls	$10,000	1	$10,000
	Subtotal, Common Actions			**$84,560**
Soil Excavation				
Pre-Excavation Delineation	sample	420	20	$8,400
Install Sheeting	sf	$25	21,470	$536,739
Excavate Hot Spot Soil and Uncovered Soils for Disposal	cy	$8	5,561	$44,489
Excavate Overlying Soils for Reuse as Backfill to Access Hot Spot Soil	cy	$8	1,107	$8,854
Excavate Overlying Asphalt, Concrete and Gravel	cy	$8	539	$4,308
Stockpile Dry Soil, Asphalt and Concrete	cy	$4	4,111	$16,443
Stockpile and Dewater Excavated Hot Spot Soil from Below Water Table	cy	$15	3,715	$55,720
Stockpile and Dewater Soil for Reuse as Backfill	cy	$15	1,328	$19,922
Post Excavation Sampling	sample	$420	45	$18,896
Install Snow Fencing for Demarcation	sf	$0.16	39,225	$6,276
Develop and Implement a Perimeter Air Monitoring Plan	ls	$58,000	1	$58,000
Waste Characterization Sampling - 1/750 cy	sample	$1,000	7	$7,415
Health and Safety Plan	ls	$10,000	1	$10,000
Hot Spot Allowances				
Excavate Supplemental Hot Spots for Disposal	cy	$8	2593	$20,741
Install Sheeting	sf	$25	5,600	$140,000
Excavate Overlying Asphalt, Concrete and Gravel	cy	$8	93	$741
Stockpile Dry Soil, Asphalt and Concrete for Disposal	cy	$4	1667	$6,667
Stockpile and Dewater Excavated Soil from Below Water Table for Disposal	cy	$15	926	$13,889
Install Snow Fencing for Demarcation	sf	$0.16	5000	$800
	Subtotal, Excavation			**$978,299**
Permeable Reactive Barrier for Groundwater Treatment				
ZVI Wall Construction and Licensing	ls	$1,674,133	1	$1,674,133
	Subtotal, Permable Reactive Barrier			**$1,674,133**
Soil Vapor Extraction				
Install 4"-dia PVC Well screens	lf	$24.99	1,300	$3,749
Install 4"-dia Polyethylene Horizontal Well Casing	lf	$16.92	1,300	$2,538
Install filter pack	cf	$0.84	340.17	$32.97
Install plug	each	$43.37	3	$130.11
Connection piping	lf	$8.21	1,300	$1,232
Manifold piping	lf	$8.21	75	$616
Install vacuum port & sample ports	each	$200	3	$600
Install flow control valves	each	$250	3	$750
Install vacuum monitoring points	each	$300	3	$900
Misc. pipe fittings, etc.	ls	$5,000	1	$5,000
Control system	each	$5,000	1	$5,000
Shed for blower and controls	each	$8,000	1	$8,000
Install blower	each	$5,221	1	$5,221
Install condensate tank and pump	each	$5,000	1	$5,000
	Subtotal, Soil Vapor Extraction			**$28,547**

TABLE 4-5
REMEDIAL ACTION ALTERNATIVE V: HOT SPOT EXCAVATION AND SURFACE COVER, REMOVAL OF UNCAPPED SOILS, ZVI WALL, SVE AND SEDIMENT REMOVAL
METAL ETCHING
FREEPORT, NEW YORK

Surface Covers				
Supply and Install 6" Gravel Base in Southern Soil/Weeded Area	cy	$30	73	$2,194
		Subtotal, Installation		**$2,194**
Dewatering for Hot Spot Excavation Below Water Table - based on 50 gpm				
Install Groundwater Dewatering System	ls	$16,000	1	$16,000
Operate Dewatering System	week	$5,000	5	$25,000
Install Groundwater Treatment System	ls	$28,000	1	$28,000
Operate Treatment System, Including Media Replacement	week	$7,500	5	$37,500
Disposal of Spent Treatment Media	month	$7,000	2	$14,000
SPDES Permit				
Obtain SPDES Permit	ls	$20,000	1	$20,000
Analyze for VOCs, SVOC, TSS, BOD, pH, Fecal Coliform, Oil and Grease, Metals	event	$795	6	$4,770
Clay Anthracite Vessel, capable 50 gpm flow, 1,500 lbs clay	vessel	$7,550	1	$7,550
		Subtotal, Dewatering		**$152,820**
Soil Treatment and Disposal				
Load Soil for Disposal (accounts for volume increase of dewatering agent)	cy	$2	8,773	$17,546
Dispose Non-hazardous soil	ton	$73	15,791	$1,152,753
Dispose Cover Material (Concrete and Asphalt)	cy	$25	1,199	$29,984
		Subtotal, Disposal		**$1,200,283**
Site Restoration				
Supply Backfill	cy	$29	6,564	$190,352
Install Backfill	cy	$4	7,671	$30,682
Repave Site (Entire gravel and soil areas outside of hot spot areas)	sf	$1.75	44,387	$77,677
Install Post-Remedial Groundwater Monitoring Wells	well	$1,500	6	$9,000
		Subtotal, Site Restoration		**$307,712**
Sediment Removal				
Baseline Studies, Design, and Permitting				
Design Support Testing	of total	$333,625	10%	$33,362
Evaluation of RD/RA Studies & Additional Design Work	of total	$333,625	20%	$66,725
Permitting	ls	$25,000	1	$25,000
	Subtotal, Study, Design, and Permitting:			**$125,087**
Sediment Removal (continued)				
Dredging				
Site Prep and Facility Construction	of	$351,184	5%	$17,559
Contractor Work Plans	LS	$5,000	1	$5,000
Health & Safety	LS	$5,000	1	$5,000
Silt Curtain	SF	$28	1,820	$50,960
Sediment Processing Area	BCY	$5	900	$4,501
Dredging	BCY	$40	900	$36,008
Dewatering	BCY	$52	900	$46,810
Stabilization (portland cement 10%)	BCY	$30	90	$2,701
Testing and Monitoring (during remediation)	days	$2,000	7	$14,000
Testing for Sediment Disposal - 1/500 cy	sample	$1,595	2	$2,872
Transportation and Disposal	ton	$56.29	1,980	$111,479
Water Treatment	ls	$31,795	1	$31,795
Construction Monitoring (in addition to construction oversight)	mo.	$30,000	0.75	$22,500
	Subtotal Construction and Disposal:			**$351,184**
Site Restoration				
Backfilling (assume 100% of removed)	cy	$41.65	450	$18,747
		Subtotal, Site Restoration		**$18,747**
			Remedial Action Cost Estimate	
		Subtotal Remedial Action Capital Cost		$4,923,565
		Contingency (25%)		$1,230,891
		Mobilization/Demobilization (5%)		$246,178
		Remedial Design (8%)		$393,885
		Project Management (5%)		$246,178
		Construction Management (6%)		$295,414
		Total Remedial Action Capital Cost		**$7,336,113**

TABLE 4-5
REMEDIAL ACTION ALTERNATIVE V: HOT SPOT EXCAVATION AND SURFACE COVER, REMOVAL OF UNCAPPED SOILS, ZVI WALL, SVE AND SEDIMENT REMOVAL
METAL ETCHING
FREEPORT, NEW YORK

OPERATIONS, MAINTENANCE, AND MONITORING (OM&M) COSTS

Annual Certification for OM&M	ls	$1,000	1	$1,000
		Subtotal, Annual Certification Present Value		**$15,372**
Cover Maintenance				
Repair and replacement of 1/3 of the surface cover, excluding hot spot areas and soil allowance locations, over 2.06 acres of Site every 10 years ($1.70/sf with a 2% inflation rate and a 5% discount factor)	ls	$58,527	1	$58,527
Groundwater Monitored Natural Attenuation				
Net present value for sampling six wells: Quarterly Monitoring for two years for VOCs, natural attenuation parameters, and metals ($45,000 per year, 2% inflation, 5% discount factor) Annual Monitoring for 28 years for VOCs, natural attenuation parameters, and metals ($11,250 per year, 2% inflation, 5% discount factor)	ls	$ 286,813	1	$286,813
Implement Site Management Plan				
Conduct SMP work in Years 3, 15 and 30 ($20,000 in 2004 dollars for Year 3 effort & $10,000 in 2004 dollars for subsequent efforts, 2% inflation, 5% discount factor)	ls	$28,999	1	$28,999
SVE Maintenance (annual costs)				
Equipment maintenance and parts	month	$500	12	$6,000
Electrical usage	97,985	kilowatt hour	0.14	$13,718
O&M manpower	week	$600.00	52	$31,200
Management, engineering, oversight	month	$2,500.00	12	$30,000
Carbon changeout (cost for freight and forklift rental)	event	$2,500.00	2	$5,000
Carbon refill	lb	$1.50	4000	$6,000
Sampling manpower	day	$600.00	4	$2,400
Quarterly laboratory analysis of extracted vapors	sample	$350.00	8	$2,800
Field air monitoring with photoionization detector (PID)	day	$75.00	56	$4,200
		Subtotal, Annual Cost		$101,318
		Net Present Value, 6 Years O&M		**$514,258**
		Total O&M Costs		$903,969
		Project Management Costs (6%)		$54,238
		Contingency (10%)		$90,397
		Total Present Worth of Annual Operations and Maintenance Costs		**$1,048,604**

TOTAL PRESENT WORTH OF COSTS — $8,384,717

TABLE 4-6
REMEDIAL ACTION ALTERNATIVE VI:FULL-SCALE SOIL EXCAVATION, ZVI WALL, AND SEDIMENT REMOVAL
METAL ETCHING
FREEPORT, NEW YORK

Item Description	Unit	Unit Cost	Quantity	Total Cost	Notes
<u>CAPITAL COSTS</u>					
Common Actions					
C1: Sub-Slab Depressurization	sf	$4.10	3,600	$14,760	1
C2: Storm Sewer Cleaning					
Storm Sewer Cleaning	day	$2,500	2	$5,000	2
Disposal of Sediment and Addition of Kiln Dust	drum	$120	40	$4,800	3
C3: Tank Removal	ls	$30,000	1	$30,000	4
C4: Environmental Easement	ls	$20,000	1	$20,000	5
		Subtotal, Common Actions		**$74,560**	
Demolish Site Buildings	ls	$120,000	1	**$120,000**	29
Pre-Design Studies					
Geotechnical Pre-Design Studies	ls	$50,000	1	$50,000	6
Dewatering Pre-Design Studies and Additional Design	ls	$25,000	1	$25,000	7
		Subtotal, Pre-Design		**$75,000**	
Soil Excavation (0-14 feet)					
Install Sheeting	sf	$30	61,992	$1,859,760	8
Excavate Soil	cy	$8	46,667	$373,333	9
Excavate Overlying Asphalt, Concrete and Ballast	cy	$8	1,667	$13,333	9
Stockpile Dry Soil, Asphalt, Concrete and Ballast	cy	$4	11,667	$46,667	10
Stockpile and Dewater Remaining Excavated Soil	cy	$15	42,000	$630,000	11
Post Excavation Sampling	sample	$420	36	$15,120	12
Develop and Implement a Perimeter Air Monitoring Plan	ls	$362,000	1	$362,000	13
Testing for Soil Disposal - 1/750 cy	sample	$1,000	75	$74,667	14
Health and Safety Plan	ls	$15,000	1	$15,000	15
		Subtotal, Excavation		**$3,389,880**	
Dewatering based on 50 gpm					
Install Groundwater Dewatering System	ls	$320,000	1	$320,000	16
Operate Dewatering System	week	$15,000	86	$1,290,000	17
Install Groundwater Treatment System	ls	$560,000	1	$560,000	18
Operate Treatment System, Including Media Replacement	week	$25,000	86	$2,150,000	19
Disposal of Spent Treatment Media	month	$7,000	22	$150,500	20
<u>SPDES Permit</u>					
Obtain SPDES Permit	ls	$20,000	1	$20,000	21
Analyze for VOCs, SVOC, TSS, BOD, pH, Fecal Coliform, Oil and Grease, Metals	week	$795	156	$124,020	20
Clay Anthracite Vessel, capable 50 gpm flow, 1,500 lbs clay	vessel	$7,550	3	$22,650	22
	Subtotal, Dewatering SPDES Permit Option			**$4,637,170**	
Soil Treatment and Disposal					
Load Soil for Disposal	cy	$2	53,667	$107,333	23
Freight and Disposal Non-hazardous soil:	ton	$56	96,600	$5,437,614	24
Dispose Cover Material (Concrete, Asphalt, Gravel)	cy	$25	1,667	$41,667	25
	Subtotal, Treatment and Disposal			**$5,586,614**	
Permeable Reactive Barrier for Groundwater Treatment					
ZVI Wall Construction and Licensing	ls	$1,674,133	1	**$1,674,133**	26

TABLE 4-6
REMEDIAL ACTION ALTERNATIVE VI:FULL-SCALE SOIL EXCAVATION, ZVI WALL, AND SEDIMENT REMOVAL
METAL ETCHING
FREEPORT, NEW YORK

Item Description	Unit	Unit Cost	Quantity	Total Cost	Notes
Site Restoration					
Supply Backfill	cy	$29	46,667	$1,353,333	28
Install Backfill	cy	$4	48,588	$194,353	28
Install Post-Remdial Groundwater Monitoring Wells	well	$1,500	6	$9,000	27
Replacement of demolished Site buildings	sf	$100	3600	$360,000	29
		Subtotal, Site Restoration		**$1,556,687**	
Sediment Removal					
<u>Baseline Studies, Design, and Permitting</u>					
Design Support Testing	of total	$358,808	10%	$35,881	32
Evaluation of RD/RA Studies & Additional Design Work	of total	$358,808	20%	$71,762	33
Health and Safety Plan	ls	$5,000	1	$5,000	15
Permitting	ls	$25,000	1	$25,000	34
	Subtotal, Study, Design, and Permitting:			**$137,642**	
<u>Dredging</u>					46
Site Prep and Facility Construction	of	$358,808	5%	$17,940	35
Contractor Work Plans	LS	$5,000	1	$5,000	36
Health & Safety	LS	$5,000	1	$5,000	15
Silt Curtain	SF	$28	1,804	$50,512	37
Sediment Processing Area	BCY	$5	900	$4,501	38
Dredging	BCY	$40	900	$36,008	39
Dewatering	BCY	$52	900	$46,810	40
Stabilization (portland cement 10%)	BCY	$30	90	$2,701	41
Testing and Monitoring (during remediation)	days	$2,000	30	$60,000	42
Testing for Sediment Disposal - 1/500 cy	sample	$1,595	2	$2,872	43
Transportation and Disposal	ton	$56.29	1,485	$83,609	24
Water Treatment	ls	$31,795	1	$31,795	44
Construction Monitoring (in addition to construction oversight)	mo.	$30,000	1.00	$30,000	45
	Subtotal Construction and Disposal:			**$376,748**	
<u>Site Restoration for Sediment Removal</u>					
Backfilling (assume 100% of removed)	cy	$33.00	450	$14,853	28
		Subtotal, Site Restoration		**$14,853**	
			<u>Remedial Action Cost Estimate</u>		31
	Subtotal Remedial Action Capital Cost			$17,643,287	
			Contingency (25%)	$4,410,822	
		Mobilization/Demobilization (5%)		$882,164	
			Remedial Design (6%)	$1,058,597	
			Project Management (5%)	$882,164	
		Construction Management (6%)		$1,058,597	
		Total Remedial Action Capital Cost		**$25,935,632**	

TABLE 4-6
REMEDIAL ACTION ALTERNATIVE VI:FULL-SCALE SOIL EXCAVATION, ZVI WALL, AND SEDIMENT REMOVAL
METAL ETCHING
FREEPORT, NEW YORK

Item Description	Unit	Unit Cost	Quantity	Total Cost	Notes
OPERATIONS, MAINTENANCE, AND MONITORING (OM&M) COSTS					
Annual Certification for OM&M	ls	$1,000	1	$1,000	
Subtotal, Annual Certification Present Value				**$15,372**	
Groundwater Monitoring					
Annual groundwater monitoring for 30 years for VOCs and TAL Metals ($11,250 per year, 2% inflation, 5% discount factor)	ls	$286,813	1	$ 286,813	30
Total O&M Costs				$302,185	
Project Management Costs (8%)				$24,175	
Contingency (10%)				$30,219	
Total Present Worth of Annual Operations and Maintenance Costs				**$356,578**	
TOTAL PRESENT WORTH OF COSTS				**$26,292,211**	

TABLE 4-6
REMEDIAL ACTION ALTERNATIVE VI:FULL-SCALE SOIL EXCAVATION, ZVI WALL, AND SEDIMENT REMOVAL
METAL ETCHING
FREEPORT, NEW YORK

Notes

1 Approximate capital cost for materials and labor installation of Interim Remedial Measure sub-slab depressurization (SSD) system.
2 Cost is for contractor and vacuum truck per day based on previous ERM experience.
3 The cost is based on previous ERM experience. This cost includes disposal of 3.6 cubic yards of sediment and addition of kiln dust using 55 gallon drums. A 300% volume increase was assumed due to the addition of water to the sediment prior to removal. Quantity was estimated assuming that the storm drain is 2.5 feet by 1.5 feet with one inch of sediment. Quantity also assumed that the storm sewer is 97 feet long with a 2 foot diameter, and is 25% filled with sediment. The addition of kiln dust was assumed to increase the sediment volume by 25%.
4 Location of tank is unknown at this time. This cost is for tank removal based on previous ERM experience.
5 Estimated cost for legal fees to obtain deed restrictions and annual certification based on previous ERM experience.

6 Cost for pre-design studies to determine soil parameters (e.g., strength) and evaluation of geotechnical design scenarios. Cost includes installation of deep soil borings to define the thickness of the underlying clay layer and underlying strata.

7 Cost for pre-design studies to determine dewatering parameters (e.g., rate) and evaluation of design scenarios. Based upon similar project experience.
8 Sheeting cost for installation of interlocking, water-tight, sheeting along excavation perimeter to provide structural support for the side walls. The sheeting will be placed around perimeter of excavation areas. Cost assumes that the sheeting will be installed across entire Study Area, which is 1,476 feet in perimeter and will be left in place, not recycled. Alternatively, excavation boxes may be evaluated during the design phase. Cost provided by EnviroClean including labor, equipment and materials, and sealing at junctures for water tightness.

9 Cost for soil/fill excavation, concrete excavation, and below building soil excavation and backfill/compaction provided by American Environmental Assessment Corporation of Wyandanch, NY. Assumes that excavation will occur throughout the Site. 46,667 cubic yards will be excavated.
10 Cost for stockpiling excavated material provided by EnviroClean.
11 Cost for supply and addition of moisture removal agents; includes: mixing structure and mixing equipment.
12 Cost for analysis of TCL VOCs and target analyte list (TAL) metals obtained from Accutest Laboratories. Quantity assumes one post-excavation sample is collected per 2500 feet of the bottom excavation.
13 Cost includes preparation of an air monitoring plan, and the weekly presence of one on-site health and safety person for air monitoring on-Site. This person would also monitor particulate levels. Cost also includes the purchase price for two MIE particulate monitor and a photoionization detector. Cost based on previous ERM experience.
14 Cost provided by Accutest. Analysis includes PCBs, TAL metals, TCLP VOCs, TCLP SVOCs, TCLP Metals, and RCRA Characteristics. Assumed the collection of one sample per 750 cubic yards of excavated material.
15 Cost for preparation of health and safety plan. Based upon similar project experience.
16 Cost provided by Griffin Dewatering-New England, Inc. of Shorthills NJ dated 20 November 2002 to install dewatering system. Cost includes for materials and labor to dewater the excavation area with dewatering equipment rented over a minimum six-month period.
17 Weekly cost provided by Griffin Dewatering to operate the dewatering system including generators and union operation.
18 Cost provided by Griffin Dewatering for pretreatment of dewatering effluent prior to discharge assuming a SPDES permit is obtained. Cost includes installation, removal and furnishing of groundwater treatment system and carbon materials.
19 Cost provided by Griffin Dewatering, Inc.
20 Costs from Envirotrol for similar site.
21 Cost to obtain SPDES permit based upon similar project experience.
22 Cost provided by NEEP Systems of West Lebanon, NH. Assumes replacement of vessel every six months.
23 Loading soil for disposal quote based on cost provided by EnviroClean.
24 Non-hazardous transportation and disposal cost provided by American Environmental Assessment Corp. of Wyandanch, NY at $52/ton.Tax is 8.25%. Sediment and concrete will be disposed of, with a 1.5 tons/cy density assumed.
25 Cost for asphalt and concrete disposal provided by American Environmental Assessment Corporation of Wyandanch, NY.

26 Cost provided by GeoSierra, Inc. of Atlanta, GA in September 2005. Cost includes the installation of three PRB walls that are each 10 feet apart from one another. Each wall extends from 2 to 30 feet bgs, is 170 feet long and 3 inches thick. The shallow portion of the wall, from 2 to 5 feet bgs, will be installed via trenching. The rest of the wall will be installed via injection to 30 feet below grade.

TABLE 4-6
REMEDIAL ACTION ALTERNATIVE VI:FULL-SCALE SOIL EXCAVATION, ZVI WALL, AND SEDIMENT REMOVAL
METAL ETCHING
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Notes

27 Six monitoring wells will required for sampling within 25 to 30 feet of the wall. Two wells upgradient of the ZVI wall, two wells downgradient of the ZVI wall, one well to the east of the wall, and one well to the west of the wall would be installed.

28 Cost for supply and installation of backfill and gravel provided by EnviroClean.

29 Cost of demolition obtained from Garito Contracting, Inc. of Yonkers, NY. Replacement of demolished site buildings is based upon previous ERM experience.

30 Six wells would be sampled over the course of two days with samples for VOCs, natural attenuation analysis, and metals annually for 30 years. Cost included laboratory analysis, field equipment, labor, and preparation of data summary memo.

31 A scope contingency of 10% and bid contingency of 15% was assumed for a total contingency 25%. Indirect costs for project management, remedial design, and construction management are based on a percentage of capital costs. The following summarizes percentages applied for these costs. These percentages were obtained from USEPA July 2000 "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study". USEPA recommends project management costs for O&M as 5 to 10% of O&M costs (USEPA, 2000).

Exhibit 5-8
Example Percentages for Professional/Technical Services Capital Costs

Capital Cost Element	< $100K (%)	$100K-$500K (%)	$500K-$2M (%)	$2M-$10M (%)	> $10M (%)
Project Management	10	8	6	5	5
Remedial Design	20	15	12	8	6
Construction Management	15	10	8	6	6

32 Costs estimated to be 10% of the dredging cost excluding site preparation and facility construction based on EPA guidance and previous ERM experience on similar project.

33 Estimated additional design costs based on the complexity of the sediment removal design. RD would need to take into consideration subsurface structural and overhead structural impediments to sediment removal, unique sediment removal techniques, barge access, etc. RD/RA studies includes additional delineation, bathymetric survey, tide and float, dewatering, materials handling evaluations. Cost estimated to be 20% of the dredging cost excluding site preparation and facility construction based on EPA guidance and previous ERM experience on similar project.

34 Permitting costs for sediment removal is based upon similar project experience.

35 Site preparation and facility construction including soil handling areas, dewatering equipment, and water treatment equipment. Cost estimated to be 5% of the dredging cost excluding site preparation and facility construction.

36 Estimated costs for contractor workplans over and above those included in unit contractor prices for any area with unusual access problems.

37 Unit cost provided in Table 4-10, "Typical Unit Costs for Containment Barriers" USEPA, http://www.epa.gov/glnpo/arcs/EPA-905-B94-003/gifs/tab4-10.gif, for vinyl-coated silt curtains.

38 Unit cost provided by Nicholas Mucci of Cashman Marina and Dredging for sediment processing. Includes stockpiling, stabilizing, and on-loading soils to trucks.

