PROPOSED REMEDIAL ACTION PLAN

Hercules Inc.
State Superfund Project
Port Ewen, Ulster County
Site No. 356001
February 2019

Prepared by
Division of Environmental Remediation
New York State Department of Environmental Conservation

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SECTION 1: SUMMARY AND PURPOSE OF THE PROPOSED PLAN

The New York State Department of Environmental Conservation (the Department), in consultation with the New York State Department of Health (NYSDOH), is proposing a remedy for the above referenced site. The disposal of hazardous wastes at the site has resulted in threats to public health and the environment that would be addressed by the remedy proposed by this Proposed Remedial Action Plan (PRAP). The disposal of hazardous wastes at this site, as more fully described in Section 6 of this document, has contaminated various environmental media. The proposed remedy is intended to attain the remedial action objectives identified for this site for the protection of public health and the environment. This PRAP identifies the preferred remedy, summarizes the other alternatives considered, and discusses the reasons for the preferred remedy.

The New York State Inactive Hazardous Waste Disposal Site Remedial Program (also known as the State Superfund Program) is an enforcement program, the mission of which is to identify and characterize suspected inactive hazardous waste disposal sites and to investigate and remediate those sites found to pose a significant threat to public health and environment. The New York State Hazardous Waste Management Program (also known as the Resource Conservation and Recovery Act [RCRA] Program) requires corrective action for releases of hazardous waste and hazardous constituents to the environment. This facility is subject to both of these programs, and this document meets the RCRA program requirements for the draft Statement of Basis.

The Department has issued this document in accordance with the requirements of New York State Environmental Conservation Law and Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York; 6 NYCRR Part 373 (RCRA) as well as (6 NYCRR) Part 375 (State Superfund). This document is a summary of the information that can be found in the site-related reports and documents in the document repository identified below.

SECTION 2: CITIZEN PARTICIPATION

The Department seeks input from the community on all PRAPs. This is an opportunity for public participation in the remedy selection process. The public is encouraged to review the reports and documents, which are available at the following repository:

Town of Esopus Library
Attn: Town Librarian
128 Canal Street
Port Ewen, NY 12466
Phone: (845) 338-5580

A public comment period has been set from:

February 22, 2019 to March 24, 2019

A public meeting is scheduled for the following date: March 11, 2019 at 7 pm.

Public meeting location:
Town of Esopus, Town Hall
284 Broadway
Ulster Park, New York 12487

At the meeting, the findings of the remedial investigation (RI) and the feasibility study (FS) will be presented along with a summary of the proposed remedy. After the presentation, a question-and-answer period will be held, during which verbal or written comments may be submitted on the PRAP.

Written comments may also be sent through to:

Salvatore F. Priore, P.E.
NYS Department of Environmental Conservation
Division of Environmental Remediation
625 Broadway
Albany, NY 12233
salvatore.priore@dec.ny.gov

The Department may modify the proposed remedy or select another of the alternatives presented in this PRAP based on new information or public comments. Therefore, the public is encouraged to review and comment on the proposed remedy identified herein. Comments will be summarized and addressed in the responsiveness summary section of the Record of Decision (ROD). The ROD is the Department's final selection of the remedy for this site.

Receive Site Citizen Participation Information By Email

Please note that the Department's Division of Environmental Remediation (DER) is "going paperless" relative to citizen participation information. The ultimate goal is to distribute citizen participation information about contaminated sites electronically by way of county email listservs. Information will be distributed for all sites that are being investigated and cleaned up in a particular county under the State Superfund Program, Environmental Restoration Program, Brownfield Cleanup Program, Voluntary Cleanup Program, and Resource Conservation and Recovery Act Program. We encourage the public to sign up for one or more county listservs at http://www.dec.ny.gov/chemical/61092.html

SECTION 3: SITE DESCRIPTION AND HISTORY

Location: The Hercules site is located at 161 Ulster Avenue, Ulster Park, approximately one mile south of the village of Port Ewen in Ulster County New York. The site is approximately 1.5 miles west of the Hudson River and is situated along the eastern base of Hussey Hill.

Site Features: The Hercules site is an approximately 260-acre property that includes the main plant site and land east of the rail line outside the fenced main plant area (the Wetland Complex). The western portion of the site consists primarily land on the east side of Hussey Hill. Manufacturing operations took place in the developed portion of the site, which occupies approximately 100 acres. Disposal activities occurred within the developed area and within wetland areas in the eastern portion of the property. Most of the surrounding areas are naturally vegetated with cover types ranging from old fields to forested areas. Approximately 50 buildings remain on-site, however manufacturing is no longer occurring at the site.

Current Zoning and Land Use: The former active manufacturing portion of the site is located within the Heavy Industry zone. The wetlands area to the east of the former manufacturing area is located within the Light Industry zone. The area to the west is primarily within the R-40 zone, which allows for development at 1-acre per family; however, this area of the site is the steep east side of Hussey Hill. The site is located within a rural and natural setting. The company retains an office on-site, and a storage building is utilized by a different company for storage and distribution of explosives. The site was used primarily as an industrial facility. The presence of energetic and potentially explosive materials in some site areas limits the current use of the site. As part of the corrective measures for the site, the owner filed a Declaration of Restrictions in 2004 which includes restrictions on the property to limit future use of the site to industrial uses.

Past Use of the Site: The site was an active manufacturing facility producing explosive primers and igniters. The site was involved with production of various explosives and related materials since 1912. The plant was originally constructed by Brewster Explosives Company, sold to Hercules Incorporated in 1922, and subsequently sold to IRECO, Incorporated in 1985. IRECO was renamed Dyno Nobel, Inc. in 1993. The manufacturing of explosives at the site continued through each ownership transfer.

Contamination of the site resulted from various waste streams from the manufacturing of explosives and related products. The waste streams were managed in dozens of solid waste management units (SWMUs). These wastes included both liquid and solid wastes as well as off-specification products. Many of the SWMUs utilized water to reduce the reactive or explosive nature of the waste by keeping the wastes wetted, while others burned the wastes. Remedial investigations have been conducted at the site since the early 1990s under the oversight of both the U.S. Environmental Protection Agency and NYSDEC.

Operable Units: The site was divided into two operable units. An operable unit represents a portion of a remedial program for a site that for technical or administrative reasons can be addressed separately to investigate, eliminate or mitigate a release, threat of release or exposure pathway resulting from the site contamination.

Operable unit (OU) 1 of the Hercules site is defined as the 260-acre on-site area that includes the main plant area, the hillside to the west (Hussey Hill) and the wetlands area to the east, along with multiple contiguous parcels owned by Hercules, Dyno Nobel, IRECO and/or related entities, comprising a total of approximately 410 acres. It also includes off-site areas of wetlands and areas along and proximate to Plantasie Creek from the property boundaries north to Mountain View Road which require remediation.

OU2 consists of areas along and proximate to Plantasie Creek from the OU 1 boundary north, to the extent that additional investigation documents site-related contamination.

Site Geology and Hydrology: The site is at an approximate elevation of 160 feet; however, Hussey Hill rises to an elevation of approximately 760 feet along the western border of the site.

Groundwater throughout most of the manufacturing site is approximately 20 feet deep and is subdivided into a shallow groundwater zone (dominated by silts and clays) and a deeper groundwater zone comprised of gravels and sands. Groundwater flow in the shallow zone is mainly towards the east with localized convergence of surface water and groundwater to form wetland areas. The groundwater flow within the deeper overburden appears to be strongly aligned to the intermittent stream feature, which flows from the south-west to the northeast across the southern end of the site. Bedrock was encountered at depths ranging between 1.5 ft. below ground surface and 85.1 ft. below ground surface.

Surface water at the site is captured by three drainage swales that empty into a wetland area just to the east of the site. The wetland contains SWMU 1: The Shooting Pond, which was used to dispose of off-spec explosives, SWMU 22: Former Landfill, and SWMU 35: Stone Fence Dump. This wetland complex drains to the north to Plantasie Creek, which in turn empties into Rondout Harbor, and then into the Hudson River, which is about 1.5 miles away from the site.

Operable Unit (OU) Number 01 is the subject of this document.

A site location map is attached as Figure 1.

SECTION 4: LAND USE AND PHYSICAL SETTING

The Department may consider the current, intended, and reasonably anticipated future land use of the site and its surroundings when evaluating a remedy for soil remediation. For this site, alternatives (or an alternative) that restrict(s) the use of the site to commercial use (which allows for industrial use) as described in Part 375-1.8(g) are/is being evaluated in addition to an alternative which would allow for unrestricted use of the site.

A comparison of the results of the investigation to the appropriate standards, criteria and guidance values (SCGs) for the identified land use and the unrestricted use SCGs for the site contaminants is included in the Tables for the media being evaluated in Exhibit A.

SECTION 5: ENFORCEMENT STATUS

Potentially Responsible Parties (PRPs) are those who may be legally liable for contamination at a site. This may include past or present owners and operators, waste generators, and haulers.

The PRPs for the site, documented to date, include:

Hercules, Inc.

Dyno Nobel, Inc.

6NYCRR Part 373 Hazardous Waste Management Permits include RCRA Corrective Action. This requires owners and/or operators of hazardous waste treatment, storage and disposal facilities to investigate and, when appropriate, remediate releases of hazardous wastes and/or constituents to the environment.

Historically, Brewster Explosives Company originally built the facility near the turn of the 20th Century. Aetna Explosives Company purchased the facility in 1915, sold it to Hercules Incorporated (Hercules) in 1922, who subsequently sold the company to IRECO Incorporated in 1985.

In July 1993, IRECO was renamed Dyno-Nobel Incorporated, the current property owner and facility operator. In 2009, Ashland Inc. (Ashland) acquired Hercules, and assumed the historical liability Hercules retained at the Site.

The Department initially issued a RCRA Order on Consent with Dyno-Nobel (Respondent) on April 15, 1996 that obligated the Respondent to conduct a RCRA Facility Investigation (RFI) of identified solid waste management units (SWMUs) and areas of concern (AOCs) at the site for site contaminants and explosive materials. Subsequently, a comprehensive Superfund Order was executed with Dyno-Nobel in July 2018, which integrated the Respondent’s inactive hazardous waste disposal site response obligations and RCRA Corrective Action obligations to implement a remedial program at the site.

SECTION 6: SITE CONTAMINATION

6.1: Summary of the Remedial Investigation

A Remedial Investigation (RI) has been conducted. The purpose of the RI was to define the nature and extent of any contamination resulting from previous activities at the site. The field activities and findings of the investigation are described in the RI Report.

The following general activities are conducted during an RI:

- Research of historical information,
- Geophysical survey to determine the lateral extent of wastes,

- Test pits, soil borings, and monitoring well installations,
- Sampling of waste, surface and subsurface soils, groundwater, and soil vapor,
- Sampling of surface water and sediment,
- Ecological and Human Health Exposure Assessments.

The analytical data collected on this site includes data for:

- groundwater
- surface water
- soil
- sediment
- soil vapor

6.1.1: Standards, Criteria, and Guidance (SCGs)

The remedy must conform to promulgated standards and criteria that are directly applicable or that are relevant and appropriate. The selection of a remedy must also take into consideration guidance, as appropriate. Standards, Criteria and Guidance are hereafter called SCGs.

To determine whether the contaminants identified in various media are present at levels of concern, the data from the RI were compared to media-specific SCGs. The Department has developed SCGs for groundwater, surface water, sediments, and soil. The NYSDOH has developed SCGs for drinking water and soil vapor intrusion. The tables found in Exhibit A list the applicable SCGs in the footnotes. For a full listing of all SCGs see: http://www.dec.ny.gov/regulations/61794.html

6.1.2: RI Results

The data have identified contaminants of concern. A "contaminant of concern" (COC) is a hazardous waste that is sufficiently present in frequency and concentration in the environment to require evaluation for remedial action. Not all contaminants identified on the property are contaminants of concern. The nature and extent of contamination and environmental media requiring action are summarized in Exhibit A. Additionally, the RI Report contains a full discussion of the data. The contaminant(s) of concern identified at this site is/are:

1,1-dichloroethane	cis-1,2-dichloroethene
1,1-dichloroethene	lead
acetone	mercury
arsenic	selenium
barium	trichloroethene (TCE)
cadmium	methylene chloride
copper	1,1,1-trichloroethane

1,2-dichloroethane zinc

As illustrated in Exhibit A, the contaminant(s) of concern exceed the applicable SCGs for:

- groundwater
- soil
- sediment
- soil vapor intrusion

6.2: Interim Remedial Measures

An interim remedial measure (IRM) is conducted at a site when a source of contamination or exposure pathway can be effectively addressed before issuance of the Record of Decision.

The following IRM(s) has/have been completed at this site based on conditions observed during the RI.

IRM Munitions Removal and Fencing

Explosives removal was undertaken from July 24, through October 7, 1996 to address health and safety concerns associated with areas of the site that may have contained explosives at reactive concentrations. UXB International Inc. investigated 17 SWMUs for primary and secondary explosives. Two locations were found to contain explosive quantities of both primary and secondary explosives as follows:

SWMU 41: Detonator Production Building Condensate Collection Sumps
SWMU 48: Mercury Fulminate Area
Explosive material was removed from these areas until subsequent sampling indicated that explosive quantities were no longer present.

The following three locations were found to contain numerous detonation caps and related debris, which was collected in five-gallon pails for disposal:

SWMU 1: Shooting Pond
SWMU 38S: Suspected Grenade Disposal Areas South
SWMU 38N: Suspected Grenade Disposal Areas North.

These activities are documented in the report entitled “Documentation of Interim Corrective Measures (ICM) for Explosives, Dyno Nobel Facility, Port Ewen, New York” (Eckenfelder, 1997a). The objectives of the IRM for explosives removal were met and the screened areas were deemed safe for further investigation during the RI. A review and verification of this conclusion will be performed as part of any necessary pre-design investigation for the selected remedy. Due to the presence of potential energetic materials, Dyno Nobel installed a fence around SWMUs 1, 22 and 35. Approximately 4,300 linear feet of chain-link fence was installed around the three SWMUs.

6.3: Summary of Environmental Assessment

This section summarizes the assessment of existing and potential future environmental impacts presented by the site. Environmental impacts may include existing and potential future exposure pathways to fish and wildlife receptors, wetlands, groundwater resources, and surface water.

The Fish and Wildlife Resources Impact Analysis (FWRIA) for OU 01, which is included in the RI report, presents a detailed discussion of the existing and potential impacts from the site to fish and wildlife receptors.

Site soils, wetland sediments, groundwater and surface water were analyzed for volatile organic compounds (VOCs) and metals as the primary contaminants of concern (COCs) from the Corrective Measures Study (CMS). Soil vapor was analyzed for VOCs.

Groundwater:
Groundwater at the site exceeds groundwater standards for VOCs and inorganics. At a depth of about 15 to 25 feet, trichloroethene (TCE) has been found at levels up to 810,000 parts per billion (ppb), which is several orders of magnitude higher than the groundwater water standards of 5.0 ppb. TCE degradation products, including cis-1,2-dichloroethene (cis-1,2-DCE) were also detected above standards. The groundwater investigation indicated that the dissolved VOC plume is located at and east of the Shell Plant trending in an east/southeast direction and is approximately 400 feet long by 200 feet wide and predominantly west of the rail line. Inorganics, including aluminum, cadmium, cobalt and selenium exceeded their respective SCGs of 100 ppb, 5 ppb, 5 ppb and 10 ppb, respectively. Semi-VOCs (SVOCs), polychlorinated biphenyls (PCBs), pesticides testing was limited; data gaps will be addressed during a pre-design investigation. Groundwater contamination has not migrated off-site.

Soil:
Throughout the manufacturing site, soil at over 30 SWMUs was found to have some heavy metal contamination. The primary contaminants are mercury and lead. The highest level of mercury was 7,400 ppm (in SWMU 33) and the highest levels of lead was 27,000 ppm (in SWMU 21). Barium, cadmium and copper were also detected at high concentrations. The contamination is generally found within the first 2 to 3 feet from the ground surface. Soil contamination has not been determined to be migrating off-site.

Wetland Sediment:
The wetland sediments contained mercury concentrations ranging from non-detect to 240 ppm, and lead from non-detect to 5,400 ppm. This contamination is also restricted to the first few feet below the surface of the sediment but could extend deeper under the SWMUs. Investigation beneath these SWMUs was precluded by the potentially explosive nature of the waste.

Site Drainageways Sediment:
The northern and southern drainageways of the site transverse the Active Plant Area and discharge to the Wetlands Complex (i.e., wetlands area east of the plant). Concentrations of arsenic, cadmium, copper, lead, mercury, and zinc in the sediment in the drainageways exceeded the SGCs.

Stream Sediment:
In the stream sediment downstream of the wetland, copper, lead, mercury and zinc exceed the sediment screening criteria. This contaminated sediment is located in both on-site and off-site areas of Plantasie Creek downstream to an area approximately 800 feet to the north of the property boundary. Any contaminated sediment identified downstream of that location will be addressed in the future under a second operable unit (OU-2).

Surface Water:
Surface water sampling conducted within the SWMU 1/22 Wetlands Complex and at reference stations concurrent with sediment sampling showed four out of six target inorganics were detected in filtered samples. Detected inorganics included copper, lead, selenium, and zinc. Concentrations of cadmium and mercury were below detection in all filtered samples. Overall, surface water is negligibly impacted on-site and the proposed remedy will further reduce the potential for future impacts to the surface water.

Soil Vapor:
Because of its proximity to the identified on-site VOC groundwater plume, a soil vapor intrusion investigation was performed at the Shell Plant. In July 2002, four sub-slab soil vapor samples and one indoor air sample were collected at the Shell Plant building. TCE was detected as high as 188 mcg/m^3 in a sub-slab soil vapor sample. In March 2007, an indoor and sub-slab soil vapor sample were collected in the same area; TCE was detected in the indoor air sample at a concentration of 0.75 mcg/m^3 and in the sub-slab at a concentration of 190 mcg/m^3. Based on a review of the data as compared to the NYSDOH Soil Vapor Intrusion Guidance decision matrices, mitigation was recommended however it was agreed that annual indoor air monitoring would occur instead of mitigation. The building is not currently in use and not occupied. Should the building become re-occupied, the potential for soil vapor intrusion at the Shell Plant will be re-evaluated. Additionally, an evaluation of the potential for SVI to occur will be completed at the existing office building, the active warehouse, and any existing on-site buildings that become re-occupied or for any proposed new construction. Groundwater and soil sampling data indicate soil vapor contamination does not extend off site.

6.4: Summary of Human Exposure Pathways

The site is fenced and it is unlikely that people will come in contact with contaminants in soil unless they dig below the ground surface. Contaminated groundwater at the site is not used for drinking or other purposes, and the site is served by a public water supply that obtains water from a different source not affected by this contamination. People may come in contact with contamination present in downstream wetland sediments. Volatile organic compounds in the soil or groundwater may move into the soil vapor (air spaces within the soil), which in turn may move into overlying buildings and affect the indoor air quality. This process, which is similar to the movement of radon gas from the subsurface into the indoor air of buildings, is referred to as soil vapor intrusion. The potential exists for people to inhale site contaminants in indoor air due to soil vapor intrusion if the former Shell Plant building is re-occupied or there is further on-site redevelopment or occupancy in the area of the on-site volatile organic compounds groundwater plume. Sampling indicates soil vapor intrusion is not a concern for off-site buildings.

