Honeywell

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December 18, 2017

Mr. Tracy Smith
Division of Environmental Remediation
Remedial Bureau D
New York State Department of Environmental Conservation
625 Broadway
Albany, NY 12233-7013

Re: **Semet Residue Ponds Site**
Order on Consent: Index # R7-0197-87-06 Site #734008
OU-2 Feasibility Study Report

Dear Mr. Smith:

Enclosed for review is the Semet Residue Ponds Site OU-2 Feasibility Study Report, prepared by O'Brien & Gere on behalf of Honeywell. Please contact Clare Leary of O'Brien & Gere (Clare.Leary@obg.com or 315-956-6472) or me if you have any questions.

Sincerely,

John P. McAuliffe by CLL

John P. McAuliffe, P.E.
Syracuse Program Director

Attachments (1 copy, ec)

cc:	Robert Nunes	USEPA (1 copy, ec)
	Tom Mongelli	USEPA (ec)
	Harry Warner	NYSDEC Region 7 (1 copy, ec)
	Mark Sergott	NYSDOH (1 copy, ec)
	Maureen Schuck	NYSDOH (ec)
	Margaret A. Sheen, Esq.	NYSDEC, Region 7 (ec)
	Argie Cirillo, Esq.	USEPA (ec)
	Brian D. Israel, Esq.	Arnold & Porter (ec)
	Joseph Heath, Esq.	(ec)
	Thane Joyal, Esq.	(1 copy, ec)
	Jeanne Shenandoah	Onondaga Nation (1 copy, ec)
	Curtis Waterman	HETF (ec)
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	William Hague	Honeywell (ec)
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	Christopher Calkins	OBG (ec)
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FEASIBILITY STUDY

Semet Residue Ponds Site
OU-2 Feasibility Study

Honeywell

December 2017

OBG

DECEMBER 18, 2017 | 1163 | 63447

Semet Residue Ponds Site
OU-2 Feasibility Study

Prepared for:

Honeywell

DOUGLAS M. CRAWFORD, P.E., VP
O'Brien & Gere Engineers, Inc.

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LIST OF ACRONYMS

ACO	Administrative Consent Order
ARAR	Applicable or Relevant and Appropriate Requirement
BCA	Brushy Cleared Area
bgs	below ground surface
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
BTX	Benzol, Toluol, Xylol
BUD	Beneficial Use Determination
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CKD	Cement Kiln Dust
COEC	Constituents of Ecological Concern
COPC	Contaminants of Potential Concern
Crucible	Crucible Specialty Metals
cy	cubic yards
DER	Division of Environmental Remediation
ERA	Ecological Risk Assessment
ESD	Explanation of Significant Differences
FS	Feasibility Study
FFS	Focused Feasibility Study
Ft	feet or foot
GAC	granular activated carbon
GRA	General Response Action
GWTP	Groundwater Treatment Plant
HHRA	Human Health Risk Assessment
HI	Hazard Index
Honeywell	Honeywell International Inc.
HQ	Hazard Quotient
I-690	Interstate 690
IRM	Interim Remedial Measure
ISCO	*In Situ* Chemical Oxidation

ISS	*In Situ* Solidification/Stabilization
LDR	Land Disposal Restriction
LKD	Lime Kiln Dust
LHCS	Lakeshore Hydraulic Containment System
Metro	Metropolitan Wastewater Treatment Plant
MG	million gallons
MSL	mean sea level
MtCO2e	million metric tons of carbon dioxide equivalent
NAPL	Non-Aqueous Phase Liquid
NCP	National Oil and Hazardous Substances Contingency Plan
6 NYCRR	Title 6 New York Codes, Rules and Regulation
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOT	New York State Department of Transportation
OBG	O'Brien & Gere
OCDWEP	Onondaga County Department of Water Environmental Protection
O&M	Operation and Maintenance
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PAH	Polycyclic Aromatic Hydrocarbon
POC	Point of Compliance
PTE	1-phenyl-1-(4-methlyphenyl)ethane
RA	Remedial Action
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RI	Remedial Investigation
ROD	Record of Decision
RSL	Regional Screening Level
RSTS	Remedy Selection Treatability Study

SCO	Soil Cleanup Objective
SMA	Semet Material Area
SMP	Site Management Plan
SPDES	State Pollutant Discharge Elimination System
SVOC	Semi-volatile Organic Compound
TarGOST®	Tar-specific Green Optical Screening Tool
USEPA	United States Environmental Protection Agency
ULSD	Ultra Low Sulfur Diesel
VOC	Volatile Organic Compound
WMA	Waste Management Area

EXECUTIVE SUMMARY

This Report documents the Operable Unit (OU)-2 Feasibility Study (FS) that was conducted to develop and evaluate remedial alternatives to address Semet Residue Ponds Site (Site) OU-2 soil/fill material[1] . OU-1 consists of Semet Residue[2] suitable for beneficial reuse that was deposited in five man-made ponds on a portion of the Site, and groundwater. OU-2 consists of contaminated material in the Brushy Cleared Area (BCA) and below and in the proximity of the ponds (*i.e.*, the area west of the BCA). The BCA is located on the northeast portion of the Site. Deep groundwater is not part of OU-1 or OU-2; deep groundwater will be addressed in a separate FS Report. The Site is depicted on **Figure ES-1** to the right and on attached **Figure 1-2**. This FS was prepared to develop and evaluate remedial alternatives to: address OU-2; render the site suitable for reuse; provide long-lasting protection to the local community and environment; and restore the Onondaga Lake shoreline.

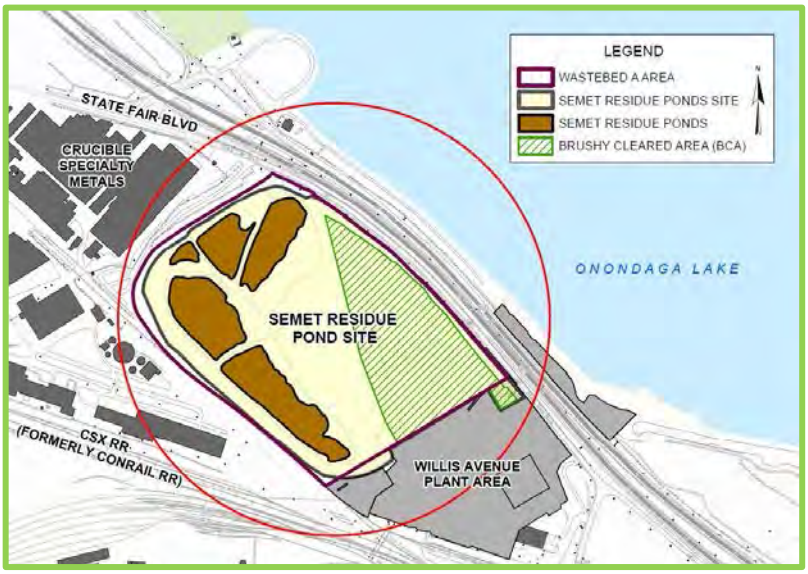

Figure ES-1: Semet Residue Ponds Site Location

This FS was conducted pursuant to the Administrative Consent Order (ACO) (R7-0197-87-06) between the New York State Department of Environmental Conservation (NYSDEC) and Honeywell International, Inc. (Honeywell) dated April 26, 1989 (NYSDEC 1989), and in accordance with NYSDEC's *Division of Environmental Remediation (DER) Technical Guidance for Site Investigation and Remediation (DER-10)* (NYSDEC 2010a), the *National Oil and Hazardous Substances Contingency Plan (NCP)* (40 Code of Federal Regulations [CFR] Part 300.430; USEPA 1990), and USEPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)* (USEPA 1988).

Development of this OU-2 FS follows the completion of various investigations, field demonstrations, and remedial activities in which the nature and extent of contamination at the Site, and the potential risks posed to human health and the environment were evaluated. This FS also follows construction and ongoing operation of an OU-1 remedial action and Interim Remedial Measures (IRMs) that prevent discharge of shallow and intermediate groundwater into Tributary 5A and Onondaga Lake. Collectively, based on field measurements and

[1] The Site was used historically as a settling basin (Solvay Wastebed A) for Solvay waste. Solvay waste is an inert material consisting largely of calcium carbonate, calcium silicate, and magnesium hydroxide that was a waste product from the Solvay Process. The waste is a non-hazardous combination of process residuals, unreacted material and mineral salts taken out as a chloride-rich slurry exhibiting elevated pH (10 to12 standard units).. In addition to the Solvay waste, the area received coarse ash and cinder from stoker-fired boilers, and soil/miscellaneous fill material appears to have been used to cover portions of the wastebed. The term "soil/fill material" throughout this document refers to Solvay waste, fill materials (*e.g.*, coarse ash and cinder from stoker-fired boilers, and soil/miscellaneous fill material) that have been placed at the Site, and soil that has formed above the Solvay waste.

[2] Semet Residue is a tarry organic-based residue generated by the acid washing of coke light oil during the production of benzene, toluene, naphthalene, xylene, and "motor benzol" at the benzol, toluol, xylol (BTX) Plant formerly operated by Honeywell predecessor Allied Chemical Corporation (later AlliedSignal).

observations, the remedial action and IRMs have been demonstrated to be achieving hydraulic control, and hence potential shallow and intermediate groundwater discharge to Tributary 5A and Onondaga Lake are being mitigated by these systems (Parsons and O'Brien & Gere (OBG) 2013, 2014 and 2017; OBG 2017g).

Further, a minimum of 12 inches of soil cover has been placed over a portion of the northern berm of the Site as part of an IRM. This IRM serves to prevent direct contact with soil/fill material in this area. Finally, over 30,500 tons of Semet Residue have been removed from the site for off-site thermal processing for beneficial reuse as part of OU-1 field demonstrations.

The focus of this FS is to address potential unacceptable risks to human health and the environment associated with some constituents in Site-wide soil/fill material such that the property can be returned to productive use.

Introduction

The Semet Residue Ponds Site comprises approximately 49 acres in the Town of Geddes, Onondaga County, New York. As depicted on **Figure ES-2**, the Site is located in an industrial area adjacent to Interstate 690 (I-690) that runs parallel to the southern shore of Onondaga Lake. The Site is bordered on the west and south by the Crucible Specialty Metals Corporation (Crucible), on the south by Conrail Railroad tracks and an industrial complex, on the north by State Fair Boulevard and I-690, and on the east by the former Willis Avenue Plant Area (Willis Plant Area). Generally, two areas are identified at the Site, the BCA and the area to the west of the BCA where the Semet Residue ponds and associated berms are present. The area west of the BCA encompasses approximately 34.2 acres of the Site. The BCA, an approximate 13-acre area on the northern and eastern portion of the Site and 1.5 acres of berm along the north of the BCA are characterized by this soil/fill material. The surface of the BCA varies between dense to sparsely vegetated areas, with some surface soil.