39 Unit dredging cost provided by Nicholas Mucci of Cashman Marina and Dredging.

40 Unit dewatering cost for 30% solids obtained from Table 6-9, "Unit Costs for Belt Filter Press Dewatering", USEPA http://www.epa.gov/glnpo/arcs/EPA-905-B94-003/gifs/tab6-9.gif . Assume 30% solids for sediments after initial gravity settling of dredging slurry in all Areas.

41 The quantity of dewatering (i.e., stabilization) material would be determined during the RD/RA testing. For cost estimation purposes, it was assumed that a 1:10 concrete to sediment mixture would be needed. The unit price is $30/CY and includes materials and processing.

42 Daily rate include materials and services for testing and monitoring during construction (e.g., river monitoring and air monitoring).

43 Cost includes waste characterization analysis for total PCBs, TCLP VOCs, SVOCs, metals, corrosivity, ignitability and TPH. Quantity assumes one sample collected per 500 cy of removed sediment.

44 Quantity assumes 80% water content for the sediment with a safety factor of 2. Cost assumes treatment via filters and activated carbon with discharge back into river.

45 Testing and monitoring during construction is additional labor above construction monitoring as part of environmental monitoring for continual monitoring of suspended solids in river water and air.

TABLE 4-6
REMEDIAL ACTION ALTERNATIVE VI:FULL-SCALE SOIL EXCAVATION, ZVI WALL, AND SEDIMENT REMOVAL
METAL ETCHING
FREEPORT, NEW YORK

Notes

46 The amount of sediment that is to be dredged was calculated for two areas of 3,000 and 9,200 square feet and assuming that the volume to a depth of two feet would be removed for a total volume of approximately 900 cubic yards. A 10% increase by volume was assumed for addition of portland cement and the disposal quantity was calculated based on 1.5 tons/cubic yard.

APPENDICES

APPENDIX A

enviro**metal** technologies inc.

Memorandum

To: Jim Ortman, GeoSierra, e-mail: jortman@geosierra.com

From: Andrzej Przepiora, EnviroMetal Technologies Inc.

Date: 5 June 2006

Re: **Performance of Granular Iron Permeable Reactive Barriers in Tidal-Influenced Groundwaters**

Two types of potential effects need to be considered for the design and performance assessment of iron permeable reactive barriers (PRBs) in tidal-influenced aquifers:

- the influence of high concentrations of chloride on iron reactivity; and
- the influence of tidal water level fluctuations on PRB hydraulic performance.

Iron Reactivity in the Presence of High Chloride Concentrations

ETI has conducted over 200 treatability column tests with different site groundwaters, including 30 brackish and saline waters (TDS>1,000 mg/L). The highest chloride concentrations in the tested waters were 9,500 mg/L at a site in Irvine, CA and 24,000 mg/L at a harbor site in Sweden. Results of the tests with high salinity waters do not indicate any distinct correlation between the VOC degradation rate and the chloride concentration. Chloride is a conservative species in iron systems; if significant concentrations of VOCs are present, the chloride concentrations in the iron zone effluent increase due to chloride production from VOC dechlorination.

The influence of a single inorganic constituent, like chloride, on iron reactivity is difficult to differentiate in tests with natural groundwaters, due to their complex composition and the interference from other constituents. However, a considerable research has been conducted in this area, using controlled laboratory experiments. Reardon (1995) conducted detailed corrosion rate measurements of commercial granular irons in the presence of chloride at concentrations ranging from 0.02M (710 mg/L) to 3.0M (106,500 mg/L). The iron corrosion rate is an indirect measurement of iron reactivity, as iron corrosion drives the dehalogenation reaction. Although not directly related to the absolute rate of degradation rate, the corrosion rate quantifies the amount of hydrogen produced during iron oxidation. Based on the corrosion test results, at a chloride concentration of 0.8 M (28,400 mg/L), the iron corrosion rate slowed down by about 50%, compared to the results in distilled water (Reardon, 1995).

745 Bridge Street West, Suite 7
Waterloo, Ontario
Canada N2V 2G6
Tel: 519.746.2204
Fax: 519.746.2209
Web page: www.eti.ca

However, the amount of the hydrogen generated even at this slower rate was still sufficient to degrade 100's mg/L of VOCs. In contrast to these results, extensive published data in the field of corrosion science suggest that chloride causes pitting corrosion that could "clean" the iron surface of iron oxides and thus increase the corrosion rate (e.g.; Szklarska-Smialowska, 1991).

According to published results from iron reactivity tests, chloride either enhances the iron reactivity or has no influence on it (Devlin et al., 2005; Devlin and Allin, 2005). Clausen et al. (2003) observed that TCE degradation rates in iron improved in the presence of 10 mM (355 mg/L) of chloride, compared to the rates observed in experiments without chloride present.

Hydraulic PRB Performance in Tidal-Influenced Aquifers

A pilot-scale iron PRB system at NAS Alameda Point, CA was installed in a shallow, tidal-influenced aquifer (Battelle, 2002). Based on the experience at this site, the main challenge in designing an effective passive treatment system in this hydrogeologic environment is an adequate evaluation of the plume capture zone. Granular iron has a high porosity (>50%) and high hydraulic conductivity (~150 ft/day) and thus should not affect the ambient groundwater flow field, however, there are a few issues to take into design considerations when designing a PRB in a tidal-influenced aquifer.

The issues to consider with the flow field are transient flow reversal and/or flow direction change, and transient changes in the water level. Another important PRB design issue, related to these transient hydrogeologic conditions, is an adequate iron thickness to provide a sufficient residence time for VOC treatment. Temporal and/or spatial variations in both the influent VOC concentrations and groundwater velocities are anticipated and should be evaluated as part of PRB design efforts.

Summary

Based on previous results, high chloride concentrations at the site of up to 22,000 mg/L are not perceived to be detrimental to the iron reactivity. Therefore, ETI recommends that the iron degradation rates determined in the previous treatability test conducted with the low chloride site water be applied to the iron PRB thickness determination for the entire PRB.

If a PRB is installed in a tidal-influenced aquifer, transient changes in the flow velocity and direction, water levels, and influent VOC concentrations should be evaluated along the proposed PRB alignment to provide complete hydraulic capture as well as an adequate residence time for complete VOC degradation.

References

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APPENDIX B

DISCUSSION OF GROUNDWATER FLUSHING MODEL
FEASIBILITY STUDY SUPPORT
METAL ETCHING, FREEPORT, NEW YORK

Groundwater modeling has been performed to support the analysis of soil and groundwater remedial alternatives for the Feasibility Study (FS) at the Metal Etching Site located in Freeport, New York (the Site). The approach utilizes simplifying assumptions and the use of basic analytical models. To support the development of the FS remedial alternatives, solute travel periods, anticipated time to reach the maximum contaminant levels (MCLs) and flushing efficiency of the aquifer with respect to the contaminant plume have been calculated. Calculations are based under the assumption that the source of the contamination has been removed. The purpose of this section is to provide a summary of the methods utilized to generate the groundwater flushing model for the constituents of concern (COCs) at the Site, and a summary of the work performed is provided below.

Background Information

The groundwater investigation at the Site has revealed elevated levels of PCE, TCE, Cis-1,2-DCE, VC, benzene, toluene, ethylbenzene, and total Xylene (BTEX) compounds exceeding the NYSDEC TOGS criteria. Of the VOC compounds listed above, PCE has by far the highest concentration and will move the slowest in the aquifer (i.e, it is the most retarded). The PCE decay species (trichloroethene, cis-1,2-dichloroethene and vinyl chloride) can be ignored, as these chemicals are less retarded and therefore migrate at higher velocities. Benzene, toluene and total Xylene compounds will also travel at higher velocities than PCE. On that basis, worst case groundwater concentrations for PCE (groundwater sampling data from October 2004) and literature values that best suited site conditions were carried throughout calculations in the flushing model.

Several remedial alternatives in the FS were evaluated employing excavation and monitored natural attenuation of the groundwater plume. To support the FS alternatives an evaluation of the Site hyrdrogeologic conditions, contaminant concentrations, and factors affecting contaminant migration in groundwater have been evaluated and are presented in the paragraphs below and supported on the Flushing Model Work Sheet Table B-1.

PCE Plume and Hydrogeological Characteristics of the Site

Groundwater analytical data collected from soil borings and monitoring wells at the Site indicate that a PCE groundwater plume exists at the Site. The groundwater concentrations were plotted on a Site map and contoured using the

GISKey Krieging package. Based on the PCE groundwater plume, Figure 2-6 in the FS Report, a conservative estimation of the PCE plume dimensions were measured at; 95 feet wide; 200 feet long; and 35 feet deep (based on depth to top of "20 Foot Clay" the basal unit of the unconfined aquifer).

Groundwater elevation contour maps developed from the tidal influence study were also developed using the triangular integrated network (TIN) algorithm. The average groundwater elevation at the Site indicates a south-southeasterly flow direction from monitoring well cluster MW-02S&D toward the MW-07S&D cluster (see Figure 3-X in the RI Report). The groundwater gradient (change in potential head across the site) was calculated to be 0.0064 ft/ft.

Literature conductivity (K) values for the upper glacial aquifer have been measured on the order of 270 ft/day (Prince & Schnieder [1989] – Upper Glacial). Site specific conductivity data was not collected at the Site, therefore, the accepted literature values were used in the model. Typical porosity values for well sorted sands and/or gravels have been measured at 25 to 50 % and the bulk density of sand/gravel is 1.7g/cm^3. On Long Island, New York typically used porosity for sand is 25 % which was used in the model.

Additionally, the fraction of organic carbon (F_{oc}) in the soil was estimated at approximately 1%. Based on total organic carbon samples collected from the Freeport Creek averaging approximate 12,025 mg/kg, the estimated 1% (F_{oc}) is a conservative number for the Site setting.

Anticipated Time for PCE to Reach NYSDEC TOGS

The time for PCE to reach the MCLs in the aquifer upon removal of the soil source was calculated using an accepted literature value for half-life ($t_{1/2}$) of 270 days as published in Handbook of Environmental Degradation Rates, 1990. It is preferable to use Site specific half-life data for constituents; however, historic concentrations over time do not exist and as a result using linear regression method to calculate Site specific data was not possible. Once the half-life is obtained, the degradation rate (**k**) was calculated for PCE. The degradation rate (**$k = 0.693/ t_{1/2}$**) was calculated at 0.0026 $days^{-1}$. Using the degradation rate, the time anticipated for the compound to reach the NYSDEC TOGS value was calculated (**$time= - (\ln (C/C_0))/k$**). The time calculated to reach NYSDEC TOGS was 6.16 years, using an initial concentration (**C_0**) of 1,600 ug/l MW-07D and final concentration (**C**) of 5 ug/l for the NYSDEC TOGS criteria. See Table B-1 for the flushing model calculations.

Distance:
Prior to calculating the projected migration distance of the plume, the seepage velocity and retardation factor for PCE were calculated. The seepage velocity (V_w) as well as the retardation factor (R_f) were calculated using the values presented in the previous section. Seepage velocity is calculated by multiplying the conductivity (K) by the hydraulic gradient (i) and dividing through by the porosity ($V_w = K * i / n$). The calculated seepage velocity for the Site is 6.912 ft/day. The retardation factor (**R_f (compound) = 1 + ((bulk density/n) x K_d (compound)**) for PCE was calculated to be 19.836.

The contaminant transport rate for PCE ($V_s = V_w / R_f$) was ascertained and then used to calculate the total distance that the contaminant will travel over the duration of the time for PCE to reach MCLs. To calculate travel distance the contaminant transport rate was multiplied by time (previously calculated at 6.16 years) resulting in the distance that the constituent will travel. The total distance that PCE will travel over the course of 6.16 years is calculated to be 783.12 ft. According to the model PCE will migrate into the Freeport Creek.

Aquifer Flushing Efficiency

Darcy's Law was used to calculate the time to flush one pore volume of PCE contaminated groundwater through the area designated to be the width and depth of the PCE plume (width of 95 feet and depth of 35 feet). Darcy's Law is described as; **$Q = K * i * A$**, where (**Q**) is equal to the discharge (for the area of the PCE plume), (**K**) is the hydraulic conductivity of the aquifer, (i) is the hydraulic gradient of the aquifer and (**A**) is equal to the area of the plume. Therefore, the discharge (**Q**) through the designated area is 42,983 gal/day. If the entire volume of the PCE plume is calculated (LxWxD) and multiplied by the porosity of the formation then the pore volume of contaminated groundwater in the aquifer totals 1,243,636 gallons.

The estimated time to flush one pore volume through the designated discharge area is calculated by dividing the volume of the plume in gallons by the calculated discharge (Q) from above. The result equals 28.93 days to flush one pore volume through the designated area.

A published table from HMCRI In Situ Bioremediation Short Course (December 5, 1991), calculates the fraction of contaminants remaining after flushing 1, 3, 5, 25 and 75 pore volumes of water through an aquifer. The reference table indicates that 75 pore volumes will flush nearly 100%PCE from the aquifer (flushing efficiency for PCE). Thus by multiplying the 28.93 days for one pore volume flush by 75 pore volumes, a time of 5.95 years is obtained to reach near

100% removal of the PCE in the aquifer. This value nearly matches the time to reach MCL's calculated from the degradation rate for PCE of 6.16 years.

Sensitivity Analysis

Site variables such as porosity, conductivity, fraction of organic carbon and the soil bulk density affect contaminant travel time and ultimately the flushing efficiency times. Potential ranges in Site variables can alter the outcomes of these basic and generalized analytical models. Thus, a sensitivity analysis has been performed on those variables most prone to changeability.

Porosity:
By increasing the porosity of the formation by 10% the following parameters were altered:

- Seepage velocity (V_w) decreased from 6.912 to 4.94 ft/day;
- The retardation factor decreased from 19.84 to 14.45;
- The volume of the plume increased from 1,243,636 gallons to 1,741,091 gallons;
- Time duration for one flushing pore volume increased from 28.93 to 40.51 and the 75 flushing pore volumes increased from 5.95 years to 8.32 years.

Conductivity:
By decreasing the conductivity of the aquifer to 200 ft/day the following parameters were altered:

- Seepage velocity (V_w) decreased from 6.912 to 5.12 ft/day;
- Q decreased from 42,983 gal/day to 31,839 gal/day;
- The retardation factor was unchanged;
- The volume of the plume was unchanged;
- Time duration for one flushing pore volume increased from 28.93 to 39.06 and the 75 flushing pore volumes increased from 5.95 years to 8.03 years.

Fraction of Organic Carbon:
By increasing the F_{oc} of the formation 5% the following parameters were altered:

- Seepage velocity (V_w) was unchanged;
- The retardation factor increased from 19.84 to 95.18;
- The volume of the plume was unchanged;
- Time duration for the flushing pore volumes was unchanged.

Bulk Density of the formation:
By decreasing the bulk density of the formation to 1.5 g/cm^3 the following parameters were altered:

- Seepage velocity (V_w) was unchanged;
- The retardation factor decreased from 19.84 to 17.62;

- The volume of the plume was unchanged;
- Time duration for the flushing pore volumes was unchanged.

Table B-1
Flushing Model Worksheet
Metal Etching Site
435 South Main Street
Freeport, New York
Site No. 1-30-110

Compound of Concern	Maximum Concentration Detected (ug/L) (C_0)	Partition Coefficient Koc	Well ID/Sample Point with Greatest Concentration	Distance to Freeport Creek (Feet)	NYSDEC TOGS 1.1.1 (ug/L) (C)	Literature Value Half-Life (Days)
PCE	1600	277	MW-07D	120	5	270
TCE	25	126	MW-07D	120	5	-
CIS-1,2-DCE	370	-	MW-07S	120	5	-
VC	400	57	MW-07S	120	2	-
Benzene	18	83	SB-02	80	1	-
Toluene	410	300	SB-36	120	5	-
Etthylbenzene	240	1100	SB-56	40	5	-
Xylene	440	240	SB-36	120	5	-
MTBE	2100	-	SB-31	160	10	-

Parameter	Site Conditions:			Source
Conductivity (k)	**K=**	270	ft/day	Prince & Schneider (1989)- Upper Glacial
Gradient (i)	**i=**	0.0064	ft/ft	Measured Gradient: Established from Average GW Elevation Tidal Study
Porosity (n)	**$n_{e=}$**	0.25	dimensionless	Literature Consensus for sand
Seepage Velocity (V_w)	**Vw=**	6.912	ft/day	V_w = ki/n
Organic Carbon (F_{oc})	**Foc=**	0.01	dimensionless	
Bulk Density	**Pb=**	1.7	g/cm^3	Typical Value

DISTRIBUTION COEFFICIENT: K_d

Distribution Coefficient: Kd (Compound) = Foc x Koc (Compound)		
Distribution Coefficient (K_d - PCE)	L/kg	2.770
Distribution Coefficient (K_d - TCE)	L/kg	1.260
Distribution Coefficient (K_d - DCE)	L/kg	-
Distribution Coefficient (K_d - VC)	L/kg	0.570
Distribution Coefficient (K_d - Benzene)	L/kg	0.830
Distribution Coefficient (K_d - Toluene)	L/kg	3.000
Distribution Coefficient (K_d - Ethylbenzene)	L/kg	11.000
Distribution Coefficient (K_d - Xylene)	L/kg	2.400

RETARDATION FACTOR: R_f

Retardation Factor: Rf (compound) = 1 + ((bulk density/n) x Kd (compound))		
Retardation Factor R_f (PCE)	dimensionless	19.836
Retardation Factor R_f (TCE)	dimensionless	9.568
Retardation Factor R_f (DCE)	dimensionless	-
Retardation Factor R_f (VC)	dimensionless	4.876
Retardation Factor Rf - Benzene	dimensionless	6.644
Retardation Factor Rf - Toluene	dimensionless	21.4
Retardation Factor Rf - Ethylbenzene	dimensionless	75.8
Retardation Factor Rf - Xylene	dimensionless	17.32

CONTAMINANT TRANSPORT RATE: V_s

Retarded Solute Flow Velocities: Vs (Compound) = Vw/Rf (Compound)		
Solute Flow Velocity (V_s - PCE)	ft/day	0.3485
Solute Flow Velocity (V_s - TCE)	ft/day	0.7224
Solute Flow Velocity (V_s - DCE)	ft/day	-
Solute Flow Velocity (V_s - VC)	ft/day	1.4176
Solute Flow Velocity (V_s - Benzene)	ft/day	1.0403
Solute Flow Velocity (V_s - Toluene)	ft/day	0.3230
Solute Flow Velocity (V_s - Ethylbenzene)	ft/day	0.0912
Solute Flow Velocity (V_s - Xylene)	ft/day	0.3991

ANTICIPATED TIME FOR PCE TO REACH NYSDEC TOGS

Time to Reach NYSDEC TOGS: t=-((ln(C/Co))/k

C=Final Concentration (NYSDEC TOGS)
Co=Initial Concentration
k=degradation rate (days^-1) or $0.693/t_{1/2}$
$t_{(1/2)}$=half-Life (days)
t= time (days)

Degradation Rate Of PCE

k= $0.693/t_{(1/2)}$
k= 0.0026 days^-1

Time to Reach NYSDEC TOGS

t= - $(\ln(C/C_0))/k$
t= 2,247.40 days
t= **6.16** **years**

PLUME DISCHARGE (Q)

Plume Area ($feet^2$) = 3,325 (from Figure 4-10 PCE in Groundwater)
Gradient (dimensionless) = 0.0064 (Actual Site Gradient Measured from Average Groundwater Elevations during Tidal Study)
Hydraulic Conductivity (feet/day) = 270 (regional value for Upper Glacial Aquifer)

Discharge Calculation

Darcy's Law: Q = K x I x A

Q = 5,746 $feet^3$/day
Q = 42,983 gal/day
Q = 162,707 L/day

PCE Plume Volume

V ($feet^3$)= 665,000 (from Figure 4-10 PCE in Groundwater)
V (gallons)= 1,243,636
V (liters)= 4,707,676

Mass Flux Calculation = Q*Concentration		
Min. PCE Concentration in this Zone=	0.05	mg/L
Max. PCE Concentration in this Zone=	1.6	mg/L
Avg. PCE Concentration in this Zone =	0.50	mg/L
Plume Mass Flux in this Zone (Min) =	8,135	mg/day
Plume Mass Flux in this Zone (Max) =	260,332	mg/day
Plume Mass Flux in this Zone (avg) =	81,354	mg/day

FLUSHING EFFICIENCIES

Time Duration to Flush one Pore Volume: No Retardation

Time= Volume of PCE Plume/Q
Time= 28.93 days
Time= 0.08 years

Flushing Efficiencies with PCE No Retardation Considered:		
1 Flushing Volume	0.08	Years
3 Flushing Volumes	0.24	Years
5 Flushing Volumes	0.40	Years
25 Flushing Volumes	1.98	Years
75 Flushing Volumes	**5.95**	**Years**

Sources:

Pankow and Cherry (1996)
Prince & Schneider (1989)
Fetter, C.W. 1993. Contaminant Hydrogeology. New York: MacMillan Publishing Company
R. Allen Freeze and John A. Cherry, Groundwater, Prentice Hall, Inc., 1979, p. 405.
Philip H. Howard, Robert S. Boethling, William F. Jarvis, William M. Meylan and Edward M. Michalinko, Handbook of Environmental Degradation Rates, Lewis Publishers, Inc., 1990
U.S. Department of Health and Human Services, Toxicological Profile for Tetrachloroethene, 1995.
In Situ Bioremediation Short Course, HMCRI December 5, 1991, Remediation Technologies, Inc. (Flushing Efficiencies)

enviro**metal**
technologies
inc.

Memorandum

To: Jim Ortman, GeoSierra, e-mail: jortman@geosierra.com

From: Andrzej Przepiora, EnviroMetal Technologies Inc.

Date: 5 June 2006

Re: **Performance of Granular Iron Permeable Reactive Barriers in Tidal-Influenced Groundwaters**

Two types of potential effects need to be considered for the design and performance assessment of iron permeable reactive barriers (PRBs) in tidal-influenced aquifers:

- the influence of high concentrations of chloride on iron reactivity; and
- the influence of tidal water level fluctuations on PRB hydraulic performance.

Iron Reactivity in the Presence of High Chloride Concentrations

ETI has conducted over 200 treatability column tests with different site groundwaters, including 30 brackish and saline waters (TDS>1,000 mg/L). The highest chloride concentrations in the tested waters were 9,500 mg/L at a site in Irvine, CA and 24,000 mg/L at a harbor site in Sweden. Results of the tests with high salinity waters do not indicate any distinct correlation between the VOC degradation rate and the chloride concentration. Chloride is a conservative species in iron systems; if significant concentrations of VOCs are present, the chloride concentrations in the iron zone effluent increase due to chloride production from VOC dechlorination.

The influence of a single inorganic constituent, like chloride, on iron reactivity is difficult to differentiate in tests with natural groundwaters, due to their complex composition and the interference from other constituents. However, a considerable research has been conducted in this area, using controlled laboratory experiments. Reardon (1995) conducted detailed corrosion rate measurements of commercial granular irons in the presence of chloride at concentrations ranging from 0.02M (710 mg/L) to 3.0M (106,500 mg/L). The iron corrosion rate is an indirect measurement of iron reactivity, as iron corrosion drives the dehalogenation reaction. Although not directly related to the absolute rate of degradation rate, the corrosion rate quantifies the amount of hydrogen produced during iron oxidation. Based on the corrosion test results, at a chloride concentration of 0.8 M (28,400 mg/L), the iron corrosion rate slowed down by about 50%, compared to the results in distilled water (Reardon, 1995).

745 Bridge Street West, Suite 7
Waterloo, Ontario
Canada N2V 2G6
Tel: 519.746.2204
Fax: 519.746.2209
Web page: www.eti.ca

However, the amount of the hydrogen generated even at this slower rate was still sufficient to degrade 100's mg/L of VOCs. In contrast to these results, extensive published data in the field of corrosion science suggest that chloride causes pitting corrosion that could "clean" the iron surface of iron oxides and thus increase the corrosion rate (e.g.; Szklarska-Smialowska, 1991).