6.5: Summary of the Remediation Objectives

The objectives for the remedial program have been established through the remedy selection process stated in 6 NYCRR Part 375. The goal for the remedial program is to restore the site to pre-disposal conditions to the extent feasible. At a minimum, the remedy shall eliminate or mitigate all significant threats to public health and the environment presented by the contamination identified at the site through the proper application of scientific and engineering principles.

The remedial action objectives for this site are:

Groundwater

RAOs for Public Health Protection

- Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.
- Prevent contact with, or inhalation of volatiles, from contaminated groundwater.

RAOs for Environmental Protection

- Restore ground water aquifer to pre-disposal/pre-release conditions, to the extent practicable.
- Prevent the discharge of contaminants to surface water.
- Remove the source of ground or surface water contamination.

Soil

RAOs for Public Health Protection

- Prevent ingestion/direct contact with contaminated soil.
- Prevent inhalation of or exposure from contaminants volatilizing from contaminants in soil.

RAOs for Environmental Protection

- Prevent migration of contaminants that would result in groundwater or surface water contamination.
- Prevent impacts to biota from ingestion/direct contact with soil causing toxicity or impacts from bioaccumulation through the terrestrial food chain.

Surface Water

RAOs for Public Health Protection

- Prevent ingestion of water impacted by contaminants.
- Prevent contact or inhalation of contaminants from impacted water bodies.
- Prevent surface water contamination which may result in fish advisories.

RAOs for Environmental Protection

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

Sediment

RAOs for Public Health Protection

- Prevent direct contact with contaminated sediments.
- Prevent surface water contamination which may result in fish advisories.

RAOs for Environmental Protection

- Prevent releases of contaminant(s) from sediments that would result in surface water levels in excess of (ambient water quality criteria).
- Prevent impacts to biota from ingestion/direct contact with sediments causing toxicity or impacts from bioaccumulation through the marine or aquatic food chain.

Soil Vapor

RAOs for Public Health Protection

- Mitigate impacts to public health resulting from existing, or the potential for, soil vapor intrusion into buildings at a site.

SECTION 7: SUMMARY OF THE PROPOSED REMEDY

To be selected, the remedy must be protective of human health and the environment, be cost-effective, comply with other statutory requirements, and utilize permanent solutions, alternative technologies or resource recovery technologies to the maximum extent practicable. The remedy must also attain the remedial action objectives identified for the site, which are presented in Section 6.5. Potential remedial alternatives for the Site were identified, screened and evaluated in the FS report.

A summary of the remedial alternatives that were considered for this site is presented in Exhibit B. Cost information is presented in the form of present worth, which represents the amount of money invested in the current year that would be sufficient to cover all present and future costs associated with the alternative. This enables the costs of remedial alternatives to be compared on a common basis. As a convention, a time frame of 30 years is used to evaluate present worth costs for alternatives with an indefinite duration. This does not imply that operation, maintenance, or monitoring would cease after 30 years if remediation goals are not achieved. A summary of the Remedial Alternatives Costs is included as Exhibit C.

The basis for the Department's proposed remedy is set forth at Exhibit D.

The proposed remedy is referred to as the Consolidation of Soils, Sediment and Groundwater remedy.

The estimated present worth cost to implement the remedy is $10,287,000. The cost to construct the remedy is estimated to be $8,374,000 and the estimated average annual cost is $51,000.

The elements of the proposed remedy are as follows:

1. Remedial Design

A remedial design program will be implemented to provide the details necessary for the construction, operation, optimization, maintenance, and monitoring of the remedial program. A pre-design investigation will be conducted to collect any additional data necessary to complete the design.

Green remediation principles and techniques will be implemented to the extent feasible in the design, implementation, and site management of the remedy as per DER-31. The major green remediation components are as follows:

- Considering the environmental impacts of treatment technologies and remedy stewardship over the long term;
- Reducing direct and indirect greenhouse gases and other emissions;
- Increasing energy efficiency and minimizing use of non-renewable energy;
- Conserving and efficiently managing resources and materials;
- Reducing waste, increasing recycling and increasing reuse of materials which would otherwise be considered a waste;
- Maximizing habitat value and creating habitat when possible;
- Fostering green and healthy communities and working landscapes which balance ecological, economic and social goals; and
- Integrating the remedy with the end use where possible and encouraging green and sustainable re-development.

2. Excavation

All on-site source soils and soils in the upper foot which exceed commercial soil cleanup objectives (SCOs) as defined by 6NYCRR Part 375-6.8 (approximately 17,000 cubic yards [cy]), will be excavated from the Active Plant Area and consolidated on-site in the adjacent Wetlands Complex, with the exception of soils within SWMUs 23 and 32 which may contain energetics (see discussion in remedy element 4). The consolidated area will be managed as a Corrective Action Management Unit (CAMU) pursuant to the RCRA regulatory program. Soil in any off-site upland areas which became impacted by site contaminants of concern through sediment deposition flood events will be excavated to meet the unrestricted use soil cleanup objectives. Soil in the ecological buffer areas, defined as five feet back from the top of the stream bank to a depth of two feet, which exceed the SCOs for protection of ecological resources (on-site) and unrestricted use (off-site) as defined by 6 NYCRR Part 375-6.8, will be excavated. All excavated materials which are not hazardous will be consolidated in the CAMU noted above. All excavated soils determined to be hazardous based on the toxicity characteristic leaching procedure (TCLP) will be transported off-site for proper disposal at an approved hazardous waste (Part 373) disposal facility.

On-site soil which does not exceed the above excavation criteria may be used as part of the cover system described in remedy element 4 to backfill excavations and establish the designed grades at the site.

On-site soil which does not exceed the above excavation criteria or the protection of groundwater SCOs for any constituent may be used beneath the cover system, including below the water table, to backfill the excavation or re-grade the site.

Clean fill meeting the requirements of 6 NYCRR Part 375-6.7(d) for commercial use of the site will be brought in to replace the excavated soil and establish the designed grades at the site. The site will be re-graded to accommodate installation of a cover system as described in remedy element No 4.

3. Sediment Excavation
Approximately 18,000 cubic yards (CY) of sediment in the Wetlands Complex and associated drainage ways is proposed to be excavated and consolidated in the CAMU. On-site and some contiguous off-site sediments which exceed the Class A guidance values as defined in the "Screening and Assessment of Contaminated Sediments" (NYSDEC Division of Fish and Wildlife, June 2014) will be excavated and consolidated. Excavated sediments determined to be hazardous based on toxicity characteristic leaching procedure (TCLP) analyses will be transported off-site for proposed disposal and not consolidated on-site. The drainageways that cross the site and drain on-site surface water to the Wetlands Complex will be excavated to meet the Class A sediment guidance values to prevent recontamination of the wetland areas. The drainageway ecological buffer zones will be excavated to meet Protection of Ecological Resources SCOs. This area of wetland/drainageway sediment removal is estimated to be approximately 12 acres.

Stream banks and ecological buffer zones will be restored with imported soil meeting the SCOs for unrestricted use off-site and ecological SCOs on-site. Sediment areas will be restored with material meeting Class A sediment guidance values and in accordance with a Department-approved wetland restoration/stream re-routing plan to be developed during the design phase. If present, emergent and submerged aquatic vegetation in the remediation area will also be restored. The design will include a monitoring plan for areas disturbed by the remedy, and all activities will be consistent with the requirements of 6 NYCRR Part 608.

4. Consolidation/Capping
On-site soils which exceed the commercial SCOs (as defined by 6 NYCRR Part 375-6.8), on-site and contiguous off-site sediments which exceed Class A guidance values, and soil in the ecological buffer areas which exceeds the protection of ecological resources SCOs, will be excavated, consolidated on-site above the water table and capped. The consolidation area will be located on-site within the Area of Contamination (AOC-P)/CAMU in the on-site wetland containing SWMUs 1, 22, and 35, because these areas cannot be excavated due to the potential presence of energetic (explosive) materials. The consolidation area will be approximately 5 acres in area and will receive an engineered cap designed, constructed and maintained in conformance with the substantive requirements of 6 NYCRR Part 360 solid waste regulations. The exact dimensions of the consolidation unit will be determined during the design phase of the remedy. The final acreage of wetlands taken for the consolidation area shall be off-set by new wetlands constructed adjacent to the consolidation cell.

5. Cover System
A site cover will be required to allow for commercial use of the site in areas where the upper one foot of exposed surface soil exceeds the applicable soil cleanup objectives (SCOs). Where a soil cover is to be used it will be a minimum of one foot of soil placed over a demarcation layer, with the upper six inches of soil of sufficient quality to maintain a vegetative layer. Soil cover material, including any fill material brought to the site, will meet the SCOs for cover material for the use of the site as set forth in 6 NYCRR Part 375-6.7(d). Substitution of other materials and

components may be allowed where such components already exist or are a component of the tangible property to be placed as part of site redevelopment. Such components may include, but are not necessarily limited to: pavement, concrete, paved surface parking areas, sidewalks, building foundations and building slabs. The pre-design investigation will determine which areas of the site meet the soil cleanup objectives in the top 1 foot of surface soil.

SWMUs 23 and 32 have the potential to contain soils and wastes that are energetic. A foot of soil cover will be placed if deemed feasible in the design. The soil cover will extend laterally to where the upper one foot of exposed surface soil meets the commercial SCOs, and the area will be fenced to prevent access. If it is determined during design that SWMUs 23 and 32 cannot be covered, the area will be encircled with a soil berm to prevent surface water and sediment releases and the area will be fenced to prevent access.

6. Groundwater Remedy
In-situ chemical oxidation (ISCO) or equivalent technology will be implemented to treat VOC contaminants in saturated soils and groundwater. A chemical oxidant will be injected into the subsurface to destroy the groundwater contaminants located near SWMU 24 (i.e., the Shell Plant; building) in the southern portion of the site where TCE and related degradation products were found at elevated levels. Groundwater is estimated to be 15 to 20 feet below ground surface (BGS) and the injection interval is estimated to be 15 to 25 feet BGS. The method and depth of injection will be determined during the remedial design.

Prior to the full implementation of this technology, additional sampling will be conducted to better delineate the treatment area and to locate the ISCO injection points. Any soil which is identified as a source of this groundwater contamination will be removed and disposed off-site if feasible. Laboratory and on-site pilot-scale studies are typically required to inform the full-scale design.

Dissolved inorganics will be monitored to assess the effect of soil/source soil removal.

7. Institutional Control
Imposition of an institutional control in the form of an environmental easement for the controlled property which will:

- require the remedial party or site owner to complete and submit to the Department a periodic certification of institutional and engineering controls in accordance with Part 375-1.8 (h)(3);
- allow the use and development of the controlled property for commercial use and industrial use as defined by Part 375-1.8(g), although land use is subject to local zoning laws;
- restrict the use of groundwater as a source of potable or process water, without necessary water quality treatment as determined by the NYSDOH or County DOH; and
- require compliance with the Department approved Site Management Plan.

8. Site Management Plan
A Site Management Plan is required, which includes the following:

a. An Institutional and Engineering Control Plan that identifies all use restrictions and engineering controls for the site and details the steps and media-specific requirements necessary to ensure the following institutional and/or engineering controls remain in place and effective:

Institutional Controls: The Environmental Easement list in remedy element No. 7 above.

Engineering Controls: The consolidation area listed in remedial element No. 4 including the Part 360 cap and the soil covers listed in remedial element No. 5 above.

This plan includes, but may not be limited to:

- an Excavation Plan which details the provisions for management of future excavations in areas of remaining contamination;

- a provision for further investigation and remediation should large-scale redevelopment occur, if any of the existing structures are demolished, or if the subsurface is otherwise made accessible. The nature and extent of contamination in areas where access was previously limited or unavailable will be immediately and thoroughly investigated pursuant to a plan approved by the Department. Based on the investigation results and the Department determination of the need for a remedy, a Remedial Action Work Plan (RAWP) will be developed for the final remedy for the site, including removal and/or treatment of any source areas to the extent feasible. Citizen Participation Plan (CPP) activities will continue through this process. Any necessary remediation will be completed prior to, or in association with, redevelopment. This includes all buildings and locations of former buildings;

- a provision for demolition of the Shell Plant Building if unsafe, inactive or vacant;

- a provision should redevelopment occur to ensure no soil exceeding protection of groundwater concentrations will remain below storm water retention basin or infiltration structures.

- descriptions of the provisions of the environmental easement including any land use, and groundwater use restrictions;

- a provision for evaluation of the potential for soil vapor intrusion in any existing or future buildings on the site, including but not limited to the existing Shell Plant building, the existing occupied office building, and the active warehouse, including provisions for implementing actions recommended to address exposures related to soil vapor intrusion;

- a provision that should a building foundation or building slab be removed in the future, a cover system consistent with that described in Paragraph 5 above will be placed in any areas where the upper one foot of exposed surface soil exceeds the applicable soil cleanup objectives (SCOs)

- provisions for the management and inspection of the identified engineering controls;

- maintaining site access controls and Department notification;

- the steps necessary for the periodic reviews and certification of the institutional and/or engineering controls; and,

- a provision for the monitoring and maintenance of sediment traps installed to control contaminated sediment from entering and re-impacting the drainageways during the remedial action and a timeframe applicable to stabilizing the streambeds.

b. A Monitoring Plan to assess the performance and effectiveness of the remedy. The plan includes, but may not be limited to:

- monitoring of groundwater to assess the performance and effectiveness of the remedy;

- monitoring of the consolidation cell;

- wetland and stream monitoring plan which will include provisions for replanting and removal of invasive species for a period of 5 years;

- a schedule of monitoring and frequency of submittals to the Department; and,

- monitoring for vapor intrusion for any buildings on the site as may be required by the Institutional and Engineering Control Plan discussed above.

c. A Maintenance Plan for the sediment traps and cover systems noted above.

9. Financial Assurance
Unless implementation of the remedy for the site is completed (excluding Site Management) within 60 months of the date of issuance of the final Record of Decision (ROD), Hercules/Dyno-Nobel shall post financial assurance using one or more of the financial instruments in 6 NYCRR 373-2.8, in the amount of the cost projection for the remainder of the remedy selected in the Record of Decision (ROD). Financial assurance must include all remedial activities for the site that have not been implemented.

Exhibit A

Nature and Extent of Contamination

This section describes the findings of the Remedial Investigation for all environmental media that were evaluated. As described in Section 6.1, samples were collected from various environmental media to characterize the nature and extent of contamination. The 2014 Corrective Measures Study incorporates the historical investigation data for this site and is the primary document upon which this PRAP is based.

For each medium for which contamination was identified, a table summarizes the findings of the investigation. The tables present the range of contamination found at the site in the media and compares the data with the applicable SCGs for the site. The contaminants are arranged into two categories; volatile organic compounds (VOCs), and inorganics. For comparison purposes, the SCGs are provided for each medium that allows for unrestricted use. For soil, if applicable, the Restricted Use SCGs identified in Section 4 and Section 6.1.1 are also presented.

Waste/Source Areas

As described in the 2014 Revised CMS Study report, waste/source materials were identified at the site and are impacting groundwater, soil, surface water, sediment and soil vapor.

Wastes are defined in 6 NYCRR Part 375-1.2(aw) and include solid, industrial and/or hazardous wastes. Source areas are defined in 6 NYCRR Part 375(au). Source areas are areas of concern at a site were substantial quantities of contaminants are found which can migrate and release significant levels of contaminants to another environmental medium. Wastes and source areas were identified at the site at a number of Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs). Figure 3 shows the SWMUs and AOCs. There are no known source areas located off-site.

A SWMU includes any discernible unit at which solid wastes have been placed at any time, irrespective of whether the unit was intended for the management of hazardous or solid wastes. Such units include any area at the site where solid wastes have been routinely and systematically released. An AOC is an area at the site, or an off-site area, which was not at the time known to be SWMU, where hazardous wastes and/or constituents are present or are suspected to be present as a result of a release from the site. Detailed description of the SWMUs and AOCs is presented in the Soils section below.

A VOC source area is located in the immediate area of the Shell Plant (SWMUs 24, 30, and 37) and inorganics (metals) are in the balance of the SWMUs, some of which are located in the Wetlands Complex. SWMUs 22, 23, 32, and 35 are locations that were previously used for on-site disposal of various wastes. Because of the potential presence of energetic materials within these SWMUs, investigative activities were restricted to the perimeter and adjacent areas. The waste/source areas identified will be addressed in the remedy selection process.

Groundwater

Groundwater beneath the site is subdivided into a shallow groundwater zone (dominated by silts and clays) and a deeper groundwater zone comprised of gravels and sands. Groundwater flow in the shallow zone is mainly towards the east, with localized convergence of surface water and groundwater to form wetland areas (see Figure 4). The groundwater flow within the deeper overburden appears to be strongly aligned to the intermittent stream feature, which flows from the southwest to the northeast across the southern end of the site. Bedrock was encountered at depths ranging between 1.5 ft. below ground surface and 85.1 ft. below ground surface.

Groundwater samples were collected to assess groundwater conditions on-site. Semi-annual groundwater monitoring from select monitoring wells has been performed at the site since 2001. The monitoring well network includes monitoring wells located in the vicinity of the Shell Plant (MW-3, MW-4A, MW-4B, MW-21R, MW-21D, MW-22R, MW-22D, and MW-25S), which are monitored for VOCs, and monitoring wells located downgradient of SWMUs/AOCs located in the northern Active Plant Area (MW-2B, MW-15S, MW-15D, MW-16S, MW-24S, MW-24D, MW-26S, and MW-26D), which are monitored for inorganics.

The results indicate that contamination in shallow and intermediate overburden along with some shallow and intermediate bedrock groundwater at the site exceeds the SCGs for volatile organic compounds and inorganics. Contaminated groundwater is not known to have migrated off-site.

Table 1 - Groundwater

Detected Constituents	Concentration Range Detected (ppb)[a]	SCG[b] (ppb)	Frequency Exceeding SCG
VOCs			
1 1 1-Trichloroethane	ND to 47,000	5	22 of 128
1 1-Dichloroethane	ND to 500	5	6 of 128
1 1-Dichloroethene	ND to 43,000	5	27 of 128
1 2-Dichloroethane	ND to 500	0.6	5 of 128
Acetone	ND to 17,000	50	3 of 128
Chloroform	ND to 160	7	1 of 128
cis-1 2-Dichloroethene	ND to 720	5	33 of 128
Dibromochloromethane	ND to 100	50	3 of 128
Methylene Chloride	ND to 4,300	5	6 of 128
Tetrachloroethene	ND to 150	5	1 of 128
trans-1 2-Dichloroethene	ND to 12	5	3 of 128
Trichloroethene	ND to 810,000	5	59 of 128
Inorganics (Total Metals *ug*/L)			
Aluminum	ND to 34,400	100	70 of 281
Antimony	ND to 6.4	3	1 of 281
Arsenic	ND to 48.1	25	1 of 281
Cadmium	ND to 41.5	5	8 of 281
Chromium	ND to 57.6	50	4 of 281

Cobalt	ND to 30.6	5	10 of 281
Iron	ND to 61300	300	82 of 281
Lead	ND to 168	25	4 of 281
Magnesium	ND to 37,400	35,000	3 of 281
Manganese	ND to 3,880	300	36 of 281
Selenium	ND to 1,470	10	44 of 281
Sodium	ND to 90,200	20,000	39 of 281
Thallium	ND to 3.9	0.5	1 of 281
Vanadium	ND to 60.5	5	6 of 281
Zinc	ND to 73,000	2,000	1 of 281

Notes:
a - ppb: parts per billion, which is equivalent to micrograms per liter, ug/L, in water.
b - SCG: Standard Criteria or Guidance - Ambient Water Quality Standards and Guidance Values (TOGs 1.1.1), 6 NYCRR Part 703, Surface water and Groundwater Quality Standards, and Part 5 of the New York State Sanitary Code (10 NYCRR Part 5).