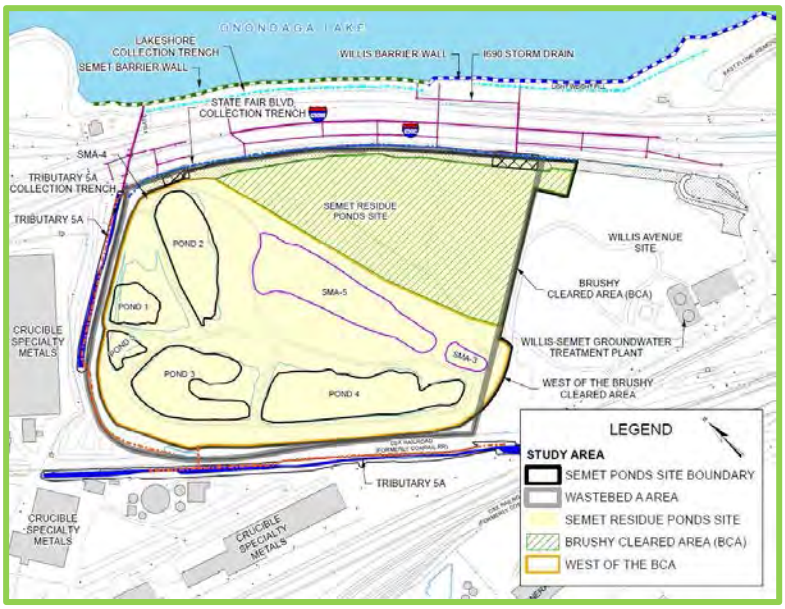

Figure ES-2: Semet Residue Ponds Site Plan

Before 1917, the Site was a settling basin (Wastebed A) for Solvay process waste. From 1917 to 1970, waste Semet Residue from Honeywell's former Benzol plant was deposited in five bermed excavations in Wastebed A.

On March 28, 2002, following completion of the RI/FS process and public comment, NYSDEC and USEPA documented their selection of a final remedial alternative for the Semet Residue in ponds and groundwater at the Site in a *Record of Decision* (*ROD*) (NYSDEC and USEPA 2002). The selected remedy included measures to prevent the migration of contaminated groundwater, and to manage and treat the Semet Residue.

The 2002 *ROD* remedy for the Semet Residue, removal and on-site processing to produce a soft tar product, RT-12, for reuse in off-site driveway sealer production, was not implemented due to changes in market conditions. Remedial alternatives for the Semet Residue were re-evaluated in a 2006 *Revised Focused Feasibility Study (FFS) Report* (OBG 2006a), prepared under a 2004 ACO (# D7-0005-01-09; NYSDEC 2004). An alternate on-site process for beneficial reuse remedy was concluded to best meet the FS evaluation criteria for the Semet Residue in the 2006 *Revised FFS Report* (OBG 2006a). Subsequent to the 2006 *FFS*, findings regarding reduced estimated quantities of Semet Residue and changes in the market for anticipated products (solvents and fuel "heel")

prompted re-evaluation of the off-site thermal processing/reuse alternative. Updated Semet Residue quantity estimates and an updated evaluation of the off-site thermal processing/reuse alternative were documented in a *Revised FFS Amendment* completed in 2017 (OBG 2017a). NYSDEC and USEPA issued an *Explanation of Significant Differences (ESD)* in July 2017 to document modifications to the selected remedy which entailed off-site rather than on-site processing/reuse of materials.

The 2002 *ROD* also established that contaminated material below and in proximity of the ponds and in the BCA, which exceed Site cleanup goals would be addressed as a separate OU. Over the years, various investigations have been performed at the Site that provided information related to site media other than Semet Residue in the ponds and Site groundwater. This information has been summarized in a *Data Summary Document* (OBG 2017b).

As summarized in the 2017 *Data Summary Document*, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs) and mercury were detected in soil/fill material samples collected at the Site. A comparison of analytical concentrations to NYSDEC's Soil Cleanup Objectives (SCOs) show exceedances exist at the surface and subsurface at the Site. In addition, the *Revised Semet Ponds Site Soil/Fill Material Human Health Risk Assessment (HHRA)* (OBG 2017c) and the *Revised Semet Ponds Site Soil/Fill Material Ecological Risk Assessment (ERA)* (OBG 2017d) concluded Site soil/fill material presents potentially unacceptable risks to receptors. Accordingly, remedial alternatives to address exceedances to NYSDEC's SCOs and unacceptable risks presented by soil/fill material are presented in this FS.

Groundwater Remedial Actions and Interim Remedial Measures

The following groundwater remedial action and interim remedial measure described in the 2002 *ROD* have been implemented at the Site:

- To remedy migration of groundwater to Onondaga Lake and a drainage ditch that discharges to Onondaga Lake called Tributary 5A, as well as associated Site impacts to sediment and surface water, a shallow groundwater collection system was installed beneath Tributary 5A from 2010 to 2012 (**Figure ES-3**). As part of this remedial action, sediment in Tributary 5A was removed and an isolation layer was installed. Groundwater collected by this system is treated at the Willis Avenue Groundwater Treatment Plant (GWTP). Operation, maintenance, and monitoring of the groundwater remedy is ongoing.
- To prevent the migration of impacted shallow and intermediate groundwater to Onondaga Lake, the Willis-Semet Hydraulic Containment System IRM was installed in 2006 and 2007. The Semet portion of this IRM consists of approximately 1,440 linear feet (ft) of barrier wall and groundwater collection system along the Onondaga Lake shoreline. Groundwater collected from this system is treated at the Willis-Semet GWTP. The Willis-Semet GWTP, installed in 2006 and upgraded three times since then, treats groundwater collected across Honeywell sites in/around Syracuse, New York (Syracuse portfolio). The Willis-Semet Hydraulic Containment System was identified as a component of the OU-1 remedy in the 2002 *ROD*.

Figure ES-3. Construction of Tributary 5A Collection System

In addition to the above-mentioned OU-1 groundwater remedies, an additional groundwater IRM was implemented at the Site:

- Groundwater discharging from the Site observed to be infiltrating into storm water sewers along State Fair Boulevard was mitigated in 2012 by the I-690 Storm Drainage System IRM (and groundwater collection trench along State Fair Boulevard). This groundwater collection system is connected to the Tributary 5A remedial action. Groundwater collected by this system is treated at the Willis-Semet GWTP.

As a result of the groundwater remedial action and IRM described above, potential impacts from groundwater migration have been addressed. Specifically, the *2012 and 2013 Source Control Summary for the Onondaga Lake Bottom Subsite* (Parsons and OBG 2013), the *2014 Source Control Summary for the Onondaga Lake Bottom Subsite* (Parsons and OBG 2014), and the *2015 and 2016 Source Control Summary for the Onondaga Lake Bottom Subsite* (Parsons and OBG 2017) document that mitigation of the following potential sources has been demonstrated:

- Area groundwater associated with the Semet Residue Ponds Site
- Tributary 5A
- I-690 Storm Drain System (and groundwater collection trench along State Fair Boulevard)

The *2015 and 2016 Source Control Summary* documents continued mitigation of these sources (Parsons and OBG 2017).

Semet Residue Field Demonstration and Remedial Action

The following demonstration activities related to the remedy for the Semet Residue described in the 2002 *ROD* and 2017 *ESD* are being implemented at the Site:

Figure ES-4: Semet Residue Removal Dewatering and Conveyance Field Demonstration

- To address Semet Residue at the Site, a field demonstration program was implemented during which Semet Residue was excavated for off-site thermal processing for beneficial reuse. Specifically, excavated Semet Residue was dewatered for transport (**Figure ES-4**), as needed, and then transported to a Resource Conservation and Recovery Act (RCRA)-permitted thermal processing for beneficial reuse facility. Process aqueous liquid was managed on-site at the Willis Avenue GWTP. A temporary fiber-based or cement-based spray cover was used for odor and emission control. To date, as described above, over 30,500 tons of Semet Residue have been beneficially reused off-site.
- Following this field demonstration program and the *ESD*, a remedial design work plan has been submitted (OBG 2017e). The remedial design is underway with anticipated remedial action implementation starting in 2018, consistent with the demonstration program implementation methods.

Soil/Fill Material Interim Remedial Measure

In addition to the remedial action and IRMs to address Site groundwater, and the remedial action to address Semet Residue, an IRM was implemented for the northern berm. This IRM consisted of the following:

- To improve the aesthetic and ecological value of the I-690 corridor in the vicinity of the Site, vegetation was removed, soil was removed and replaced with clean fill/topsoil prior to application of 6-inches of topsoil. Native grass and forb species, and native trees and shrubs were introduced after the topsoil was applied.

This FS addresses soil/fill material at the Site. The following table summarizes how media at the site are either addressed by current remedial efforts or will be evaluated in this FS:

Table ES-1 – Summary of Site Media

Site Media	Site Area	IRM or RA	Operable Unit	Evaluated in FS
Semet Residue	West of BCA – Semet Residue in Ponds 1 through 5, suitable for beneficial reuse	2002 *ROD*/2017 *ESD* Remedy	OU-1	No
	West of BCA – Semet Residue, remaining following OU-1 remedy	None	OU-2	Yes
Soil/Fill Material	BCA and West of BCA	Berm Improvement IRM	OU-2	Yes
Shallow Intermediate Groundwater	Site	Tributary 5A RA, Willis-Semet Hydraulic Containment System IRM; 2002 *ROD*	OU-1	No

Feasibility Study Remedial Action Objectives

Remedial Action Objectives (RAOs) for Semet Residue and groundwater were presented in the 2002 *ROD*, and are addressed by the anticipated removal and beneficial reuse of Semet Residue and the groundwater remedial action and IRMs that have been implemented at the Site. RAOs for soil/fill material are presented in this FS and were developed to be protective of human health and the environment.

Potential chemical-specific Applicable or Relevant and Appropriate Requirements (ARARs) and the HHRA and ERA performed for the Site were considered during the development of soil/fill material RAOs. The following bullets summarize these considerations:

- Soil/fill concentrations were compared to New York State (NYS) Part 375 SCOs, identified as potential chemical-specific ARARs for the Site, for the reasonably anticipated future industrial or commercial land use. VOCs, SVOCs, metals and some pesticides in soil/fill material were detected at concentrations exceeding the corresponding NYS Part 375 SCOs for industrial and commercial use.
- The *Soil/Fill Material Human Health Risk Assessment* (OBG 2017c) concluded that concentrations of constituents of potential concern (COPCs) in soil/fill material at the Site warrant control of exposures to surface/subsurface soil/fill material for industrial and construction workers at the Site.
- The *Soil/Fill Material Ecological Risk Assessment* (OBG 2017d) concluded that concentrations of constituents of ecological concern (COECs) in soil/fill material at the Site warrant control of exposures for ecological receptors at the Site. However, it should be noted, that given the anticipated industrial or commercial use for the Site, it is not anticipated to provide suitable ecological habitat.

Waste Management Area

The NCP (40 CFR Part 300.430) preamble language sets forth the USEPA's policy that, for groundwater, "remediation levels generally should be attained throughout the contaminant plume, or at and beyond the edge of the waste management area when waste is left in place." Solvay waste containing Site-related contaminants and Semet Residue is present at the Site, thus, the Site can be characterized as a waste management area (WMA).

For the Semet Residue Ponds Site, the WMA would consist of Wastebed A and the land directly east of Wastebed A because of the fill material present between Wastebed A and Onondaga Lake.