According to published results from iron reactivity tests, chloride either enhances the iron reactivity or has no influence on it (Devlin et al., 2005; Devlin and Allin, 2005). Clausen et al. (2003) observed that TCE degradation rates in iron improved in the presence of 10 mM (355 mg/L) of chloride, compared to the rates observed in experiments without chloride present.

Hydraulic PRB Performance in Tidal-Influenced Aquifers

A pilot-scale iron PRB system at NAS Alameda Point, CA was installed in a shallow, tidal-influenced aquifer (Battelle, 2002). Based on the experience at this site, the main challenge in designing an effective passive treatment system in this hydrogeologic environment is an adequate evaluation of the plume capture zone. Granular iron has a high porosity (>50%) and high hydraulic conductivity (~150 ft/day) and thus should not affect the ambient groundwater flow field, however, there are a few issues to take into design considerations when designing a PRB in a tidal-influenced aquifer.

The issues to consider with the flow field are transient flow reversal and/or flow direction change, and transient changes in the water level. Another important PRB design issue, related to these transient hydrogeologic conditions, is an adequate iron thickness to provide a sufficient residence time for VOC treatment. Temporal and/or spatial variations in both the influent VOC concentrations and groundwater velocities are anticipated and should be evaluated as part of PRB design efforts.

Summary

Based on previous results, high chloride concentrations at the site of up to 22,000 mg/L are not perceived to be detrimental to the iron reactivity. Therefore, ETI recommends that the iron degradation rates determined in the previous treatability test conducted with the low chloride site water be applied to the iron PRB thickness determination for the entire PRB.

If a PRB is installed in a tidal-influenced aquifer, transient changes in the flow velocity and direction, water levels, and influent VOC concentrations should be evaluated along the proposed PRB alignment to provide complete hydraulic capture as well as an adequate residence time for complete VOC degradation.

References

Battelle Press, 2002. Evaluating the Longevity and Hydraulic Performance of Permeable Reactive Barriers at the Department of Defense sites. Columbus, Ohio, pp. 239.

Devlin, J.F., Allin, K.O., Dambache, M., Mariett, M., and Moylan, J., 2005. Investigating Performance Limits of Granular Iron Reactive Barriers in Groundwater of Different Geochemical Compositions. 2nd International Symposium on Permeable Reactive Barriers and Reactive Zones, PRB/RZ 2005, November 14-16, Antwerp, Belgium – ISBN 905857007x, pp. 84 - 88.

Devlin, J. F. and Allin, K .O., 2005. Major Anion Effects on the Kinetics and Reactivity of Granular Iron in Glass-Encased Magnet Batch Reactor Experiments. Environ. Sci. Technol., 39, pp. 1868-1874

ETI, 2005. Bench-Scale Treatability Report in Support of a Granular Iron Permeable Reactive Barrier Installation at the Harbor Drive Facility, San Diego, CA. March 2005**.**

Klausen, J.M., Vikesland, P.J., Kohn, T.M., Burris, D.R., Ball, W.P. and Roberts, A.L., 2003. Longevity of Granular Iron Groundwater Treatment Processes: Solution Composition Effects on Reduction of Organohalides and Nitroaromatic Compounds. Environ. Sci. Technol., 37(6), pp. 1208 - 1218.

Reardon, E.J., 1995. Anaerobic Corrosion of Granular Iron: Measurement and Interpretation of Hydrogen Evaluation Rates. Environ. Sci. Technol., Vol. 29, No. 12. pp. 2936-2945.

Szklarska-Smialowska, Z., 1991. Nucleation and Development of Pitting Corrosion in Iron and Steel. In: Flis, J. (Ed.), Corrosion of Metals and Hydrogen-Related Phenomena, Materials Science Monographs 59. Elsevier, Amsterdam, the Netherlands, pp. 9– 46.

DISCUSSION OF GROUNDWATER FLUSHING MODEL
FEASIBILITY STUDY SUPPORT
METAL ETCHING, FREEPORT, NEW YORK

Groundwater modeling has been performed to support the analysis of soil and groundwater remedial alternatives for the Feasibility Study (FS) at the Metal Etching Site located in Freeport, New York (the Site). The approach utilizes simplifying assumptions and the use of basic analytical models. To support the development of the FS remedial alternatives, solute travel periods, anticipated time to reach the maximum contaminant levels (MCLs) and flushing efficiency of the aquifer with respect to the contaminant plume have been calculated. Calculations are based under the assumption that the source of the contamination has been removed. The purpose of this section is to provide a summary of the methods utilized to generate the groundwater flushing model for the constituents of concern (COCs) at the Site, and a summary of the work performed is provided below.

Background Information

The groundwater investigation at the Site has revealed elevated levels of PCE, TCE, Cis-1,2-DCE, VC, benzene, toluene, ethylbenzene, and total Xylene (BTEX) compounds exceeding the NYSDEC TOGS criteria. Of the VOC compounds listed above, PCE has by far the highest concentration and will move the slowest in the aquifer (i.e, it is the most retarded). The PCE decay species (trichloroethene, cis-1,2-dichloroethene and vinyl chloride) can be ignored, as these chemicals are less retarded and therefore migrate at higher velocities. Benzene, toluene and total Xylene compounds will also travel at higher velocities than PCE. On that basis, worst case groundwater concentrations for PCE (groundwater sampling data from October 2004) and literature values that best suited site conditions were carried throughout calculations in the flushing model.

Several remedial alternatives in the FS were evaluated employing excavation and monitored natural attenuation of the groundwater plume. To support the FS alternatives an evaluation of the Site hyrdrogeologic conditions, contaminant concentrations, and factors affecting contaminant migration in groundwater have been evaluated and are presented in the paragraphs below and supported on the Flushing Model Work Sheet Table B-1.

PCE Plume and Hydrogeological Characteristics of the Site

Groundwater analytical data collected from soil borings and monitoring wells at the Site indicate that a PCE groundwater plume exists at the Site. The groundwater concentrations were plotted on a Site map and contoured using the

GISKey Krieging package. Based on the PCE groundwater plume, Figure 2-6 in the FS Report, a conservative estimation of the PCE plume dimensions were measured at; 95 feet wide; 200 feet long; and 35 feet deep (based on depth to top of "20 Foot Clay" the basal unit of the unconfined aquifer).

Groundwater elevation contour maps developed from the tidal influence study were also developed using the triangular integrated network (TIN) algorithm. The average groundwater elevation at the Site indicates a south-southeasterly flow direction from monitoring well cluster MW-02S&D toward the MW-07S&D cluster (see Figure 3-X in the RI Report). The groundwater gradient (change in potential head across the site) was calculated to be 0.0064 ft/ft.

Literature conductivity (K) values for the upper glacial aquifer have been measured on the order of 270 ft/day (Prince & Schnieder [1989] – Upper Glacial). Site specific conductivity data was not collected at the Site, therefore, the accepted literature values were used in the model. Typical porosity values for well sorted sands and/or gravels have been measured at 25 to 50 % and the bulk density of sand/gravel is 1.7g/cm^3. On Long Island, New York typically used porosity for sand is 25 % which was used in the model.

Additionally, the fraction of organic carbon (F_{oc}) in the soil was estimated at approximately 1%. Based on total organic carbon samples collected from the Freeport Creek averaging approximate 12,025 mg/kg, the estimated 1% (F_{oc}) is a conservative number for the Site setting.

Anticipated Time for PCE to Reach NYSDEC TOGS

The time for PCE to reach the MCLs in the aquifer upon removal of the soil source was calculated using an accepted literature value for half-life ($t_{1/2}$) of 270 days as published in Handbook of Environmental Degradation Rates, 1990. It is preferable to use Site specific half-life data for constituents; however, historic concentrations over time do not exist and as a result using linear regression method to calculate Site specific data was not possible. Once the half-life is obtained, the degradation rate (**k**) was calculated for PCE. The degradation rate (**$k = 0.693/ t_{1/2}$**) was calculated at 0.0026 days^{-1}. Using the degradation rate, the time anticipated for the compound to reach the NYSDEC TOGS value was calculated (**$time= - (\ln (C/C_0))/k$**). The time calculated to reach NYSDEC TOGS was 6.16 years, using an initial concentration (**C_0**) of 1,600 ug/l MW-07D and final concentration (**C**) of 5 ug/l for the NYSDEC TOGS criteria. See Table B-1 for the flushing model calculations.

Distance:
Prior to calculating the projected migration distance of the plume, the seepage velocity and retardation factor for PCE were calculated. The seepage velocity (**V_w**) as well as the retardation factor (**R_f**) were calculated using the values presented in the previous section. Seepage velocity is calculated by multiplying the conductivity (K) by the hydraulic gradient (i) and dividing through by the porosity (**V_w=K*i/n**). The calculated seepage velocity for the Site is 6.912 ft/day. The retardation factor (**R_f (compound) = 1 + ((bulk density/n) x K_d (compound)**) for PCE was calculated to be 19.836.

The contaminant transport rate for PCE (**V_s= V_w / R_f**) was ascertained and then used to calculate the total distance that the contaminant will travel over the duration of the time for PCE to reach MCLs. To calculate travel distance the contaminant transport rate was multiplied by time (previously calculated at 6.16 years) resulting in the distance that the constituent will travel. The total distance that PCE will travel over the course of 6.16 years is calculated to be 783.12 ft. According to the model PCE will migrate into the Freeport Creek.

Aquifer Flushing Efficiency

Darcy's Law was used to calculate the time to flush one pore volume of PCE contaminated groundwater through the area designated to be the width and depth of the PCE plume (width of 95 feet and depth of 35 feet). Darcy's Law is described as; **Q= K*i*A**, where (**Q**) is equal to the discharge (for the area of the PCE plume), (**K**) is the hydraulic conductivity of the aquifer, (i) is the hydraulic gradient of the aquifer and (**A**) is equal to the area of the plume. Therefore, the discharge (**Q**) through the designated area is 42,983 gal/day. If the entire volume of the PCE plume is calculated (LxWxD) and multiplied by the porosity of the formation then the pore volume of contaminated groundwater in the aquifer totals 1,243,636 gallons.

The estimated time to flush one pore volume through the designated discharge area is calculated by dividing the volume of the plume in gallons by the calculated discharge (Q) from above. The result equals 28.93 days to flush one pore volume through the designated area.

A published table from HMCRI In Situ Bioremediation Short Course (December 5, 1991), calculates the fraction of contaminants remaining after flushing 1, 3, 5, 25 and 75 pore volumes of water through an aquifer. The reference table indicates that 75 pore volumes will flush nearly 100%PCE from the aquifer (flushing efficiency for PCE). Thus by multiplying the 28.93 days for one pore volume flush by 75 pore volumes, a time of 5.95 years is obtained to reach near

100% removal of the PCE in the aquifer. This value nearly matches the time to reach MCL's calculated from the degradation rate for PCE of 6.16 years.

Sensitivity Analysis

Site variables such as porosity, conductivity, fraction of organic carbon and the soil bulk density affect contaminant travel time and ultimately the flushing efficiency times. Potential ranges in Site variables can alter the outcomes of these basic and generalized analytical models. Thus, a sensitivity analysis has been performed on those variables most prone to changeability.

Porosity:
By increasing the porosity of the formation by 10% the following parameters were altered:

- Seepage velocity (V_w) decreased from 6.912 to 4.94 ft/day;
- The retardation factor decreased from 19.84 to 14.45;
- The volume of the plume increased from 1,243,636 gallons to 1,741,091 gallons;
- Time duration for one flushing pore volume increased from 28.93 to 40.51 and the 75 flushing pore volumes increased from 5.95 years to 8.32 years.

Conductivity:
By decreasing the conductivity of the aquifer to 200 ft/day the following parameters were altered:

- Seepage velocity (V_w) decreased from 6.912 to 5.12 ft/day;
- Q decreased from 42,983 gal/day to 31,839 gal/day;
- The retardation factor was unchanged;
- The volume of the plume was unchanged;
- Time duration for one flushing pore volume increased from 28.93 to 39.06 and the 75 flushing pore volumes increased from 5.95 years to 8.03 years.

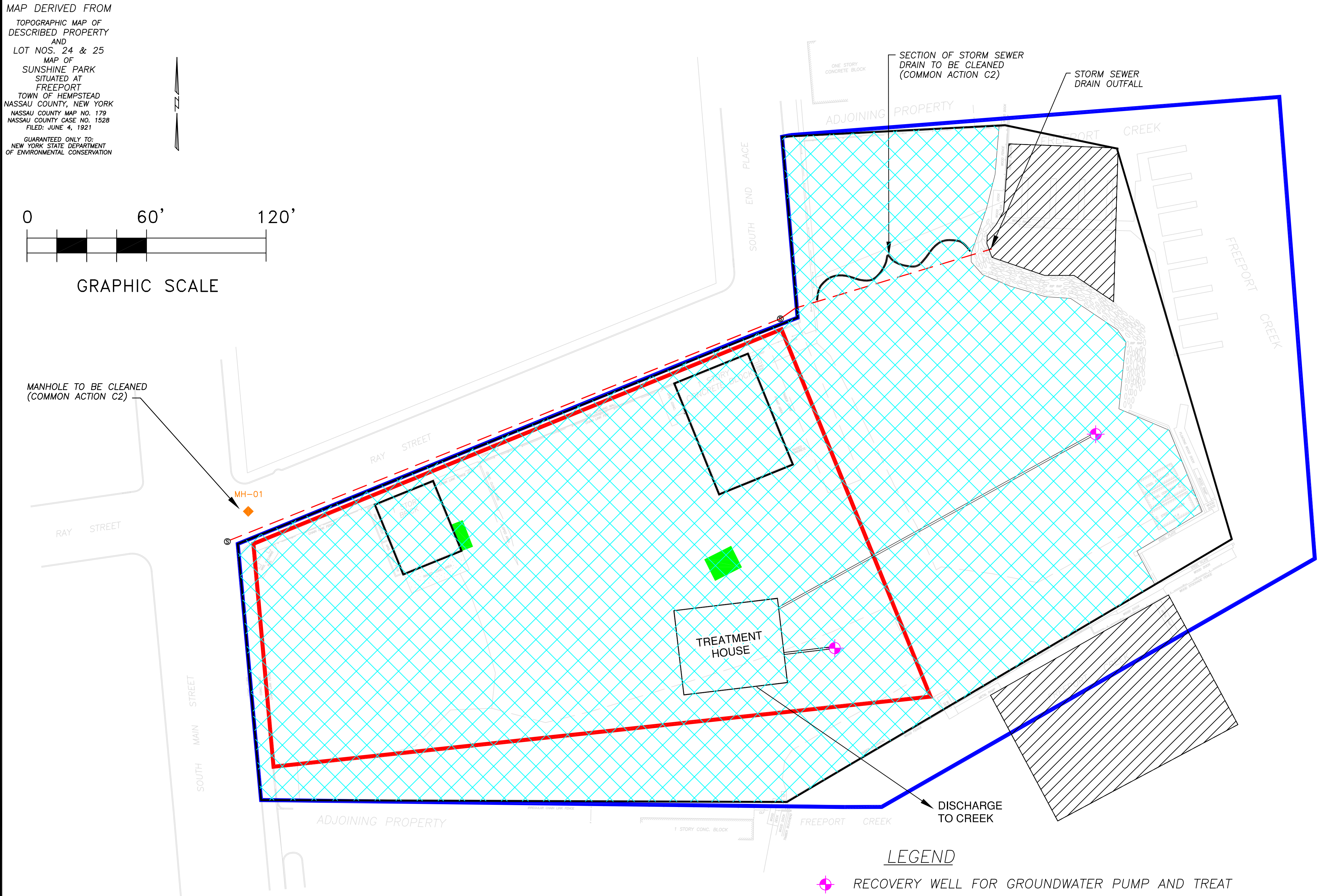
Fraction of Organic Carbon:
By increasing the F_{oc} of the formation 5% the following parameters were altered:

- Seepage velocity (V_w) was unchanged;
- The retardation factor increased from 19.84 to 95.18;
- The volume of the plume was unchanged;
- Time duration for the flushing pore volumes was unchanged.

Bulk Density of the formation:
By decreasing the bulk density of the formation to 1.5 g/cm^3 the following parameters were altered:

- Seepage velocity (V_w) was unchanged;
- The retardation factor decreased from 19.84 to 17.62;

- The volume of the plume was unchanged;
- Time duration for the flushing pore volumes was unchanged.



LEGEND

- RECOVERY WELL FOR GROUNDWATER PUMP AND TREAT
- STUDY AREA
- SITE
- STORM SEWER DRAIN
- PIPING FOR GROUNDWATER EXTRACTION
- AREA OF SEDIMENT REMOVAL (MAY CHANGE BASED ON PRE-DESIGN STUDIES)
- POTENTIAL UST TO BE REMOVED (COMMON ACTION C3)
- EXCAVATION OF SOILS TO 14' BELOW GRADE EXCEEDING VOC AND METALS SCGs
- BUILDING TO BE DEMOLISHED

NOTE:

1. THE NEED FOR SUB-SLAB DEPRESSURIZATION (COMMON ACTION C1) FOR NEW BUILDINGS CONSTRUCTED POST-REMEDIATION WOULD BE EVALUATED THROUGH SOIL GAS SAMPING FOLLOWING REMEDIAL ACTION IMPLEMENTATION.

2. ENVIRONMENTAL EASEMENT (COMMON ACTION C4) WOULD BE IMPLEMENTED TO RESTRICT GROUNDWATER USE.

TITLE

ALTERNATIVE P8: FULL SCALE SOIL EXCAVATION, GROUNDWATER PUMP AND TREAT, AND SEDIMENT REMOVAL METAL ETCHING SITE FREEPORT, NEW YORK

PREPARED FOR

NYSDEC

ERM Environmental Resources Management

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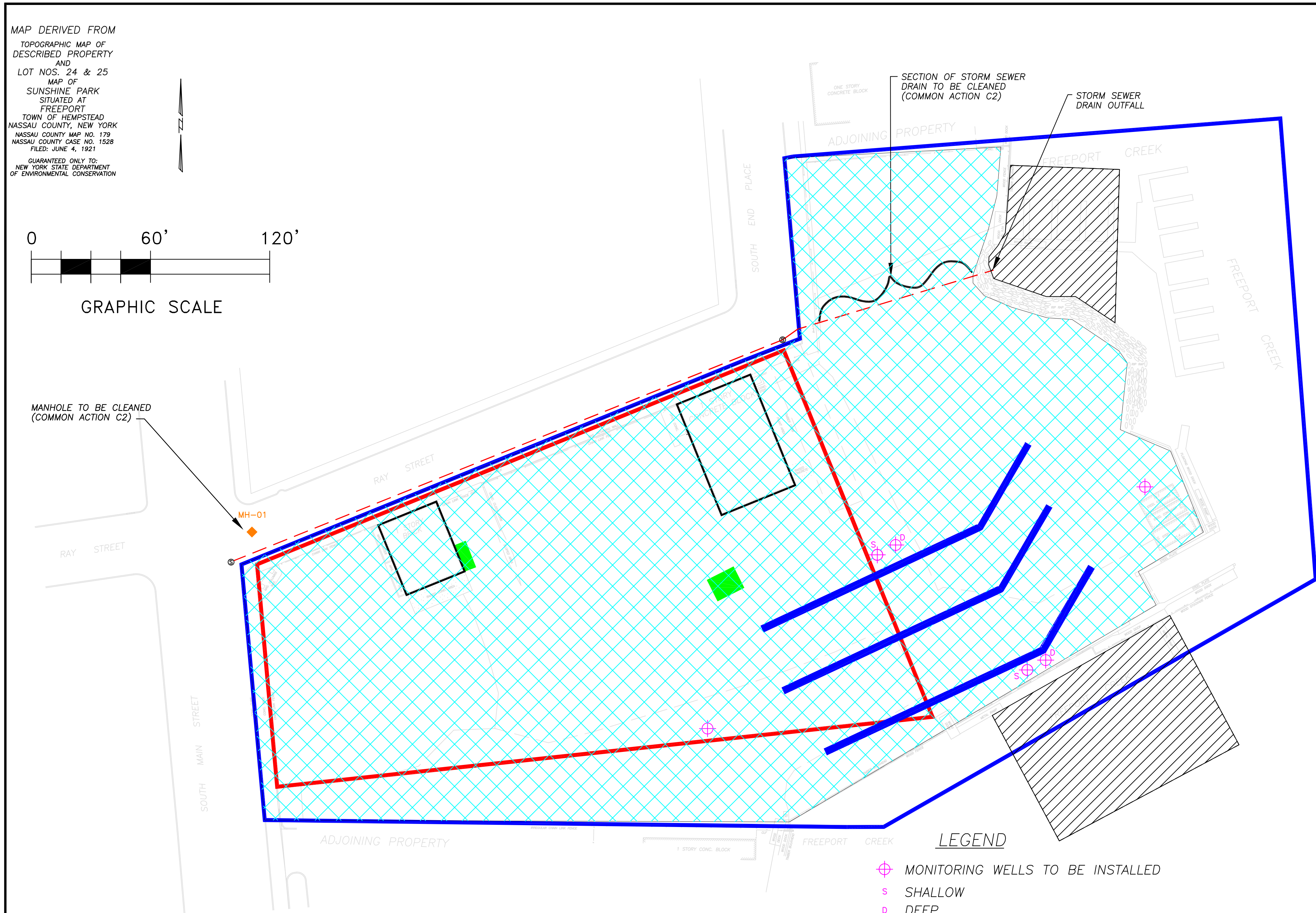
MFM/EMF	0011475	0011475-01-055	GRAPHIC / 11/1/06	3-8



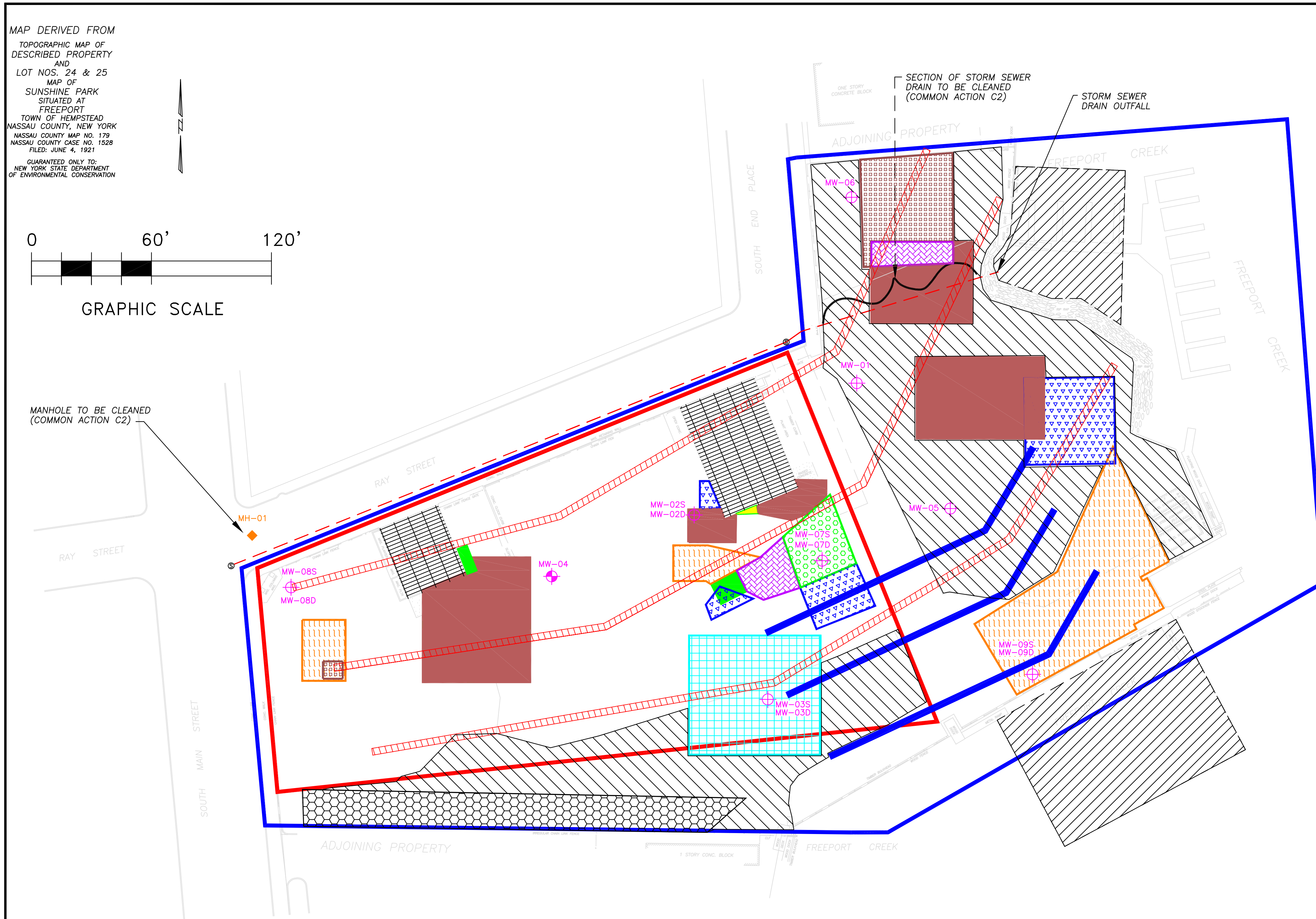
LEGEND

- MONITORING WELLS TO BE INSTALLED
- S SHALLOW
- D DEEP
- STUDY AREA
- SITE
- STORM SEWER DRAIN
- AREA OF SEDIMENT REMOVAL (MAY CHANGE BASED ON PRE-DESIGN STUDIES)
- POTENTIAL UST TO BE REMOVED (COMMON ACTION C3)
- EXCAVATION OF SOILS EXCEEDING VOC AND METALS SCGs TO 14' BELOW GRADE
- BUILDING TO BE DEMOLISHED PRIOR TO SOIL EXCAVATION
- ZERO VALENT IRON WALL

NOTE:

1. THE NEED FOR SUB-SLAB DEPRESSURIZATION (COMMON ACTION C1) FOR NEW BUILDINGS CONSTRUCTED POST-REMEDIATION WOULD BE EVALUATED THROUGH SOIL GAS SAMPING FOLLOWING REMEDIAL ACTION IMPLEMENTATION.
2. ENVIRONMENTAL EASEMENT (COMMON ACTION C4) WOULD BE IMPLEMENTED TO RESTRICT GROUNDWATER USE.