The primary VOC groundwater contaminants are limited to the vicinity of the Shell Plant Building (SWMUs 24, 30, and 37), associated with operation of the former explosives manufacturing.

Based on the findings of the RI, the past disposal of hazardous waste has resulted in the contamination of groundwater. The site contaminants that are considered to be the primary contaminants of concern which will drive the remediation of groundwater to be addressed by the remedy selection process are: trichloroethene, 1,1,1-trichloroethane, methylene chloride, cis-1,2-dichloroethene, 1,1-dichloroethane, 1,1-dichloroethene, and 1,2-dichloroethane and inorganic metals such as arsenic, barium, cadmium, copper, lead mercury and selenium. It should be noted that dissolved metals were not analyzed and may be found at lower concentrations if filtered samples were analyzed.

Soil

With the exception of the Shell Plant, the site impacts are related to inorganics (metals. arsenic, barium, cadmium, copper, lead, mercury, and selenium) were identified as the primary constituents of primary concern in the Active Plant Area exceeding the commercial and industrial use SCOs. Arsenic, barium, cadmium, copper, and lead are predominantly present in the northern and southern portions of the Active Plant Area.

Solid Waste Management Units (SWMUs):

- SWMU No. 1: Shooting Pond - This unit managed off-specification explosive pentaeryythritol tetranitrate (PETN), secondary explosive diazodinitrophenol (DDNP), secondary explosive cyclotetramethylene tetranetramine (HMX), polymer bound explosive (PBX), secondary explosive cyclotrimethylene trinitramine (RDX), lead azide, lead styphnate, detonation caps and devices, and sump powder waste. Interim Remedial Measures at this unit did not find any explosives at reactive quantities. However, metals concentrations were found in the pond sediment above the screening criteria.
- SWMU No. 2: Burning Cage Incinerator - This unit managed approximately 1,200 to

2,500 pounds of explosive-contaminated waste per burn with approximately 500 pounds of ash generated at each of two to four burns per week.

- SWMU No. 3: Copper Wire Burning Area - This unit managed (burned) scrap copper wire covered with plastic insulation until July 1993. The waste usually included some blasting caps. The waste potentially contained, or has in the past contained, arsenic, copper, cadmium, lead, mercury, selenium, silver, and chromium.
- SWMU No. 4: Iron Wire Burning Area - This unit burned scrap iron wire covered with plastic insulation. The waste included blasting caps. The waste potentially contained arsenic, barium, cadmium, lead, mercury, selenium, silver, and chromium.
- SWMU No. 5: Wire Burning Area III - Facility personnel were not able to identify what waste had been burned at the unit. The unit showed dark stains and was littered with bits of paper and wire.
- SWMU Nos. 6 and 7: Open Burning Pads - These units managed up to 500 pounds at a time of reactive and ignitable wastes, which were not suitable for open detonation. The residual waste may have also contained arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver, or tellurium.
- SWMU No. 8: Former Burning Area - This unit managed reactive and ignitable wastes, which were not suitable for open detonation. The waste may have contained arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver, or tellurium.
- SWMU No. 9: Waste Powder Catch Basins - Building 2037 - This unit managed waste powder (unknown type) in water.
- SWMU No. 10: Waste Powder Catch Basins - Building 2048 - This unit managed waste PETN, RDX, HMX, PBX, and DDNP powder in water.
- SWMU No. 11: Waste Powder Catch Basins - Building 2049 - This unit managed waste DDNP powder (unknown type) in water.
- SWMU No. 13: Former Waste Powder Catch Basins, Lead Azide Building - The unit managed waste lead azide powder in water (Hazardous Waste Code K046).
- SWMU No. 21: Lead Recycling Unit Area - This unit managed waste ignition powders and blasting cap components containing lead and selenium.
- SWMU No. 22: Former Landfill - Potentially hazardous and non-hazardous wastes, including ash, flashed debris, and general building debris are reported to have been disposed in this unit.
- SWMU No. 23: Former Dump - This unit managed used equipment and 55-gallon drums and has potentially managed PCB-containing transformers.
- SWMU No. 24: Former Wastewater Treatment Facility - This unit is known to have managed acidic wastewaters and waste degreaser solvents, and potentially explosive-containing process waters and explosive-containing waste oils.
- SWMU No. 26: Burnable Waste Satellite Areas - These units consisted of open-topped metal dumpsters, which managed waste packaging materials possibly contaminated with explosive materials.
- SWMU No. 29: Drainage Ditch (Downgradient of Building 2049) - This unit managed process wastewaters containing potentially explosive material and may have managed waste degreaser solvents.
- SWMU No. 30: Drainage Ditch (Downgradient of Building 2036) - This unit managed acidic process wastewaters potentially containing explosive material and waste degreaser solvents.

- SWMU No. 32: Old Dump (near water tower) - The wastes managed by this unit are unknown. Miscellaneous metal debris and the remains of old drums were observed during the second Visual Site Inspection (VSI).
- SWMU No. 33: Mercury Fulminate Tanks Area - This unit formerly consisted of wooden tanks, which managed a protective water bath that may have contained trace amounts of mercury fulminate.
- SWMU No. 35: Stone Fence Dump - The wastes managed by this unit include metal drums and debris. It could not be determined if other materials have also been managed at the unit.
- SWMU No. 37: Former Shell Plant Drum Storage Area - This unit managed waste degreaser solvents, including TCE and Freon, in drums stored directly on the ground.
- SWMU No. 39: Former Wash Water Discharge Area (Building 2009) - This unit managed PETN and DDNP powders in water.
- SWMU No. 40: Pilot Line Condensate Collection Sump - This unit managed steam condensate that contained trace amounts of lead styphnate.
- SWMU No. 42: SAC Building Steam Collection Canisters - This unit managed steam condensate containing fuse powders and DDNP.
- SWMU No. 46: Vacuum Line Condensate Collection Sump Building 2059 – This unit managed steam condensate that potentially contained trace amounts of antimony sulfide, barium salts, boron, HMX, RDX, dibutylphthalate, diphenylamine, graphite, latex, lead azide, lead dioxide, lead styphnate, nitrocellulose, nitroglycerin, PETN, potassium nitrate, stearic acid, tetrazene, tetryl, viton, and zirconium.
- SWMU No. 47: Building 2058 Fuse Room - This unit consisted of a wooden box which collected wash water containing lead and selenium.
- SWMU No. 48: Mercury Fulminate Area - This unit consists of a fill area for construction and demolition debris from various projects throughout the facility. The presence of mercury fulminate has been documented in this area.
- SWMU 52: Former Commercial Lab Shooting Area - This unit is located immediately adjacent to the training center. This unit currently consists of a vegetated area with obvious soil staining and evidence of shot debris and cap remnants. Available information indicates that this area was used for testing (shooting) commercial blasting caps for an unknown period of time ceasing in the early to mid-1990s. Additionally, shot debris accumulated in a water tank in the former commercial laboratory was spread on the grass and soil in this area.
- SWMU 54: Former Historical Production Area – This unit is located in the central portion of the site and consists of the north and south press areas, charge room and shell room. This area was in use when production began at the facility in 1912 and was phased out sometime before the mid-1930s.
- SWMU 56: Vent System for Static Security Testing Chamber.

<u>Areas of Concern (AOC)</u>:

The areas of concern (AOC) identified in the RCRA Facility Investigation (RFI) are shown in Figure 3 and summarized below.

- AOC A: Kerosene Tank Leak - This AOC contains soil stained with a small amount of kerosene, which has leaked from a storage tank.

- AOC B: Open Burning Pads Area - This AOC is an area of soil to which waste explosive debris and kerosene has been released.
- AOC C: Open Detonation Pit - This AOC consists of a metal-sided pit, which managed detonators and blasting caps produced at the facility.
- AOC D: Detonation Test Building - This unit is used to test detonators and blasting caps produced at the facility.
- AOC G*:* Former Drying House - All that remains of the original structure is debris consisting of bricks, concrete, piping, metal sheeting, and a section of boardwalk.
- AOC H: Former Drying House – This unit is very similar to AOC G with regard to other types of debris present.
- AOC I: Roof Drainage from Deto Building – This unit conveys shot debris from roof of Deto building (from permitted air emissions source) onto ground near down spout.
- AOC J: Former Drying House - All that remains of the original structure is debris consisting of bricks, concrete, piping, and metal sheeting.
- AOC M: Former Drying House - This unit is very similar to AOC G with regard to other types of debris present.
- AOC N: Former Drying House - This unit is very similar to AOC G with regard to other types of debris present.
- AOC O: Former Drying House - This unit is very similar to AOC G with regard to other types of debris present.

The majority of mercury impacts in site soils were identified at the following locations:

- the western central portion of the Active Plant Area in the vicinity of the former mercury fulminate tanks area (SWMUs 9, 10, 11, 29, and 33);
- the northeastern portion of the Active Plant Area which was formerly the Burnable Waste Satellite Accumulation Area (SWMU 26G), Open Detonation Pit (AOC C), and Detonation Test Building (AOC D);
- the southeastern portion of the Active Plant Area at SWMU 13 (Waste Powder Catch Basins for the Lead Azide Building);
- SWMU 52 Former Commercial Lab Shooting Area, which is transected be the northern drainage way; and
- SWMU 54 (Former Historical Production Area) which is transected by the southern drainage way.

Arsenic, barium, cadmium, copper, and lead are predominantly present in the northern and southern portions of the Active Plant Area.

- The highest concentrations of arsenic were detected at SWMU 52 and AOC H.
- The highest concentrations of barium were at SWMUs 7, 8, and AOC B.
- The highest concentrations of cadmium were at SWMUs 3 and 5.
- The highest concentrations of copper were at SWMUs 3 and 5.
- The highest concentrations of lead were at SWMU 52.

The majority of selenium impacts in site soils were identified in the northern portion of the site in and around the former open burning pads (SWMUs 6, 7, 8, and AOC B) and the burnable waste satellite accumulation areas (SWMU 26G, AOC C, and AOC D). These areas are consistent with the ecological exposure evaluation performed in the Active Plant Area, which identified exposure to selenium in N1 and N3 areas as the greatest potential risk to wildlife receptors that potentially forage on at the margins of the facility.

Based on a comparison of COC concentrations with the SCOs, SWMUs 26E, 39, 42, 46, 47, and 56 were determined to require no further action in the subsurface due to low or no exceedances of the commercial use SCOs but surface soils which do not meet the commercial SCOs would require one-foot soil cover system. A pre-design study will be implemented to determine locations requiring a cover.

SWMUs 22, 23, 32, and 35 are locations that were previously used for on-site disposal of various wastes. The presence of potentially reactive materials at these landfills was identified as a safety concern if excavation was proposed. These SWMUs do not present a significant hazard in place. Rather, the hazards are associated with conducting intrusive activities or handling/processing such materials which subjects the materials to potential ignition sources such as friction, heat, shock or static electricity, without which there is no potential for explosion. This risk was acknowledged in the RFI Work Plan (Eckenfelder, 1997b) and soil sampling was restricted to the perimeter of the landfill SWMUs.

A total of 1,736 samples were collected from the SWMUs and AOCs. These samples were analyzed for all inorganic metals as well as selenium. The table below identifying the levels and locations of soil contamination is arranged into five columns; SWMU/AOC, Inorganics (metals) Detected, Maximum Concentration Detected, SCGs, Number of Exceedances and Total Number of samples taken. Additional soil sampling will be required during a pre-design investigation to inform the design. This investigation will include any samples necessary to further assess surface soils and soils in the top one foot of the site.

Table 2 - Soil

SWMU/AOC	Detected Constituents	Concentration Range Detected (ppm)[a]	Unrestricted SCG[b] (ppm)	Frequency Exceeding Unrestricted SCG	Restricted Use SCG[c] (ppm)	Frequency Exceeding Restricted SCG
Inorganics						
SWMU 2 and AOC A	Copper	ND to 70,000	50	11 of 33	270	15 of 33
Same as above	Cadmium	ND to 98	2.5	3 of 33	9.3	1 of 33
Same as above	Lead	ND to 4,800	63	9 of 33	1,000	3 of 33
Same as above	Arsenic	ND to 17	13	10 of 33	16	1 of 33
SWMU 3 and 5	Copper	ND to 100,000	50	7 of 21	270	7 of 21
Same as above	Cadmium	ND to 940	2.5	7 of 21	9.3	4 of 21
Same as above	Lead	ND to 5,200	63	3 of 21	1,000	1 of 21
Same as above	Arsenic	ND to 54	13	2 of 21	16	2 of 21
SWMU 4	Cadmium	ND to 16	2.5	10 of 13	9.3	1 of 13
Same as above	Copper	ND to 1600	50	11 of 13	270	7 of 13
Same as above	Arsenic	ND to 32	13	12 of 13	16	2 of 13
SWMUs 6, 7, 8, 32 & AOC B	Barium	ND to 17,000	350	45 of 53	400	7 of 53

Same as above	Lead	ND to 14000	63	52 of 53	1,000	4 of 53
Same as above	Selenium	ND to 7,900	3.9	45 of 53	1,500	1 of 53
SWMU 9	Mercury	ND to 110	0.18	20 of 21	47	3 of 21
SWMU 10	Mercury	ND to 750	0.18	29 of 31	47	12 of 31
SWMU 11	Mercury	ND to 240	0.18	15 of 16	47	2 of 16
SWMU 13	Mercury	ND to 150	0.18	22of 29	47	4 of 29
SWMU 21	Barium	ND to 6200	350	2 of 30	400	1 of 30
Same as above	Copper	ND to 320	50	5 of 30	270	1 of 10
Same as above	Lead	ND to 27,000	63	11 of 30	1,000	2 of 30
SWMU 26D	Lead	ND to 1,800	63	8 of 17	1,000	2 of 17
Same as above	Copper	ND to 3,400	50	5 of 17	270	3 of 17
SMWU 26E	Selenium	0.63 to 7	3.9	1of 6	1,500	0 of 6
Same as above	Mercury	0.2 to 17	0.18	5 of 6	47	0 of 6
SWMU 26G, AOCs C & D	Arsenic	ND to 72	13	3 of 36	16	2 of 36
Same as above	Copper	ND to 8,800	50	8 of 36	270	4 of 36
Same as above	Mercury	ND to 1,500	0.18	18 of 36	47	2 of 36
Same as above	Selenium	ND to 1,600	3.9	15 of 36	1,500	1 of 36
SWMU 29	Mercury	ND to 140	0.18	4 of 7	47	1 of7
SWMU 33	Mercury	ND to 7,400	0.18	19 of 21	47	6 of 21
SWMU 39	Selenium	ND to 911	3.9	2 of 21	1,500	0 of 21
Same as above	Cobalt	ND to 34	N/A	0 of 21	N/A	0 of 21
SWMU 40	Lead	ND to 2,000	63	2 of 11	1,000	1 of 11
SWMU 42	Selenium	0.66 to 76	3.9	2 of 11	1,500	0 of 11
Same as above	Chromium	15 to 94	30	0 of 11	400	0 of 11
SWMU 46	Lead	ND	63	ND	1,000	0 of 3
SWMU 47	Selenium	0.69 to 99	3.9	7 of 12	1,500	0 of 12
SWMU 48	Copper	ND to 3900	50	3 of 18	270	2 of 18
Same as above	Mercury	ND to 15	0.18	2 of 18	47	0 of 18
SWMU 52	Lead	ND to 41,000	63	60 of 186	1,000	17 of 186
Same as above	Arsenic	ND to 130	13	39 of 186	16	21 of 186
Same as above	Copper	ND to 29,000	50	96 of 186	270	46 of 186
Same as above	Mercury	ND to 2,100	0.18	69 of 186	47	10 of 186
Same as above	Barium	ND to 1,300	350	15 of 186	400	11 of 186
SWMU 54	Mercury	ND to 2,100	0.18	46 of 51	47	9 of 51
SWMU 56	Selenium	ND to 15.1	3.9	1 of 3	1,500	0 of 3
AOC- G	Arsenic	ND to 46	13	7 of 13	16	6 of 13
Same as above	Copper	ND to 972	50	11 of 13	47	5 of 13
AOC- H	Arsenic	ND to 337	13	7 of 19	16	3 of 19
Same as above	Copper	ND to 2,590	50	18 of 19	270	11 of 19
Same as above	Lead	ND to 16,100	63	18 of 19	1,000	5 of 19
AOC- I	Lead	ND to 3,220	63	5 of 20	1,000	2 of 20
AOC- J	Arsenic	ND to 59	13	1 of 8	16	1 of 8
Same as above	Copper	ND to 12,300	50	3 of 8	270	2 of 8
Same as above	Lead	ND to 1,150	63	3 of 8	1,000	1 of 8
AOCs M, N, O	Arsenic	ND to 83	13	11of 44	16	7 of 44
Same as above	Copper	ND to 2,190	50	13 of 44	270	5 of 44
Same as above	Lead	ND to 5,500	63	28 of 44	1,000	6 of 44
VOCs						

Table 1 – Soil continued

No Data Available						

Notes:

a - ppm: parts per million, which is equivalent to milligrams per kilogram, mg/kg, in soil;

b - SCG: Part 375-6.8(a), Unrestricted Soil Cleanup Objectives.

c - SCG: Part 375-6.8(b), Restricted Use Soil Cleanup Objectives for the Protection of Public Health for {Insert Allowable Use} Use, unless otherwise noted.

The primary soil contaminants are inorganics associated with residues and disposal from the manufacture of explosives. This contamination is primarily associated with the SWMUs and AOCs shown on Figure 3.

Based on the findings of the Remedial Investigation, the past disposal of hazardous waste has resulted in the contamination of soil. The site contaminants identified in soil which are considered to be the primary contaminants of concern, to be addressed by the remedy selection process are, copper, cadmium, lead, arsenic, barium selenium and mercury.

Surface Water

Water entering the Active Plant Area of the site comes from direct precipitation and runoff from Hussey Hill on the west side of the site. Surface water flows across the site primarily through the two drainage ways crossing the site from west to east. A third drainage way runs across the southern edge of the Active Plant Area. Surface water flows into the Wetlands Complex from both the Active Plant Area and from intermittent and perennial tributaries which feed the Wetlands Complex from the south.

The outlet from the Wetlands Complex is a perennial stream that discharges to an unnamed tributary of Plantasie Creek. This tributary and others of Plantasie Creek flow northward into Rondout Creek approximately two miles north of the site. Rondout Creek discharges into the Hudson River north of Port Ewen, New York (Figure 1).