A groundwater RAO was included in the 2002 *ROD* to eliminate, to the extent practicable, migration of groundwater to Onondaga Lake and Tributary 5A that does not attain applicable state and federal water quality criteria for Site-related constituents. As described above, the Tributary 5A remedial action and the Willis-Semet Hydraulic Containment System IRM were included in the selected remedy documented in the 2002 *ROD* to address this RAO. In addition, institutional controls and monitoring were also included to address groundwater in the 2002 *ROD*. Therefore, since site groundwater was previously addressed, development of an RAO for shallow and intermediate groundwater was not required. The RAOs to address soil/fill material at the Site are as follows:

RAOs for Public Health Protection

- Prevent, or reduce to the extent practicable, ingestion of/direct contact with contaminated soil/fill material.
- Prevent, or reduce to the extent practicable, inhalation of or exposure to contaminants volatilizing from contaminated soil/fill material and unacceptable inhalation threat associated with soil vapor.

RAOs for Environmental Protection

- Prevent, to the extent practicable, migration of contaminants in soil/fill material that could result in groundwater, sediment or surface water contamination.
- Prevent, or reduce, to the extent practicable, the release of site-related contaminants to surface water and sediment that may cause unacceptable adverse effects on surface water or sediment quality in Onondaga Lake.

Development of Remedial Alternatives

The following steps were followed in developing remedial alternatives:

- Developed general response actions (GRAs), which are medium-specific actions that may, either alone or in combination, form alternatives to satisfy the RAOs.
- Identified areas and volumes of media, which describe the material(s) to be addressed.
- Identified and screened remedial technologies and process options, which resulted in a series of potential remediation technologies that address Site soil/fill material.
- Evaluated technologies and process options for effectiveness, implementability, and cost.

Technologies and process options including institutional controls; natural recovery; containment; *in situ* chemical, physical, biological, and thermal treatment; *ex situ* chemical, biological, and thermal treatment; and removal and disposal to address soil/fill material were screened and evaluated.

Once these steps were completed, remedial alternatives were assembled based on the findings of the screening process. In light of the Site's location, nearby property use and recent economic development in the area, development of the Site has also been considered during the assembly of remedial alternatives. Specifically, the proximity to the NYS Fairgrounds, the recent construction of the Lakeview Point Amphitheater, and recent commitments to economic development in the vicinity of these two venues make this property a prime candidate for redevelopment. Not only would this property present additional locations for parking for the NYS Fairgrounds, the access to rail and I-690 make this a viable commercial or industrial property once Site environmental concerns are addressed. As such, reasonable development scenarios were considered when developing the alternatives.

The range of assembled alternatives is consistent with the NCP and DER-10. The assembled alternatives in the FS are as follows:

Table ES-2: Semet Residue Ponds Site FS Remedial Alternatives			
		Alternative 1 No Further Action (with Continued Operation and Maintenance (O&M) of IRM)	**Alternative 2** Grading and Backfill
Alternative 3 Engineered Soil Cover	**Alternative 4** Enhanced Engineered Cover	**Alternative 5** *In Situ* Treatment of Targeted Material[3] and Enhanced Engineered Cover	**Alternative 6** Removal

Table ES-3: Components of Remedial Alternatives

Remedial Component	Remedial Alternative 1	2	3	4	5	6
No further action	●					
Institutional controls/limited actions ▪ Institutional controls, site management plan, periodic reviews		●	●	●	●	●
O&M of existing IRM ▪ *Alternatives 1 through 5:* Willis-Semet Berm Site Improvement IRM	●	●	●	●	●	
Grading and backfill of ponds		●	●	●	●	
Engineered soil cover (Site-wide)			●			
Engineered soil cover (BCA)				●	●	
Enhanced engineered cover (Geomembrane or asphalt; Area west of BCA)				●	●	
In situ targeted material treatment					●	
Passive Semet Residue recovery wells, if found necessary and effective		●	●	●	●	
Site-wide soil/fill material excavation						●
Site-wide soil/fill material off-site disposal						●

Alternative components are incremental, with Alternative 2 including backfilling of emptied ponds and grading and passive Semet Residue recovery wells (if necessary and effective). A 1-ft thick soil cover option is added to Alternative 2 components for Alternative 3, and an enhanced cover option including a geomembrane or asphalt is added for the cover component in Alternatives 4 and 5. In addition to the enhanced cover in Alternative 5, *in situ* treatment of targeted material using *in situ* stabilization/solidification is also added. Alternative 6 includes full removal of soil/fill material exhibiting concentrations greater than NYS Part 375 SCOs for unrestricted land use.

[3] Targeted material refers to the portion of remaining Semet Residue following completion of the OU-1 remedy at the bottom of certain ponds that cannot be beneficially reused and contains free aqueous phase. For clarity, targeted material was evaluated separately from soil/fill material in the technology screening. Such material has only been encountered in Ponds 3 and 4 during demonstration programs.

Detailed Analysis of Remedial Alternatives

The assembled alternatives were analyzed in detail using the evaluation criteria as required by state and federal regulations and guidance. The detailed analysis of alternatives indicates:

- Alternative 1 does not fully address protection of human health, as there are no restrictions on the use of the Site.
- Alternative 2, which includes grading and backfill of the Semet Residue ponds (emptied, to the maximum extent practicable under the OU-1 remedy), is less protective than Alternatives 3, 4, and 5 in the near term, since portions of the surface of the Site may remain exposed under this remedy. Full protection from potential exposures to soil/fill material would be attained following development of the Site. At this time, parking lots are envisioned as part of the infrastructure needs for the nearby NYS Fairgrounds and Lakeview Point Amphitheater.
- Alternative 6, which includes full excavation of the soil/fill material at the Site, is not implementable. Specifically, removal of approximately 1.16 million cubic yards (cy) of soil/fill material to depths of up to 25 ft below ground surface (bgs) is not implementable due to the volume of material to be managed, the stability concerns and water management needs associated with excavation, and significant impacts to the community and the existing Onondaga Lake remedy. The significant impacts from this Alternative would require the following:
  - Removal of the existing Tributary 5A remedy
  - Approximately 70 trucks of material/day if implemented over 6 to 7 years.

  In addition to constructability and community concerns, Alternative 6 is also impractical because of the potential lack of adequate and sufficient capacity for off-site management of 1.16 million cubic yards (cy) of excavated soil/fill material and the volumetric portion expected to be classified as characteristic hazardous waste.
- Alternatives 3, 4, and 5, which include institutional controls and engineered cover, are protective of human health and the environment by controlling direct exposure to soil/fill material. Alternatives 4 and 5, which include an enhanced engineered cover that incorporates low permeability elements such as a geomembrane or asphalt over the area west of the BCA, provide the most protectiveness.

Based on the evaluation of alternatives as documented in this FS Report, it is concluded that Alternatives 4 and 5 would provide the best balance of the evaluation criteria while achieving the RAOs set forth in this FS Report. The cover systems coupled with institutional controls provide adequate and reliable protection relative to human health exposures to constituents of concern in soil/fill material at the Site and would be consistent with reasonably anticipated future industrial or commercial use of the Site. These alternatives, in conjunction with the OU-1 remedial elements (Semet Residue removal, the existing implemented groundwater collection systems [Tributary 5A and the Willis-Semet Hydraulic Containment System IRM], and institutional controls restricting groundwater use) and the currently implemented IRM (Berm Improvement IRM) provide adequate and reliable protection of human health exposures to Site-related contaminants in soil/fill material and groundwater at the Site.

This FS Report documents the development and evaluation of remedial alternatives to address soil/fill material in sufficient detail such that risk management decision makers may select a remedy for the Site. Following review of the information and evaluations documented in this FS Report, NYSDEC and USEPA will document the preferred remedial action in a Proposed Plan. Following receipt of public comments on the Proposed Plan, the selected remedial alternative will be documented in a ROD.

1. INTRODUCTION

This Report documents the Operable Unit (OU)-2 Feasibility Study (FS) that was conducted to develop and evaluate potential remedial alternatives to address soil/fill material[4] at the Semet Residue Ponds Site (Site) in Geddes, NY. The Site is depicted on **Figure 1** below. OU-1 consists of Semet Residue[5] that was deposited in five man-made ponds on a portion of the Site, and groundwater. OU-2 consists of contaminated soil/fill material in the Brushy Cleared Area (BCA), and below and in the vicinity of the ponds (*i.e*, the area west of the BCA), which exceed Site cleanup goals (New York State Department of Environmental Conservation (NYSDEC) and United States Environmental Protection Agency (USEPA) 2002). Potential impacts from Site shallow and intermediate groundwater to Onondaga Lake have been addressed as the result of implemented Interim Remedial Measures (IRMs) and remedial actions including the construction of a barrier wall and collection system along the lakeshore. Deep groundwater will be addressed regionally in a separate FS Report.

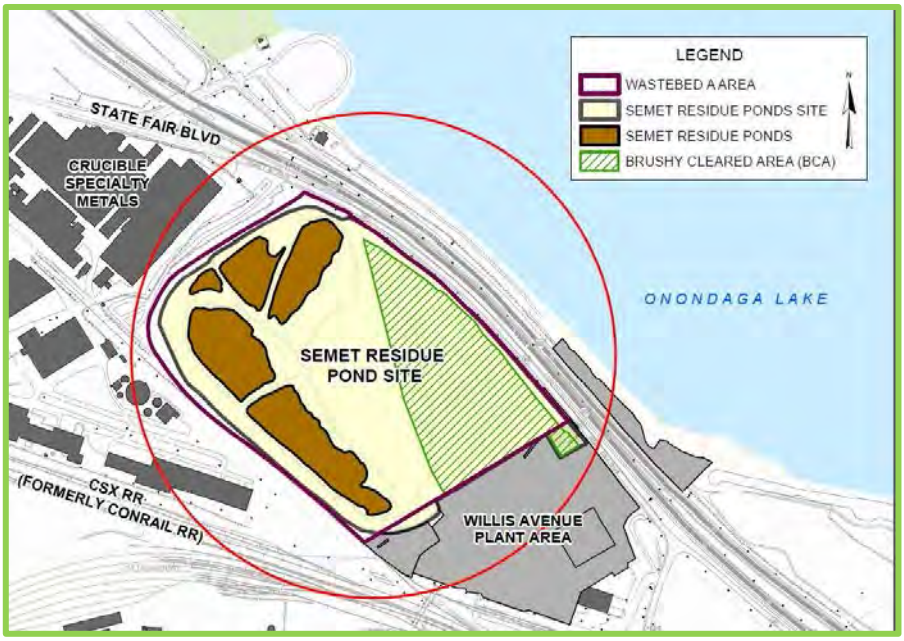

Figure 1: Semet Residue Ponds Site Location

The Site is listed as Class 2 on the New York State (NYS) Registry of Inactive Hazardous Waste Disposal Sites (Site #7-34-008), and is also a subsite to the Onondaga Lake NPL site. The Site has been the subject of various Administrative Consent Orders (ACOs) between the NYSDEC and Honeywell International, Inc. (Honeywell), including a Remedial Investigation(RI)/FS ACO (R7-0197-87-06) dated April 26, 1989(NYSDEC 1989) and a FS/Remedial Design(RD)/Remedial Action (RA) ACO (D7-0005-01-09) dated January 22, 2004 (NYSDEC 2004).