TITLE	ALTERNATIVE P7 AND VI: FULL SCALE SOIL EXCAVATION, ZVI WALL AND SEDIMENT REMOVAL METAL ETCHING SITE FREEPORT, NEW YORK
PREPARED FOR	NYSDEC
ERM Environmental Resources Management	SCALE: GRAPHIC; DATE: 11/1/06; FIGURE: 3-7
DRAWN: MFM/EMF	JOB NO.: 0011475; FILE NAME: 0011475-01-054



LEGEND

- STUDY AREA
- SITE
- STORM SEWER DRAIN
- AREA OF SEDIMENT REMOVAL (MAY CHANGE BASED ON PRE-DESIGN STUDIES)
- MW-08S / MW-08D — MONITORING WELLS TO BE INSTALLED, TO BE MONITORED FOR 30 YEARS FOR MONITORED NATURAL ATTENUATION (MNA)
- MW-05 — EXISTING MONITORING WELLS TO BE MONITORED FOR 30 YEARS FOR MNA
- POTENTIAL UST TO BE REMOVED (COMMON ACTION C3)
- SUB-SLAB DEPRESSURIZATION BENEATH SITE BUILDINGS (COMMON ACTION C1)
- HOT SPOT EXCAVATION 0 TO 1 FEET BELOW GRADE
- HOT SPOT EXCAVATION 0 TO 4 FEET BELOW GRADE
- HOT SPOT EXCAVATION 0 TO 14 FEET BELOW GRADE
- HOT SPOT EXCAVATION 0 TO 9 FEET BELOW GRADE
- HOT SPOT EXCAVATION 0 TO 6 INCHES AND 4 TO 9 FEET BELOW GRADE
- HOT SPOT EXCAVATION 0 TO 6 INCHES AND 4 TO 14 FEET BELOW GRADE
- HOT SPOT EXCAVATION 0 TO 1 FEET BELOW GRADE AND 4 TO 9 FEET BELOW GRADE
- HOT SPOT EXCAVATION 0 TO 1 FEET BELOW GRADE AND 4 TO 9 FEET BELOW GRADE
- REMOVAL OF UNCAPPED SOILS 0 TO 6 INCHES BELOW GRADE
- INSTALL ASPHALT OR BALLAST COVER OVER CURRENTLY EXPOSED SOILS TO BE MAINTAINED THROUGH SITE MANAGEMENT PLAN AS PART OF ENVIRONMENTAL EASEMENT[1]
- PIPING FOR SOIL VAPOR EXTRACTION SYSTEM
- ZERO VALENT IRON WALL

NOTE:

1. REFER TO FIGURE 2-1 FOR SURFACE COVERS TO BE MAINTAINED THROUGH SITE MANAGEMENT PLAN AS PART OF ENVIRONMENTAL EASEMENT (COMMON ACTION C4)

TITLE

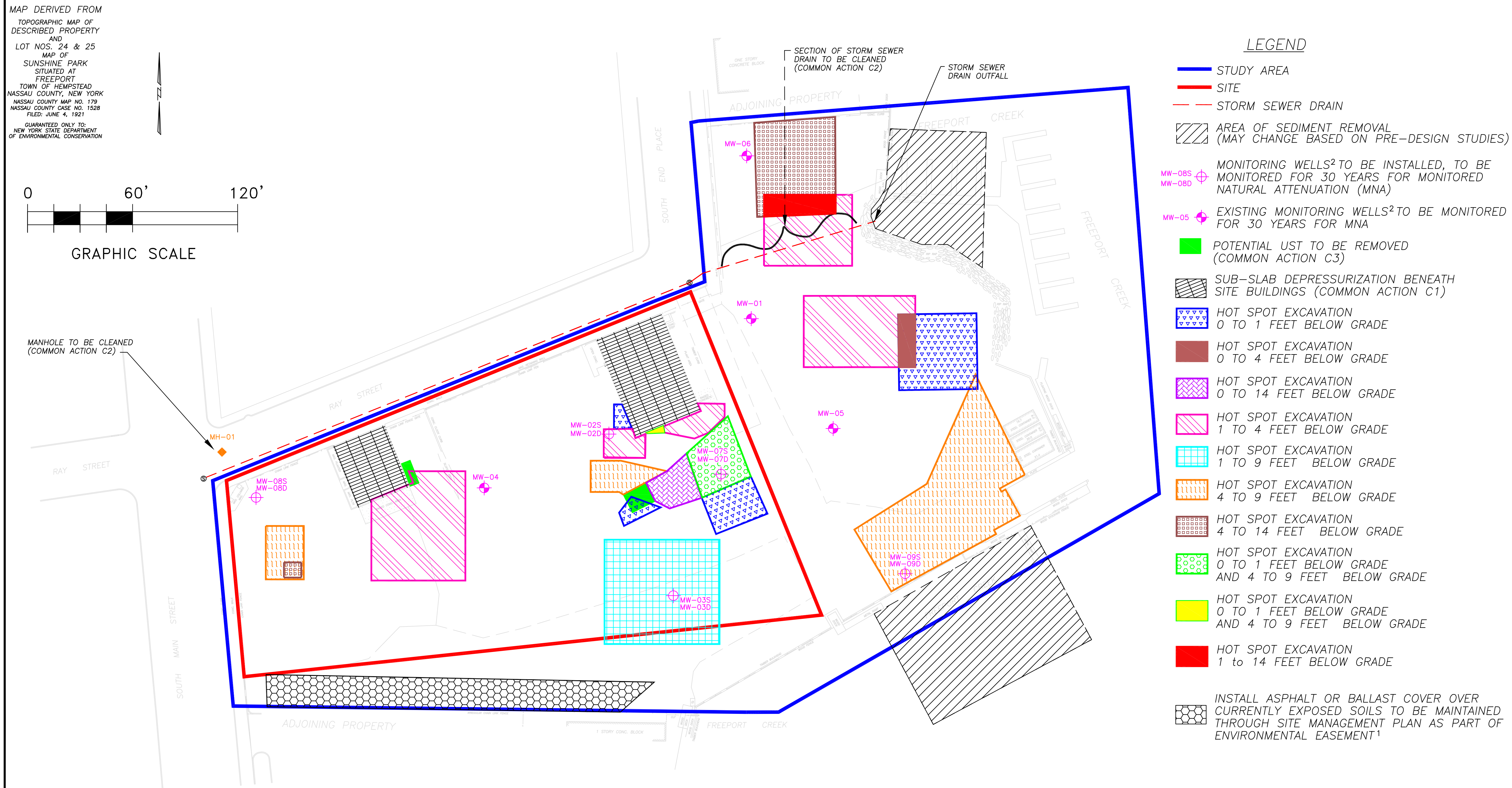
ALTERNATIVE P6 & V:
HOT SPOT SOIL EXCAVATION AND SURFACE COVER, REMOVAL OF UNCAPPED SOIL, ZVI WALL, SVE, AND SEDIMENT REMOVAL
METAL ETCHING SITE
FREEPORT, NEW YORK

PREPARED FOR

NYSDEC

ERM Environmental Resources Management

DRAWN:	JOB NO.:	FILE NAME:	SCALE	FIGURE
MFM/EMF	0011475	0011475-01-053	GRAPHIC	3-6
			DATE: 11/1/06	



NOTE:

1. REFER TO FIGURE 2-1 FOR SURFACE COVERS TO BE MAINTAINED THROUGH SITE MANAGEMENT PLAN AS PART OF ENVIRONMENTAL EASEMENT (COMMON ACTION C4)
2. BIOLOGICAL ENHANCEMENTS TO BE INJECTED INTO GROUNDWATER MONITORING WELLS.

TITLE	ALTERNATIVE P5: HOT SPOT SOIL EXCAVATION AND SURFACE COVER GROUNDWATER MNA WITH BIOLOGICAL ENHAMCEMENTS, AND SEDIMENT REMOVAL METAL ETCHING SITE FREEPORT, NEW YORK
PREPARED FOR	NYSDEC
ERM Environmental Resources Management	
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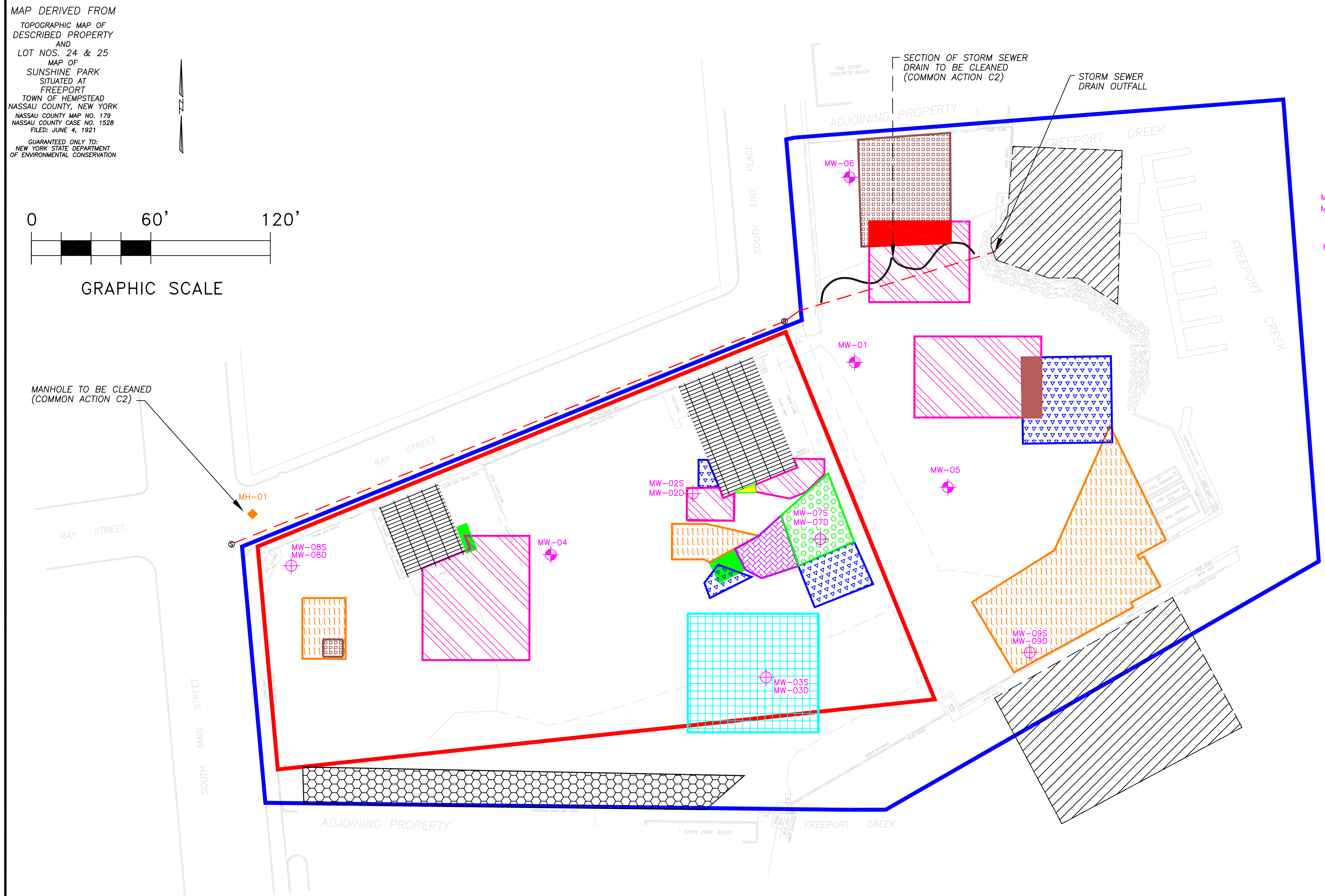
FILE NAME: 0011475-01-052	SCALE: GRAPHIC
DATE: 11/1/06	FIGURE: 3-5



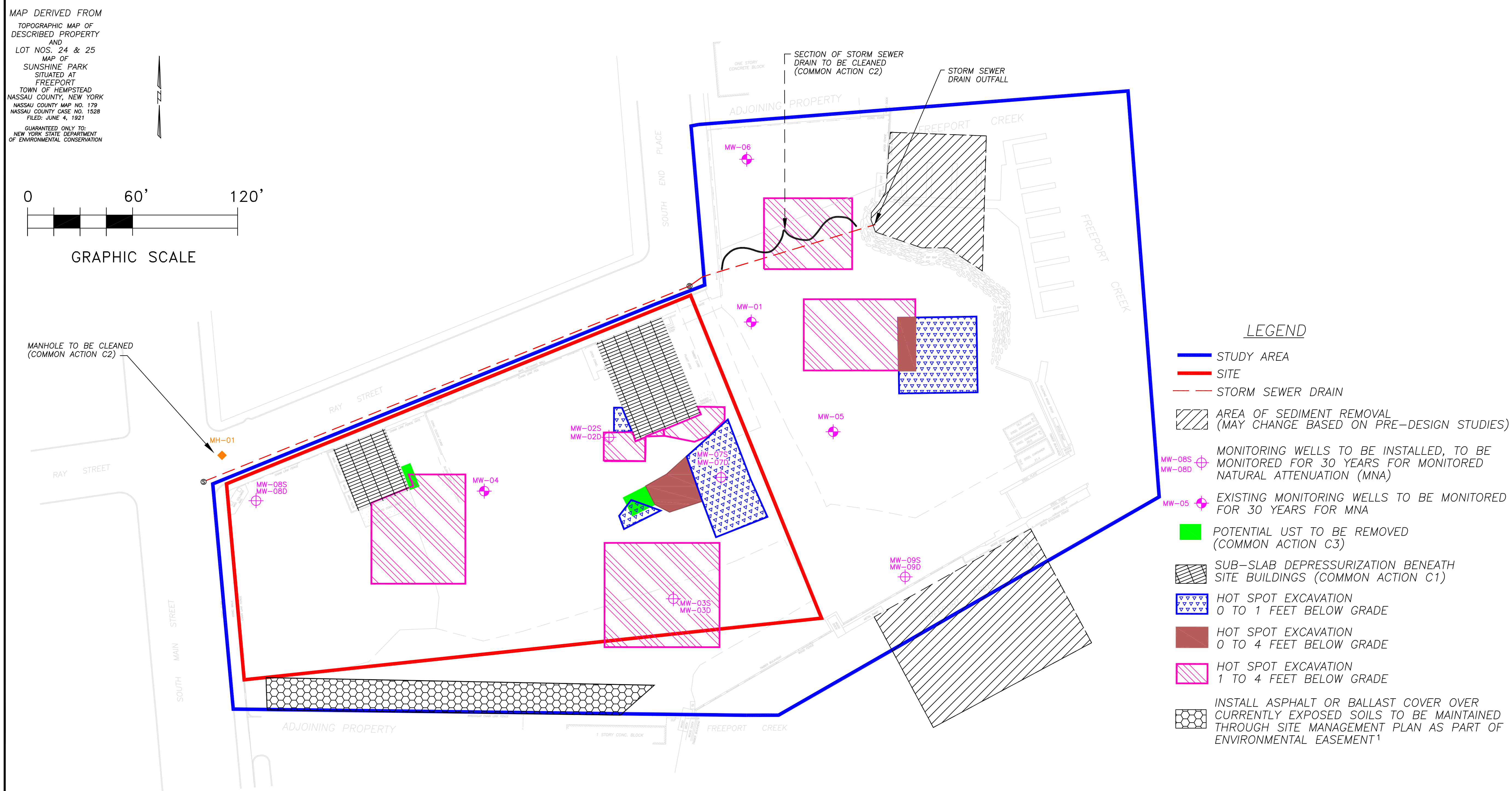
LEGEND

- STUDY AREA
- SITE
- STORM SEWER DRAIN
- AREA OF SEDIMENT REMOVAL (MAY CHANGE BASED ON PRE-DESIGN STUDIES)
- MW-08S / MW-08D — MONITORING WELLS TO BE INSTALLED, TO BE MONITORED FOR 30 YEARS FOR MONITORED NATURAL ATTENUATION (MNA)
- MW-05 — EXISTING MONITORING WELLS TO BE MONITORED FOR 30 YEARS FOR MNA
- POTENTIAL UST TO BE REMOVED (COMMON ACTION C3)
- SUB-SLAB DEPRESSURIZATION BENEATH SITE BUILDINGS (COMMON ACTION C1)
- HOT SPOT EXCAVATION 0 TO 1 FEET BELOW GRADE
- HOT SPOT EXCAVATION 0 TO 4 FEET BELOW GRADE
- HOT SPOT EXCAVATION 0 TO 14 FEET BELOW GRADE
- HOT SPOT EXCAVATION 1 TO 4 FEET BELOW GRADE
- HOT SPOT EXCAVATION 1 TO 9 FEET[1] BELOW GRADE
- HOT SPOT EXCAVATION 4 TO 9 FEET[1] BELOW GRADE
- HOT SPOT EXCAVATION 4 TO 14 FEET[1] BELOW GRADE
- HOT SPOT EXCAVATION 0 TO 1 FEET BELOW GRADE AND 4 TO 9 FEET[1] BELOW GRADE
- HOT SPOT EXCAVATION 0 TO 1 FEET BELOW GRADE AND 4 TO 9 FEET[1] BELOW GRADE
- HOT SPOT EXCAVATION 1 to 14 FEET[1] BELOW GRADE
- INSTALL ASPHALT OR BALLAST COVER OVER CURRENTLY EXPOSED SOILS TO BE MAINTAINED THROUGH SITE MANAGEMENT PLAN AS PART OF ENVIRONMENTAL EASEMENT[2]

NOTE:

1. HOT SPOT EXCAVATION INTERVALS DEEPER THAN 4 FEET BELOW GRADE ARE TO BE BACKFILLED WITH CLEAN FILL AND ZERO VALENT IRON MIXTURE.
2. REFER TO FIGURE 2-1 FOR SURFACE COVERS TO BE MAINTAINED THROUGH SITE MANAGEMENT PLAN AS PART OF ENVIRONMENTAL EASEMENT (COMMON ACTION C4)

TITLE	ALTERNATIVE P4 AND IV: HOT SPOT SOIL EXCAVATION, SURFACE COVER GROUNDWATER MNA AND SEDIMENT REMOVAL METAL ETCHING SITE FREEPORT, NEW YORK
PREPARED FOR	NYSDEC
ERM Environmental Resources Management	SCALE: GRAPHIC
DRAWN: MFM/EMF	JOB NO.: 0011475
FILE NAME: 0011475-01-039	DATE: 11/1/06
FIGURE	3-4



NOTE:

1. REFER TO FIGURE 2-1 FOR SURFACE COVERS TO BE MAINTAINED THROUGH SITE MANAGEMENT PLAN AS PART OF ENVIRONMENTAL EASEMENT (COMMON ACTION C4)

TITLE

ALTERNATIVE P3 AND III:
HOT SPOT SOIL EXCAVATION TO THE WATER TABLE AND SURFACE COVER, GROUNDWATER MNA AND SEDIMENT REMOVAL
METAL ETCHING SITE
FREEPORT, NEW YORK

PREPARED FOR

NYSDEC

ERM Environmental Resources Management

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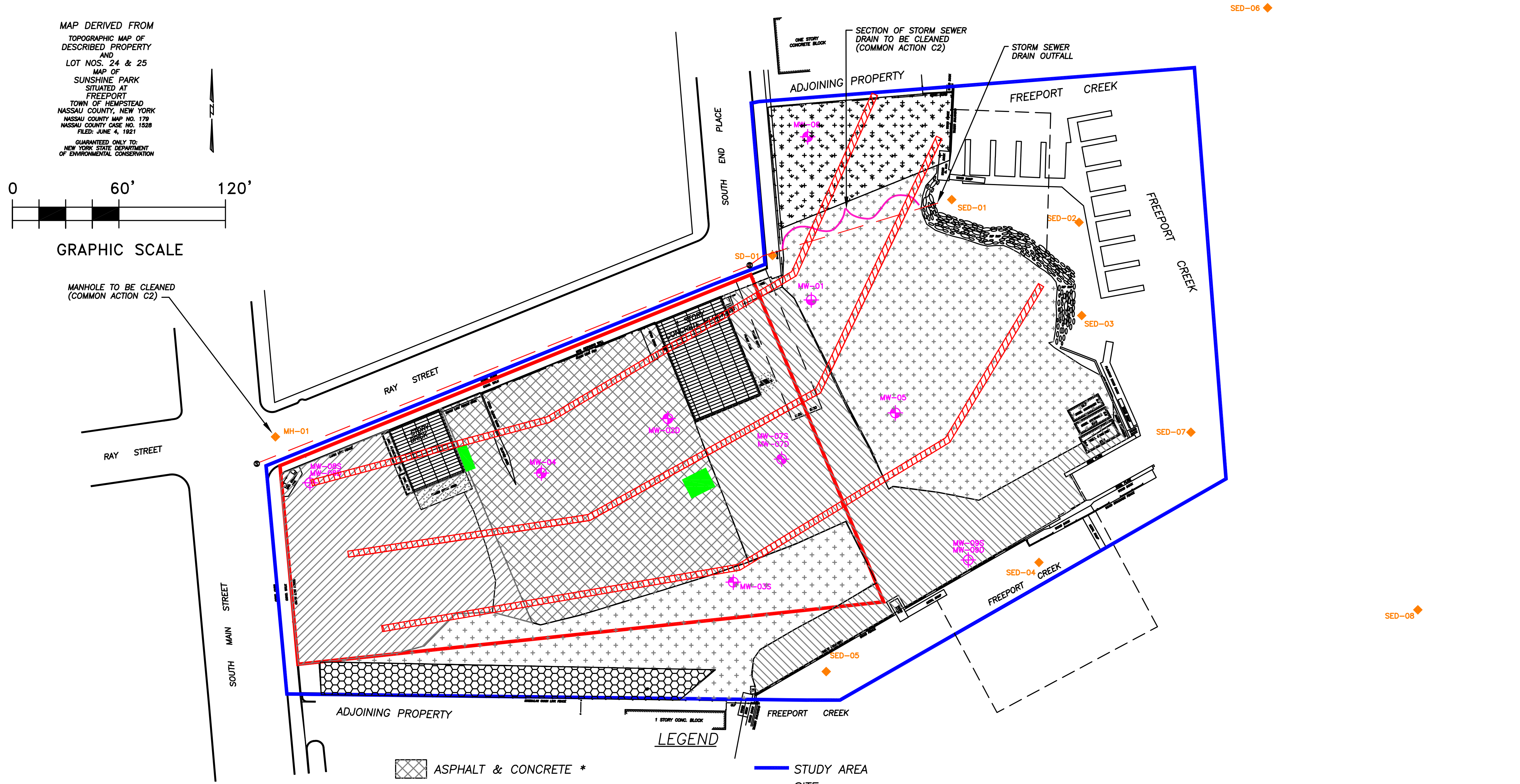