SWMU 1/22 Wetlands Complex:

The Wetlands Complex (SWMU 1/22) generally refers to the wetlands surrounding SWMUs 1, 22, and 35 within the site property. Investigations were conducted in the SWMU 1/22 Wetlands Complex to evaluate potential ecological impacts associated with site-related inorganics in surface water, sediment, and biological tissues, including sediment investigation, surface water characterization, fish community evaluation, and biological tissue sampling. Surface water sampling was conducted within the SWMU 1/22 Wetlands Complex. The results are summarized below in Table 3. Concentrations of inorganics in filtered samples did not exceed NYSDEC surface water quality standards (SWQS).

Table 3 - SWMU 1/22 Wetlands Complex- Surface Water

Total Inorganics (ug/L)	Maximum Concentration Detected (ug/L) Filtered	NYSDEC Class C SWQS (ug/L) Filtered*	Frequency Total Number of Samples 9
Cadmium	ND	2.52	0 of 9
Copper	12.0	11.0	1 of 9
Lead	0.26	4.9	0 of 9
Mercury	ND	0.77	0 of 9
Selenium	1.4	4.6	0 of 9
Zinc	4.5	101.2	0 of 9

Notes:
* Based on 127 mg/L Hardness
SWQS = Surface Water Quality Standard
μg/L = micrograms per liter
ND= Analyte was not detected in any sample

Stream Channel Surface Water:
Surface water samples are also collected on a semi-annual basis from the stream channel running through the wetlands, at the northern property boundary. Results of this routine surface water sampling are provided in Table 4 below and show historically no elevated concentrations of inorganics above SCGs except for copper in one sample. in filtered samples. No VOCs were detected in surface water during the investigation.

Table 4 - Stream Channel Surface Water

Detected Constituents	Concentration Range Detected (ppb)[a]	NYSDEC Class C SWQS (ug/L) Filtered*	Frequency Exceeding SCG
Aluminum	ND- 31.6	100	0 of 5
Copper	ND -18.4	11	1 of 5
Iron	ND- 121	300	0 of5
Lead	ND	4.9	0 of5
Selenium	ND	4.6	0 of5
Silver	ND	0.1	0 of5
Zinc	ND -17.2	101.2	0 of5

Notes:
* Based on 127 mg/L Hardness
a - ppb: parts per billion, which is equivalent to micrograms per liter, ug/L, in water.
b-SCG: Ambient Water Quality Standards and Guidance Values (TOGs 1.1.1) and 6 NYCRR Part 703: Surface Water and Groundwater Quality Standards.

Concentrations of inorganics in filtered samples did not exceed NYSDEC SWQS. Findings indicate that chronic exposure to inorganics concentrations in surface water are not likely to result in adverse effects to aquatic life. No VOCs were detected in surface water during the investigation. Therefore, based on historical and routine sample results, corrective measures for surface water are not required and remediation will be based on the sediments being addressed as part of the proposed remedy.

Sediments

The sediment impacts within the Wetlands Complex are primarily associated with historic waste management practices in and adjacent to the Wetlands Complex. In addition, historic operations at the site located within and immediately adjacent to the site drainageways have led to soil impacts which have migrated into the drainageways and into the Wetlands Complex. The majority of impacted sediment has been deposited in the Wetlands Complex, with the concentrations of impacted sediments rapidly declining downstream (north) of the Wetlands Complex. The primary COCs detected in the Wetlands Complex are mercury, selenium, lead, cadmium, copper, mercury and zinc. Elevated concentrations of copper, lead, mercury, selenium, silver and zinc have also been detected in the sediment in site drainage ways which lead to the Wetlands Complex.

In the drainage way traversing the northern portion of the site, concentrations of inorganics did not indicate a distinct trend along the flow path or with sampling depth. The maximum concentration of mercury in the surface sampling interval was observed at the farthest upstream sampling station; concentrations of mercury varied by station and depth in the remaining samples. At the station near the discharge to the SWMU 1/22 Wetland Complex, concentrations of copper, mercury, selenium, silver, and zinc were elevated in the surficial sediment sample. If the concentration of a contaminant in sediment is below the Class A sediment guidance value (SGV), the contaminant can be considered to present little or no potential for risk to aquatic life. If the concentration of a contaminant is above the Class C SGV, there is a high potential for the sediments to be toxic to aquatic life.

Table 5 - Northern Drainage Sediment

Detected Constituents	Concentration Range (ppm)	SGV[b] (ppm)		Frequency Exceeding SGV	Frequency Exceeding SGV
		Class A	Class C	Class A	Class C
Arsenic	1.5 – 72.6	<10	> 33.0	3 of 20	1 0f 20
Cadmium	0.26 – 7.5	<1	>5	6 of 20	1 of 20
Copper	23.7 - 794	<32	>150	17 of 20	5 of 20
Lead	17.9 - 159	<36	>130	10 of 20	1 of 20
Mercury	0.25 - 29.4	<0.2	>1	20 of 20	13of 20
Silver	0.039 - 27.1	<1	>2.2	3 of 20	1 of 20
Zinc	65.4 - 1770	<120	>460	5 of20	2 of 20

Notes:
a - ppm: parts per million, which is equivalent to milligrams per kilogram, mg/kg, in sediment;
b - SGV: The Department's Technical Guidance for Screening Contaminated Sediments.

In the drainage way traversing the southern portion of the site, greater concentrations of inorganics were observed at sample stations downgradient (east) of the railroad tracks relative to stations on the Active Plant (Figure 6). The greatest concentrations were observed at the two sampling stations near the discharge to the wetlands. Sediments at these sampling stations generally had the greatest concentrations of copper, lead, mercury and zinc at all depths when compared to other stations within the drainage ditch.

Table 6 - Southern Drainage Sediment

Detected Constituents	Concentration Range (ppm)	SGV^{b} (ppm)		Frequency Exceeding SGV	Frequency Exceeding SGV
		Class A	Class C	Class A	Class C
Arsenic	1.3 - 90.4	<10	> 33.0	11 of 20	3 of 20
Cadmium	0.17 – 5.2	<1	>5	11 of 20	1 of 20
Copper	14.5 - 6940	<32	>150	16 of 20	10 of 20
Lead	16.1 - 356	<36	>130	12 of20	11 of 20
Mercury	0.12 - 114	<0.2	>1	18 of 20	17 of 20
Zinc	58.8 - 1770	<120	>460	12 of 20	10 of 20

Notes:
a - ppm: parts per million, which is equivalent to milligrams per kilogram, mg/kg, in sediment;
b - SCG: The Department's Technical Guidance for Screening Contaminated Sediments.

SWMU 1 managed off-specification PETN, DDNP, HMX, PBX, RDX, lead azide, lead styphnate, detonation caps and devices, and sump powder wastes. Since SWMU 1 was previously used as a shooting pond, energetic materials are potentially present within the pond sediments. The pond covers approximately 3,000 square feet (SF) and has a maximum depth of about 20 ft. at its center. Based on the sampling results, copper, lead, and mercury exceed the guidance values for Class C sediment established in NYSDEC's *Technical Guidance for Screening Contaminated Sediments* (NYSDEC, 1999), Revised 2014.

The results of bulk sediment analyses of target inorganics in the Wetland Complex and reference wetland stations are presented in Table 7 – SWMU 1/22 Sediment. In general, greater concentrations of target inorganics were observed at sediment sampling stations in close proximity to SWMU 22. Concentrations of lead, mercury, and selenium at upstream stations were generally comparable to or greater than concentrations at downstream stations.

Table 7 - SWMU 1/22 Sediment

Detected Constituents	Concentration Range (ppm)	SGV^{b} (ppm)		Frequency Exceeding SGV	Frequency Exceeding SGV
		Class A	**Class C**	**Class A**	**Class C**
Copper	524 – 18,800	<32	>150	8 of 8	8 Of 8
Lead	128 - 2060	<36	>130	8 of 8	7 Of 8
Cadmium	0.22 – 26.6	<1	>5	5 of 8	2 Of 8
Mercury	3.5 – 82.4	<0.2	>1	8 of 8	8 Of 8
Zinc	26.2 - 2110	<120	>460	7 of 8	3 Of 8

Notes:
a - ppm: parts per million, which is equivalent to milligrams per kilogram, mg/kg, in sediment;
b - SCG: The Department=s ATechnical Guidance for Screening Contaminated Sediments.

Based on the results of the June 2010 sediment sampling downstream of the SWMU 1/22 Wetlands Complex additional sampling was conducted to further characterize the concentrations of inorganics, particularly mercury, that were elevated in sediments. Analytical results of the downstream sediment sampling are provided on Figure 6 and summarized in Table 8.

The results of the downstream sediment sampling indicated concentrations of all metals exceeding their respective SGCs. The highest concentrations of inorganics, particularly copper and mercury, are found in the surface interval zero to one foot. The contaminated sediment is found off-site downstream as well. Additional off-site sediment remediation (beyond the area identified on Figure 7) will be addressed in a separate remedy.

Table 8 - Downstream Sediment

Detected Constituents	Concentration Range (ppm)	SGV[b] (ppm)		Frequency Exceeding SGV	Frequency Exceeding SGV
		Class A	Class C	Class A	Class C
Cadmium	0.45 – 3.3	<1	>5	3 of 6	0 of 6
Copper	179 - 2,440	<32	>150	6 of 6	6 of 6
Lead	25.9 - 128	<36	>130	5 of 6	0 of 6
Mercury	1.1 - 45.3	<0.2	>1	6 of 6	6 of 6
Zinc	89.3 - 404	<120	>460	5 of 6	0 of 6

Notes:
a - ppm: parts per million, which is equivalent to milligrams per kilogram, mg/kg, in sediment;
b - SCG: The Department=s ATechnical Guidance for Screening Contaminated Sediments.

Five pesticides, three VOCs, and five semi-volatile organic compounds (SVOCs) were detected in sediments from at least one of the sample locations. Thirteen additional naturally occurring inorganics were also detected in the wetland sediments. Comparisons of these detected constituents to available sediment screening criteria (NYSDEC, 1999), Revised June 2014, indicated only two slight exceedances for arsenic and manganese. The concentrations of detected organic constituents were all below applicable criteria. During a sampling event in 2010, some minor detections of VOCs were observed along with the presence of other petroleum hydrocarbon compounds was confirmed by the Extractable Petroleum Hydrocarbon (EPH) analysis but were below the sediment criteria. The primary sediment contaminants are inorganics including arsenic, cadmium, copper, lead, mercury and zinc associated with the disposal or deposition from runoff from the main plant area. Based on the findings of the Remedial Investigation, the disposal of hazardous waste has resulted in the contamination of sediment. The site contaminants that are considered to be the primary contaminants of concern which will drive the remediation of sediment to be addressed by the remedy selection process are, arsenic, cadmium, copper, lead, mercury and zinc.

Soil Vapor

The evaluation of the potential for soil vapor intrusion resulting from the presence of site related soil or groundwater contamination was evaluated by the sampling of, sub-slab soil vapor under structures, and indoor air inside structures. At this site due to the presence of buildings in the impacted area a full suite of samples was collected to evaluate whether soil vapor intrusion was occurring.

In 2002, four sub-slab soil gas samples were collected beneath the Shell Plant building and one ambient outdoor air sample was collected in the area because of the building's proximity to a localized VOC groundwater plume. Indoor air samples were not collected at that time because the machining equipment present in the building used lubricating oils that contained VOCs. TCE was found in one sub-slab sample (SG-4) at a concentration that exceeds the updated NYSDOH *Guidance for Evaluating Vapor Intrusion in the State of New York* matrix criteria for requiring mitigation. In 2007, a sub-slab sample and indoor air sample were collected in the same area as SG-4, as well as an ambient air sample. Detected concentrations of TCE and cis-1,2- DCE in indoor air are at least in part, likely attributable to underlying soil gas, but were not detected at levels that require mitigative actions. Based upon the high sub-slab concentrations of TCE, mitigation of the Shell Plant building was recommended but it was agreed that annual indoor air sampling would be conducted instead of a mitigation system at that time. The building is not currently in use and not occupied. Should the building become re-occupied, the potential for soil vapor intrusion to occur will be re-evaluated.

Based on the concentration detected, and in comparison with the NYSDOH Soil Vapor Intrusion Guidance, the primary soil vapor contaminant is TCE which is associated with operations at the Shell Plant.

Based on the findings of the Remedial Investigation, the presence of TCE has resulted in the contamination of soil vapor. The site contaminant that is considered to be the primary contaminant of concern which will drive the remediation of soil vapor to be addressed by the remedy selection process is TCE.

Exhibit B

Description of Remedial Alternatives

The following alternatives were considered based on the remedial action objectives (see Section 6.5) to address the contaminated media identified at the site as described in Exhibit A.

SOIL ALTERNATIVES

Soil Alternative 1: No Action

The No Action Alternative is evaluated as a procedural requirement and as a basis for comparison. This alternative leaves the site in its present condition and does not provide any additional protection to public health and the environment. There are no costs with this Alternative.

Soil Alternative 2: Cover System with Institutional Controls

This alternative consists of constructing a cover over SWMUs 23 and 32 which cannot be excavated. If the pre-design investigation reveals that the upper one foot of exposed surface soil at other locations on site which cannot be excavated exceeds the applicable soil cleanup objectives (SCOs) these additional areas would also require a cover. Where a soil cover is required, a minimum of one foot of soil will be placed over a demarcation layer, with the upper six inches of soil of sufficient quality to maintain a vegetative layer. Soil cover material, including any fill material brought to the site, must meet the SCOs for cover material for commercial use of the site as set forth in 6 NYCRR Part 375-6.7(d). Substitution of other materials and components may be allowed where such components already exist or are a component of the tangible property to be placed as part of site redevelopment. Such components may include, but are not necessarily limited to: pavement, concrete, paved surface parking areas, sidewalks, building foundations and building slabs.

This alternative includes implementation of a land use restriction in the form of an environmental easement, preparation of a Site Management Plan (SMP), and maintenance of the fencing surrounding the facility.

Present Worth:	$256,000
Capital Cost:	$234,000
Annual Costs:	$2,000

Soil Alternative 3: Excavation, On-Site Consolidation of Non-hazardous Waste & Part 360 Capping

This alternative consists of excavating all source areas and on-site soils in the upper foot in the SWMUs/AOCs that exceed commercial SCOs and soils in ecological buffer areas which exceed the protection of ecological resources SCOs (on-site) and unrestricted SCOs (off-site), except for soils within SWMUs 23 and 32 which may contain energetics. Soil in any off-site upland areas which are impacted by site contaminants of concern deposited by flood events will be excavated to meet unrestricted use SCOs.

Approximately 17,000 cubic yards (CY) of soil from the plant site above commercial use SCOs are estimated to require excavation under this alternative. Non-hazardous soils would be consolidated on-site in the Wetlands Complex and capped. All excavated soils determined to be hazardous based on TCLP analysis will be transported off-site for proper disposal at an approved hazardous waste (Part 373) disposal facility.

SWMUs 23 and 32 (Energetic Areas) and non-source soil less than one foot deep which exceeds the commercial SCOs and which cannot be excavated will require a soil cover. On-site soil which does not exceed the above excavation criteria may be used as part of the soil cover, to backfill the excavation to the extent that a sufficient volume of on-site soil is available and establish the designed grades at the site.

On-site soil which does not exceed the above excavation criteria or the protection of groundwater SCOs for any constituent may be used beneath the cover system, including below the water table, to backfill the excavation or re-grade the site.

Clean fill meeting the requirements of 6 NYCRR Part 375-6.7(d) for commercial use of the site will be brought in to replace the excavated soil and establish the designed grades at the site.

The consolidation area will be located within the on-site wetland complex at AOC P, (SWMUs 1, 22, and 35) which cannot be excavated due to the potential presence of energetic (explosive) materials. The consolidation area will be approximately 5 acres in size and will receive an engineered cap designed, constructed and maintained in conformance with the substantive requirements of 6 NYCRR Part 360 solid waste regulations. The consolidation cell will also comply with RCRA requirements for a corrective action management unit (CAMU). The exact dimensions of the consolidation unit will be determined during the design phase of the remedy. The final acreage of wetlands taken for the consolidation area would be offset by new wetlands constructed adjacent to the consolidation cell.

This alternative includes implementation of an environmental easement, preparation of a SMP, and maintenance of the fencing surrounding the consolidation unit.

Present Worth:	$3,870,000
Capital Cost:	$2,470,000
Annual Costs:	$12,000

Soil Alternative 4: Excavation and Off-Site Disposal

This alternative consists of excavation of all source areas and on-site soils in the upper foot in the SWMUs/AOCs which exceed commercial SCOs, soils in the ecological buffer areas which exceed the protection of ecological resources SCOs, as defined by 6 NYCRR Part 375-6.8, soil in any off-site upland areas which exceed unrestricted use and which are impacted by site contaminants of concern deposited by flood events; and transporting the soil to an off-site facility for disposal. This includes approximately 17,000 cubic yards (CY) of contaminated soil exceeding the commercial use SCOs in the Active Plant Area. All excavated soils determined to be hazardous based on TCLP analysis would be disposed at an approved hazardous waste (Part 373) disposal facility.

On-site soil which does not exceed the above excavation criteria may be used as part of the cover system, to backfill the excavation to the extent that a sufficient volume of on-site soil is available and establish the designed grades at the site.

On-site soil which does not exceed the above excavation criteria or the protection of groundwater SCOs for any constituent may be used beneath the cover system, including below the water table, to backfill the excavation or re-grade the site.

Clean fill meeting the requirements of 6 NYCRR Part 375-6.7(d) for commercial use of the site will be brought in to replace the excavated soil and establish the designed grades at the site.

This alternative includes implementation of an environmental easement and preparation of a SMP.

Present Worth:	$6,900,000
Capital Cost:	$6,830,000
Annual Costs:	$5,000

Soil Alternative 5: Excavation and Off-site Disposal (Unrestricted Use)

This alternative consists of excavation of all soils and sediment (OU1) which exceed unrestricted SCOs and transporting the soil to an off-site facility for disposal. This includes an estimated 69,000 cubic yards (CY) of contaminated soil and sediment. All excavated soils determined to be hazardous based on TCLP analysis would be disposed at an approved hazardous waste (Part 373) disposal facility. This alternative in conjunction with conjunction with groundwater Alternative 3 would constitute a remediation to pre-release conditions.

Present Worth:	$20,000,000 - $33,000,000*
Capital Cost:	$19,000,000 - $32,000,000*
Annual Costs:	$100,000

*depending how many CY are hazardous waste

SEDIMENT ALTERNATIVES

Sediment Alternative 1: No Action

The No Action Alternative is evaluated as a procedural requirement and as a basis for comparison. This alternative leaves the site in its present condition and does not provide any additional protection to public health and the environment. There would be no costs associated with this alternative.

Sediment Alterative 2: Cover System in the Wetlands Complex with Institutional Controls

This alternative calls for sediments to be covered to restrict direct contact with the contaminants. Where the upper one foot of exposed sediment exceeds the Class A sediment screening guidance, this alternative consists of construction a minimum of one foot of soil cover placed over a demarcation layer, with the upper six inches of soil of sufficient quality to maintain a vegetative layer. Soil cover material, including any fill material brought to the site, would meet the SCOs for cover material for the use of the site as set forth in 6 NYCRR Part 375-6.7(d).

In general, the cover system would consist of approximately 18 inches of clay material obtained from an on-site borrow pit which is sufficient to restrict direct contact with, and limit leaching of water through the underlying consolidated material.