In addition to groundwater, Semet Residue, present in the ponds, was addressed separately from the soil/fill material in a March 2002 *Record of Decision (ROD)* issued by NYSDEC and USEPA (NYSDEC and USEPA 2002), and are the subject of ACO D7-0005-01-09 (NYSDEC 2004). Semet residue seeps in and around the perimeter

[4] The Site was used historically as a settling basin (Solvay Wastebed A) for Solvay waste. Solvay waste is an inert material consisting largely of calcium carbonate, calcium silicate, and magnesium hydroxide that was a waste product from the Solvay Process. The waste is a non-hazardous combination of process residuals, unreacted material and mineral salts taken out as a chloride-rich slurry exhibiting elevated pH (10 to12 standard units).In addition to the Solvay waste, the area received coarse ash and cinder from stoker-fired boilers, and soil/miscellaneous fill material appears to have been used to cover portions of the wastebed. The term "soil/fill material" throughout this document refers to Solvay waste, fill materials (*e.g.*, coarse ash and cinder from stoker-fired boilers, and soil/miscellaneous fill material) that have been placed at the Site, and soil that has formed above the Solvay waste.

[5] Semet Residue is a low pH, tarry organic-based residue generated by the acid washing of coke light oil (fractional distillation) during the production of benzene, toluene, naphthalene, xylene, and "motor benzol" at the benzol, toluol, xylol (BTX) Plant once operated by Honeywell predecessor Allied Chemical Corporation (later AlliedSignal).

berms were investigated and addressed under the Interim Remedial Measure (IRM) ACO (D7-0009-01-09) dated April 16, 2002 (NYSDEC 2002a). Following changes in vendor commitments and volume estimates, the Semet Residue remedy was re-evaluated, as documented in the 2017 *Revised Focused Feasibility Study (FFS) Amendment* (O'Brien & Gere (OBG) 2017a). The modified remedy, excavation and off-site thermal processing/beneficial reuse, is presented in the 2017 *Explanation of Significant Differences (ESD)* (NYSDEC and USEPA 2017). To date, over 30,500 tons of Semet Residue have been beneficially reused as part of remedy demonstration programs; Semet Residue will be removed for off-site thermal processing for beneficial reuse under the full-scale remedial action in 2018, following completion of remedial design submittals.

This report documents the development and evaluation of remedial alternatives such that a final remedy may be selected to address Site soil/fill material. Remedial activities commenced at the Site in the early 1990s in the form of various IRMs and remedial actions. Most notably, Site groundwater migration was addressed by the Willis-Semet Hydraulic Containment System IRM, and a groundwater collection trench along State Fair Boulevard, which was installed as part of the Interstate 690 (I-690) Storm Drainage System Investigation and Rehabilitation IRM. As described above, groundwater migration was also addressed by a remedial action implemented for Tributary 5A pursuant to the 2002 *ROD*. The groundwater collection trench along State Fair Boulevard is connected to the Tributary 5A groundwater collection system. The completed IRMs, remedial actions, and evaluations of performance are summarized further in **Section 3** of this FS Report.

In addition to IRMs and remedial actions for groundwater and Semet Residue, soil/fill material on portions of the site has been addressed through a soil cover. The soil cover was installed as part of the Willis-Semet Berm Improvement IRM.

This FS Report contains six sections as summarized below:

- The remainder of this section presents a brief description of the Site and its history.
- **Section 2** presents a summary of previous environmental investigations and studies.
- The IRMs, field demonstrations and remedial actions are discussed in **Section 3**.
- The development of remedial alternatives is presented in **Section 4**.
- The detailed analysis of these alternatives is documented in **Section 5**.
- The conclusions to the FS are presented in **Section 6**.

1.1 SITE DESCRIPTION

The Semet Residue Ponds Site comprises approximately 49 acres in the Town of Geddes, Onondaga County, New York, as illustrated on **Figure 1-1**. The Site is located in an industrial area adjacent to I-690 that runs parallel to the southern shore of Onondaga Lake. The Site is bordered on the west and south by the Crucible Specialty Metals Corporation (Crucible), on the south by Conrail Railroad tracks and an industrial complex, on the north by State Fair Boulevard and I-690, and on the east by the former Willis Avenue Plant Area (Willis Plant Area) (**Figure 1-2**).

The Site is currently owned by Honeywell International, Inc., the successor of Allied Chemical and AlliedSignal, and is undeveloped with the exception of gravel/dirt access roads and a staging area used for Site activities. The Site is enclosed by site berms and a 6-foot (ft) fence, built in 1979, to restrict access. Honeywell representatives currently provide surveillance. The only access to the Site is through a locked manually opened gate.

In general, the Site is sparsely vegetated, with some areas of visible surface soil. The Site is elevated compared to the surrounding area, with the ground surface of the Site approximately 30 ft above the level of Onondaga Lake to the north and approximately 20 ft higher than the adjoining land to the west through the southeast. As

Figure 2: Aerial view of Semet Residue Ponds Site

illustrated on **Figure 1-2**, the Site consists of former Solvay Wastebed A. The northern and eastern portion of the Site includes the approximate 13-acre area designated as the BCA and 1.5 acres of berms bordering the BCA to the north. To the west of the BCA, a 34.2 acre area of the Site comprises Semet Residue, deposited in five irregularly-shaped ponds, and the Semet Material Areas (SMAs) that exhibit layers of Semet Residue and Solvay waste, and perimeter berms to the west and south.

As described above, Semet Residue is an organic-based substance generated from the fractional distillation of coke light oil; it is acidic (pH < 1) with a high VOC and organic carbon content, and it exhibits the D018 characteristic for benzene (OBG 1991). Viscosity and the potential for volatile emissions vary depending on the temperature of the residue in the ponds. Semet Residue from Ponds 3 and 4 is a loosely consolidated organic tar with a large aqueous phase component and a higher benzene concentration than Semet Residue from Ponds 1, 2, and 5. Semet Residue from Ponds 1, 2, and 5 is highly viscous tar and has no or de minimus aqueous component during dry weather. To date, the Semet Residue has been partially removed from these ponds.

Tributary 5A is a surface drainage ditch located immediately southeast and northwest of the Site as illustrated on **Figure 1-2**. Tributary 5A originates from a culvert north of the railroad tracks on the west side of Willis Avenue. It flows as a surface ditch in an east-west direction parallel to the railroad tracks until just west of the Site's western fence line and then proceeds for a distance in a culvert in a northeast direction before once again flowing as a surface ditch north towards Onondaga Lake. The tributary is considered an industrial effluent stream, defined as a stream "in which the temperature, chemistry, or transparency of the water is significantly modified by discharge of effluent from an industrial, commercial or sewage treatment plant" (Reschke 1990). The tributary receives discharge from twelve outfalls from Crucible, as well as surface water run-off from the Site, Willis Avenue Site, and the former Church and Dwight facility. According to the Crucible State Pollutant Discharge Elimination System (SPDES) Permit, Tributary 5A formerly carried a NYS stream classification of "D"; however, the tributary has been declassified. As a result, the tributary assumes the class of the surface water to which it discharges (Onondaga Lake), which is classified as Class C. Tributary 5A was the subject of a remedial action that addressed surface water, sediments and groundwater as discussed in **Section 3.1.2**.

1.2 SITE HISTORY

Before 1917, the area was a settling basin (wastebed) for Solvay process waste and known as Solvay Wastebed A. From 1917 to 1970, Semet Residue, generated by Honeywell's predecessor Allied Chemical Corporation (later AlliedSignal) and its former benzol, toluol, xylol (BTX) plant, was deposited in five bermed excavations in

Wastebed A. The Semet Residue Ponds are located in the western half of Solvay Wastebed A (**Figure 1-2**) (OBG 1989). The ponds were constructed by dragline and bulldozer excavation of the Solvay waste. Non-engineered dikes encompassing the ponds were constructed from fill materials, including concrete rubble, old electrolytic cell parts, ashes, and bricks (OBG 1991). A clay and gravel mixture was also observed in the berms during investigative work performed in 2002.

1.3 REGULATORY BACKGROUND

OBG conducted a RI/FS for the Semet Residue Ponds Site in accordance with a 1989 ACO (R7-0197-87-06) between AlliedSignal and NYSDEC (NYSDEC 1989). The *RI Report*, that evaluated Semet Residue in ponds, Site groundwater, and surface water and sediment in Tributary 5a, was issued in 1991 (OBG 1991) and approved by NYSDEC on August 1, 1995.

In December 1994, NYSDEC issued an IRM ACO stating that a cover had to be placed over Ponds 3 and 4 to minimize vapors from the Semet Residue (NYSDEC 1994). A cover, consisting of a fly ash and cement mixture, was placed over Ponds 3 and 4 in 1995 and later placed over Ponds 1, 2, and 5 as part of an IRM to reduce volatile emissions and odors from the Site. The cement-based cover is currently applied to the Ponds on an annual basis to minimize vapors. The location of the Semet Residue ponds is depicted on **Figure 1-2**.

Following the RI, several treatability studies and pilot tests were completed to provide data needed to evaluate remedial alternatives for the Semet Residue. The June 1999 FS Report (OBG 1999a) described these pilot tests and evaluated four remedial alternatives to address Semet Residue at the Site. A ROD was issued by NYSDEC and USEPA on March 28, 2002 (NYSDEC and USEPA 2002) that presented the remedy to address groundwater and Semet Residue in ponds at the Site.

The 2002 *ROD* remedy to address Semet Residue consisted of reuse of the material through removal and processing to produce a soft tar product (RT-12), which could be used to make a driveway sealer at an off-site location. The ROD also established a separate OU for the impacted material (soil/fill material) that exists below and in proximity to the Semet Residue Ponds and in the BCA. In 2002 (NYSDEC 2002b), NYSDEC approved Honeywell's December 1999 beneficial use determination (BUD) petition (OBG 1999a). The BUD stated that the proposed reclamation and commercial sale of the Semet Residue constituted a beneficial use, and the specified products were not considered a solid waste under Title 6 New York Codes, Rules and Regulation (6 NYCRR) Part 360 regulations.

The 2002 ROD remedy component selected to address groundwater included a shallow groundwater collection system, remediation of Tributary 5A sediments by excavation, and installation of an isolation layer and substrate within the limits of Tributary 5A. This remedy, now implemented, addressed shallow groundwater discharges from the Site to Tributary 5A in addition to impacts to Tributary 5A sediments and surface water as a result of operations at the adjacent Willis Plant Area. This remedial action is discussed below in **Section 3**.

In June 2002, Honeywell requested a ROD modification due to changes in market conditions related to the residue product recovery and reuse alternative selected to address Semet Residue in the ROD. NYSDEC required that the modification be evaluated in a FFS under the 2004 ACO. A FFS was completed, as documented in the July 2006 *Revised Focused FS Report* (OBG 2006a). Based on the FFS, a new reuse alternative, on-site distillation for beneficial reuse, best met the FS evaluation criteria for the Semet Residue, and a new BUD petition was prepared; the final revised BUD petition, incorporating NYSDEC comments, dated April 7, 2006 (NYSDEC 2006), was submitted to NYSDEC in August 2006 (OBG 2006b) and approved on November 21, 2006.