LEGEND

- ASPHALT & CONCRETE *
- ASPHALT *
- CONCRETE *
- GRAVEL *
- INSTALL ASPHALT OR BALLAST COVER OVER CURRENTLY EXPOSED SOILS *
- GRAVEL, SOIL & WEEDS *
- SUB-SLAB DEPRESSURIZATIN BENEATH SITE BUILDINGS (COMMON ACTION C1)
- STUDY AREA
- SITE
- STORM SEWER DRAIN
- AREA OF IMPACTED SEDIMENT TO BE MONITORED THROUGH MONITORED NATURAL RECOVERY (MNR) (MAY CHANGE BASED ON PRE-DESIGN STUDIES)
- SED-08 SEDIMENT SAMPLE
- MW-08S MW-08D MONITORING WELLS TO BE INSTALLED, TO BE MONITORED FOR 30 YEARS FOR MONITORED NATURAL ATTENUATION (MNA)
- MW-07S MW-07D EXISTING MONITORING WELLS TO BE MONITORED FOR 30 YEARS FOR MONITORED NATURAL ATTENUATION (MNA)
- POTENTIAL UST TO BE REMOVED (COMMON ACTION C3)
- PIPING FOR SOIL VAPOR EXTRACTION SYSTEM

NOTE:

* TO BE MAINTAINED THROUGH SITE MANAGEMENT PLAN AS PART OF ENVIROMENTAL EASEMENT (COMMON ACTION C4)

TITLE

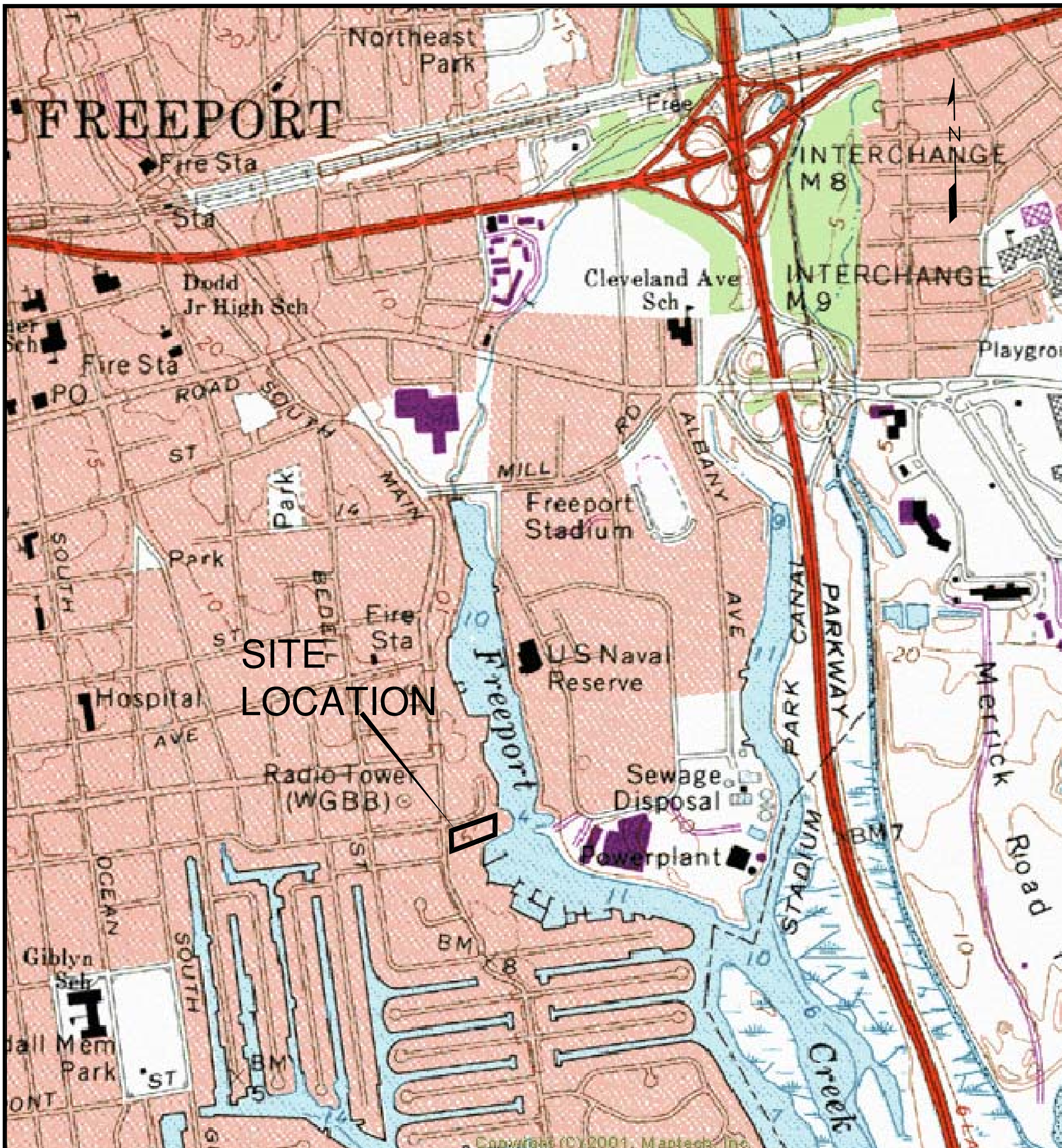
ALTERNATIVE P2 AND II: SOIL COVER, GROUNDWATER MNA, SVE, AND SEDIMENT MNR METAL ETCHING SITE FREEPORT, NEW YORK

PREPARED FOR

NYSDEC

ERM Environmental Resources Management

DRAWN:	JOB NO.:	FILE NAME:	SCALE	FIGURE
MFM/EMF	0011475	0011475-01-038	GRAPHIC	3-2
			DATE: 11/1/06	



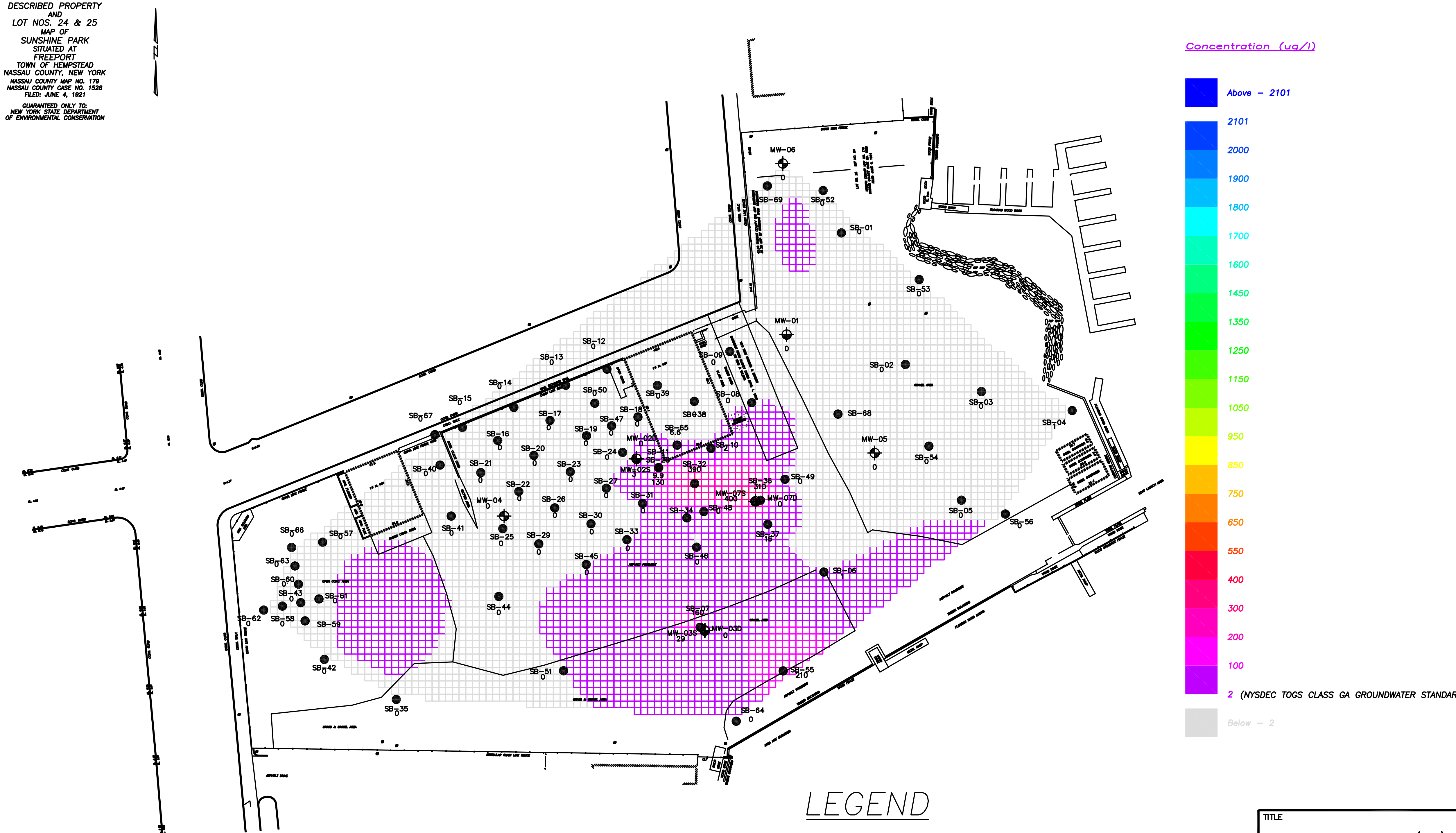
0 1000 2000

GRAPHIC SCALE IN FEET

SOURCE: USGS QUADRANGLE MAP, FREEPORT, NY, 1979

TITLE				
SITE LOCATION MAP METAL ETCHING FREEPORT, NEW YORK				
PREPARED FOR NYSDEC				
ERM Environmental Resources Management			SCALE GRAPHIC	FIGURE 1-1
DRAWN: MFM	JOB NO.: 0011475	FILE NAME: 0011475.004a	DATE 12/06/04	

MAP DERIVED FROM
TOPOGRAPHIC MAP OF
DESCRIBED PROPERTY
AND
LOT NOS. 24 & 25
MAP OF
SUNSHINE PARK
SITUATED AT
FREEPORT
TOWN OF HEMPSTEAD
NASSAU COUNTY, NEW YORK
NASSAU COUNTY MAP NO. 179
NASSAU COUNTY CASE NO. 1526
FILED: JUNE 4, 1921
GUARANTEED ONLY TO:
NEW YORK STATE DEPARTMENT
OF ENVIRONMENTAL CONSERVATION



LEGEND

SB-06 0 ● Soil Boring Location
Concentration of VC in groundwater in ug/L

MW-07D 400 ⌖ Monitoring Well Location
Concentration of VC in groundwater in ug/L

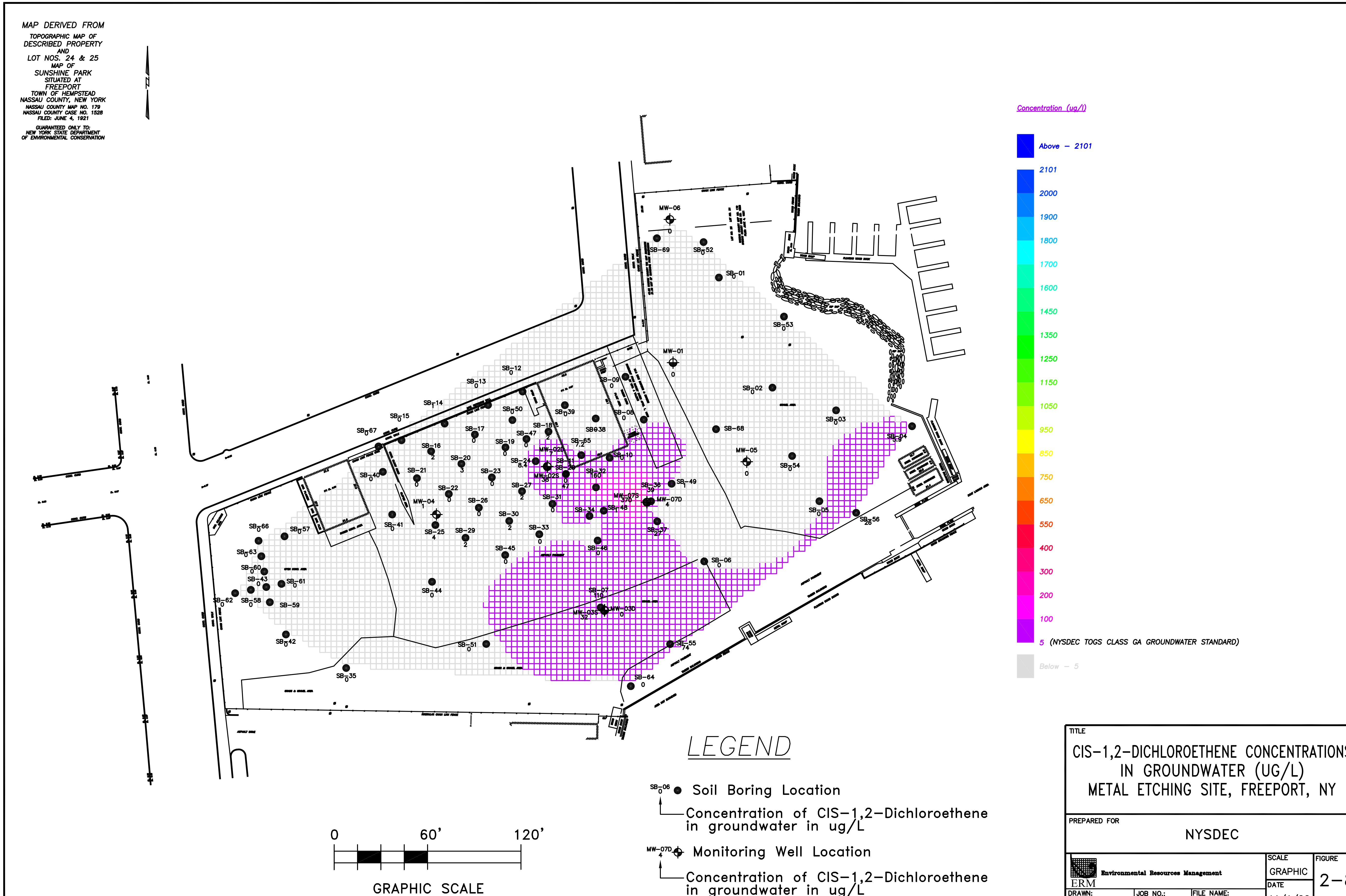
0 60' 120'
GRAPHIC SCALE

TITLE
VINYL CHLORIDE (VC) CONCENTRATIONS
IN GROUNDWATER (UG/L)
METAL ETCHING SITE, FREEPORT, NY

PREPARED FOR
NYSDEC

ERM Environmental Resources Management

DRAWN:	JOB NO.:	FILE NAME:	SCALE	FIGURE
MFM/EMF	0011475	0011475-00-046	GRAPHIC	2-9
			DATE 11/1/06	



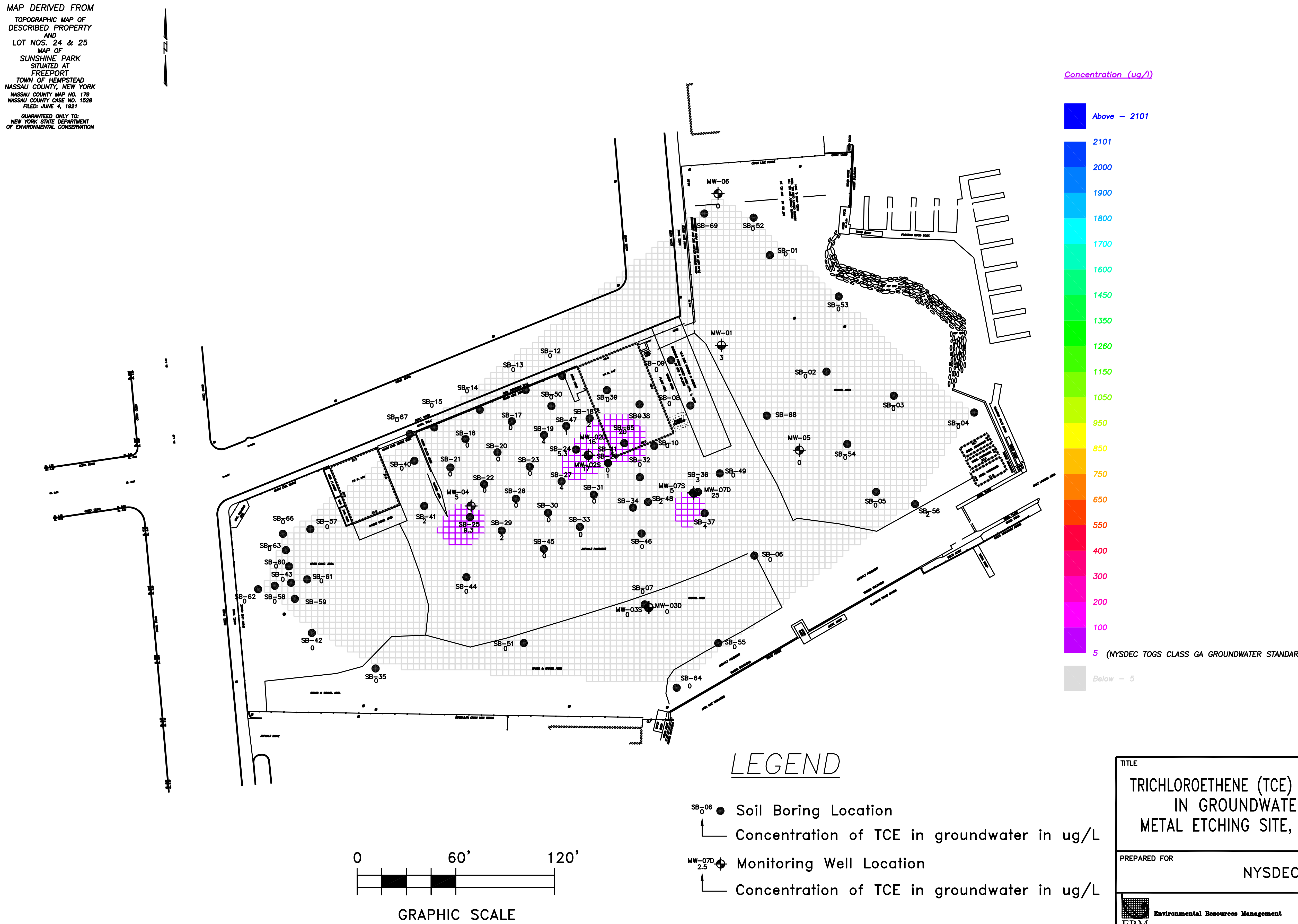
TITLE

CIS-1,2-DICHLOROETHENE CONCENTRATIONS IN GROUNDWATER (UG/L)
METAL ETCHING SITE, FREEPORT, NY

PREPARED FOR

NYSDEC

ERM Environmental Resources Management			SCALE GRAPHIC	FIGURE 2-8
DRAWN: MFM/EMF	JOB NO.: 0011475	FILE NAME: 0011475-00-045	DATE 11/1/06	



TITLE

TRICHLOROETHENE (TCE) CONCENTRATIONS IN GROUNDWATER (UG/L)
METAL ETCHING SITE, FREEPORT, NY

PREPARED FOR

NYSDEC

ERM Environmental Resources Management

DRAWN:	JOB NO.:	FILE NAME:	SCALE / DATE	FIGURE
MFM/EMF	0011475	0011475-00-044	GRAPHIC / 11/1/06	2-7

Concentrations (ug/l)

- Above – 2101
- 2101
- 2000
- 1900
- 1800
- 1700
- 1600
- 1450
- 1350
- 1250
- 1150
- 1050
- 950
- 850
- 750
- 650
- 550
- 400
- 300
- 200
- 100
- 5 (NYSDEC TOGS CLASS GA GROUNDWATER STANDARD)
- Below – 5

LEGEND

SB-06 (0) ● Soil Boring Location

└ Concentration of PCE in groundwater in ug/L

MW-07D (1600) ⊕ Monitoring Well Location

└ Concentration of PCE in groundwater in ug/L

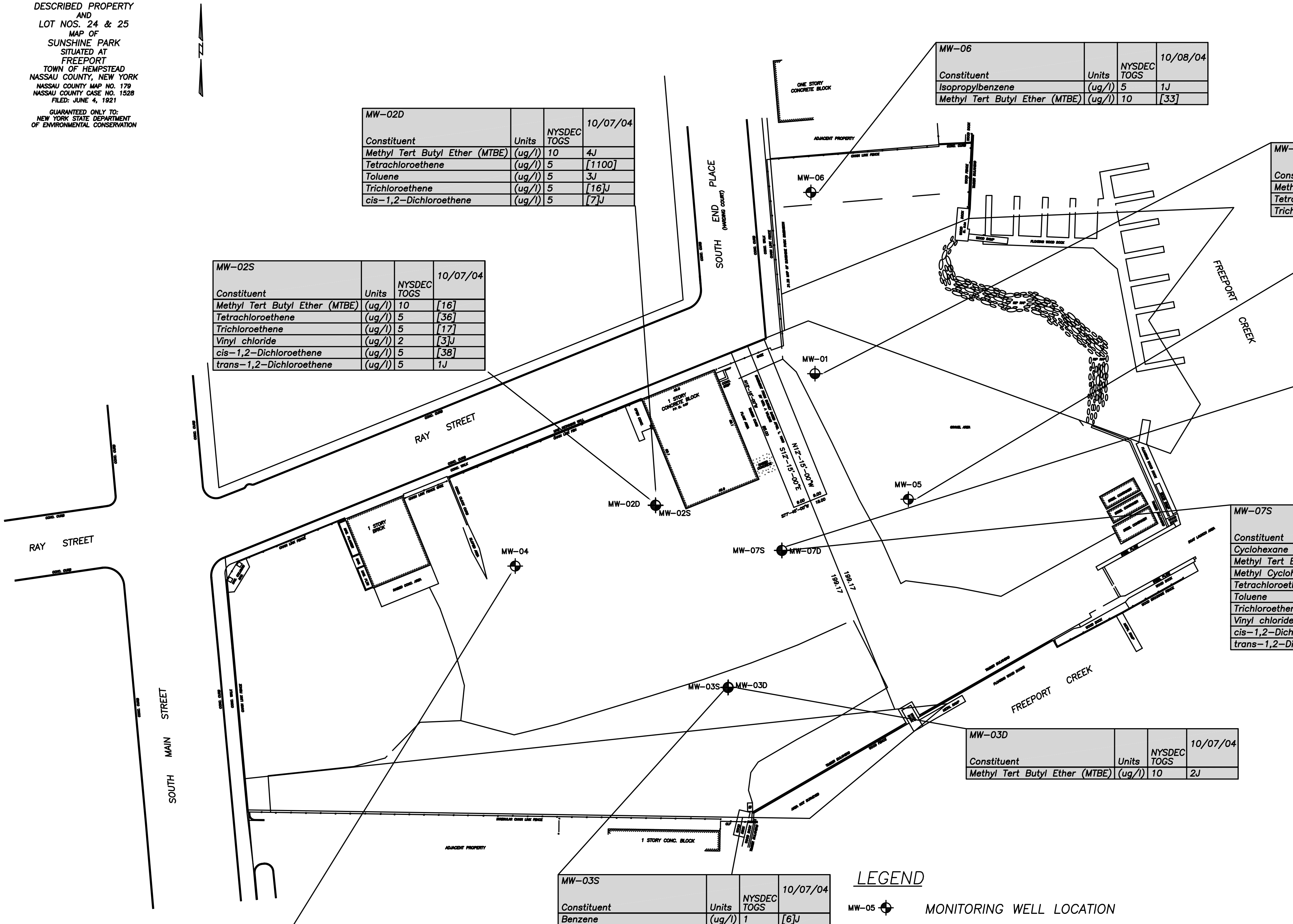
0 60' 120'