In order to place a cover over the impacted sediments in the Wetlands Complex, the wetland would be dewatered, vegetation removed, and the creek rerouted around the cover area to prevent future erosion of the cover. The drainageways bisecting the facility would be covered with riprap, or similar, to prevent erosion and future transport of impacted sediment to the Wetlands Complex. A cover would require inspection and maintenance to ensure that it continues to function as a barrier restricting direct contact with the underlying soil.

Implementation of a land use restriction in the form of an environmental easement, preparation of a SMP, and maintenance of the fencing surrounding the facility and Wetlands Complex would additionally be required. This alternative would lead to the loss of wetlands. Due this loss, federal and state requirements require offsets and wetlands reconstruction.

Present Worth:	$3,570,000
Capital Cost:	$3,260,000
Annual Costs:	$23,000

Sediment Alternative 3: Excavation, On-Site Consolidation & Part 360 Capping

This alternative consists of temporary rerouting of surface water flow and dewatering the Wetlands Complex, excavating the sediment which exceeds the Class A guidance criteria in the Wetlands Complex (outside of the SWMUs), the drainageways bisecting the Active Plant Area and the area downstream sediment (off-site) of the Wetlands Complex to the native clay layer, dewatering and transporting the sediment to a designated area within the wetlands complex, constructing an aboveground consolidation unit, grading and compacting the sediment within the designated area, and constructing a 6NYCRR Part 360 cover over the consolidated material. After excavation, the wetlands area would be restored in accordance with federal and/or state mitigation requirements. The consolidation area would require inspection and maintenance to ensure that it continues to function as a barrier restricting direct contact with the contained sediment. The consolidation cell will also comply with RCRA requirements for a corrective action management unit (CAMU). A total of approximately 18,000 CY of sediment is estimated to require consolidation.

This alternative includes implementation of a land use restriction in the form of an environmental easement, preparation of a SMP, and maintenance of the fencing surrounding the consolidation unit.

Present Worth:	$5,480,000
Capital Cost:	$5,320,000
Annual Costs:	$12,000

<u>Sediment Alternative 4: Excavation and Off-Site Disposal</u>

This alternative consists of rerouting the wetlands stream, dewatering the Wetlands Complex, excavating the sediment which exceeds the Class A guidance criteria in the Wetlands Complex, the drainageways bisecting the Active Plant Area and the area downstream (off-site) to the native clay layer, and transporting the soil to an off-site facility for disposal. After excavation, the wetlands area would be restored in accordance with federal and/or state mitigation requirements.

Present Worth:	$ 7,380,000
Capital Cost:	$ 7,320,000
Annual Costs:	$ 5,000

GROUNDWATER ALTERNATIVES

<u>Groundwater Alternative 1: No Action</u>

The No Action Alternative is evaluated as a procedural requirement and as a basis for comparison. This alternative leaves the site in its present condition and does not provide any additional protection to public health and the environment. There are no costs associated with this Alternative.

<u>Groundwater Alternative 2: Monitored Natural Attenuation</u>

This alternative consists of use restrictions on groundwater, reliance on natural attenuation processes to reduce concentrations of contaminants in groundwater, and long-term groundwater monitoring to evaluate changes in groundwater conditions. A land use restriction in the form of an environmental easement would notify future property owners of the presence of contaminants in groundwater at the site, restrict the use of on-site groundwater, and notify the owners of the applicability of an SMP. Existing groundwater use laws [10 NYCRR 5-1.31(b)], which prohibit the use of existing process wells, if any, as well as installation of private wells where a public supply is available (unless approval is expressly granted by the public water authority), would continue to minimize potential human exposure to constituents in groundwater at concentrations exceeding the groundwater quality standards/guidance values. The use restriction would apply to groundwater beneath the Site.

A SMP would be prepared under this alternative to: (1) identify areas of impacted groundwater associated with the Site; and (2) address possible future intrusive activities that would result in the potential for contact with impacted groundwater (to minimize the performance of work below the water table and/or dewatering without appropriate controls and measures).

Long-term monitoring would be performed under this alternative to evaluate the effectiveness of natural attenuation over an extended period of time. Samples would be collected from selected existing monitoring wells and analyzed for COCs. The results of the groundwater monitoring would be summarized and presented to the NYSDEC in annual reports. After a five-year period, an evaluation of the long-term monitoring would be made and presented to the NYSDEC. Based on the analytical results and trends in groundwater constituent concentrations, modifications to the monitoring may be recommended.

It is assumed that annual sampling to document natural attenuation would be conducted for an additional 25 years (i.e., for a total of 30 years).

Present Worth:	$252,000
Capital Cost:	$0.00
Annual Costs:	$18,000

Groundwater Alternative 3: In-situ Treatment of Groundwater with Institutional Controls and Monitoring

This alternative consists of in-situ treatment technology such as chemical oxidation (ISCO), or equivalent technology, that would enhance the breakdown of VOCs which exceed groundwater standards.

In-situ chemical oxidation (ISCO) or equivalent technology will be implemented to treat contaminants in soil and groundwater. A chemical oxidant would be injected into the subsurface to destroy the groundwater contaminants located near SWMU 24 (aka the 'Shell Plant' building) in the southern portion of the site where TCE and related daughter products were found at elevated levels. Groundwater is estimated to be 15 to 20 feet below ground surface (BGS) and the injection interval is estimated to be 15 to 25 feet BGS. The method and depth of injection will be determined during the remedial design.

Prior to the full implementation of this technology, a pre-design program will be required, including a soil boring program along with the installation of additional wells to better delineate the impacted soils and groundwater and to locate the ISCO injection points more accurately. Laboratory and on-site pilot scale studies will be conducted to more clearly define design parameters. Between the pilot and the full-scale implementations, it is estimated that four shallow and four deep injection points will be installed. It is estimated that the chemical oxidant chemical oxidant will be injected during approximately two separate events over several months. Groundwater monitoring would be required to assess performance of this remedy.

A land use restriction in the form of an environmental easement would notify future property owners of the presence of constituents of potential concern in groundwater at the site, restrict the use of on-site groundwater, and notify the owners of the applicability of a Site Management Plan.

A Site Management Plan would be prepared under this alternative to: (1) identify areas of impacted groundwater associated with the site; and (2) address possible future intrusive activities that would result in the potential for contact with impacted groundwater (e.g. minimize the performance of work below the water table and/or dewatering without appropriate controls and measures). Long-term monitoring would be performed under this alternative to evaluate the effectiveness of the remedy. The results of the groundwater monitoring would be summarized and presented to the NYSDEC in annual reports. After a five-year period, an evaluation of the long-term monitoring would be made and presented to the NYSDEC.

Present Worth:	$602,000
Capital Cost:	$350,000
Annual Costs:	$19,000

Soil Vapor/Indoor Air Remedial Measures Alternative

Indoor air quality monitoring will be performed at the Shell Plant on an annual basis until the Shell Plant is demolished or rendered uninhabitable. If any building is constructed on the site, an SVI Investigation will be conducted as necessary and a Sub-Slab Depressurization System (SSDS) will be installed.

Present Worth:	$79,000
Capital Cost:	$0
Annual Costs:	$6,000

Exhibit C

Remedial Alternative Costs

Remedial Alternative	Capital Cost ($)	Annual Costs ($)	Total Present Worth ($)
No Action	0	0	0
Soil – Commercial Use			
***Soil Alternative 2 –** Cover System with Institutional Controls (only for SWMUs 23 and 32 which contain energetic materials)	234,000	2,000	256,000
***Soil Alternative 3 –** Excavation, On-site Consolidation of Non-hazardous Waste & Part 360 Capping	2,470,000	12,000	3,870,000
Soil Alternative 4 – Excavation and Off-site Disposal	6,830,000	5,000	6,900,000
Soil Alternative 5 – Excavation and Off-site disposal (Unrestricted Use)	19,000,000	100,000	20,000,000
Sediment			
Sediment Alternative 2 – Cover System in the Wetlands Complex with Institutional Controls	3,260,000	23,000	3,570,000
***Sediment Alternative 3 –** Excavation, On-site Consolidation & Part 360 Capping	5,320,000	12,000	5,480,000
Sediment Alternative 4 – Excavation and Off-site Disposal	7,320,000	5,000	7,380,000
Groundwater			
Groundwater Alternative 2 – Monitored Natural Attenuation	0	18,000	252,000
***Groundwater Alternative 3 –** In-situ Treatment of Groundwater with Institutional Controls and Monitoring	350,000	19,000	602,000
Indoor Air / Soil Vapor			
***Soil Vapor/Indoor Air Remedial Measures**	0	6,000	79,000

Remedial Alternative	Capital Cost ($)	Annual Costs ($)	Total Present Worth ($)
Recommended Alternative: Cover System with Institutional Controls (SWMUs 23 and 32 containing energetic materials), Soil and Sediment Excavation, On-site Consolidation of Non-hazardous Waste & Part 360 Capping, In-situ Treatment of Groundwater with Institutional Controls and Monitoring, Soil Vapor/Indoor Air Remedial Measures	**8,374,000**	**51,000**	**10,287,000**

- Present Worth is calculated by adding the capital cost (e.g., engineering cost, development of site management plan, installation of the monitoring network, or installation of a future soil vapor intrusion mitigation system, etc.) to the present worth of the annual costs (e.g., operation, maintenance, monitoring, and periodic review) computed for the expected duration of the operation of the remedy or 30 years, whichever is less.
- Capital Cost is the cost to engineer and construct the remedy.
- Annual Cost is average annual Site Management cost over the duration of the operation of the remedy or 30 years whichever is less. It does not vary for different years.
- * Proposed Remedy Elements

Exhibit D

SUMMARY OF THE PROPOSED REMEDY

SOIL REMEDY

The Department is proposing Alternative Soil Alternative 2: Soil Cover (only for two specific SWMUs for which potential explosive material may be impracticable) and Soil Alternative 3: Excavation, On-Site Consolidation of Non-hazardous Waste & Part 360 Capping as the remedy for soil remedy for this site. These alternatives would achieve the remediation goals for the site by eliminating direct contact with contaminated soils above the commercial SCOs and prevent migration of contaminated soils from the plant site to the wetlands. The elements of this remedy are described in Section 7. Select elements of the proposed remedy are depicted in Figure 5.

Basis for Selection

The proposed remedy is based on the results of the RI and the evaluation of alternatives. The criteria to which potential remedial alternatives are compared are defined in 6 NYCRR Part 375. A detailed discussion of the evaluation criteria and comparative analysis is included in the FS report.

The first two evaluation criteria are termed "threshold criteria" and must be satisfied in order for an alternative to be considered for selection.

1. <u>Protection of Human Health and the Environment.</u> This criterion is an overall evaluation of each alternative's ability to protect public health and the environment.

Soil Alternative 1 (No Action) does not provide any protection to public health and the environment and will not be evaluated further. The proposed remedy, a combination of Soil Alternatives 2 and 3 satisfies this criterion by eliminating direct contact with the soil which exceeds the commercial SCOs for the site through excavation, consolidation and capping of the soils and covering of soils that cannot be excavated. Soil Alternative 4, Excavation and Off-site disposal would also satisfy this criterion by removing the soils which exceed the SCO from the site. Soil Alternative 5, Excavation and Off-site Disposal (Unrestricted Use) would also satisfy this criterion by removing the soils which exceed the unrestricted SCO from the site. Soil Alternatives 4 and 5, however, may only meet a portion of this criterion if technically impracticable to excavate the energetic areas of the site. In this case Alternatives 4 and 5 would be combined with Alternative 2 for select areas of the site.

2. <u>Compliance with New York State Standards, Criteria, and Guidance (SCGs).</u> Compliance with SCGs addresses whether a remedy will meet environmental laws, regulations, and other standards and criteria. In addition, this criterion includes the consideration of guidance which the Department has determined to be applicable on a case-specific basis.

Soil Alternatives 2 and 3 would satisfy this criterion by covering and/or removing the contaminated soils and consolidating them in an engineered cell with a Part 360 capping system. These alternatives comply with SCGs to the extent practicable. They address areas of contamination and comply with the restricted use soil cleanup objectives at the surface through construction of a cover system and the excavation, consolidation and capping of contaminated soils. Alternatives 4 and 5 also comply with this criterion by removing contaminated soils and disposing of them off-site, however it may me technically impracticable to excavate all of the potentially explosive materials. Because Alternatives 2, 3, 4 and 5 satisfy the threshold criteria, the remaining criteria are particularly important in selecting a final remedy for the site.

The next six "primary balancing criteria" are used to compare the positive and negative aspects of each of the remedial strategies.

3. Long-term Effectiveness and Permanence. This criterion evaluates the long-term effectiveness of the remedial alternatives after implementation. If wastes or treated residuals remain on-site after the selected remedy has been implemented, the following items are evaluated: 1) the magnitude of the remaining risks, 2) the adequacy of the engineering and/or institutional controls intended to limit the risk, and 3) the reliability of these controls.

Long-term effectiveness is best accomplished by those alternatives involving excavation of the contaminated soils. Alternatives 3 and 4 result in the excavation of the contaminated soils in the top 1 foot only. Alternative 2 creates a barrier. Alternative 5 results removal of all contaminated soil to pre-disposal conditions. All except Alternative 5 involve contaminated soils remaining either under cover or cap and require long-term management and property restrictions. These controls are reliable for the contamination that would remain. Institutional and engineering controls are not required for Alternative 5.

4. Reduction of Toxicity, Mobility or Volume. Preference is given to alternatives that permanently and significantly reduce the toxicity, mobility or volume of the wastes at the site.

Alternative 2 would not reduce the toxicity or volume of contaminants remaining but is the only effective alternative for those areas with potential energetic materials. Alternative 3 (excavation, consolidation, and capping) reduces the mobility of on-site waste by managing it under a cap. Alternatives 4 and 5 (excavation and off-site disposal) reduce the toxicity, mobility, and volume of on-site waste by transporting approximately either 17,000 or 69,000 cubic yards of contaminated soil off-site for disposal. Soil Alternative 5 would achieve the greatest reduction in, mobility and volume.

5. Short-term Impacts and Effectiveness. The potential short-term adverse impacts of the remedial action upon the community, the workers, and the environment during the construction and/or implementation are evaluated. The length of time needed to achieve the remedial objectives is also estimated and compared against the other alternatives.

Alternatives 2 through 4 all have short-term impacts which could easily be controlled. Alternative 2 would have a small impact, as only clean cover soil would be imported to the site and placed. Alternatives 3 and 4 would have a greater potential impact even employing routine engineering controls, due to the much greater volume of traffic, noise, and potential odor releases associated with excavation of a large volume of soil. However, Alternative 5 would have a significant impact due to the traffic resulting from the transportation of approximately 69,000 cubic yards of contaminated soil off-site and potential importation of a significant volume of soil for backfill, resulting in the increased potential for spills and releases on public road, wear and tear of public roads, and generation of greenhouse gas emissions.

6. Implementability. The technical and administrative feasibility of implementing each alternative are evaluated. Technical feasibility includes the difficulties associated with the construction of the remedy and the ability to monitor its effectiveness. For administrative feasibility, the availability of the necessary personnel and materials is evaluated along with potential difficulties in obtaining specific operating approvals, access for construction, institutional controls, and so forth.

Alternatives 2 through 4 are readily implementable. However, Alternatives 4 and 5 would necessitate increased truck traffic, noise and dust and increased structural stress on local roads for several to many months. Alternative 5 may not be fully implementable due to the probable presence of explosives in certain areas, excavation of which may be technically impracticable.

7. Cost-Effectiveness. Capital costs and annual operation, maintenance, and monitoring costs are estimated for each alternative and compared on a present worth basis. Although cost-effectiveness is the last balancing criterion evaluated, where two or more alternatives have met the requirements of the other criteria, it can be used as the basis for the final decision.

The costs of the alternatives vary significantly. Alternative 2 has a low cost, but the contaminated soil would not be addressed other than by institutional and engineering controls. However, Alternative 2 is the only option for those areas with the potential for energetic materials. With its large volume of soil to be handled, Alternatives 4 and 5 (excavation and off-site disposal) would have the highest present worth cost with Alternative 5 likely at least doubling the cost of the remedy without significant environmental benefit and with significant short-term impacts. On-Site Consolidation and Capping (Alternative 3) would be significantly less expensive than Alternative 4, yet it would provide equal protection.

8. Land Use. When cleanup to pre-disposal conditions is determined to be infeasible, the Department may consider the current, intended, and reasonable anticipated future land use of the site and its surroundings in the selection of the soil remedy.

Since the anticipated use of the site will be commercial/ industrial, Alternatives 2, 3, and 4 all allow for the current, intended, and reasonable anticipated future land use of the site. Residual contamination remaining on-site in conjunction with all of these alternatives would be controllable with implementation of a Site Management Plan and/or engineering controls.

The final criterion, Community Acceptance, is considered a "modifying criterion" and is taken into account after evaluating those above. It is evaluated after public comments on the Proposed Remedial Action Plan have been received.

9. Community Acceptance. Concerns of the community regarding the investigation, the evaluation of alternatives, and the PRAP are evaluated. A responsiveness summary will be

prepared that describes public comments received and the manner in which the Department will address the concerns raised. If the selected remedy differs significantly from the proposed remedy, notices to the public will be issued describing the differences and reasons for the changes.

The combination of Soil Alternatives 2 and 3 is being proposed because, as described above, it satisfies the threshold criteria and provides the best balance of the balancing criterion.

SEDIMENT REMEDY

The Department is proposing Sediment Alternative 3 Excavation, On-Site Consolidation in an Engineered Cell & Part 360 Capping System as the remedy for sediment for this site. Sediment Alternative 3 would achieve the remediation goals for the site by excavating uncontained contaminated sediment and containing it within an engineered cell to eliminate the potential for direct contact, migration and ecological impacts. The elements of this remedy are described in Section 7. Select elements of the proposed remedy are depicted in Figure 5.

Basis for Selection

The proposed remedy is based on the results of the RI and the evaluation of alternatives. The criteria to which potential remedial alternatives are compared are defined in 6 NYCRR Part 375. A detailed discussion of the evaluation criteria and comparative analysis is included in the FS report.

1. Protection of Human Health and the Environment. Sediment Alternative 1 (No Action) does not provide any protection to public health and the environment and will not be evaluated further. Sediment Alternative 2 would not address sediment contamination outside of the Wetland Complex and would not be fully protective of the environment. The proposed sediment remedy (Sediment Alternative 3) would satisfy this criterion by capping sediments in the Wetland Complex area and removing contaminated sediments from the remaining wetland areas drainage ditches and downstream areas. Alternative 4 (Excavation and Off-site Disposal) would also satisfy this criterion by removing all contaminated sediment from these areas.

2. Compliance with New York State Standards, Criteria, and Guidance (SCGs). Alternative 2 would not fully comply with SCGs because sediment outside of the Wetland Complex would not be remediated. Alternative 3 would comply with SCGs to the extent practicable by excavating sediments exceeding the Class A guidelines where energetic materials are not present, and consolidating and capping contamination where energetic materials may be present. Alternative 4 also complies with this criterion by removing contaminated sediments and disposing of them off-site. Because Alternatives 3 and 4 satisfy the threshold criteria, the remaining criteria are particularly important in selecting a final remedy for the site.