During preliminary conceptual design related to the on-site distillation for beneficial reuse alternative in 2008 and 2009, review of historical photographs and additional information indicated that a re-evaluation of the Semet Residue volume was necessary. Two field investigations were completed in 2009 and 2010 to refine the estimated volume of Semet Residue - a volume verification investigation (OBG 2009a) and an OU-1 Pre-Design Investigation (PDI; OBG 2010). As documented in the *OU-1 PDI Report*, the estimated volume of Semet Residue,

17 million gallons (MG), was significantly less than what was previously assumed during ROD and FFS development (60 – 80MG).

Given the lower estimated Semet Residue volume, it was concluded that further evaluation of the off-site and on-site thermal processing for beneficial reuse alternatives were warranted. Remedy selection treatability studies (RSTSs) were conducted to reduce uncertainties related to thermal processing for beneficial reuse alternatives. RSTSs were documented in the following reports:

- June 2011 *Semet Residue Characterization for Thermal Treatment RSTS Report* (Honeywell 2011), approved on June 28, 2011
- December 2011 *Cold and Hot Weather RSTS Report* (OBG 2011), approved on February 17, 2012 (NYSDEC 2012)
- October 2014 *Expanded RSTS Report* (OBG 2014), approved on October 22, 2014 (NYSDEC 2014).

RSTS results confirmed the potential viability of off-site thermal processing for beneficial reuse of the Semet Residue in ponds. Field demonstrations were conducted from 2014 to 2017 to provide information needed to advance remedy selection and development, including material handling and thermal processing capacity details, limitations at the cement kilns associated with material handling and chemical characteristics that could impact acceptance and/or processing rates, and the efficacy of excavation and off-site blending of the Semet Residue for cement kiln beneficial reuse (OBG 2015a, 2016c, 2017i).

An updated evaluation of the off-site thermal processing/reuse alternative, incorporating RSTS and demonstration results, was presented in the 2017 *Revised FFS Amendment Report* (OBG 2017a). The 2017 *Revised FFS Amendment Report* also described and incorporated updated Semet Residue quantity estimates. The updated total estimated volume of Semet Residue prior to demonstration removal efforts as documented in the 2017 *Revised FFS Amendment Report* was 10 MG, or 49,000 cubic yards (cy) (47,000 tons).

In July 2017, following the issuance of the 2017 *FFS Amendment Report,* NYSDEC and USEPA issued an *ESD* (NYSDEC and USEPA 2017). The 2017 *ESD* documented the modified remedy as excavation of Semet Residue, on-site dewatering, and off-site thermal processing for beneficial reuse at a Resource Conservation and Recovery Act (RCRA)-permitted facility. To date, over 30,500 tons of Semet Residue have been beneficially reused.

2. SITE CHARACTERIZATION

Site characterization data have been presented in the 1991 RI Report (*Remedial Investigation Report*, OBG 1991). Since the 1991 RI, data have been collected as part of IRMs and remedial actions, Semet Residue volume refinement efforts, and treatability study and demonstration activities for the OU-1 remedy. Site characterization data for soil/fill material were summarized and presented in the *Data Summary Document* (OBG 2017b). To support the development and evaluation of remedial alternatives for Site soil/fill material, characterization data for soil/fill material are summarized below.

2.1 SITE INVESTIGATIONS

A comprehensive list of relevant historical reports and investigations performed at the Site is provided in Appendix A of the *Data Summary Document* (OBG 2017b). These reports cover various types of studies conducted at the Site from 1980 through 2014. An overview of the types of studies completed is listed below.

- Site history completed in 1989 (*History of Semet Residue Ponds*, OBG 1989)
- RI completed in 1991 (*Remedial Investigation Report*, OBG 1991)
- FS completed in 1999 (*Feasibility Study Revised Final Report*, OBG 1999b)
- FFS completed in 2006 (*Revised Focused Feasibility Study Revised Report*, OBG 2006a)
- Groundwater remedial actions designed, constructed, and operating to intercept, collect and treat groundwater discharging from the Site (identified as the groundwater remedy in the 2002 ROD).
  - *Semet Ponds/Willis Avenue Ground Water IRM Treatability Testing Final Report*(OBG 2000)
  - *Pre-Design Summary Report*; Semet Residue Ponds Remedial Design; Ground Water Remedial Alternative (OBG 2005)
  - *95% Remedial Design Report*; Semet Residue Ponds Remedial Design; Ground Water Remedial Alternative (OBG 2009b)
  - *Semet Residue Ponds Groundwater Alternative Remedial Design Supplemental Pre-Design Studies Data Summary Report* (OBG 2008)
- Investigations performed to refine the Semet Residue volume estimate, completed in 2009 and 2010, which generated significant information and data related to the soil/fill material:
  - *Semet Residue Ponds Volume Verification Investigation Report*, OBG 2009a
  - *Semet Residue Ponds OU-1 Pre-Design Investigation Report*, OBG 2010

Analytical results from these investigations for soil/fill material are summarized in the *Data Summary Document* (OBG 2017b)**.** In the fall of 2016, a Supplemental Demonstration Investigation was performed to evaluate conditions west of the BCA and documented in the *2016 Demonstration Program Report* (OBG 2017f). Highlights are presented below in **Sections 2.2** and **2.3**.

2.2 SUMMARY OF SITE GEOLOGY AND HYDROGEOLOGY

Based on the Site geologic and hydrogeologic data collected during the RI and subsequent investigations, the following conclusions have been developed:

- As described in **Section 1.1**, Wastebed A site ground surface is approximately 30 ft above the level of Onondaga Lake to the north and approximately 10 to 20 ft higher than the adjoining land to the west through

the southeast. Wastebed A ranges from 30 ft to 35 ft thick of soil/fill material. The Semet Residue ponds were excavated into Wastebed A and had an average Semet Residue thickness of 4 ft.

- Site geology consists of seven distinct layers including the soil/fill material, marl/peat, clay and silt, fine grained sand and silt, sand with gravel, till, and bedrock.
  - The soil/fill material is approximately 30 ft to 35 ft thick and is composed mostly of Solvay waste, with some coarse ash/cinders and other fill material (gravel, fire brick, and concrete), and soil. The grain size of the Solvay waste ranges from silt to clay, but becomes coarser when consolidated. The texture ranges from toothpaste-like to cemented.
  - The marl/peat layer is up to 12 ft thick and found across the Site, with the exception of along the southern edge. The marl is gray-green in color and fossiliferous and occurs with varying amounts of sand, silt, and clay in the matrix. The marl has a sulfur odor characteristic of decaying natural organic matter. A layer of dark brown-to-black peat with visible vegetative debris is typically encountered at the top of the marl. The peat unit ranges up to 2 ft in thickness and thins toward the south. The peat and marl units are typical shallow lake water deposits.
  - The clay and clay-rich silt layer range from 2 ft to 10 ft thick. The layers thicken to the north toward Onondaga Lake, but become absent to the south.
  - The fine grained sand and silt deposit up to 50 ft thick was encountered underlying the clay and silt layer. The fine grained sand and silt deposit is thickest on the northeast and northwest portions of the Site but thins to the south. This deposit is generally red brown and grades into a finer grained silty sand and clayey silt deposit towards the lake.
  - A medium-to-coarse grained sand with silt unit is present beneath the fine grained sand and silt. This deposit ranges from less than 1 ft to 15 ft thick. The sand unit gradually decreases in thickness across the Site in a southerly direction. The majority of the deposit is medium to coarse grained sand with fine grained sand and silt with localized zones of coarse grained sand with trace gravel.
  - The till overlying the bedrock consists of sand and gravel in a clay-silt matrix. The till unit is relatively thin (less than 2 ft thick) and was not encountered in borings near the western and southwestern boundaries of the Site. Based on historical data, there appears to be a bedrock knob in the area where till was not encountered.
  - The bedrock encountered beneath the unconsolidated sediments is the Silurian age red to green Vernon Shale. The top of the bedrock surface generally dips towards Onondaga Lake. Samples from borings that encountered the Vernon shale revealed that the surface of the shale has weathered to a cohesive clay-silt.
- Based on groundwater gradient data, hydraulic conductivity test and grain size analysis, five groundwater zones were differentiated at the Site: shallow, intermediate, confining, deep and bedrock.
  - The shallow hydrogeologic unit consists of anthropogenic fill/waste material. Shallow groundwater ranges from 5 to 15 ft below ground surface.
  - The intermediate hydrogeologic unit consists of the marl and peat material, underlain by a confining layer which includes the clay and silt unit.
  - The confining layer includes the clay and silt unit.
  - The deep hydrogeologic unit is composed of the fine grained sand and silt and the medium to coarse grained sand.
  - The bedrock hydrogeologic unit is comprised of Vernon Shale.
- Shallow groundwater generally flows radially from the Site toward Onondaga Lake and Tributary 5A. Intermediate groundwater generally flows toward Onondaga Lake. As noted above, and described in **Section**

3, this groundwater flow is captured by the two groundwater collection systems that have been installed as IRMs.

2.3 NATURE AND EXTENT OF CONTAMINATION

This section presents a summary of the nature and extent of contamination of soil/fill material at the Site to be addressed in the FS.

As described in **Section 1**, the area was used as a settling basin for Solvay process waste. Coarse ash/cinders and other fill material (gravel, fire brick, and concrete), and soil are also present. Semet Residue, an organic-based substance generated by Allied Chemical, was deposited in five bermed excavations. Semet Residue is intermixed and/or layered with the soil/fill material within the SMAs and immediately beneath and adjacent to the Semet Residue ponds. Soil/fill material is present across the approximately 49 acres of the site in Wastebed A, varying from 30 to 35 ft thick.

For the purpose of identifying areas to be addressed in this FS, and to support the development and evaluation of remedial alternatives, reasonably anticipated land use have been considered. Analytical results presented in the *Data Summary Document* (OBG 2017b) were compared to the respective soil cleanup objectives (SCOs) in 6 NYCRR 375 for industrial and commercial land use in consideration of anticipated future land use. In addition, for purposes of developing an alternative to evaluate pre-disposal conditions, analytical results were compared to the 6 NYCRR 375 SCOs for unrestricted land use. Based on these considerations, the nature and extent of contamination discussion below is presented in the context of these land uses.

In addition to environmental sample collection and analysis at the Site, the extent of contamination in the area west of the BCA was evaluated using Tar-specific Green Optical Screening Tool (TarGOST®). The TarGOST® responses were summarized in 2010 *Operable Unit 1 Pre-Design Investigation* (OBG 2010) and the associated analytical soils data are included in the *Data Summary Document* (OBG 2017b).