GRAPHIC SCALE

TITLE: TETRACHLORETHENE (PCE) CONCENTRATIONS IN GROUNDWATER (UG/L) METAL ETCHING SITE, FREEPORT, NY			
PREPARED FOR: NYSDEC			
ERM Environmental Resources Management		SCALE: GRAPHIC DATE: 11/1/06	FIGURE: 2-6
DRAWN: MFM/EMF	JOB NO.: 0011475	FILE NAME: 0011475-00-043	

MAP DERIVED FROM
TOPOGRAPHIC MAP OF
DESCRIBED PROPERTY
AND
LOT NOS. 24 & 25
MAP OF
SUNSHINE PARK
SITUATED AT
FREEPORT
TOWN OF HEMPSTEAD
NASSAU COUNTY, NEW YORK
NASSAU COUNTY MAP NO. 179
NASSAU COUNTY CASE NO. 1528
FILED: JUNE 4, 1921

GUARANTEED ONLY TO:
NEW YORK STATE DEPARTMENT
OF ENVIRONMENTAL CONSERVATION



MW-06			10/08/04
Constituent	Units	NYSDEC TOGS	
Isopropylbenzene	(ug/l)	5	1J
Methyl Tert Butyl Ether (MTBE)	(ug/l)	10	[33]

MW-02D			10/07/04
Constituent	Units	NYSDEC TOGS	
Methyl Tert Butyl Ether (MTBE)	(ug/l)	10	4J
Tetrachloroethene	(ug/l)	5	[1100]
Toluene	(ug/l)	5	3J
Trichloroethene	(ug/l)	5	[16]J
cis-1,2-Dichloroethene	(ug/l)	5	[7]J

MW-01			10/08/04
Constituent	Units	NYSDEC TOGS	
Methyl Tert Butyl Ether (MTBE)	(ug/l)	10	4J
Tetrachloroethene	(ug/l)	5	[13]
Trichloroethene	(ug/l)	5	3J

MW-02S			10/07/04
Constituent	Units	NYSDEC TOGS	
Methyl Tert Butyl Ether (MTBE)	(ug/l)	10	[16]
Tetrachloroethene	(ug/l)	5	[36]
Trichloroethene	(ug/l)	5	[17]
Vinyl chloride	(ug/l)	2	[3]J
cis-1,2-Dichloroethene	(ug/l)	5	[38]
trans-1,2-Dichloroethene	(ug/l)	5	1J

MW-05			10/08/04
Constituent	Units	NYSDEC TOGS	
Cyclohexane	(ug/l)		2J
Isopropylbenzene	(ug/l)	5	2J
Methyl Tert Butyl Ether (MTBE)	(ug/l)	10	[54]

MW-07D			10/07/04
Constituent	Units	NYSDEC TOGS	
Tetrachloroethene	(ug/l)	5	[1600]
Trichloroethene	(ug/l)	5	[25]J
cis-1,2-Dichloroethene	(ug/l)	5	4J

MW-07S			10/07/04
Constituent	Units	NYSDEC TOGS	
Cyclohexane	(ug/l)		4J
Methyl Tert Butyl Ether (MTBE)	(ug/l)	10	[10]J
Methyl Cyclohexane	(ug/l)		8J
Tetrachloroethene	(ug/l)	5	3J
Toluene	(ug/l)	5	2J
Trichloroethene	(ug/l)	5	[5]J
Vinyl chloride	(ug/l)	2	[400]
cis-1,2-Dichloroethene	(ug/l)	5	[370]
trans-1,2-Dichloroethene	(ug/l)	5	3J

MW-03D			10/07/04
Constituent	Units	NYSDEC TOGS	
Methyl Tert Butyl Ether (MTBE)	(ug/l)	10	2J

MW-03S			10/07/04
Constituent	Units	NYSDEC TOGS	
Benzene	(ug/l)	1	[6]J
Chlorobenzene	(ug/l)	5	1J
Cyclohexane	(ug/l)		1J
Methyl Tert Butyl Ether (MTBE)	(ug/l)	10	[130]
Methyl Cyclohexane	(ug/l)		2J
Vinyl chloride	(ug/l)	2	[29]
cis-1,2-Dichloroethene	(ug/l)	5	[32]

MW-04			10/08/04
Constituent	Units	NYSDEC TOGS	
Methyl Tert Butyl Ether (MTBE)	(ug/l)	10	[140]
Tetrachloroethene	(ug/l)	5	3J
Trichloroethene	(ug/l)	5	[5]J
cis-1,2-Dichloroethene	(ug/l)	5	1J

LEGEND

MW-05 ⊕ MONITORING WELL LOCATION

[ ] DETECTED GROUNDWATER CONCENTRATION IS ABOVE NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION (NYSDEC) TECHNICAL AND OPERATIONAL GUIDANCE SERIES 111 (TOGS) CLASS GA GROUNDWATER STANDARD

J ESTIMATED VALUE

0 60' 120'

GRAPHIC SCALE

TITLE

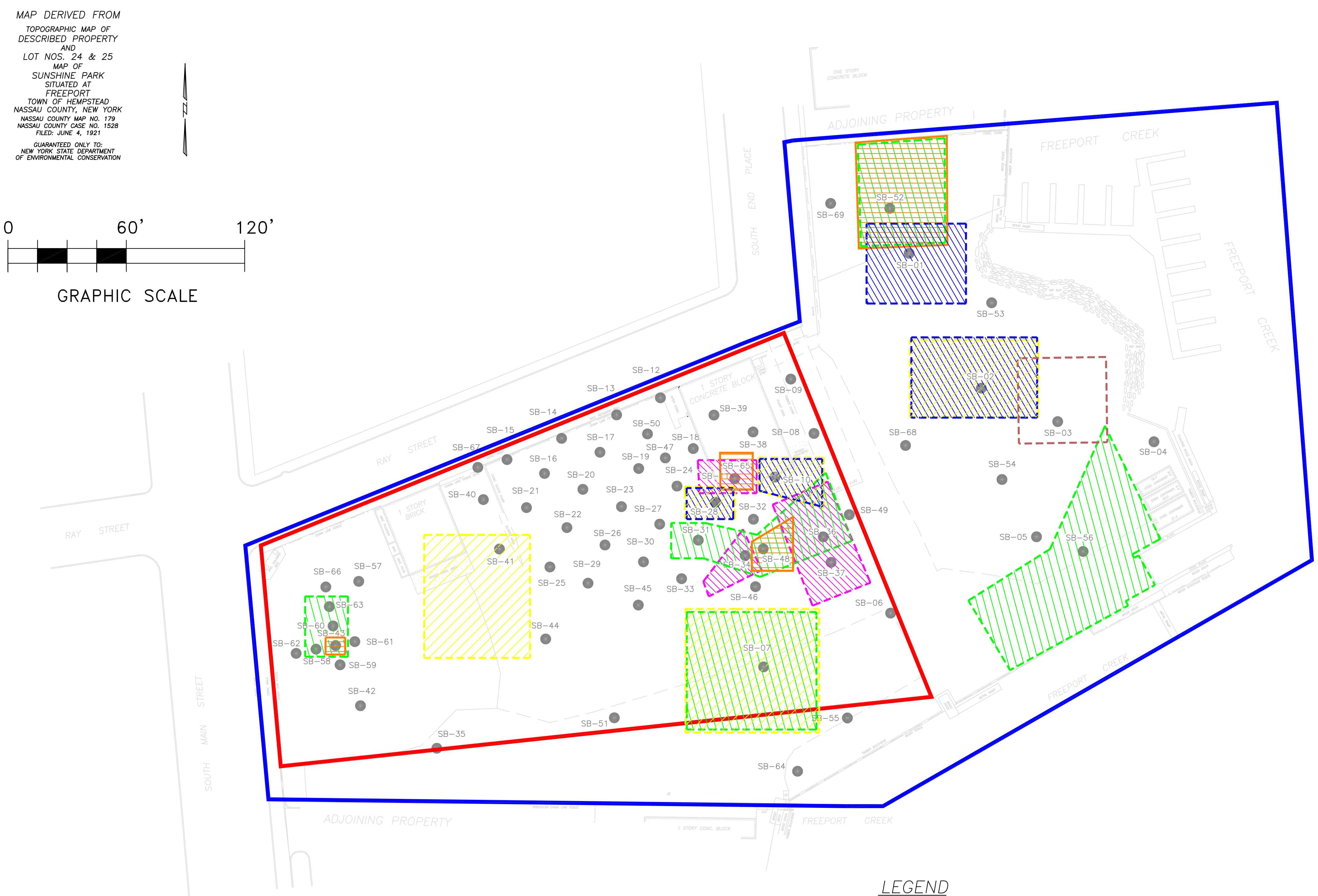
VOC DETECTIONS AND EXCEEDENCES IN GROUNDWATER AVOVE TOGS CRITERIA METAL ETCHING SITE, FREEPORT, NY

PREPARED FOR

NYSDEC

ERM Environmental Resources Management

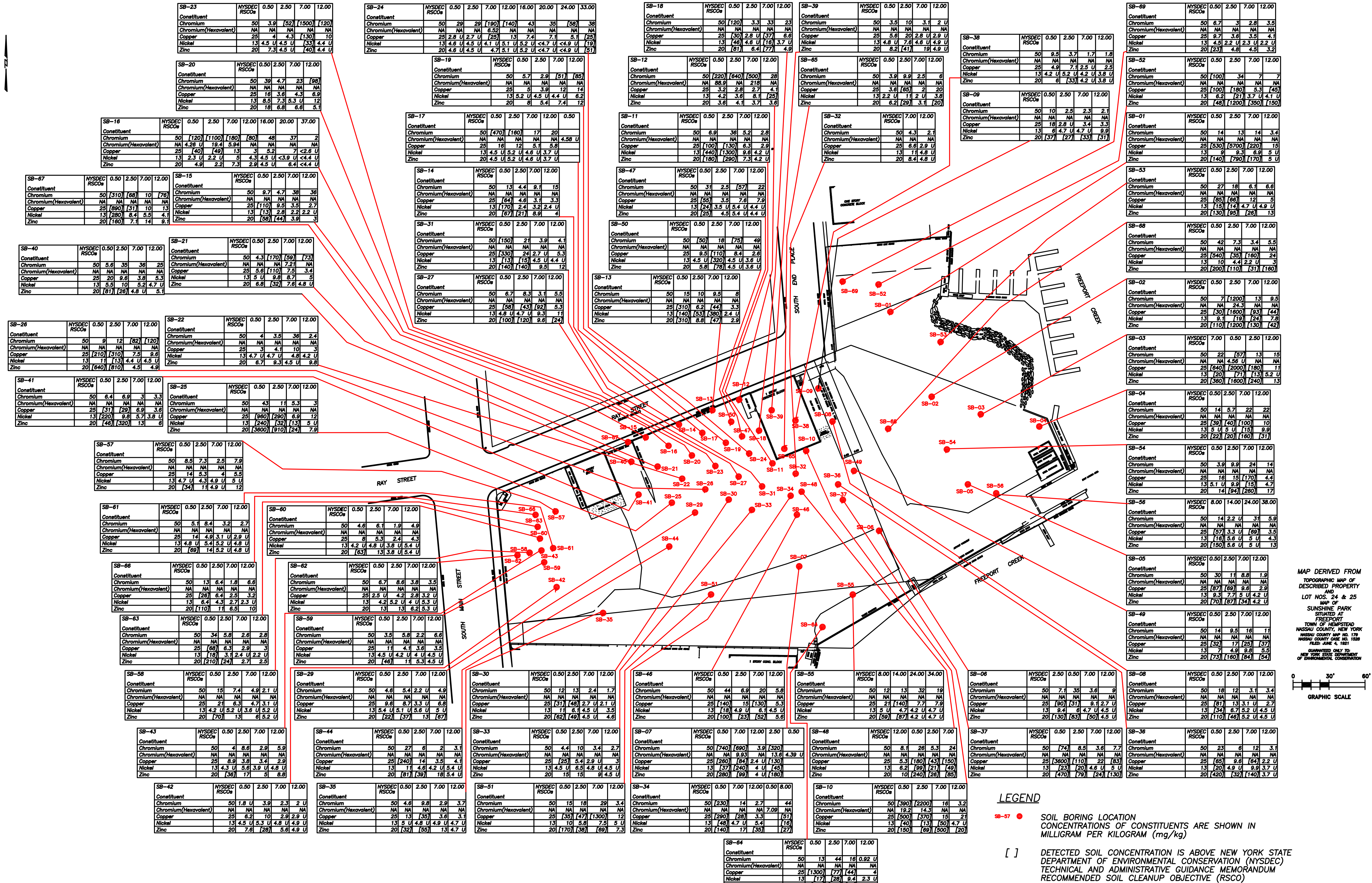
DRAWN: MFM/EMF	JOB NO.: 0011475	FILE NAME: 0011475-00-041	SCALE GRAPHIC / DATE 10/23/06	FIGURE 2-5



LEGEND

- SB-64 SOIL BORING
- STUDY AREA
- SITE
- SOIL EXCEEDING VOC SCGs FROM 0–1' BELOW GRADE (2,653 FT^2)
- SOIL EXCEEDING VOC SCGs FROM 1'–4' BELOW GRADE (11,267 FT^2)
- SOIL EXCEEDING VOC SCGs FROM 4'–9' BELOW GRADE (14,069 FT^2)
- SOIL EXCEEDING VOC SCGs FROM 9'–14' BELOW GRADE (3,323 FT^2)
- HOT SPOT SOIL FOR INORGANICS FROM 0–1' BELOW GRADE (1,938 FT^2)
- HOT SPOT SOIL FOR INORGANICS FROM 1'–4' BELOW GRADE (5,646 FT^2)

TITLE	HOT SPOT SOIL FOR INORGANICS AND SOIL EXCEEDING VOC TAGM RSCOs METAL ETCHING SITE FREEPORT, NEW YORK
PREPARED FOR	NYSDEC
ERM Environmental Resources Management	SCALE: GRAPHIC; FIGURE: 2–4
DRAWN: MFM/EMF; JOB NO.: 0011475; FILE NAME: 0011475-01-024	DATE: 10/25/06



MAP DERIVED FROM TOPOGRAPHIC MAP OF DESCRIBED PROPERTY AND LOT NOS. 24 & 25 MAP OF SUNSHINE PARK SITUATED AT FREEPORT TOWN OF HEMPSTEAD NASSAU COUNTY, NEW YORK NASSAU COUNTY MAP NO. 179 NASSAU COUNTY CASE NO. 1328 FILED JUNE 4, 1921 GUARANTEED ONLY TO: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

0 30' 60'
GRAPHIC SCALE

LEGEND

SB-57 ●	SOIL BORING LOCATION CONCENTRATIONS OF CONSTITUENTS ARE SHOWN IN MILLIGRAM PER KILOGRAM (mg/kg)
[ ]	DETECTED SOIL CONCENTRATION IS ABOVE NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION (NYSDEC) TECHNICAL AND ADMINISTRATIVE GUIDANCE MEMORANDUM RECOMMENDED SOIL CLEANUP OBJECTIVE (RSCO)
U	NOT DETECTED AT INDICATED DETECTION LIMIT

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

NYSDEC

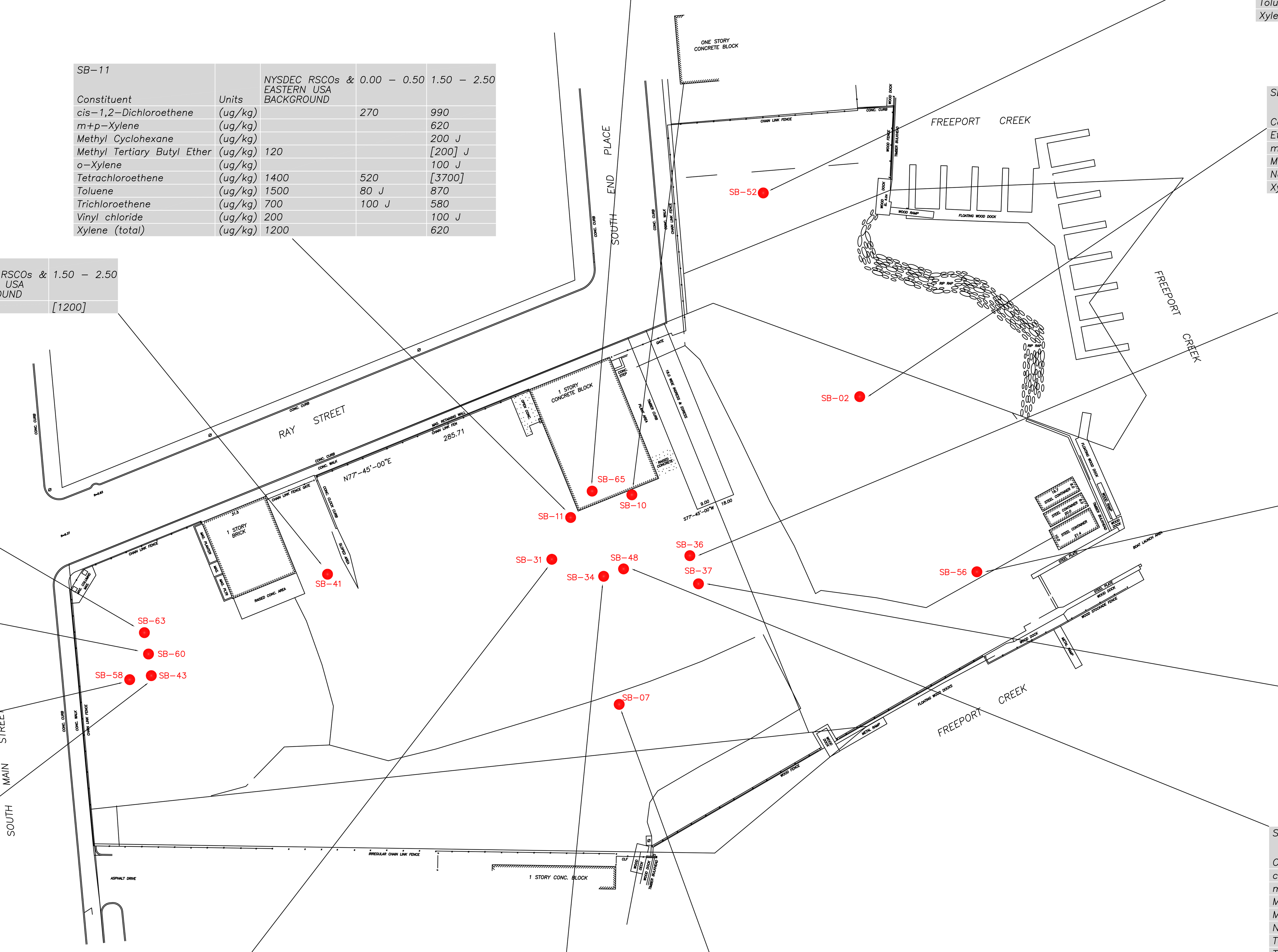
ERM Environmental Resources Management

CHECKED	
DESIGN ENGINEER	
PROJECT ENGINEER	
PROJECT MANAGER	
APPROVED	

METALS DETECTIONS IN SOIL ABOVE TAGM RSCO
METAL ETCHING SITE NO. 1-30-110
FREEPORT, NEW YORK

DRAWN	MFM/EMF	DATE	10/24/06
SCALE	GRAPHIC	JOB NO.	0011475.2
REVISED DATE		FILE NAME	0011475-00-040

DRAWING NO. 2-3
REV. NO.
SHEET OF



SB-65 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	0.00 – 0.50	1.50 – 2.50	11.00 – 12.00
cis-1,2-Dichloroethene	(ug/kg)		1700		200 J
Tetrachloroethene	(ug/kg)	1400	200 J		
Trichloroethene	(ug/kg)	700	[10000]	100 J	[1100]

SB-10 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	0.00 – 0.50	1.50 – 2.50	6.00 – 7.00
cis-1,2-Dichloroethene	(ug/kg)		70 J	200 J	70 J
Methyl Cyclohexane	(ug/kg)		200 J		
Tetrachloroethene	(ug/kg)	1400		200 J	
Toluene	(ug/kg)	1500	60 J		90 J
Trichloroethene	(ug/kg)	700	100 J	[1700]	

SB-52 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	6.00 – 7.00	11.00 – 12.00
Ethylbenzene	(ug/kg)	5500	5200	1500
m+p-Xylene	(ug/kg)		3000	1400
Methyl Cyclohexane	(ug/kg)		42000	21000
Naphthalene	(ug/kg)	13000	6700	2800
o-Xylene	(ug/kg)		1000	290
Toluene	(ug/kg)	1500	360	80 J
Xylene (total)	(ug/kg)	1200	[4000]	[1700]

SB-11 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	0.00 – 0.50	1.50 – 2.50
cis-1,2-Dichloroethene	(ug/kg)		270	990
m+p-Xylene	(ug/kg)			620
Methyl Cyclohexane	(ug/kg)			200 J
Methyl Tertiary Butyl Ether	(ug/kg)	120		[200] J
o-Xylene	(ug/kg)			100 J
Tetrachloroethene	(ug/kg)	1400	520	[3700]
Toluene	(ug/kg)	1500	80 J	870
Trichloroethene	(ug/kg)	700	100 J	580
Vinyl chloride	(ug/kg)	200		100 J
Xylene (total)	(ug/kg)	1200		620

SB-02 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	0.00 – 0.50	1.50 – 2.50	6.00 – 7.00	11.00 – 12.00
Ethylbenzene	(ug/kg)	5500		1600	200 J	
m+p-Xylene	(ug/kg)			2000	60 J	
Methyl Cyclohexane	(ug/kg)		1400	54000 J	42000 J	590
Naphthalene	(ug/kg)	13000		1200	3800	350
Xylene (total)	(ug/kg)	1200		[2000]	60 J	

SB-41 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	1.50 – 2.50
Trichloroethene	(ug/kg)	700	[1200]