3. Long-term Effectiveness and Permanence. Long-term effectiveness is best accomplished by those alternatives involving excavation of the contaminated sediments. Alternatives 3 and 4 result in the removal of contaminated sediments. Alternative 3 would involve contaminated sediments remaining under a cap and require long-term treatment and management with property

restrictions. These controls are reliable for the contamination that would remain.

4. Reduction of Toxicity, Mobility or Volume. Alternative 3 (excavation, consolidation, and capping) reduces the mobility of on-site waste by managing it under a cap. Alterative 4 (excavation and off-site disposal) reduces the mobility and volume of on-site waste by transporting approximately 18,000 cubic yards of contaminated soil off-site.

5. Short-term Impacts and Effectiveness. Alternatives 3 and 4 have short-term impacts which could easily be controlled. Alternatives 3 and 4 would have a potential impact even employing conventional construction practices, due to the volume of traffic, noise, and potential odor releases associated with excavation of a large volume of sediment. However, Alternative 4 would have the largest impact due to the traffic resulting from the transportation of approximately 18,000 cubic yards of contaminated sediment off-site resulting in the increased potential for spills and releases on public road, wear and tear of public roads, and generation of greenhouse gas emissions.

Alternatives 3 and 4 are readily implementable. However, Alternative 4 would necessitate increased truck traffic, noise and dust and increased structural stress on local roads for several months.

7. Cost-Effectiveness. The costs of the alternatives vary significantly. With the large volume of sediment to be removed, Alternative 4 (excavation and off-site disposal) would have the highest present worth cost. Excavation, On-Site Consolidation in an Engineered Cell & Capping (Alternative 3) would be much less expensive than Alternative 4, yet it would provide equal protection.

8. Land Use. Since the anticipated use of the site is commercial/industrial, Alternatives 3 and 4 are compatible with the reasonably anticipated future land use with implementation of a Site Management Plan.

9. Community Acceptance. Alternative 3 is being proposed because, as described above, it satisfies the threshold criteria and provides the best balance of the balancing criterion.

GROUNDWATER REMEDY

The Department is proposing Alternative Groundwater Alternative 3: In-situ Treatment of Groundwater with Institutional Controls and Monitoring as the groundwater remedy for this site. Alternative 2 would achieve the remediation goals for the site by reducing the concentrations of contaminants in the groundwater which currently render the groundwater unusable without treatment and are a potential source of soil vapor. The elements of this remedy are described in Section 7. The location of the proposed remedy (Shell Plant) is depicted in Figure 3.

Basis for Selection

The proposed remedy is based on the results of the RI and experience with implementation of this technology at many sites statewide for this type of contamination. This technology was not evaluated in the FS, however, the concentrations of dissolved contamination are indicative of a source area and call for a more aggressive remedy. The criteria to which potential remedial alternatives are compared are defined in 6 NYCRR Part 375.

1. Protection of Human Health and the Environment. Groundwater Alternative 1 (No Action) does not provide any protection to public health and the environment and will not be evaluated further. Groundwater alternatives 2 and 3 would satisfy this criterion by limiting the use of groundwater at the site.

2. Compliance with New York State Standards, Criteria, and Guidance (SCGs). Alternative 2 relies upon natural processes to ultimately attain groundwater standards over an extended period of time. Alternative 3 uses in-situ treatment of groundwater with institutional controls and monitoring processes to actively reduce concentrations of VOCs in groundwater and achieve groundwater standards to the extent practicable.

3. Long-term Effectiveness and Permanence. Alternative 2 may result in attaining groundwater standards over the long term if it can be documented that the dissolved plume is stable and shrinking and contaminants are being eliminated. In-situ treatment along with monitoring processes may be more effective over the long-term at reducing concentrations of VOCs in groundwater. Through the establishment of a land use restriction and SMP, both alternatives would meet the groundwater RAOs related to potential direct contact, ingestion, and inhalation human health exposure pathways. The land use restriction and SMP would remain in place, unchanged, unless Site conditions were to change and make these measures unnecessary. If changes were to occur that would require modifications to the land use restriction/SMP, such modifications would be presented to the NYSDEC for review and approval, as appropriate.

Both the land use restriction and SMP would be apparent to possible future site owners during comprehensive due diligence activities performed in connection with property transfer. Taken together, these treatment processes and institutional controls could be expected to adequately and reliably provide for the management of groundwater exhibiting constituents at concentrations exceeding standards.

4. Reduction of Toxicity, Mobility or Volume. Given the apparent source area which may continue to feed the dissolved plume over an extended period of time, Alternative 2 would not likely reduce the toxicity or volume of the contaminants within the planning horizon. The control over mobility of the contaminants under alternative 2 would have to be demonstrated as a stable or shrinking plume is a necessary component of a natural attenuation remedy. The proposed groundwater alternative would result in the reduction of toxicity through destruction of contaminants of concern. As a result of targeting the source area of the groundwater contamination, the mobility and volume of the contaminants would also be reduced.

5. Short-term Impacts and Effectiveness. No short-term impacts would be anticipated with regard to Alternative 2. Implementation of a pilot study and the remedy for the proposed alternative requires the installation of injection and monitoring wells. Short-term impacts related to drilling operations are readily managed with conventional construction practices. Subsequent to the well installation, in-situ treatment and monitoring would be the only field work performed pursuant to this alternative. Personnel performing injections and groundwater monitoring would use PPE and follow requirements of a Site-specific HASP. No short-term environmental impacts or risks to the community are anticipated.

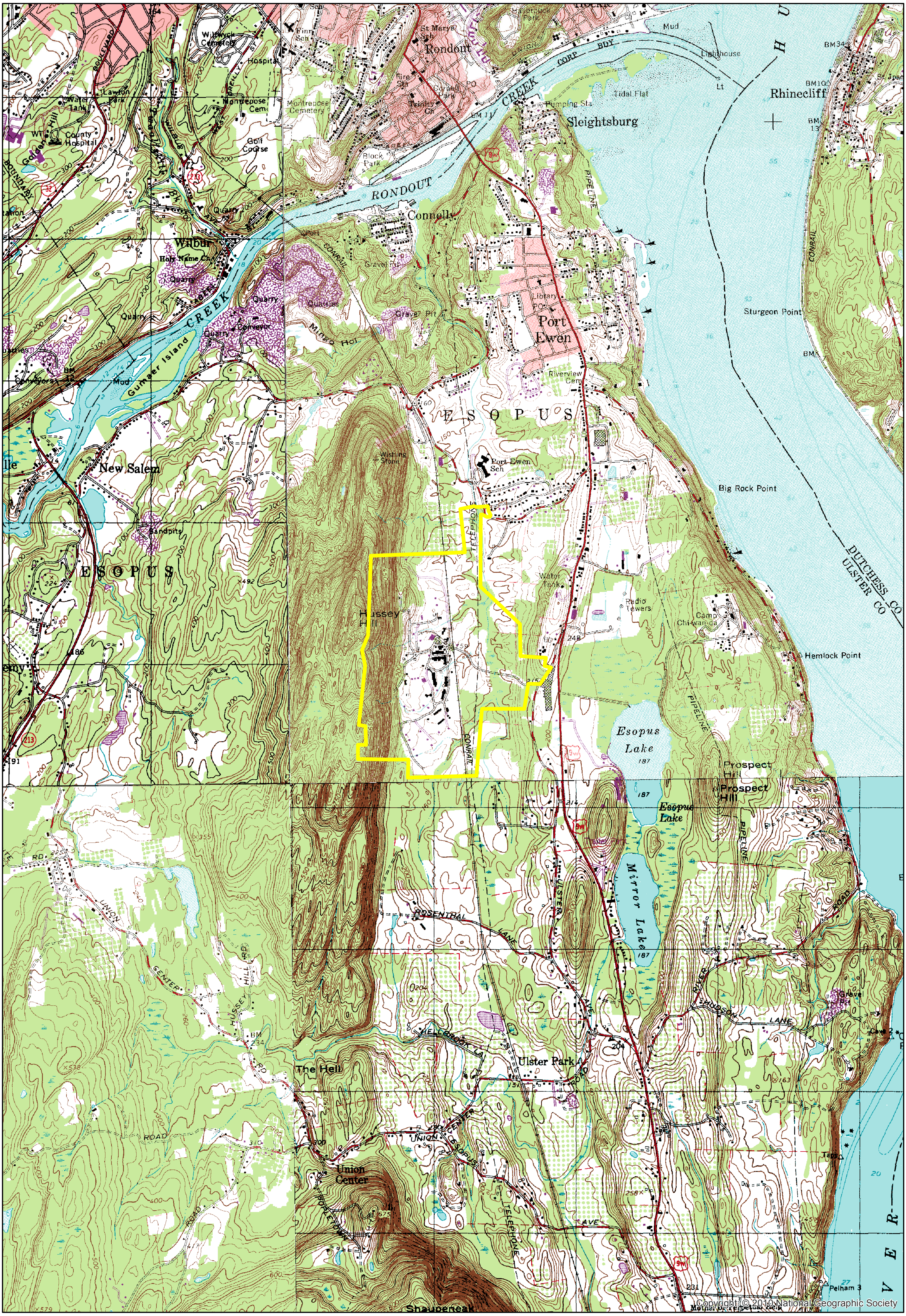
6. Implementability. Alternatives 2 and 3 are readily implementable as the technology has been widely used on sites with similar contamination.

7. Cost-Effectiveness. Alternatives 2 and 3 are cost effective due to their use over many years at many sites. The chemical oxidants are widely available. In-situ groundwater remediation technologies are generally more cost effective than extraction and treatment/active containment technologies over the long-term. Annual operation, maintenance, and monitoring are common conventional techniques.

8. Land Use. The anticipated use of the site is commercial/industrial and a restriction on the use of groundwater at the Site is already included in the current deed restrictions on the property. In addition, the residual contamination with the proposed alternative would be controllable with implementation of a Site Management Plan and environmental easement.

9. Community Acceptance. Concerns of the community regarding the investigation, the evaluation of alternatives, and the PRAP are evaluated. A responsiveness summary will be prepared that describes public comments received and the manner in which the Department will address the concerns raised. If the selected remedy differs significantly from the proposed remedy, notices to the public will be issued describing the differences and reasons for the changes.

The combination of alternatives is being proposed because, as described above, in aggregate they satisfy the threshold criteria and provide the best remedial action relative to the balancing criterion specified. Current and future property owners would be required to complete and submit annual certification to the NYSDEC that administrative and engineering controls that were put in place as part of the site remedy, are still place, have not been altered, and are still effective.



Legend

APPROXIMATE PROPERTY BOUNDARY

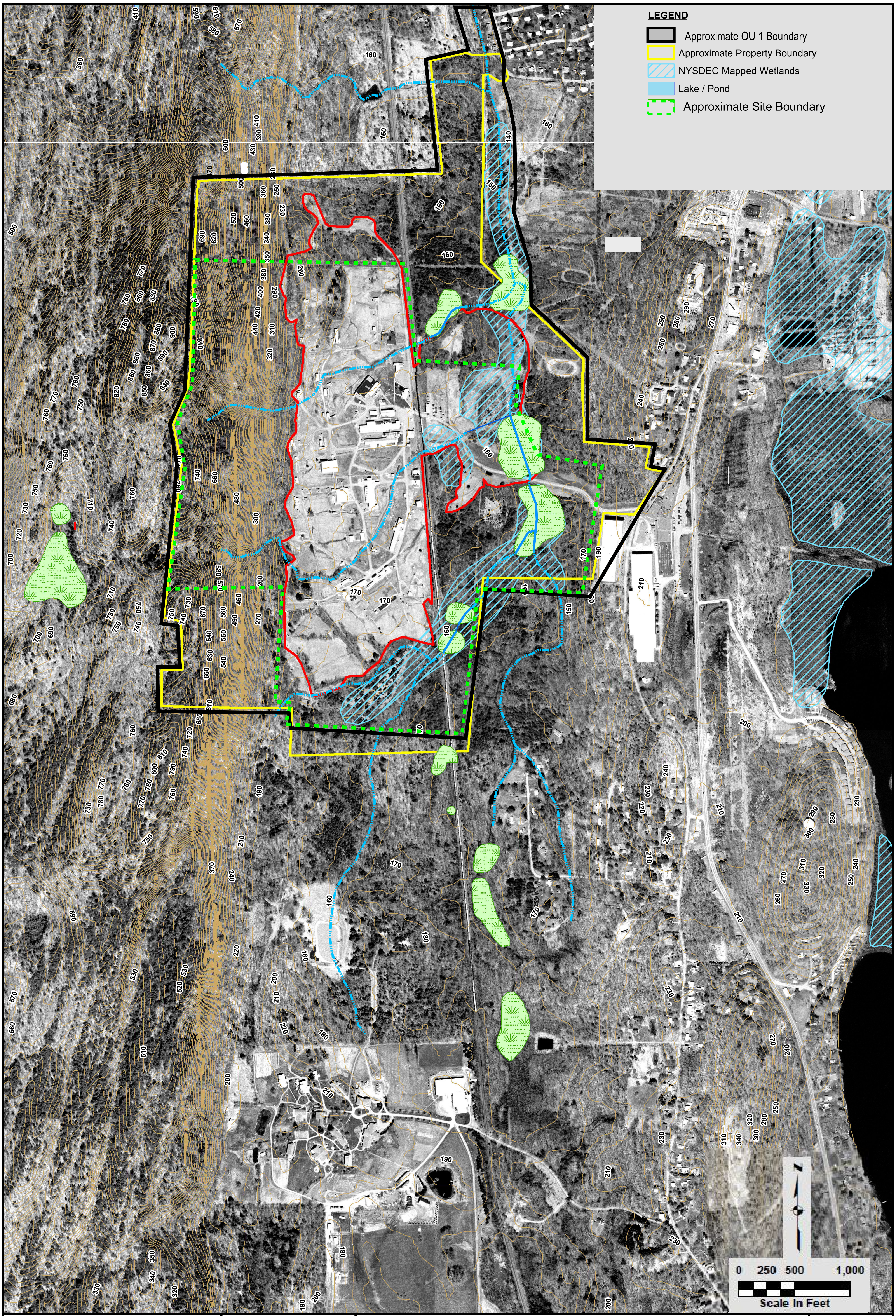
0 1,000 2,000 4,000
Feet

N

FIGURE 1 - SITE LOCATION MAP
DYNO NOBEL SITE
PORT EWEN, NEW YORK

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

EHS Support
consider it done



base map by: EHS Support consider it done

DYNO-NOBEL, INC.
PORT EWEN, NY.

Site Setting

FIGURE 2

Legend

- APPROXIMATE SWMU/AOC BOUNDARY
- APPROXIMATE PROPERTY BOUNDARY
- SWMU 1/22 BOUNDARY
- LAKE/POND
- SWAMP/MARSH
- NYSDEC MAPPED CLASS 2 WETLANDS
- NYSDEC MAPPED CLASS 3 WETLANDS
- PERENNIAL STREAM
- INTERMITTENT STREAM
- ARTIFICIAL PATH
- CONNECTOR
- RAILROAD

N

FIGURE 3. SWMUs & AOCs Location

DYNO NOBEL SITE
PORT EWEN, NEW YORK

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

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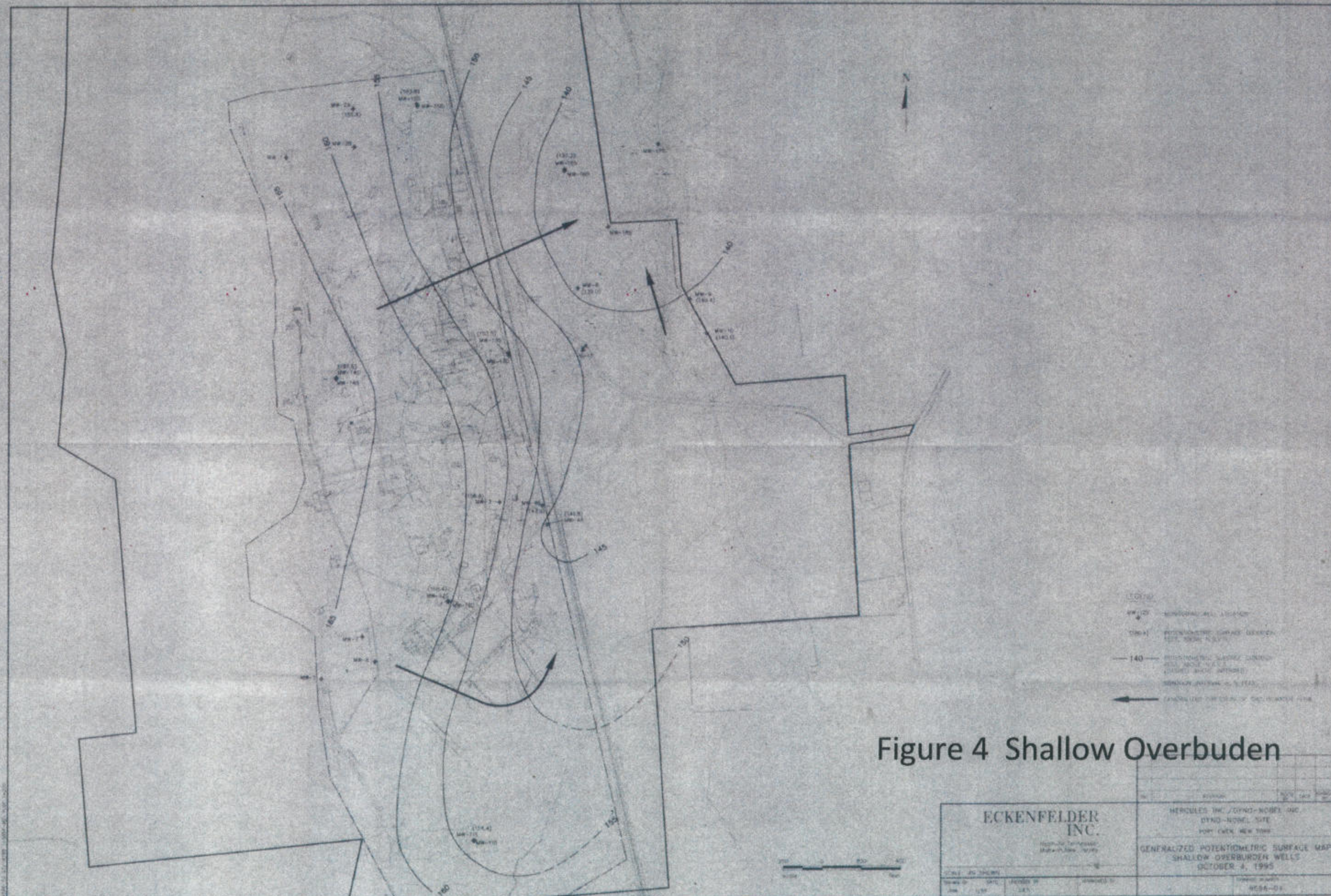
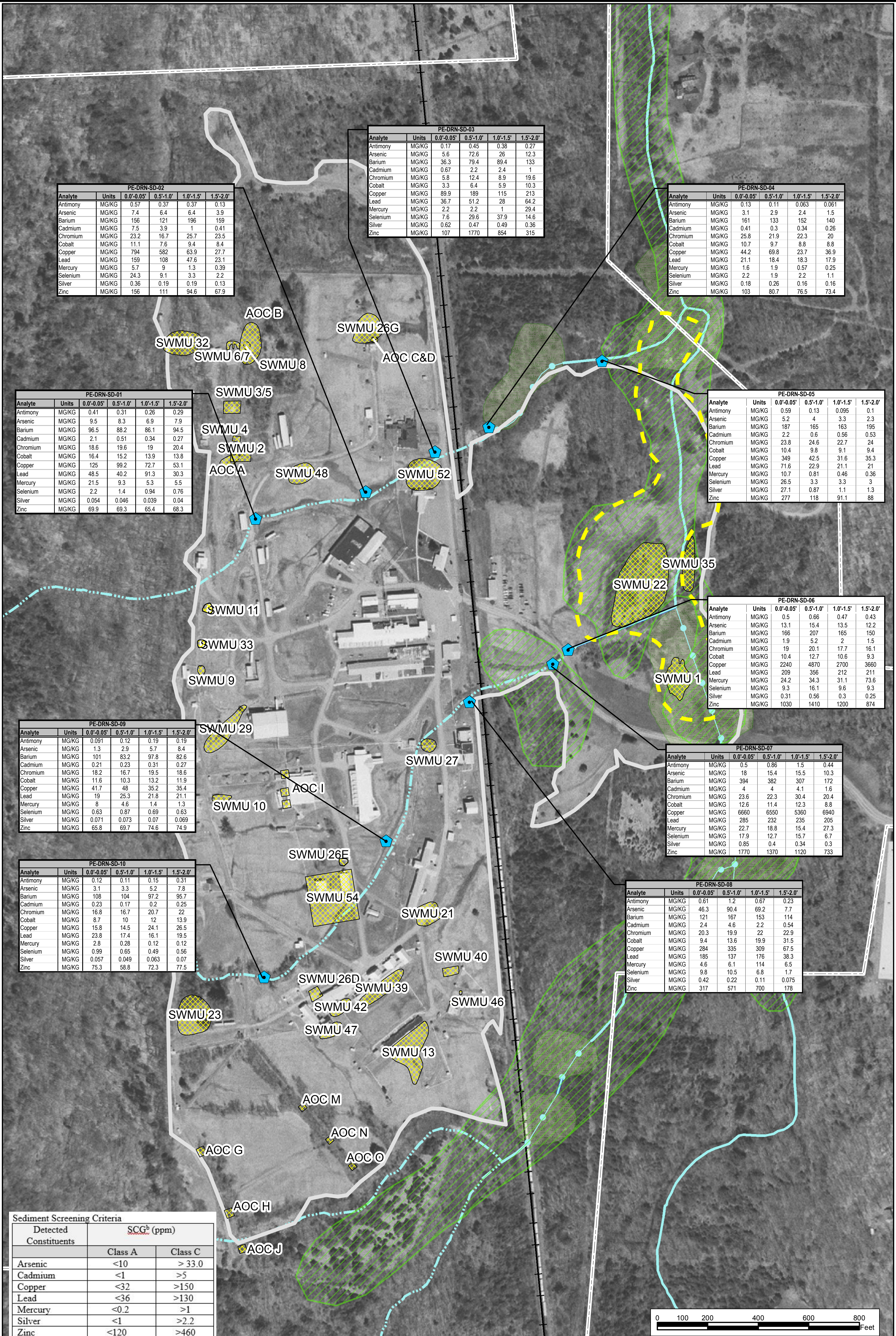