Soil/Fill Material in the Area West of the BCA

The Semet Residue ponds are located on the portion of the Site west of the BCA. As described above, the Semet Residue is being removed for beneficial reuse. The texture of the Solvay waste surrounding and beneath these ponds ranges from soft (toothpaste-like) to cemented. Analytical results showed volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs) and inorganics at concentrations above the Part 375 SCOs. In addition, TarGOST® responses correlating to detected VOC concentrations were observed in the area West of the BCA. Figures depicting the analytical results above Part 375 SCOs and figures of the TarGOST® responses are presented in the *Data Summary Document* (OBG 2017b). The analytical results comparison and TarGOST® responses are summarized as follows:

- ***VOCs.*** Benzene, toluene, ethylbenzene and xylene (BTEX) are the principal VOCs in the soil/fill material with benzene generally having the highest VOC concentrations. Typically benzene concentrations across the area west of the BCA exceeded Part 375 Industrial Use and Commercial Use SCOs**.** Toluene and xylene frequently exceeded Part 375 Commercial and Unrestricted Use SCOs with isolated Industrial Use SCO exceedances. Ethylbenzene concentrations were infrequently observed above Part 375 Unrestricted Use SCOs. VOC exceedances to Part 375 Industrial Use SCOs and Commercial Use SCOs were noted as deep as 20 ft below ground surface (bgs). VOC exceedances to Part 375 Unrestricted Use SCOs were observed as deep as 40 ft bgs.
- ***SVOCs.*** SVOCs are present in concentrations that are generally comparable to the VOC concentrations. Detected SVOCs include: 1,1'-biphenyl, 1-phenyl-1-(2,4-dimethylphenyl)ethane (PXE), 1-phenyl-1-(4-methylphenyl)ethane (PTE), 2-methylnaphthalene, naphthalene, phenol, and a various polycyclic aromatic hydrocarbon (PAHs). Naphthalene is the predominant SVOC. Of the SVOCs observed, naphthalene and benzo(a)pyrene concentrations exceeded Part 375 Industrial Use SCOs. Dibenzofuran at one sample location had a concentration exceedance for Part 375 Commercial Use SCOs. SVOC exceedances to Part 375 Industrial

Use SCOs and Commercial Use SCOs were noted as deep as 20 ft bgs. SVOC exceedances to Part 375 Unrestricted Use SCOs were observed as deep as 40 ft bgs.

- ***Inorganic constituents.*** Limited inorganic data were collected for the Site. Mercury was detected above Part 375 Unrestricted Use SCOs across the Site. Concentrations of mercury exceeding Part 375 Commercial Use and Part 375 Industrial Use SCOs were also observed at a lower frequency across the site. Barium was observed at concentrations above Part 375 Commercial Use SCOs at a single location.
- ***Pesticides and PCBs.*** Limited soil/fill samples have been analyzed for pesticides and PCBs. In one sample beta-BHC had concentrations above Part 375 Industrial Use SCOs. No PCBs have been detected in Site soil/fill material samples.
- ***TarGOST® responses.*** TartGOST® responses varied across the area West of the BCA. High responses, generally correlating with detected VOC concentrations were observed as deep as 25 ft over much of this area. Observations deeper than 35 ft were limited to fewer locations.
- ***Soil/Fill Material in the BCA***

The BCA generally consists of several inches to 2 ft of soil/fill overlying Solvay waste, located on the portion of the Site where the Semet Residue ponds are not present. The BCA has a vegetative cover of buckthorn, cottonwood, and aspens. Semet Residue has not been observed in the BCA.

- ***VOCs and SVOCs.*** Detected VOC and SVOC concentrations were below the Part 375 SCOs.
- ***Inorganic constituents.*** Mercury concentrations exceeded Part 375 Industrial Use and Part 375 Unrestricted Use SCOs in soil at the BCA. The mercury exceedances were noted as deep as 3.5 ft.
- ***Pesticides and PCBs.*** Pesticides were analyzed for one sample (SP-BCA-25A). The concentration of beta-BHC was observed above the Part 375 Industrial Use and Part 375 Unrestricted Use SCO at this location.

2.4. HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENTS

Risk assessments were performed using conservative regulatory methodologies as described in the *Semet Ponds OU-2 Site Streamlined HHRA Approach Document* (OBG 2016a) and the *Semet Ponds OU-2 Site Streamlined Ecological Risk Assessment (ERA) Approach Document* (OBG 2016b) and subsequent communications with NYSDEC and USEPA. The results of the risk assessments were documented in the *Revised Semet Ponds Site Soil/Fill Material HHRA* (OBG 2017c) and the *Revised Semet Ponds Site Soil/Fill Material ERA* (OBG 2017d) and approved by the NYSDEC. The final *HHRA Report* was approved by the NYSDEC on March 31, 2017. The final *ERA Report* was approved by the NYSDEC on February 17, 2017. Summaries of the HHRA and ERA findings are presented below.

HHRA

Non-carcinogenic hazards and lifetime excess cancer risks from exposure to soil were calculated for two receptor populations; future industrial workers that work both indoors and outdoors during their work day, and future construction workers. The hazards and risks posed to indoor/outdoor industrial workers and construction workers from exposure to contaminants of potential concern (COPCs) via incidental ingestion, dermal contact, and ambient air inhalation are as follows:

Indoor/Outdoor Industrial Worker – The calculated total excess lifetime cancer risk for all COPCs and exposure routes for the indoor/outdoor industrial worker is 2×10^{-3}, above the acceptable regulatory range of 1×10^{-4} to 1×10^{-6}; unacceptable carcinogenic risks are primarily driven by inhalation of benzene and naphthalene in surface soil/fill materials. The calculated hazard index (HI) for all COPCs and exposure routes is 3E+01, above the regulatory threshold of 1. The unacceptable hazard is driven by exposure via inhalation of naphthalene and benzene originating from surface soil/fill materials.

Construction Worker – The calculated total excess lifetime cancer risk for all COPCs and exposure routes for the construction worker is 9×10^{-5}, within the acceptable regulatory range of 1×10^{-4} to 1×10^{-6}. The calculated HI for all COPCs and exposure routes is $3x10^{1}$, above the regulatory threshold of 1; the unacceptable hazard is driven by incidental ingestion of benzene in surface/subsurface soil/fill materials and by inhalation of benzene, naphthalene, and 1,2,4-trimethylbenzene in surface/subsurface soil/fill material.

Based on the HIs computed for the indoor/outdoor industrial worker and construction worker and the lifetime excess cancer risk computed for the indoor/outdoor worker, control of exposures to surface/subsurface soil/fill material is warranted to provide adequate protection for future human users of the Site.

As documented in the 1991 *RI*, groundwater at the Site does not present a complete exposure pathway. Furthermore, the groundwater at the Site is not suitable as a drinking water supply irrespective of any contributions related to waste at the Site because the yield of the overburden groundwater unit is inadequate for water supply wells, and the high salinity of the bedrock aquifer (approximately 3,000 mg/L chlorides) precludes its use as drinking water. In addition, the indoor air pathway was not evaluated in risk assessments for the Site.

ERA

Ecological hazard quotients (HQs) were calculated for six wildlife species (American robin, northern short-tailed shrew, mourning dove, eastern cottontail rabbit, red-tailed hawk, red fox) representing distinct trophic level receptors that may be exposed to contaminants of ecological concern (COECs) in Site surface soil. Based on food chain modeling using average and upper-bound surface soil concentrations of COECs coupled with exposure assumptions under both conservative and refined scenarios, potentially unacceptable risks to the majority of ecological receptors were identified at the Site. Under the refined modeling scenario (less conservative exposure assumptions), risks were lower for the red-tailed hawk and red fox (wide-ranging wildlife receptors) relative to the American robin and short-tailed shrew. Because of its small size, high ingestion rate, and small home range, the highest HQs were calculated for the short-tailed shrew. Elevated risks under both conservative and refined exposure scenarios were attributable mainly to metals and SVOCs, which were detected more frequently and had a greater frequency of HQs exceeding the regulatory threshold (1.0) relative to pesticides and VOCs. There is some uncertainty associated with the risks attributable to select COECs in Site soil/fill material given the absence of comparative toxicity values for these chemicals.

Based on the magnitudes of the food chain HQs calculated for the terrestrial avian and mammal wildlife receptors, control of exposures to surface soil/fill material is warranted to provide adequate protection for current and future wildlife use of the Site. It should be noted that while an ERA was performed for the Site, the reasonably anticipated future use for the Site will be industrial or commercial use, which is not suitable habitat for ecological receptors.

3. INTERIM REMEDIAL MEASURES, FIELD DEMONSTRATIONS, AND REMEDIAL ACTIONS

3.1. GROUNDWATER REMEDY

The 2002 ROD documented the following remedial action objective (RAO) for groundwater (NYSDEC and USEPA 2002):

- Eliminate, to the extent practicable, migration of groundwater to Onondaga Lake and Tributary 5A that does not attain applicable state and federal water quality criteria for Site-related constituents

The selected remedy for groundwater in the 2002 ROD was hydraulic containment using a groundwater barrier, extraction, and collection trench for contaminated groundwater migrating toward Tributary 5A, and on-site groundwater treatment. The hydraulic containment was implemented as part of the Willis-Semet Hydraulic Containment System IRM. The collection trench for groundwater migrating toward Tributary 5A was implemented as a remedial action. These actions are discussed below and are depicted on **Figure 3-1**.

3.1.1 Willis-Semet Hydraulic Containment System IRM

The Semet barrier wall and associated groundwater collection system were installed as part of the Lakeshore Hydraulic Containment System (LHCS) to collect shallow and intermediate groundwater prior to discharge to Onondaga Lake. The *Final Interim Remedial Measure Engineering Report and Certification, Semet Portion Willis Avenue/Semet Tar Beds Sites IRM* (Parsons 2008) provides a detailed discussion of the LHCS. The Semet portion of the LHCS was installed as part of the Willis-Semet IRM Consent Order D-7-00004-01-09 (NYSDEC 2002c), that called for the elimination, to the extent practicable, of the migration of contaminated groundwater containing process residuals and non-aqueous phase liquid (NAPL) into Onondaga Lake (NAPL was associated with the Willis Avenue Site). This portion of the IRM consisted of the installation of 1,440 linear feet of barrier wall and groundwater collection system. This work was completed between October 2006 and May 2007. The locations of the barrier walls and collection systems are presented on **Figure 3-1**.

The Willis-Semet Hydraulic Containment System IRM included the design and construction of a groundwater treatment plant (GWTP) (**Figure 3-1**). To effectively manage the anticipated combination of groundwater and construction waters associated with the various proximal Honeywell sites, the treatment system was designed for phased expansion, which has been performed three times since start-up. The GWTP provides treatment of the groundwater prior to discharge to the Onondaga County Department of Water Environment Protection (OCDWEP) Metropolitan Wastewater Treatment Plant (Metro). The GWTP capabilities include the removal of metals and solids via pH adjust, precipitation, clarification, and filtration. The VOCs and SVOCs are removed via a combination of air stripping and granular activated carbon (GAC) adsorption. The GWTP effluent water receives enhanced ammonia removal at Metro. During wet weather events, the discharge of treated effluent to Metro may be temporarily suspended and the effluent directed to Onondaga Lake via Outfall 15A. Treatment of the vapors from the air stripper and process tank vents is by thermal oxidation and acid gas scrubbing.