SB-36 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	0.00 – 0.50	1.50 – 2.50	6.00 – 7.00	11.00 – 12.00
cis-1,2-Dichloroethene	(ug/kg)		470	200 J	300	
Methyl Cyclohexane	(ug/kg)		27000	750	420	250
Tetrachloroethene	(ug/kg)	1400	80 J		100 J	
Toluene	(ug/kg)	1500	[2800]			
Trichloroethene	(ug/kg)	700	560		[1000]	

SB-63 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	0.00 – 0.50	1.50 – 2.50	6.00 – 7.00	11.00 – 12.00
Ethylbenzene	(ug/kg)	5500			1600	
m+p-Xylene	(ug/kg)				2600	
Methyl Cyclohexane	(ug/kg)				970	
Naphthalene	(ug/kg)	13000	200 J	80 J	[19000]	1600
o-Xylene	(ug/kg)				480	
Xylene (total)	(ug/kg)	1200			[3100]	

SB-60 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	6.00 – 7.00	11.00 – 12.00
Ethylbenzene	(ug/kg)	5500	3600	80 J
m+p-Xylene	(ug/kg)		9100	200 J
Methyl Cyclohexane	(ug/kg)		1300	
Naphthalene	(ug/kg)	13000	[25000]	4500
o-Xylene	(ug/kg)		1400	
Xylene (total)	(ug/kg)	1200	[11000]	200 J

SB-56 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	4.00 – 8.00	10.00 – 14.00	20.00 – 24.00
1,4-Dichlorobenzene	(ug/kg)	8500	4800	200 J	
Chlorobenzene	(ug/kg)	1700	[3700]	90 J	
Ethylbenzene	(ug/kg)	5500	[14000]	280	
m+p-Xylene	(ug/kg)		15000	320	
Methyl Cyclohexane	(ug/kg)		34000	950	
Naphthalene	(ug/kg)	13000	11000	1200	60 J
o-Xylene	(ug/kg)		470		
Toluene	(ug/kg)	1500	270		
Xylene (total)	(ug/kg)	1200	[15000]	320	

SB-58 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	6.00 – 7.00	11.00 – 12.00
Ethylbenzene	(ug/kg)	5500	420	
m+p-Xylene	(ug/kg)		2000	
Methyl Cyclohexane	(ug/kg)		100 J	
Naphthalene	(ug/kg)	13000	10000	1300
o-Xylene	(ug/kg)		2000	
Xylene (total)	(ug/kg)	1200	[4000]	

SB-37 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	0.00 – 0.50	1.50 – 2.50	6.00 – 7.00	11.00 – 12.00
cis-1,2-Dichloroethene	(ug/kg)		12000	300 J	100 J	100 J
Methyl Cyclohexane	(ug/kg)		200 J	200 J	100 J	100 J
Tetrachloroethene	(ug/kg)	1400	[4300]	200 J	100 J	100 J
Trichloroethene	(ug/kg)	700	[2700]	80 J		70 J
Vinyl chloride	(ug/kg)	200	[1800]			

SB-43 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	6.00 – 7.00	11.00 – 12.00
Ethylbenzene	(ug/kg)	5500	1600	680
m+p-Xylene	(ug/kg)		1700	810
Methyl Cyclohexane	(ug/kg)		370	200 J
Naphthalene	(ug/kg)	13000	[22000]	[16000]
o-Xylene	(ug/kg)		680	370
Xylene (total)	(ug/kg)	1200	[2400]	[1200]

SB-48 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	11.00 – 12.00	0.00 – 0.50	1.50 – 2.50	6.00 – 7.00
cis-1,2-Dichloroethene	(ug/kg)		60 J			70 J
m+p-Xylene	(ug/kg)					80 J
Methyl Cyclohexane	(ug/kg)		1100	200 J	1000	740
Methyl Tertiary Butyl Ether	(ug/kg)	120	[450]		60 J	
Naphthalene	(ug/kg)	13000	100 J		200 J	640
Tetrachloroethene	(ug/kg)	1400				200 J
Toluene	(ug/kg)	1500				60 J
Trichloroethene	(ug/kg)	700	200 J		80 J	[730]
Xylene (total)	(ug/kg)	1200				80 J

SB-31 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	0.00 – 0.50	1.50 – 2.50	6.00 – 7.00	11.00 – 12.00
Methyl Cyclohexane	(ug/kg)				100 J	
Methyl Tertiary Butyl Ether	(ug/kg)	120			[280]	70 J
Tetrachloroethene	(ug/kg)	1400	710			60 J
Toluene	(ug/kg)	1500		60 J		70 J

SB-07 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	0.00 – 0.50	6.00 – 7.00	11.00 – 12.00	1.50 – 2.50
Benzene	(ug/kg)	60		[480]		[1400]
Ethylbenzene	(ug/kg)	5500		70 J		200 J
m+p-Xylene	(ug/kg)		80 J	370		1000
Methyl Cyclohexane	(ug/kg)		1700			170000 J
Naphthalene	(ug/kg)	13000	200 J	2600	310	8300
o-Xylene	(ug/kg)			100 J		100 J
Toluene	(ug/kg)	1500		350		1100
Xylene (total)	(ug/kg)	1200	80 J	370		1000

SB-34 Constituent	Units	NYSDEC RSCOs & EASTERN USA BACKGROUND	0.00 – 0.50	6.00 – 7.00	11.00 – 12.00	7.00 – 8.00
Ethylbenzene	(ug/kg)	5500		200 J		200 J
m+p-Xylene	(ug/kg)			410		470
Methyl Cyclohexane	(ug/kg)		17000	170000	4200	350000
Methyl Tertiary Butyl Ether	(ug/kg)	120	[370]	[1500]		
Naphthalene	(ug/kg)	13000	370	1300		680
Toluene	(ug/kg)	1500	100 J	[35000]	200 J	[78000]
Xylene (total)	(ug/kg)	1200		410		470

LEGEND

SB-63 ● SOIL BORING LOCATION WITH VOLATILE ORGANIC COMPOUND CONCENTRATIONS ABOVE NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION (NYSDEC) TECHNICAL AND ADMINISTRATIVE GUIDANCE MEMORANDUM (TAGM) #4046 RECOMMENDED SOIL CLEANUP OBJECTIVE (RSCO)

[ ] DETECTED SOIL CONCENTRATION IS ABOVE NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION (NYSDEC) TECHNICAL AND ADMINISTRATIVE GUIDANCE MEMORANDUM (TAGM) #4046 RECOMMENDED SOIL CLEANUP OBJECTIVE (RSCO)

J ESTIMATED VALUE

MAP DERIVED FROM
TOPOGRAPHIC MAP OF DESCRIBED PROPERTY AND LOT NOS. 24 & 25 MAP OF SUNSHINE PARK SITUATED AT FREEPORT TOWN OF HEMPSTEAD NASSAU COUNTY, NEW YORK
NASSAU COUNTY MAP NO. 179
NASSAU COUNTY CASE NO. 1528
FILED: JUNE 4, 1921
GUARANTEED ONLY TO: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

0 30' 60'
GRAPHIC SCALE

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

NYSDEC

Environmental Resources Management
ERM

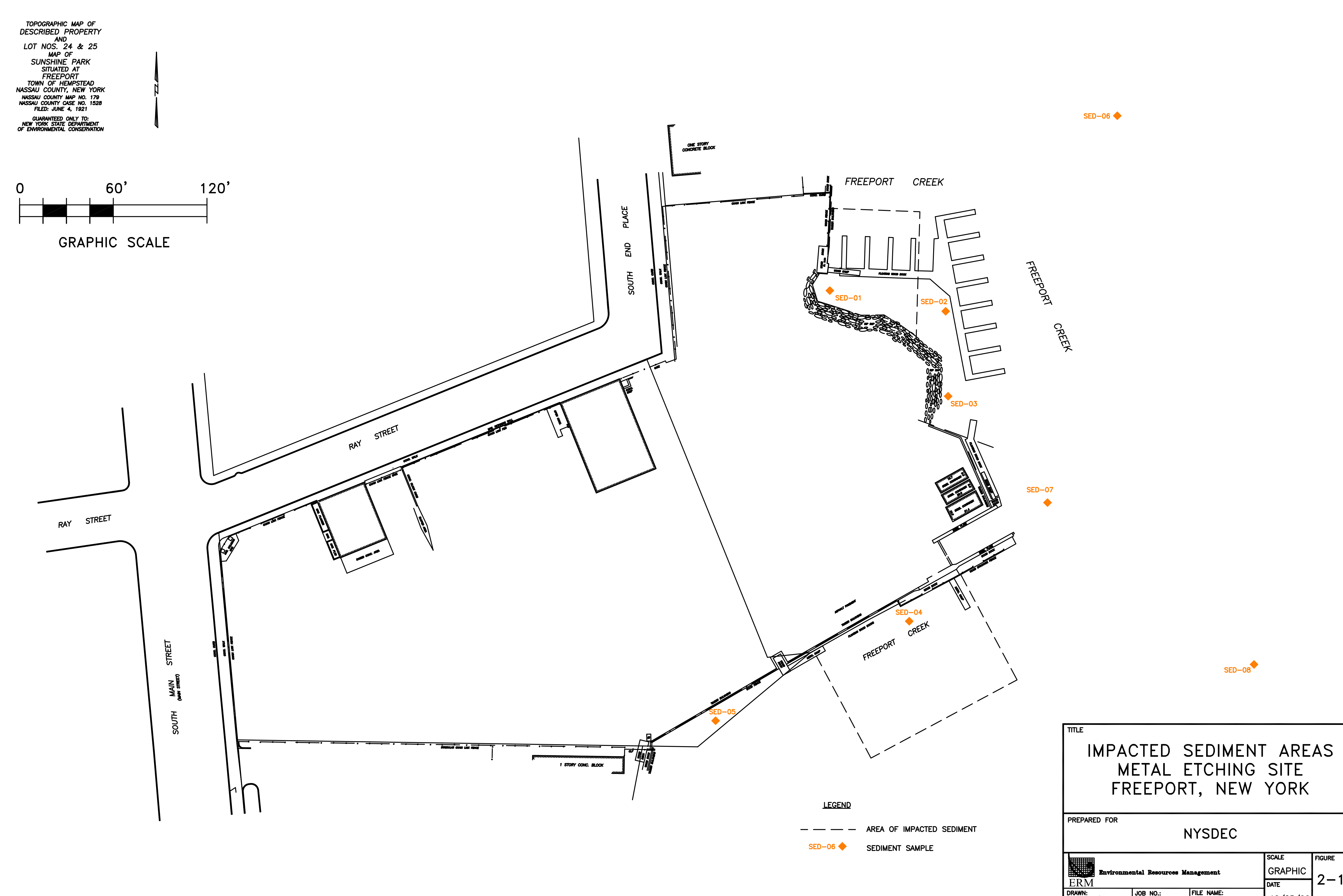
CHECKED / DATE
DESIGN ENGINEER
PROJECT ENGINEER
PROJECT MANAGER: MFM
APPROVED
APPROVED

VOC DETECTIONS IN SOIL ABOVE TAGM RSCO
METAL ETCHING SITE NO. 1-30-110
FREEPORT, NEW YORK

DRAWING NO. 2-2
REV. NO.

DRAWN	DATE	REVISED DATE
MFM/EMF	10/24/06	

SCALE	JOB NO.	FILE NAME	SHEET	OF
GRAPHIC	0011475.1	0011475-01-033		



TITLE

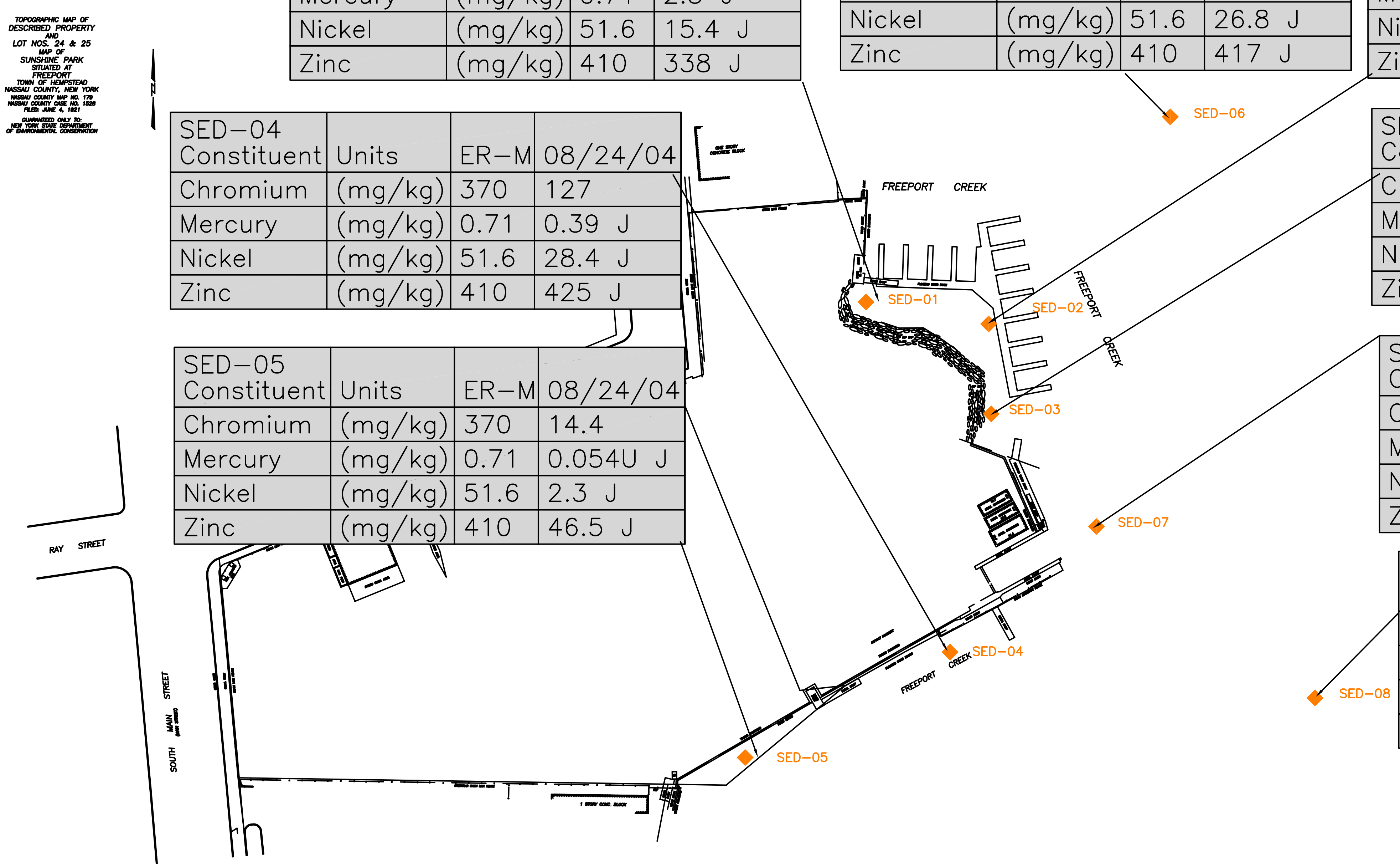
IMPACTED SEDIMENT AREAS METAL ETCHING SITE FREEPORT, NEW YORK

PREPARED FOR

NYSDEC

ERM Environmental Resources Management

DRAWN:	JOB NO.:	FILE NAME:	SCALE	DATE	FIGURE
MFM/EMF	0011475	001475-01-031	GRAPHIC	10/25/06	2-13



SED-01 Constituent	Units	ER-M	08/24/04
Chromium	(mg/kg)	370	34.7
Mercury	(mg/kg)	0.71	2.5 J
Nickel	(mg/kg)	51.6	15.4 J
Zinc	(mg/kg)	410	338 J

SED-06 Constituent	Units	ER-M	08/24/04
Chromium	(mg/kg)	370	89.2 J
Mercury	(mg/kg)	0.71	0.61 J
Nickel	(mg/kg)	51.6	26.8 J
Zinc	(mg/kg)	410	417 J

SED-02 Constituent	Units	ER-M	08/24/04
Chromium	(mg/kg)	370	16.0
Mercury	(mg/kg)	0.71	0.065 J
Nickel	(mg/kg)	51.6	8.8 J
Zinc	(mg/kg)	410	93.2 J

SED-04 Constituent	Units	ER-M	08/24/04
Chromium	(mg/kg)	370	127
Mercury	(mg/kg)	0.71	0.39 J
Nickel	(mg/kg)	51.6	28.4 J
Zinc	(mg/kg)	410	425 J

SED-03 Constituent	Units	ER-M	08/24/04
Chromium	(mg/kg)	370	3.3
Mercury	(mg/kg)	0.71	0.059U J
Nickel	(mg/kg)	51.6	3.2 J
Zinc	(mg/kg)	410	59.7 J

SED-05 Constituent	Units	ER-M	08/24/04
Chromium	(mg/kg)	370	14.4
Mercury	(mg/kg)	0.71	0.054U J
Nickel	(mg/kg)	51.6	2.3 J
Zinc	(mg/kg)	410	46.5 J

SED-07 Constituent	Units	ER-M	08/24/04
Chromium	(mg/kg)	370	3.4
Mercury	(mg/kg)	0.71	0.047U J
Nickel	(mg/kg)	51.6	1.4 J
Zinc	(mg/kg)	410	16.5 J

SED-08 Constituent	Units	ER-M	08/24/04
Chromium	(mg/kg)	370	6.5
Mercury	(mg/kg)	0.71	0.089 J
Nickel	(mg/kg)	51.6	2.6 J
Zinc	(mg/kg)	410	26.5 J

LEGEND

SED-07 — SEDIMENT SAMPLE LOCATION

ER-M — EFFECTS RANGE – MEDIUM

NOTE: ER-M VALUES DERIVED FROM NYSDEC TECHNICAL GUIDANCE FOR SCREENING CONTAMINANTED SEDIMENTS (NYSDEC 1999)

GRAPHIC SCALE: 0 — 80' — 160'

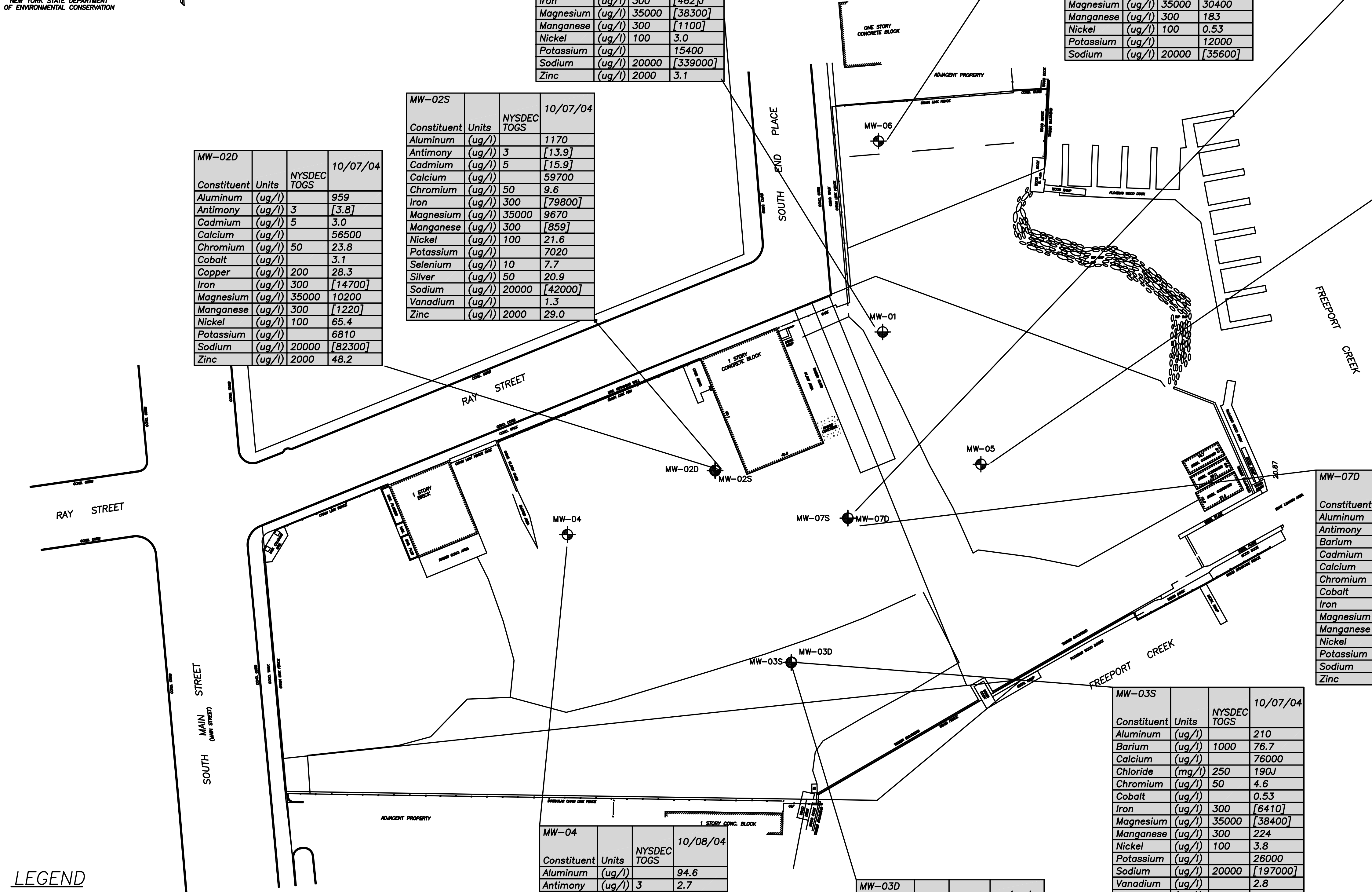
TITLE: CONSTITUENTS OF CONCERN IN SEDIMENT AGAINST ER-Ms
METAL ETCHING SITE
FREEPORT, NEW YORK

PREPARED FOR: NYSDEC SITE NO: 1-30-110

ERM Environmental Resources Management

DRAWN:	JOB NO.:	FILE NAME:	SCALE	FIGURE
MFM/EMF	0011475	0011475-01-057	GRAPHIC	2-12
			DATE: 1/9/07	

TOPOGRAPHIC MAP OF
DESCRIBED PROPERTY
AND
LOT NOS. 24 & 25
MAP OF
SUNSHINE PARK
SITUATED AT
FREEPORT
TOWN OF HEMPSTEAD
NASSAU COUNTY, NEW YORK
NASSAU COUNTY MAP NO. 179
NASSAU COUNTY CASE NO. 1528
FILED: JUNE 4, 1921
GUARANTEED ONLY TO:
NEW YORK STATE DEPARTMENT
OF ENVIRONMENTAL CONSERVATION



MW-01		NYSDEC TOGS	10/08/04
Constituent	Units		
Aluminum	(ug/l)		26.4
Antimony	(ug/l)	3	[5.1]
Arsenic	(ug/l)	25	2.4
Barium	(ug/l)	1000	51.0J
Calcium	(ug/l)		36200
Chromium	(ug/l)	50	0.73
Cobalt	(ug/l)		1.6
Iron	(ug/l)	300	[462]J
Magnesium	(ug/l)	35000	[38300]
Manganese	(ug/l)	300	[1100]
Nickel	(ug/l)	100	3.0
Potassium	(ug/l)		15400
Sodium	(ug/l)	20000	[339000]
Zinc	(ug/l)	2000	3.1

MW-06		NYSDEC TOGS	10/08/04
Constituent	Units		
Aluminum	(ug/l)		150
Antimony	(ug/l)	3	2.5
Arsenic	(ug/l)	25	3.8
Cadmium	(ug/l)	5	0.33
Calcium	(ug/l)		196000
Cobalt	(ug/l)		0.33
Iron	(ug/l)	300	[1200]J
Magnesium	(ug/l)	35000	30400
Manganese	(ug/l)	300	183
Nickel	(ug/l)	100	0.53
Potassium	(ug/l)		12000
Sodium	(ug/l)	20000	[35600]