Figure 4 Shallow Overbuden



PE-DRN-SD-01					
Analyte	Units	0.0'-0.05'	0.5'-1.0'	1.0'-1.5'	1.5'-2.0'
Antimony	MG/KG	0.41	0.31	0.26	0.29
Arsenic	MG/KG	9.5	8.3	6.9	7.9
Barium	MG/KG	96.5	88.2	86.1	94.5
Cadmium	MG/KG	2.1	0.51	0.34	0.27
Chromium	MG/KG	18.6	19.6	19	20.4
Cobalt	MG/KG	16.4	15.2	13.9	13.8
Copper	MG/KG	125	99.2	72.7	53.1
Lead	MG/KG	48.5	40.2	91.3	30.3
Mercury	MG/KG	21.5	9.3	5.3	5.5
Selenium	MG/KG	2.2	1.4	0.94	0.76
Silver	MG/KG	0.054	0.046	0.039	0.04
Zinc	MG/KG	69.9	69.3	65.4	68.3

PE-DRN-SD-02					
Analyte	Units	0.0'-0.05'	0.5'-1.0'	1.0'-1.5'	1.5'-2.0'
Antimony	MG/KG	0.57	0.37	0.37	0.13
Arsenic	MG/KG	7.4	6.4	6.4	3.9
Barium	MG/KG	156	121	196	159
Cadmium	MG/KG	7.5	3.9	1	0.41
Chromium	MG/KG	23.2	16.7	25.7	23.5
Cobalt	MG/KG	11.1	7.6	9.4	8.4
Copper	MG/KG	794	582	63.9	27.7
Lead	MG/KG	159	108	47.6	23.1
Mercury	MG/KG	5.7	9	1.3	0.39
Selenium	MG/KG	24.3	9.1	3.3	2.2
Silver	MG/KG	0.36	0.19	0.19	0.13
Zinc	MG/KG	156	111	94.6	67.9

PE-DRN-SD-03					
Analyte	Units	0.0'-0.05'	0.5'-1.0'	1.0'-1.5'	1.5'-2.0'
Antimony	MG/KG	0.17	0.45	0.38	0.27
Arsenic	MG/KG	5.6	72.6	26	12.3
Barium	MG/KG	36.3	79.4	89.4	133
Cadmium	MG/KG	0.67	2.2	2.4	1
Chromium	MG/KG	5.8	12.4	8.9	19.6
Cobalt	MG/KG	3.3	6.4	5.9	10.3
Copper	MG/KG	89.9	189	115	213
Lead	MG/KG	36.7	51.2	28	64.2
Mercury	MG/KG	2.2	2.2	1	29.4
Selenium	MG/KG	7.6	29.6	37.9	14.6
Silver	MG/KG	0.62	0.47	0.49	0.36
Zinc	MG/KG	107	1770	854	315

PE-DRN-SD-04					
Analyte	Units	0.0'-0.05'	0.5'-1.0'	1.0'-1.5'	1.5'-2.0'
Antimony	MG/KG	0.13	0.11	0.063	0.061
Arsenic	MG/KG	3.1	2.9	2.4	1.5
Barium	MG/KG	161	133	152	140
Cadmium	MG/KG	0.41	0.3	0.34	0.26
Chromium	MG/KG	25.8	21.9	22.3	20
Cobalt	MG/KG	10.7	9.7	8.8	8.8
Copper	MG/KG	44.2	69.8	23.7	36.9
Lead	MG/KG	21.1	18.4	18.3	17.9
Mercury	MG/KG	1.6	1.9	0.57	0.25
Selenium	MG/KG	2.2	1.9	2.2	1.1
Silver	MG/KG	0.18	0.26	0.16	0.16
Zinc	MG/KG	103	80.7	76.5	73.4

PE-DRN-SD-05					
Analyte	Units	0.0'-0.05'	0.5'-1.0'	1.0'-1.5'	1.5'-2.0'
Antimony	MG/KG	0.59	0.13	0.095	0.1
Arsenic	MG/KG	5.2	4	3.3	2.3
Barium	MG/KG	187	165	163	195
Cadmium	MG/KG	2.2	0.6	0.56	0.53
Chromium	MG/KG	23.8	24.6	22.7	24
Cobalt	MG/KG	10.4	9.8	9.1	9.4
Copper	MG/KG	349	42.5	31.6	35.3
Lead	MG/KG	71.6	22.9	21.1	21
Mercury	MG/KG	10.7	0.81	0.46	0.36
Selenium	MG/KG	26.5	3.3	3.3	3
Silver	MG/KG	27.1	0.87	1.1	1.3
Zinc	MG/KG	277	118	91.1	88

PE-DRN-SD-06					
Analyte	Units	0.0'-0.05'	0.5'-1.0'	1.0'-1.5'	1.5'-2.0'
Antimony	MG/KG	0.5	0.66	0.47	0.43
Arsenic	MG/KG	13.1	15.4	13.5	12.2
Barium	MG/KG	166	207	165	150
Cadmium	MG/KG	1.9	5.2	2	1.5
Chromium	MG/KG	19	20.1	17.7	16.1
Cobalt	MG/KG	10.4	12.7	10.6	9.3
Copper	MG/KG	2240	4870	2700	3660
Lead	MG/KG	209	356	212	211
Mercury	MG/KG	24.2	34.3	31.1	73.6
Selenium	MG/KG	9.3	16.1	9.6	9.3
Silver	MG/KG	0.31	0.56	0.3	0.25
Zinc	MG/KG	1030	1410	1200	874

PE-DRN-SD-07					
Analyte	Units	0.0'-0.05'	0.5'-1.0'	1.0'-1.5'	1.5'-2.0'
Antimony	MG/KG	0.5	0.86	1.5	0.44
Arsenic	MG/KG	18	15.4	15.5	10.3
Barium	MG/KG	394	382	307	172
Cadmium	MG/KG	4	4	4.1	1.6
Chromium	MG/KG	23.6	22.3	30.4	20.4
Cobalt	MG/KG	12.6	11.4	12.3	8.8
Copper	MG/KG	6660	6550	5360	6940
Lead	MG/KG	285	232	235	205
Mercury	MG/KG	22.7	18.8	15.4	27.3
Selenium	MG/KG	17.9	12.7	15.7	6.7
Silver	MG/KG	0.85	0.4	0.34	0.3
Zinc	MG/KG	1770	1370	1120	733

PE-DRN-SD-08					
Analyte	Units	0.0'-0.05'	0.5'-1.0'	1.0'-1.5'	1.5'-2.0'
Antimony	MG/KG	0.61	1.2	0.67	0.23
Arsenic	MG/KG	46.3	90.4	69.2	7.7
Barium	MG/KG	121	167	153	114
Cadmium	MG/KG	2.4	4.6	2.2	0.54
Chromium	MG/KG	20.3	19.9	22	22.9
Cobalt	MG/KG	9.4	13.6	19.9	31.5
Copper	MG/KG	284	335	309	67.5
Lead	MG/KG	185	137	176	38.3
Mercury	MG/KG	4.6	6.1	114	6.5
Selenium	MG/KG	9.8	10.5	6.8	1.7
Silver	MG/KG	0.42	0.22	0.11	0.075
Zinc	MG/KG	317	571	700	178

PE-DRN-SD-09					
Analyte	Units	0.0'-0.05'	0.5'-1.0'	1.0'-1.5'	1.5'-2.0'
Antimony	MG/KG	0.091	0.12	0.19	0.19
Arsenic	MG/KG	1.3	2.9	5.7	8.4
Barium	MG/KG	101	83.2	97.8	82.6
Cadmium	MG/KG	0.21	0.23	0.31	0.27
Chromium	MG/KG	18.2	16.7	19.5	18.6
Cobalt	MG/KG	11.6	10.3	13.2	11.9
Copper	MG/KG	41.7	48	35.2	35.4
Lead	MG/KG	19	25.3	21.8	21.1
Mercury	MG/KG	8	4.6	1.4	1.3
Selenium	MG/KG	0.63	0.87	0.69	0.63
Silver	MG/KG	0.071	0.073	0.07	0.069
Zinc	MG/KG	65.8	69.7	74.6	74.9

PE-DRN-SD-10					
Analyte	Units	0.0'-0.05'	0.5'-1.0'	1.0'-1.5'	1.5'-2.0'
Antimony	MG/KG	0.12	0.11	0.15	0.31
Arsenic	MG/KG	3.1	3.3	5.2	7.8
Barium	MG/KG	108	104	97.2	95.7
Cadmium	MG/KG	0.23	0.17	0.2	0.25
Chromium	MG/KG	16.8	16.7	20.7	22
Cobalt	MG/KG	8.7	10	12	13.9
Copper	MG/KG	15.8	14.5	24.1	26.5
Lead	MG/KG	23.8	17.4	16.1	19.5
Mercury	MG/KG	2.8	0.28	0.12	0.12
Selenium	MG/KG	0.99	0.65	0.49	0.56
Silver	MG/KG	0.057	0.049	0.063	0.07
Zinc	MG/KG	75.3	58.8	72.3	77.5

Sediment Screening Criteria

Detected Constituents	SCG[b] (ppm)	
	Class A	Class C
Arsenic	<10	> 33.0
Cadmium	<1	>5
Copper	<32	>150
Lead	<36	>130
Mercury	<0.2	>1
Silver	<1	>2.2
Zinc	<120	>460

Legend

- SWMU 1/22 BOUNDARY
- APPROXIMATE SWMU/AOC BOUNDARY
- APPROXIMATE SITE BOUNDARY
- APPROXIMATE PROPERTY BOUNDARY
- NYSDEC MAPPED CLASS 2 WETLANDS
- NYSDEC MAPPED CLASS 3 WETLANDS
- SWAMP/MARSH
- SITE DRAINAGE SEDIMENT SAMPLES
- PERENNIAL STREAM
- INTERMITTENT STREAM
- ARTIFICIAL PATH
- CONNECTOR
- RAILROAD

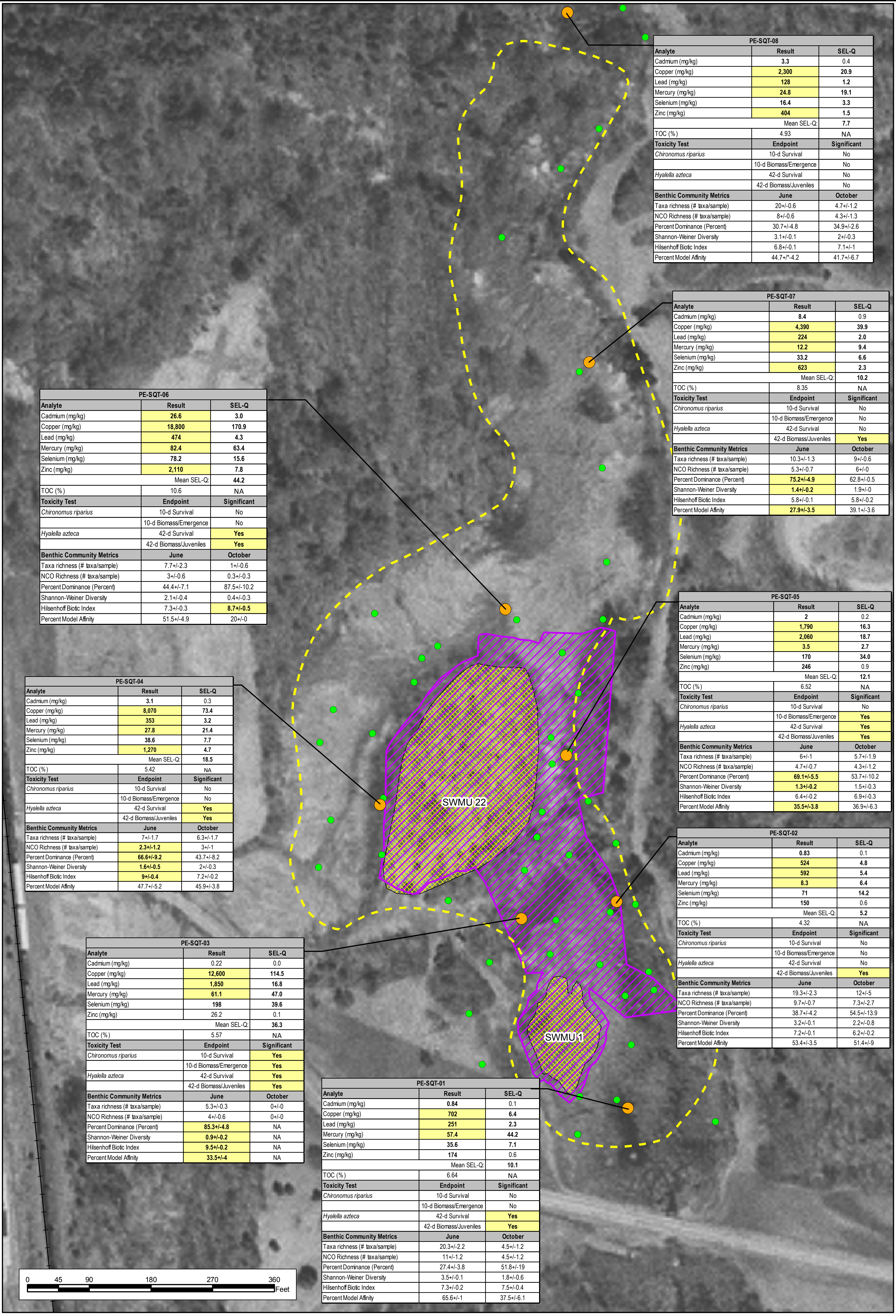
N

FIGURE 5 SITE DRAINAGE FEATURES SEDIMENT SAMPLING RESULTS

DYNO NOBEL SITE, PORT EWEN, NEW YORK

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

EHS Support
consider it done



PE-SQT-08		
Analyte	**Result**	**SEL-Q**
Cadmium (mg/kg)	**3.3**	0.4
Copper (mg/kg)	**2,300**	**20.9**
Lead (mg/kg)	**128**	**1.2**
Mercury (mg/kg)	**24.8**	**19.1**
Selenium (mg/kg)	**16.4**	**3.3**
Zinc (mg/kg)	**404**	**1.5**
	Mean SEL-Q:	**7.7**
TOC (%)	4.93	NA
Toxicity Test	**Endpoint**	**Significant**
Chironomus riparius	10-d Survival	No
	10-d Biomass/Emergence	No
Hyalella azteca	42-d Survival	No
	42-d Biomass/Juveniles	No
Benthic Community Metrics	**June**	**October**
Taxa richness (# taxa/sample)	20+/-0.6	4.7+/-1.2
NCO Richness (# taxa/sample)	8+/-0.6	4.3+/-1.3
Percent Dominance (Percent)	30.7+/-4.8	34.9+/-2.6
Shannon-Weiner Diversity	3.1+/-0.1	2+/-0.3
Hilsenhoff Biotic Index	6.8+/-0.1	7.1+/-1
Percent Model Affinity	44.7+/*-4.2	41.7+/-6.7

PE-SQT-07		
Analyte	**Result**	**SEL-Q**
Cadmium (mg/kg)	**8.4**	0.9
Copper (mg/kg)	**4,390**	**39.9**
Lead (mg/kg)	**224**	**2.0**
Mercury (mg/kg)	**12.2**	**9.4**
Selenium (mg/kg)	**33.2**	**6.6**
Zinc (mg/kg)	**623**	**2.3**
	Mean SEL-Q:	**10.2**
TOC (%)	8.35	NA
Toxicity Test	**Endpoint**	**Significant**
Chironomus riparius	10-d Survival	No
	10-d Biomass/Emergence	No
Hyalella azteca	42-d Survival	No
	42-d Biomass/Juveniles	**Yes**
Benthic Community Metrics	**June**	**October**
Taxa richness (# taxa/sample)	10.3+/-1.3	9+/-0.6
NCO Richness (# taxa/sample)	5.3+/-0.7	6+/-0
Percent Dominance (Percent)	**75.2+/-4.9**	62.8+/-0.5
Shannon-Weiner Diversity	**1.4+/-0.2**	1.9+/-0
Hilsenhoff Biotic Index	5.8+/-0.1	5.8+/-0.2
Percent Model Affinity	**27.9+/-3.5**	39.1+/-3.6