The 2012 and 2013 Source Control Summary for the Onondaga Lake Bottom Subsite (Parsons and OBG 2013) and the *2014 Source Control Summary for the Onondaga Lake Bottom Subsite* (Parsons and OBG 2014) documented observations on containment of groundwater provided by the barrier wall and containment system, and addressed concerns related to the potential recontamination of the Onondaga Lake remedy. Specifically, the documents indicate that the ability of the barrier wall and collection system to contain groundwater has been demonstrated for this IRM. The *2015 and 2016 Source Control Summary for the Onondaga Lake Bottom Subsite* (Parsons and OBG 2017) documents ongoing hydraulic control of groundwater. As such, the Willis-Semet Hydraulic Containment System IRM addressed the corresponding IRM objectives listed above, with respect to groundwater and NAPL discharges to Onondaga Lake.

3.1.2. Semet Ponds Shallow Groundwater Remedial Action (Tributary 5A)

The Semet Ponds Shallow Groundwater Remedial Action (Tributary 5A) was completed to address the ROD remedial action objective (RAO) for groundwater migration and protects potential ecological receptors from impacted sediments and surface water. The integrated remedial design included a shallow groundwater collection system, remediation of sediments by excavation, and installation of an isolation layer and substrate within the limits of Tributary 5A (**Figures 3, 4 and 5**). This addressed the Site impacts to Tributary 5A sediments and surface water due to groundwater migration. The *Honeywell Tributary 5A Groundwater Remedial Alternative Construction Completion Report* (OBG 2013a) provides a discussion of the remedy and construction efforts. The location of this remedial action is presented in **Figure 3-1**.

Figure 3: Excavation of Tributary 5A Sediment

Subsequent to the completion of construction, a *Tributary 5A Groundwater Remedial Alternative Site Monitoring and Verification Plan* (OBG 2013b) was implemented at the Site to evaluate and document comparison to performance criteria, comparison to operational objectives, media through sampling and analysis, and adaptive measures to achieve design and performance criteria. The Site monitoring and verification was initiated in 2014 and included:

- Groundwater collection system performance verification
- Surface water and sediment monitoring
- Restoration monitoring
- Channel inspection
- Semet Residue seeps inspection
- State Fair Boulevard drainage ditch (see **Section 3.2**) inspection.

The *2013 and 2014 Source Control Summary for the Onondaga Lake Bottom Subsite* (Parsons and OBG 2013) documented observations on hydraulic control provided by the Tributary 5A collection system, and addressed concerns related to the potential recontamination of Onondaga Lake remedy. Specifically, the document indicates that sources of contamination from Tributary 5A to Onondaga Lake have been addressed, thereby, mitigating the potential for recontamination of the Onondaga Lake remedy. Additionally, the *2015 and 2016 Source Control Summary for the Onondaga Lake Bottom Subsite* (Parsons and OBG 2017) documents successful ongoing operation of the Tributary 5A hydraulic containment system.

Figure 5: View of Tributary 5A Remedial Action

The Site monitoring and verification results were documented in the *Tributary 5A 2014 Annual Report* (OBG 2015b). During the 2014 calendar year, the system collected approximately 20,000,000 gallons of water that was treated at the Willis-Semet GWTP. Analytical results for surface water and sediment suggested impacts from off-site sources, and Crucible entered into Consent Order R7-20121030-88 with the NYSDEC (NYSDEC 2015) on January 9, 2015 to evaluate their potential impacts to Tributary 5A from existing outfalls and on-going operations.

Restoration monitoring indicated vegetative establishment and cover and invasive species met expectations. Minor observations including evidence of erosion and volunteer shrub seedlings were identified for corrective actions in the *Honeywell Tributary 5A 2016 Annual Report* (OBG 2017g). These corrective actions were completed in 2017.

3.2. STATE FAIR BOULEVARD COLLECTION TRENCH IRM

Figure 6: Installation of State Fair Boulevard Groundwater Collection Trench

The I-690 Storm Drainage System Investigation and Rehabilitation was performed pursuant to an IRM Consent Order between Honeywell and NYSDEC dated November 11, 1996 (NYSDEC 1996) that called for measures to prevent ongoing discharge of Site-related contaminants via the I-690 drainage pipes. The investigation was directed at two portions (eastern and western) of storm drains situated north of the Plant Area that collect surface water runoff from State Fair Boulevard and I-690 and some groundwater (via taps and open joints) in this area. Based on the initial and subsequent investigations, a phased IRM was undertaken to mitigate groundwater impacts to the I-690 storm drain and mitigate potential impacts to Onondaga Lake. The storm water conveyance pipe was lined with a cured-in-place pipe and the associated catch basins have been lined with an epoxy coating.

In connection with the I-690 Storm Drainage System Investigation and Rehabilitation IRM, the installation of a 1,942 ft groundwater collection trench (State Fair Boulevard collection trench) beneath the State Fair Boulevard drainage ditch was performed (**Figure 6**). This included the removal of soils, installation of a geomembrane and stone, and connection to the Tributary 5A collection vault constructed as part of the Tributary 5A remedial action described above. This work was completed in September 2012.

The *2014 Source Control Summary for the Onondaga Lake Bottom Subsite* (Parsons and OBG 2014) documented observations on containment of groundwater migration through the I-690 drainage system and addressed concerns related to the potential recontamination of the Onondaga Lake remedy. Specifically, the document indicates that the storm drain rehabilitation and underdrain rerouting are minimizing ongoing discharge of Site-related contaminants via the I-690 drainage pipes to Onondaga Lake. The *2015 and 2016 Source Control*

Summary for the Onondaga Lake Bottom Subsite (Parsons and OBG 2017) documents ongoing hydraulic control. As such, the I-690 drainage system addresses the corresponding IRM objectives listed above, with respect to discharges to storm water conveyance to Onondaga Lake.

The *Ballfield/Willis/Semet Berm and I-690 Underdrain Construction Completion Report* (OBG 2014b) describes these construction efforts. The location of the rehabilitated I-690 Storm Drainage System and the State Fair Boulevard collection trench are presented on **Figure 1-2**. The *Ballfield/Willis/Semet Berm and I-690 Underdrain Performance Verification and Monitoring Plan* (OBG 2015c) was approved in April 2015 by NYSDEC. This plan is currently being implemented at the Site. The *Ballfield/Willis/Semet Berm and I-690 Underdrain 2016 Annual Report* documents that the storm sewer rehabilitation continues to be successful (OBG 2017g).

3.2. WILLIS-SEMET BERM SITE IMPROVEMENTS

The overall goal of the Site Improvements Project was to increase the aesthetic and ecological value of the I-690 corridor in the vicinity of the Ballfield, Willis Avenue, and Semet Residue Ponds Sites. The berms originally had extensive areas dominated by invasive species with low aesthetic value. Existing vegetation across the berms were removed and soil sampling was performed. Berm material from select impacted areas was excavated and replaced with clean fill/topsoil prior to application of 6-inches of topsoil. In total, between 12 and 24-inches of clean fill and topsoil was placed in this area. Native grass and forb species and native trees and shrubs were introduced after the topsoil was applied (**Figure 7**). The *Ballfield/Willis/Semet Berm and I-690 Underdrain Construction Completion Report* (OBG 2014b) provides a discussion of these efforts. The Site-related portions of this IRM are presented on **Figure 1-2**. The native vegetative species have become established along the berm as documented in the *Ballfield/Willis/Semet Berm and I-690 Underdrain Performance Verification and Monitoring Annual Report* (OBG 2017h).

Figure 7: View of Vegetated Berm along the I-690 Corridor

3.3. SEMET RESIDUE FIELD DEMONSTRATIONS AND REMEDIAL ACTION

As described in **Section 1**, the 2002 ROD and 2017 *ESD* document the remedy selection for Semet Residue and groundwater at the Site. This remedial action is described below.

The remedial action objectives for this remedial action, as documented in the 2002 ROD were:

- Prevent direct contact (human and wildlife) with the pond residue
- Reduce volatile emissions from the pond residue

The components of the off-site thermal processing for beneficial reuse remedial action selected for the Semet Residue in the 2017 *ESD* are:

- Excavation of Semet Residue
- On-site dewatering of Semet Residue as needed to remove free liquids for transport

- Transport of Semet Residue off-site to a RCRA-permitted thermal processing for beneficial reuse facility
- On-site management of process aqueous generated from the dewatering screw conveyor
- Maintenance of temporary fiber-based or cement-based spray-on-cover as needed for odor and emission controls
- Fencing and site security monitoring.

Figure 8: Semet Residue Remedial Action

These components have been demonstrated at full-scale during a field demonstration and pre-design investigation programs to refine volumes, excavation, dewatering and material handling. Residue acceptance criteria were evaluated as part of the field demonstration programs, and included fuel value and inorganic solids content. Following this field demonstration program and the *ESD*, a remedial design work plan has been submitted (OBG 2017e). The remedial design is underway with anticipated remedy implementation starting in 2018.

Semet Residue, which meets the acceptance criteria at a RCRA-permitted thermal processing for beneficial reuse facility, will be excavated from the site, to the extent practicable. Specifically, Semet Residue will be excavated from the Site using tracked excavators. Excavated Semet Residue that does not contain free aqueous phase will be placed directly in a double-lined dump trailer for off-site truck transport. Excavated Semet Residue containing free aqueous phase will be loaded into an on-site dewatering screw conveyor for dewatering. The aqueous phase generated from the dewatering process will be managed at the Willis Avenue GWTP. Dewatered Semet Residue will be discharged from the dewatering screw conveyor via a belt conveyor into a double-lined dump trailer or a tanker for off-site truck transport (**Figure 8**). As described hereafter, various emission and odor control measures will be implemented. A temporary fiber-based or cement-based spray-on cover will be maintained, as needed, in excavation areas during removal activities and on the dewatering screw conveyor during dewatering operations to minimize volatile emissions and odors. Methods to minimize odors off-site (*e.g.*, orchard fans, mist curtains) will be used, as needed, along sections of the perimeter fenceline. Community air monitoring will be conducted.

Semet Residue will be transported off-site for beneficial reuse at a RCRA-permitted facility. Demonstration programs have confirmed that Semet Residue can be managed at an off-site cement kiln (OBG 2015a, 2016a). Additional RCRA-permitted thermal processing for beneficial reuse facilities were evaluated as part of the 2017 demonstration. Acceptance rates at the off-site facilities may vary with changing market conditions, but based on the demonstration programs, it is anticipated that acceptance rates considering multiple outlets will range from 10,000 to 15,000 tons per year. To date over 30,500 tons of Semet Residue have been transported off-site for beneficial reuse during the demonstrations. It is anticipated that following completion of the Semet Residue remedial action, some Semet Residue that is not practicable to be removed and beneficially reused will remain. Consistent with the 2002 *ROD*, remaining Semet Residue will be addressed by the OU-2 FS.

3.5. SEMET SEEPS IRM

In an effort to address existing and future seeps, field reconnaissance activities were performed to identify Semet Residue seeps along the outer berms. This work was performed under an April 2002 ACO (D7-009.01-

09). The initial reconnaissance was followed by annual inspections. Upon completion of the Tributary 5a remedial action described above in **Section 3.1.2**, Semet Residue seep inspection and corrective actions began to be conducted in 2014 under the *Tributary 5A Groundwater Remedial Alternative Site Monitoring and Verification Plan* (OBG 2013b).