MW-07S		NYSDEC TOGS	10/07/04
Constituent	Units		
Aluminum	(ug/l)		64.5
Antimony	(ug/l)	3	[11.3]
Barium	(ug/l)	1000	310
Cadmium	(ug/l)	5	[6.2]
Calcium	(ug/l)		229000
Chromium	(ug/l)	50	2.0
Cobalt	(ug/l)		0.89
Iron	(ug/l)	300	[29200]
Magnesium	(ug/l)	35000	[58200]
Manganese	(ug/l)	300	[761]
Nickel	(ug/l)	100	2.8
Potassium	(ug/l)		31000
Sodium	(ug/l)	20000	[198000]
Vanadium	(ug/l)		0.60

MW-02S		NYSDEC TOGS	10/07/04
Constituent	Units		
Aluminum	(ug/l)		1170
Antimony	(ug/l)	3	[13.9]
Cadmium	(ug/l)	5	[15.9]
Calcium	(ug/l)		59700
Chromium	(ug/l)	50	9.6
Iron	(ug/l)	300	[79800]
Magnesium	(ug/l)	35000	9670
Manganese	(ug/l)	300	[859]
Nickel	(ug/l)	100	21.6
Potassium	(ug/l)		7020
Selenium	(ug/l)	10	7.7
Silver	(ug/l)	50	20.9
Sodium	(ug/l)	20000	[42000]
Vanadium	(ug/l)		1.3
Zinc	(ug/l)	2000	29.0

MW-02D		NYSDEC TOGS	10/07/04
Constituent	Units		
Aluminum	(ug/l)		959
Antimony	(ug/l)	3	[3.8]
Cadmium	(ug/l)	5	3.0
Calcium	(ug/l)		56500
Chromium	(ug/l)	50	23.8
Cobalt	(ug/l)		3.1
Copper	(ug/l)	200	28.3
Iron	(ug/l)	300	[14700]
Magnesium	(ug/l)	35000	10200
Manganese	(ug/l)	300	[1220]
Nickel	(ug/l)	100	65.4
Potassium	(ug/l)		6810
Sodium	(ug/l)	20000	[82300]
Zinc	(ug/l)	2000	48.2

MW-05		NYSDEC TOGS	10/08/04
Constituent	Units		
Aluminum	(ug/l)		96.8
Antimony	(ug/l)	3	[7.2]
Barium	(ug/l)	1000	[1050]J
Cadmium	(ug/l)	5	3.6
Calcium	(ug/l)		128000
Chloride	(mg/l)	250	[400]J
Chromium	(ug/l)	50	0.90
Chromium (Hexavalent)	(mg/l)	0.050	[0.069]J
Iron	(ug/l)	300	[17400]J
Lead	(ug/l)	25	6.2
Magnesium	(ug/l)	35000	[37800]
Manganese	(ug/l)	300	[529]
Nickel	(ug/l)	100	4.6
Potassium	(ug/l)		31300
Sodium	(ug/l)	20000	[243000]
Vanadium	(ug/l)		2.6
Zinc	(ug/l)	2000	7.2

MW-07D		NYSDEC TOGS	10/07/04
Constituent	Units		
Aluminum	(ug/l)		227
Antimony	(ug/l)	3	[4.1]
Barium	(ug/l)	1000	23.2
Cadmium	(ug/l)	5	1.3
Calcium	(ug/l)		18200
Chromium	(ug/l)	50	3.5
Cobalt	(ug/l)		1.7
Iron	(ug/l)	300	[6370]
Magnesium	(ug/l)	35000	4740
Manganese	(ug/l)	300	[680]
Nickel	(ug/l)	100	3.6
Potassium	(ug/l)		2740
Sodium	(ug/l)	20000	[42400]
Zinc	(ug/l)	2000	9.8

MW-03S		NYSDEC TOGS	10/07/04
Constituent	Units		
Aluminum	(ug/l)		210
Barium	(ug/l)	1000	76.7
Calcium	(ug/l)		76000
Chloride	(mg/l)	250	190J
Chromium	(ug/l)	50	4.6
Cobalt	(ug/l)		0.53
Iron	(ug/l)	300	[6410]
Magnesium	(ug/l)	35000	[38400]
Manganese	(ug/l)	300	224
Nickel	(ug/l)	100	3.8
Potassium	(ug/l)		26000
Sodium	(ug/l)	20000	[197000]
Vanadium	(ug/l)		2.8
Zinc	(ug/l)	2000	3.4J

MW-04		NYSDEC TOGS	10/08/04
Constituent	Units		
Aluminum	(ug/l)		94.6
Antimony	(ug/l)	3	2.7
Arsenic	(ug/l)	25	2.5
Barium	(ug/l)	1000	37.1J
Calcium	(ug/l)		90900
Chromium	(ug/l)	50	14.7
Cobalt	(ug/l)		0.33
Iron	(ug/l)	300	171J
Magnesium	(ug/l)	35000	10000
Manganese	(ug/l)	300	21.3
Nickel	(ug/l)	100	16.5
Potassium	(ug/l)		10800
Sodium	(ug/l)	20000	[63500]
Zinc	(ug/l)	2000	10.9

MW-03D		NYSDEC TOGS	10/07/04
Constituent	Units		
Aluminum	(ug/l)		158
Chromium	(ug/l)	50	4.0
Iron	(ug/l)	300	[892]
Manganese	(ug/l)	300	[380]
Potassium	(ug/l)		6450
Zinc	(ug/l)	2000	2.8

LEGEND

MW-05 ⊕ MONITORING WELL LOCATION

[ ] DETECTED GROUNDWATER CONCENTRATION IS ABOVE NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION (NYSDEC) TECHNICAL AND OPERATIONAL GUIDANCE SERIES 111 (TOGS) CLASS GA GROUNDWATER STANDARD

J ESTIMATED VALUE

TITLE

METALS DETECTIONS AND EXCEEDENCES IN GROUNDWATER ABOVE TOGS CRITERIA METAL ETCHING SITE, FREEPORT, NY

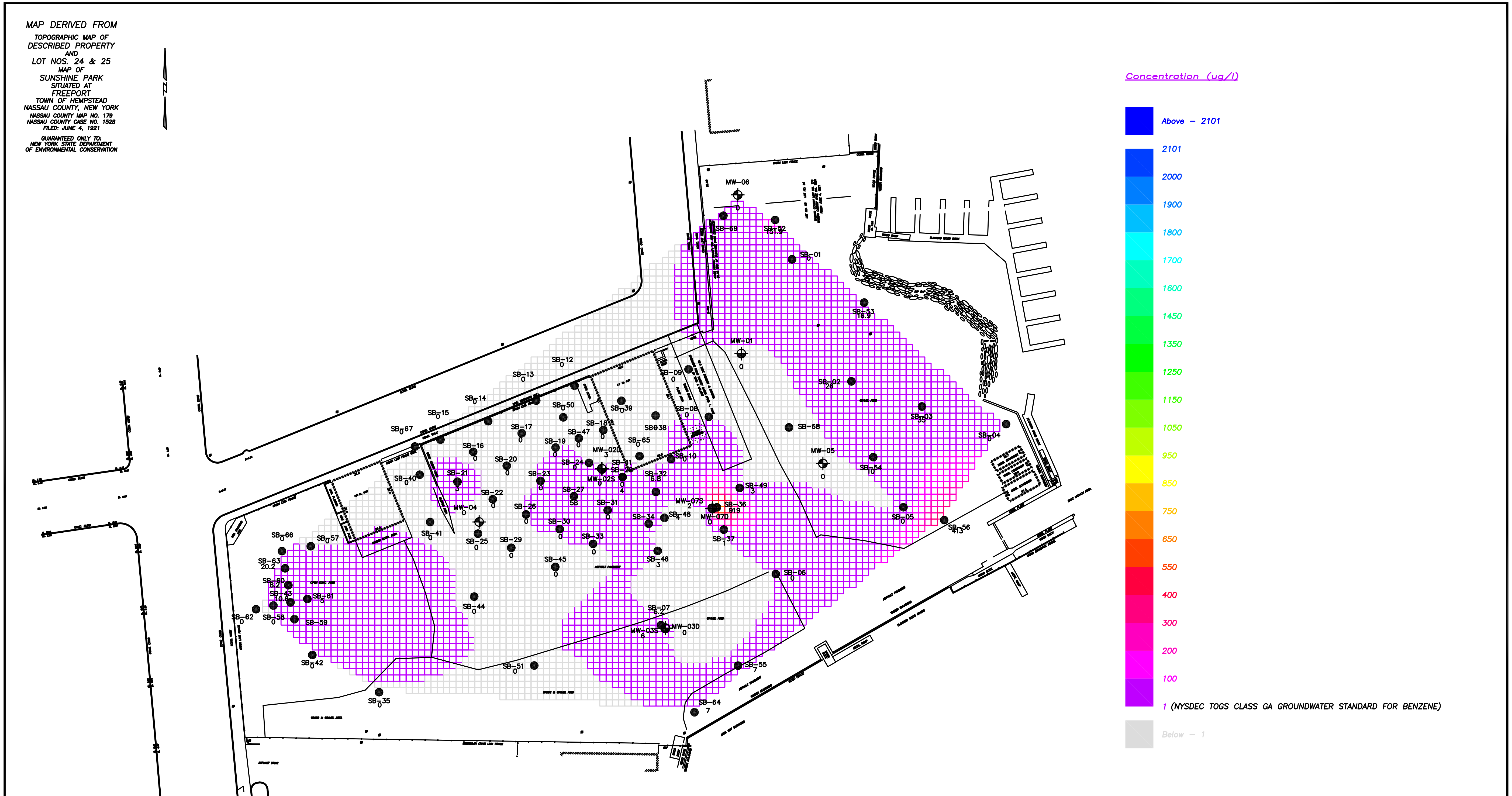
PREPARED FOR

NYSDEC

ERM Environmental Resources Management

SCALE	FIGURE
GRAPHIC	2-11
DATE 10/25/06	

DRAWN: MFM/EMF | JOB NO.: 0011475 | FILE NAME: 0011475-00-042



LEGEND

SB-06 0 ● Soil Boring Location
└ Concentration of Total BTEX in groundwater in ug/L

MW-07D 2.5 ⊕ Monitoring Well Location
└ Concentration of Total BTEX in groundwater in ug/L

0 60' 120'

GRAPHIC SCALE

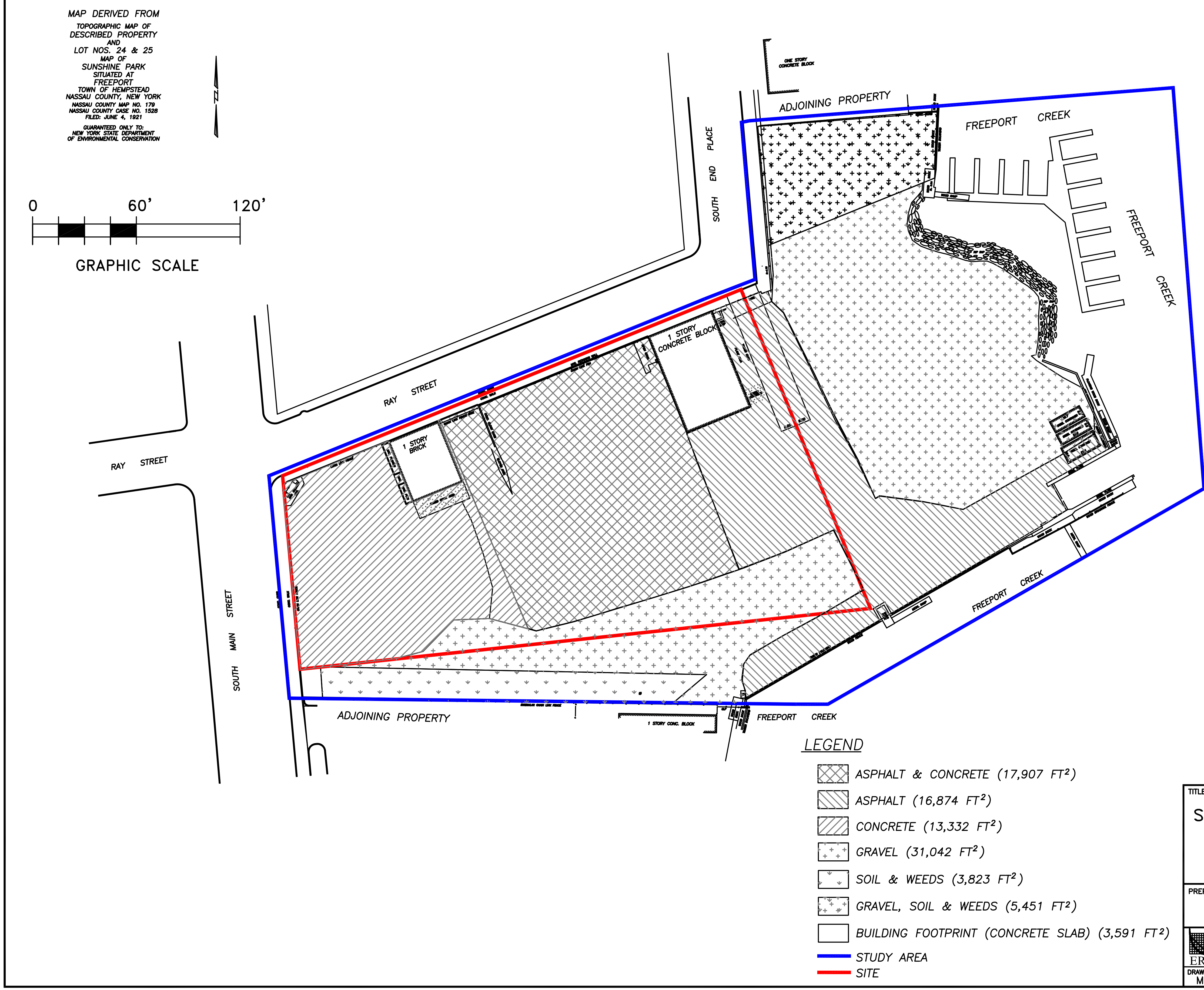
TITLE

TOTAL BENZENE, ETHYLBENZENE, TOLUENE & XYLENE (BTEX) COMPOUNDS IN GROUNDWATER (UG/L) METAL ETCHING SITE, FREEPORT, NY

PREPARED FOR

NYSDEC

ERM Environmental Resources Management			SCALE: GRAPHIC	FIGURE: 2–10
DRAWN: MFM/EMF	JOB NO.: 0011475	FILE NAME: 0011475–00–047	DATE: 11/1/06	



TITLE

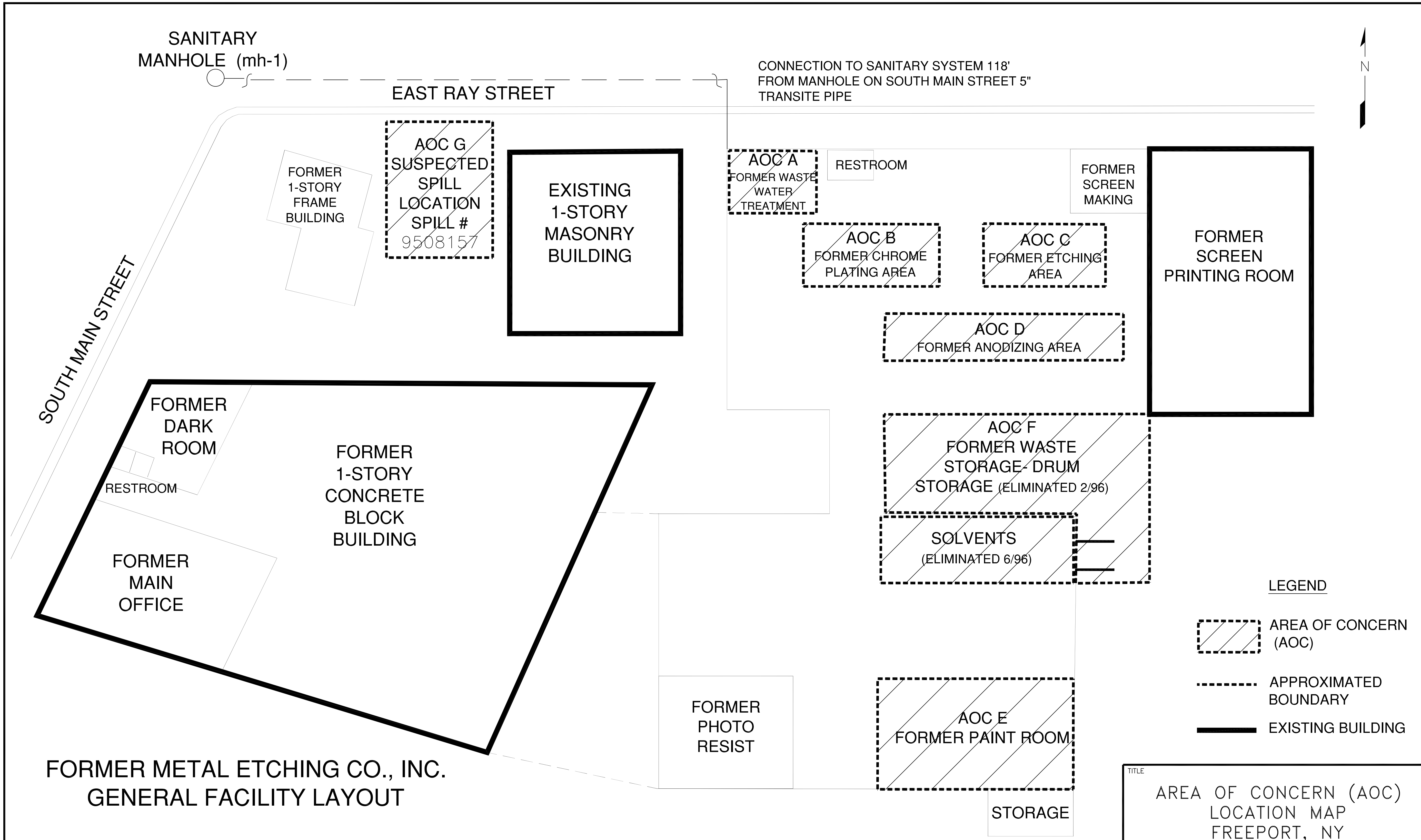
SITE OVERLYING COVER MATERIALS
METAL ETCHING SITE
FREEPORT, NEW YORK

PREPARED FOR

NYSDEC

ERM Environmental Resources Management

DRAWN:	JOB NO.:	FILE NAME:	SCALE / DATE	FIGURE
MFM/EMF	0011475	0011475-01-023	GRAPHIC / 10/17/06	2-1



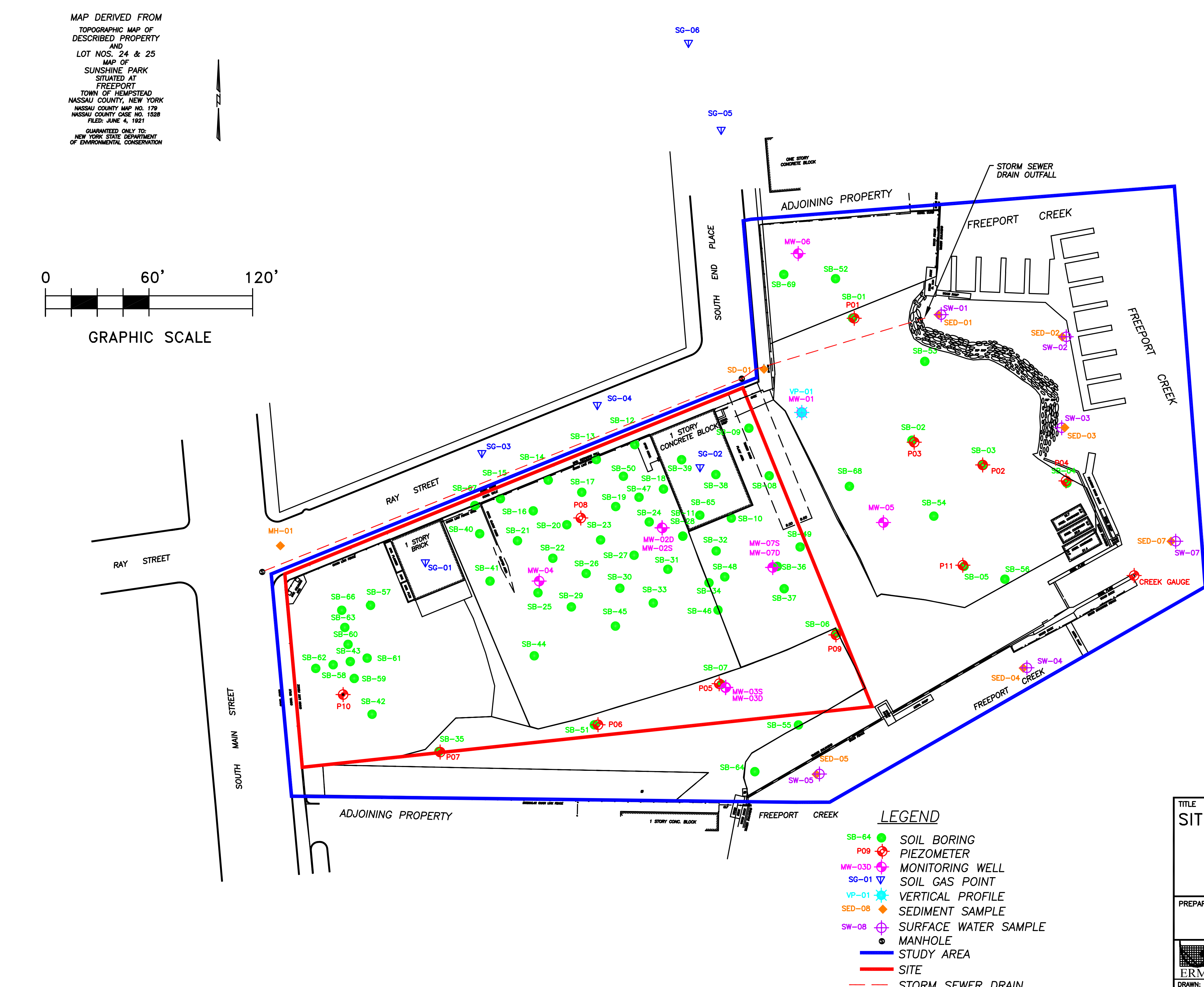
FORMER METAL ETCHING CO., INC.
GENERAL FACILITY LAYOUT

TITLE
AREA OF CONCERN (AOC)
LOCATION MAP
FREEPORT, NY

PREPARED FOR
NYSDEC SITE No. 1-30-110

ERM Environmental Resources Management

DRAWN:	JOB NO.:	FILE NAME:	SCALE	FIGURE
MM/YS/EMF	0011475	Fig 1-2	N.T.S.	1-3
			DATE 10/30/06	



TITLE

SITE AND STUDY AREA BOUNDARIES AND SAMPLE LOCATIONS
METAL ETCHING SITE
FREEPORT, NEW YORK

PREPARED FOR

NYSDEC

ERM Environmental Resources Management

DRAWN:	JOB NO.:	FILE NAME:	SCALE	FIGURE
MFM/EMF	0011475	0011475-01-022	GRAPHIC	1-2
			DATE: 10/30/06	

TITLE

GENERAL LOCATION OF POTENTIAL USTs
METAL ETCHING SITE
FREEPORT, NEW YORK

PREPARED FOR

NYSDEC

ERM Environmental Resources Management

DRAWN:	JOB NO.:	FILE NAME:	SCALE / DATE	FIGURE
MFM/EMF	0011475	0011475-01-030	GRAPHIC / 10/17/06	3-1