PE-SQT-06		
Analyte	**Result**	**SEL-Q**
Cadmium (mg/kg)	**26.6**	**3.0**
Copper (mg/kg)	**18,800**	**170.9**
Lead (mg/kg)	**474**	**4.3**
Mercury (mg/kg)	**82.4**	**63.4**
Selenium (mg/kg)	**78.2**	**15.6**
Zinc (mg/kg)	**2,110**	**7.8**
	Mean SEL-Q:	**44.2**
TOC (%)	10.6	NA
Toxicity Test	**Endpoint**	**Significant**
Chironomus riparius	10-d Survival	No
	10-d Biomass/Emergence	No
Hyalella azteca	42-d Survival	**Yes**
	42-d Biomass/Juveniles	**Yes**
Benthic Community Metrics	**June**	**October**
Taxa richness (# taxa/sample)	7.7+/-2.3	1+/-0.6
NCO Richness (# taxa/sample)	3+/-0.6	0.3+/-0.3
Percent Dominance (Percent)	44.4+/-7.1	87.5+/-10.2
Shannon-Weiner Diversity	2.1+/-0.4	0.4+/-0.3
Hilsenhoff Biotic Index	7.3+/-0.3	**8.7+/-0.5**
Percent Model Affinity	51.5+/-4.9	20+/-0

PE-SQT-05		
Analyte	**Result**	**SEL-Q**
Cadmium (mg/kg)	**2**	0.2
Copper (mg/kg)	**1,790**	**16.3**
Lead (mg/kg)	**2,060**	**18.7**
Mercury (mg/kg)	**3.5**	**2.7**
Selenium (mg/kg)	**170**	**34.0**
Zinc (mg/kg)	**246**	0.9
	Mean SEL-Q:	**12.1**
TOC (%)	6.52	NA
Toxicity Test	**Endpoint**	**Significant**
Chironomus riparius	10-d Survival	No
	10-d Biomass/Emergence	**Yes**
Hyalella azteca	42-d Survival	**Yes**
	42-d Biomass/Juveniles	**Yes**
Benthic Community Metrics	**June**	**October**
Taxa richness (# taxa/sample)	6+/-1	5.7+/-1.9
NCO Richness (# taxa/sample)	4.7+/-0.7	4.3+/-1.2
Percent Dominance (Percent)	**69.1+/-5.5**	53.7+/-10.2
Shannon-Weiner Diversity	**1.3+/-0.2**	1.5+/-0.3
Hilsenhoff Biotic Index	6.4+/-0.2	6.9+/-0.3
Percent Model Affinity	**35.5+/-3.8**	36.9+/-6.3

PE-SQT-04		
Analyte	**Result**	**SEL-Q**
Cadmium (mg/kg)	**3.1**	0.3
Copper (mg/kg)	**8,070**	**73.4**
Lead (mg/kg)	**353**	**3.2**
Mercury (mg/kg)	**27.8**	**21.4**
Selenium (mg/kg)	**38.6**	**7.7**
Zinc (mg/kg)	**1,270**	**4.7**
	Mean SEL-Q:	**18.5**
TOC (%)	5.42	NA
Toxicity Test	**Endpoint**	**Significant**
Chironomus riparius	10-d Survival	No
	10-d Biomass/Emergence	No
Hyalella azteca	42-d Survival	**Yes**
	42-d Biomass/Juveniles	**Yes**
Benthic Community Metrics	**June**	**October**
Taxa richness (# taxa/sample)	7+/-1.7	6.3+/-1.7
NCO Richness (# taxa/sample)	**2.3+/-1.2**	3+/-1
Percent Dominance (Percent)	**66.6+/-9.2**	43.7+/-8.2
Shannon-Weiner Diversity	**1.6+/-0.5**	2+/-0.3
Hilsenhoff Biotic Index	**9+/-0.4**	7.2+/-0.2
Percent Model Affinity	47.7+/-5.2	45.9+/-3.8

PE-SQT-02		
Analyte	**Result**	**SEL-Q**
Cadmium (mg/kg)	**0.83**	0.1
Copper (mg/kg)	**524**	**4.8**
Lead (mg/kg)	**592**	**5.4**
Mercury (mg/kg)	**8.3**	**6.4**
Selenium (mg/kg)	**71**	**14.2**
Zinc (mg/kg)	**150**	0.6
	Mean SEL-Q:	**5.2**
TOC (%)	4.32	NA
Toxicity Test	**Endpoint**	**Significant**
Chironomus riparius	10-d Survival	No
	10-d Biomass/Emergence	No
Hyalella azteca	42-d Survival	No
	42-d Biomass/Juveniles	**Yes**
Benthic Community Metrics	**June**	**October**
Taxa richness (# taxa/sample)	19.3+/-2.3	12+/-5
NCO Richness (# taxa/sample)	9.7+/-0.7	7.3+/-2.7
Percent Dominance (Percent)	38.7+/-4.2	54.5+/-13.9
Shannon-Weiner Diversity	3.2+/-0.1	2.2+/-0.8
Hilsenhoff Biotic Index	7.2+/-0.1	6.2+/-0.2
Percent Model Affinity	53.4+/-3.5	51.4+/-9

PE-SQT-03		
Analyte	**Result**	**SEL-Q**
Cadmium (mg/kg)	0.22	0.0
Copper (mg/kg)	**12,600**	**114.5**
Lead (mg/kg)	**1,850**	**16.8**
Mercury (mg/kg)	**61.1**	**47.0**
Selenium (mg/kg)	**198**	**39.6**
Zinc (mg/kg)	26.2	0.1
	Mean SEL-Q:	**36.3**
TOC (%)	5.57	NA
Toxicity Test	**Endpoint**	**Significant**
Chironomus riparius	10-d Survival	**Yes**
	10-d Biomass/Emergence	**Yes**
Hyalella azteca	42-d Survival	**Yes**
	42-d Biomass/Juveniles	**Yes**
Benthic Community Metrics	**June**	**October**
Taxa richness (# taxa/sample)	5.3+/-0.3	0+/-0
NCO Richness (# taxa/sample)	4+/-0.6	0+/-0
Percent Dominance (Percent)	**85.3+/-4.8**	NA
Shannon-Weiner Diversity	**0.9+/-0.2**	NA
Hilsenhoff Biotic Index	**9.5+/-0.2**	NA
Percent Model Affinity	**33.5+/-4**	NA

PE-SQT-01		
Analyte	**Result**	**SEL-Q**
Cadmium (mg/kg)	**0.84**	0.1
Copper (mg/kg)	**702**	**6.4**
Lead (mg/kg)	**251**	**2.3**
Mercury (mg/kg)	**57.4**	**44.2**
Selenium (mg/kg)	**35.6**	**7.1**
Zinc (mg/kg)	**174**	0.6
	Mean SEL-Q:	**10.1**
TOC (%)	6.64	NA
Toxicity Test	**Endpoint**	**Significant**
Chironomus riparius	10-d Survival	No
	10-d Biomass/Emergence	No
Hyalella azteca	42-d Survival	**Yes**
	42-d Biomass/Juveniles	**Yes**
Benthic Community Metrics	**June**	**October**
Taxa richness (# taxa/sample)	20.3+/-2.2	4.5+/-1.2
NCO Richness (# taxa/sample)	11+/-1.2	4.5+/-1.2
Percent Dominance (Percent)	27.4+/-3.8	51.8+/-19
Shannon-Weiner Diversity	3.5+/-0.1	1.8+/-0.6
Hilsenhoff Biotic Index	7.3+/-0.2	7.5+/-0.4
Percent Model Affinity	65.6+/-1	37.5+/-6.1

Legend

SQT SEDIMENT SAMPLING STATION

APPROXIMATE SWMU/AOC BOUNDARY

SWMU 1/22 BOUNDARY

RAILROAD

N

Note: All concentrations are represented as mg/kg. Bold sediment concentrations indicate an exceedance of the LEL; shaded concentrations indicate an exceedance of the SEL; Shaded sediment toxicity testing and benthic community results indicate statistical significance relevant to reference stations.

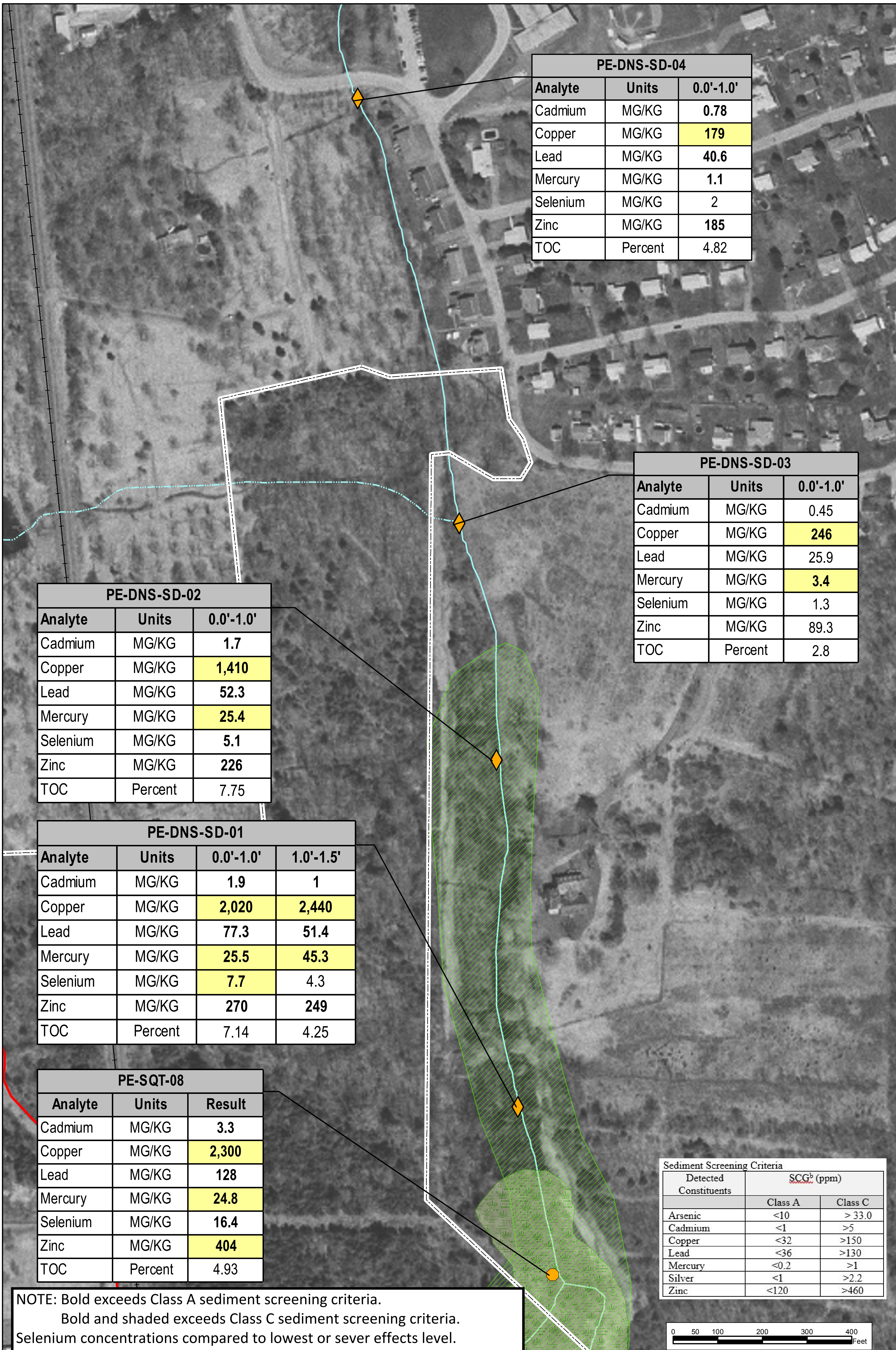
FIGURE 5b

SEDIMENT QUALITY TRIAD SAMPLING LOCATIONS
SWMU 1/22 WETLAND COMPLEX

DYNO NOBEL SITE, PORT EWEN, NEW YORK

Map Source:
Image: NYSGIS (2004)
Boundaries: Site and property boundaries approximations were determined using available data from historical maps and CAD files.

base map by:
EHS Support
consider it done



PE-DNS-SD-04		
Analyte	**Units**	**0.0'-1.0'**
Cadmium	MG/KG	**0.78**
Copper	MG/KG	**179**
Lead	MG/KG	**40.6**
Mercury	MG/KG	**1.1**
Selenium	MG/KG	2
Zinc	MG/KG	**185**
TOC	Percent	4.82

PE-DNS-SD-03		
Analyte	**Units**	**0.0'-1.0'**
Cadmium	MG/KG	0.45
Copper	MG/KG	**246**
Lead	MG/KG	25.9
Mercury	MG/KG	**3.4**
Selenium	MG/KG	1.3
Zinc	MG/KG	89.3
TOC	Percent	2.8

PE-DNS-SD-02		
Analyte	**Units**	**0.0'-1.0'**
Cadmium	MG/KG	**1.7**
Copper	MG/KG	**1,410**
Lead	MG/KG	**52.3**
Mercury	MG/KG	**25.4**
Selenium	MG/KG	**5.1**
Zinc	MG/KG	**226**
TOC	Percent	7.75

PE-DNS-SD-01			
Analyte	**Units**	**0.0'-1.0'**	**1.0'-1.5'**
Cadmium	MG/KG	**1.9**	**1**
Copper	MG/KG	**2,020**	**2,440**
Lead	MG/KG	**77.3**	**51.4**
Mercury	MG/KG	**25.5**	**45.3**
Selenium	MG/KG	**7.7**	4.3
Zinc	MG/KG	**270**	**249**
TOC	Percent	7.14	4.25

PE-SQT-08		
Analyte	**Units**	**Result**
Cadmium	MG/KG	**3.3**
Copper	MG/KG	**2,300**
Lead	MG/KG	**128**
Mercury	MG/KG	**24.8**
Selenium	MG/KG	**16.4**
Zinc	MG/KG	**404**
TOC	Percent	4.93

Sediment Screening Criteria

Detected Constituents	SCG[b] (ppm)	
	Class A	Class C
Arsenic	<10	> 33.0
Cadmium	<1	>5
Copper	<32	>150
Lead	<36	>130
Mercury	<0.2	>1
Silver	<1	>2.2
Zinc	<120	>460

NOTE: Bold exceeds Class A sediment screening criteria.
Bold and shaded exceeds Class C sediment screening criteria.
Selenium concentrations compared to lowest or sever effects level.

Legend

- New Sediment Sample Location
- SQT STATION
- APPROXIMATE PROPERTY BOUNDARY
- APPROXIMATE SITE BOUNDARY
- SWAMP/MARSH
- NYSDEC MAPPED CLASS 2 WETLANDS
- NYSDEC MAPPED CLASS 3 WETLANDS
- INTERMITTENT STREAM
- PERENNIAL STREAM
- RAILROAD

FIGURE 6 DOWNSTREAM SEDIMENT SAMPLING
SWMU 1/22 WETLAND COMPLEX
DYNO NOBEL SITE, PORT EWEN, NEW YORK

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

EHS Support
consider it done

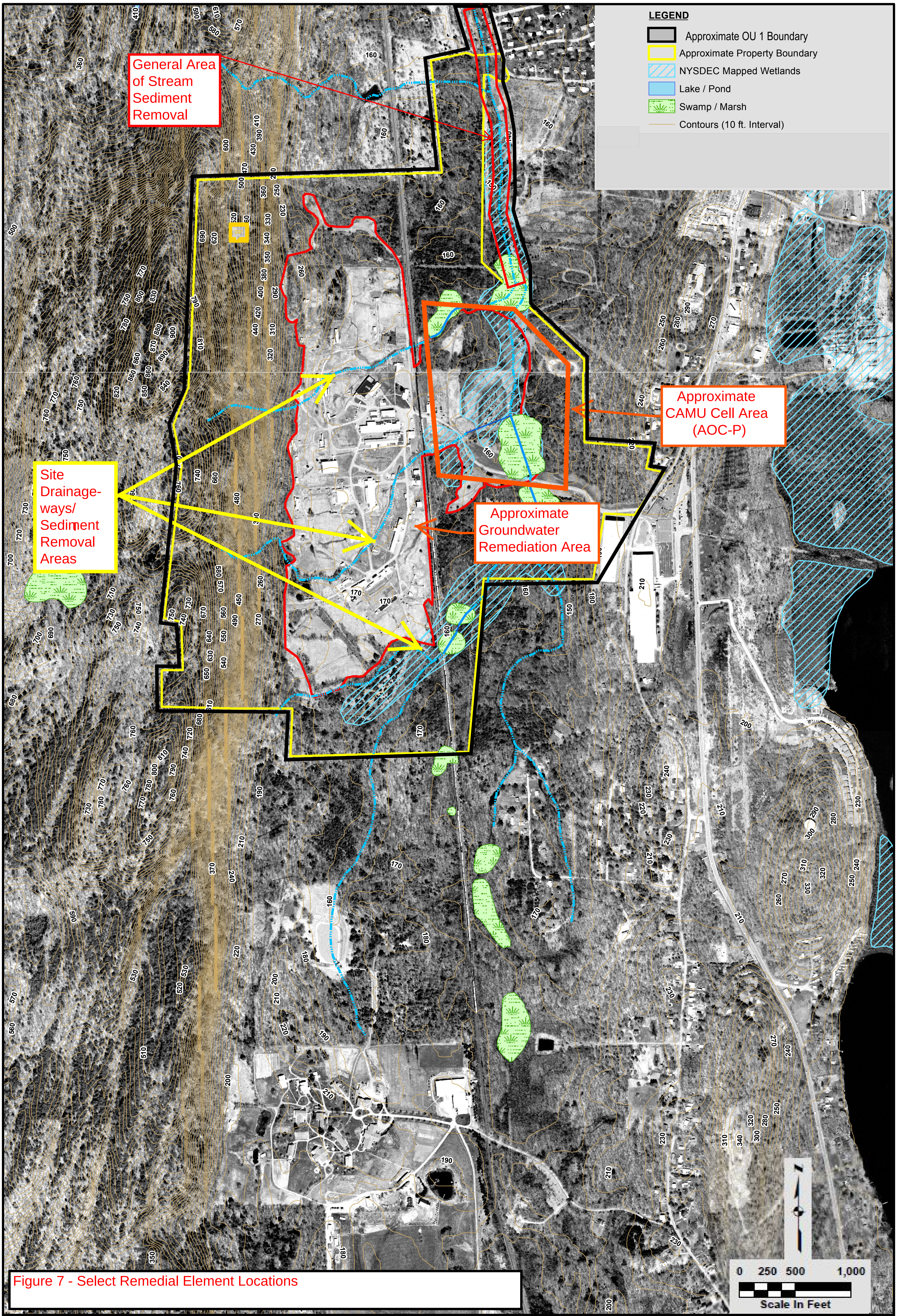


Figure 7 - Select Remedial Element Locations

base map by: EHS Support consider it done	DYNO-NOBEL, INC. PORT EWEN, NY.	Excavation, On-siteConsolidation in RCRA CAMUCell & Part 360 Capping	FIGURE 7