3.6. INTERIM REMEDIAL ACTION AND REMEDIAL ACTION CONSIDERATIONS FOR THE FS

As described above, IRMs, demonstrations and remedial actions have been (or will be) implemented at the Site and address media at the Site. The 2002 ROD documented the Tributary 5A and Willis-Semet Hydraulic Containment System as the groundwater remedy for the Site to address migration of groundwater from the Site. Groundwater collection using the State Fair Boulevard Collection System was implemented as an IRM, and, as described above, is connected to the Tributary 5A remedial action.

Portions of the northern berm at the Site were addressed by the Willis-Semet Berm Improvement IRM. As a result, a soil cover has been placed on portions of the northern berm. Consequently, this IRM will be considered a common element of each remedial alternative being developed and evaluated for OU-2.

The 2002 ROD and 2017 *ESD* documented excavation and off-site beneficial reuse of the Semet Residue as the selected remedy for this medium at the Site. Since this action is the subject of the decision document for OU-1, the removal of Semet Residue will not be considered as a part of each remedial alternative being developed for OU-2. It is anticipated that following removal of Semet Residue to the maximum extent practicable for beneficial reuse in accordance with the 2002 ROD and 2017 *ESD,* there will be Semet Residue remaining at the Site that is unsuitable for off-site thermal processing for beneficial reuse. Remaining Semet Residue will be evaluated in this FS. **Table 1** below provides a summary of each IRM and remedial action and how it relates to media to be addressed in this FS. The location of the IRMs described in Table 1 are illustrated on **Figure 1-2**.

Table 1 – Summary of Site Media

Site Media	Site Area	IRM or RA	Operable Unit	Evaluated in FS
Semet Residue	West of BCA – Semet Residue in Ponds 1 through 5, suitable for beneficial reuse	2002 *ROD*/2017 *ESD* Remedy	OU-1	No
	West of BCA – Semet Residue, remaining following OU-1 remedy	None	OU-2	Yes
Soil/Fill Material	BCA and West of BCA	Berm Improvement IRM	OU-2	Yes
Shallow Intermediate Groundwater	Site	Tributary 5A RA, Willis-Semet Hydraulic Containment System IRM; 2002 *ROD*	OU-1	No

4. DEVELOPMENT OF REMEDIAL ALTERNATIVES

This section documents the development of remedial alternatives for soil/fill material at the Site. The development of remedial alternatives for soil/fill material was performed consistent with the *Guidance for Conducting Remedial Investigation and Feasibility Studies Under CERCLA* (Comprehensive Environmental Response, Compensation, and Liability Act; USEPA 1988), NYSDEC's Division of Environmental Remediation (DER) *Technical Guidance for Site Investigation and Remediation (DER-10)* (NYSDEC 2010a), and the 1989 RI/FS ACO (NYSDEC 1989). As part of the development of remedial alternatives, RAOs and general response actions (GRAs) were identified for the FS. This section also describes the areas and volumes of media to be addressed by the remedial alternatives and identifies specific remedial technologies that, following screening, were used to develop the range of remedial alternatives evaluated in this FS. Consistent with NYSDEC's *DER-31 – Green Remediation* (NYSDEC 2011) and USEPA's *Superfund Green Remediation Strategy* (USEPA 2010), green remediation concepts were also considered during the development of alternatives in this FS. In addition, given the Site's location, nearby property use and recent economic development in the area, development of the Site has also been considered during the assembly of remedial alternatives.

4.1 DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES

RAOs are media-specific goals for protecting human health and the environment. RAOs form the basis for the FS by providing overall goals for site remediation. The RAOs are considered during the identification of appropriate remedial technologies and development of remedial alternatives for the Site, and later during the evaluation of remedial alternatives.

RAOs are based on engineering judgment, human and environmental health risks, potentially applicable or relevant and appropriate requirements (ARARs), and migration potential. Additionally, the current, intended and reasonably anticipated future land use of the Site and its surroundings, the nature and extent of Site-related contaminants exceeding chemical-specific ARARs, and potential impact(s) to nearby Sites were considered during the development of the RAOs.

RAOs for Semet Residue and groundwater were presented in the 2002 *ROD*, and are addressed by the groundwater remedial action and IRMs implemented at the Site and the Semet Residue remedy selected in the 2017 *ESD*. Documentation of the rationale employed in the development of RAOs for soil/fill material at the Site is presented below.

4.1.1 Identification of ARARs

There are three types of ARARs: chemical-specific, location-specific, and action-specific. Chemical-specific ARARs are health- or risk-based numerical values, or methodologies which when applied to site-specific conditions result in numerical values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to the ambient environment. Location-specific ARARs set restrictions on activities based on the characteristics of the land on which the activity is to be performed. Action-specific ARARs set controls or restrictions on particular types of remedial actions once the remedial actions have been identified as part of a remedial alternative. The identification of potential ARARs is documented in **Table 4-1**. The rationale for the selection of chemical-specific ARARs related to New York State's 6 NYCRR 375 SCOs and land use is further described below.

4.1.2 Land Use and Selection of Soil Cleanup Objectives

Consistent with 6 NYCRR 375-1.8 (f) and DER-10 4.2 (i) the current, intended and reasonably anticipated future uses of the Site are considered when selecting SCOs. As described in **Section 1.1**, the Site is owned by Honeywell. The following property use information is relevant to the Site:

- The property is currently zoned for industrial use.

- It is reasonably anticipated that the surrounding properties will continue to be used for industrial or commercial purposes. In addition, the Site and surrounding properties are planned to be used for parking for the State Fairgrounds and/or Amphitheater, for the foreseeable future.
- Based on current lack of viable ecological habitat and anticipated industrial or commercial property use, the Site would not be preferred habitat for ecological resources.

Given that the reasonably anticipated future use for the Site will be for industrial or commercial purposes, the following 6 NYCRR Part 375 Restricted Use SCOs are identified as appropriate SCOs for the Site:

- 6 NYCRR Part 375 SCOs for Industrial Use
  - Industrial use, as defined in 6 NYCRR Part 375-1.8(g)(2)(iv) includes land which shall only be considered for the primary purpose of manufacturing, production, fabrication, or assembly process and ancillary services.
- 6 NYCRR Part 375 SCOs for Commercial Use
  - Commercial use, as defined in 6 NYCRR Part 375-1.8(g)(2)(iv) includes land which shall only be considered for the primary purpose of buying, selling or trading transactions of merchandise or services.
- SCOs for Industrial and Commercial Use are proposed for added flexibility for redevelopment of the property.

For the purposes of evaluating the required pre-disposal conditions alternative, analytical results for soil/fill material were also compared to SCOs for Unrestricted Use.

4.1.3 Waste Management Area

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 Code of Federal Regulations (CFR) Part 300.430, USEPA 1990) preamble language sets forth the USEPA's policy that, for groundwater, "remediation levels generally should be attained throughout the contaminant plume, or at and beyond the edge of the waste management area when waste is left in place." As described in **Section 2.3**, Solvay waste containing Site-related contaminants and Semet Residue are present at the Site. Thus, the Site can be characterized as a waste management area (WMA), incorporating Wastebed A and portion of land directly east of Wastebed A because of the fill material present between Wastebed A and Onondaga Lake, as illustrated in **Figure 9**.

Due to the presence of soil/fill material deposited at the Site, shallow and intermediate groundwater restoration within the limits of the WMA within a reasonable timeframe is not practicable. Specifically, the volume of soil/fill material containing Site-related contaminants combined with the low permeability and heterogeneity of the soil/fill material at the Site limit the ability to restore shallow and intermediate groundwater to the extent necessary to meet ARARs at this time or for the foreseeable future. Therefore, conformity to groundwater ARARs identified in **Table 4-1** at the Site is technically impracticable from an engineering and scientific perspective.

As described above, the Tributary 5A remedial action and the Willis-Semet Hydraulic Containment System IRM were included in the selected remedy documented in the 2002 *ROD*. These groundwater remedial components addressed eliminating, to the extent practicable, migration of groundwater to Onondaga Lake and Tributary 5A that does not attain applicable state and federal water quality criteria for Site-related constituents, the RAO for groundwater presented in the 2002 *ROD* (NYSDEC and USEPA 2002). In addition, institutional controls and monitoring were also included to address groundwater in the 2002 *ROD*.

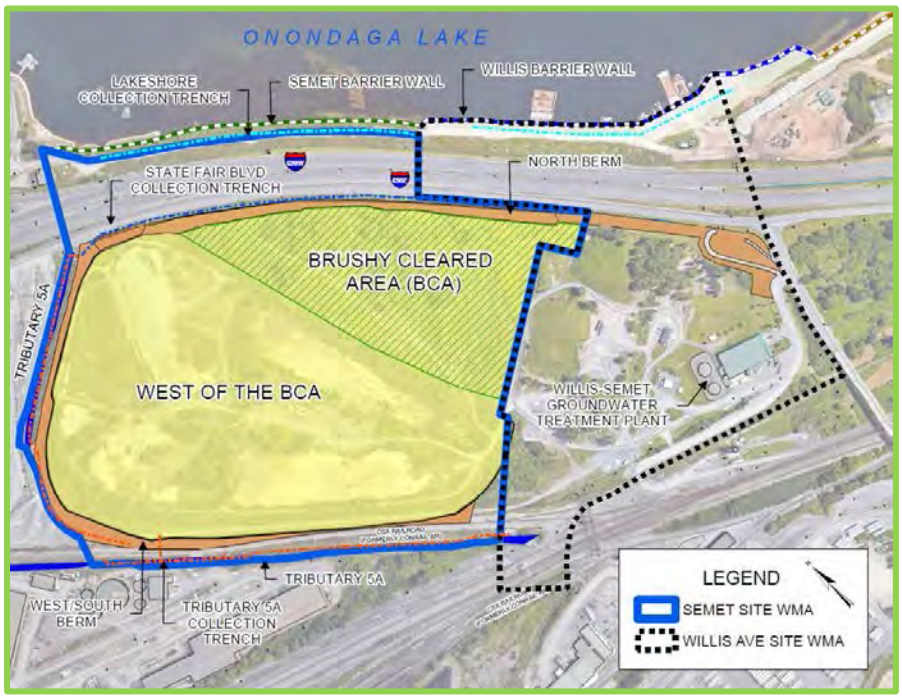

Figure 9: Semet Residue Ponds Site Waste Management Area

Accordingly, given consideration of Wastebed A as a WMA and the selection of the groundwater remedial action and IRM to address groundwater migration, an RAO for shallow and intermediate groundwater was not required.

4.1.4 RAOs for Soil/Fill Material

Potential chemical-specific ARARs and human health and ecological risks identified for soil/fill material at the Site were considered during the development of RAOs and remedial alternatives. As described in **Section 2.3**, soil/fill material samples exhibit concentrations above SCOs at the Site.

Potential hypothetical risks were identified that related to terrestrial ecological receptor exposures to constituents in soil/fill material. However, given the anticipated future industrial or commercial use of the property, it is not anticipated to represent habitat for ecological receptors.

As described in **Sections 3**, shallow and intermediate groundwater discharge to Onondaga Lake has been mitigated though the selected remedy for OU-1 documented in the 2002 *ROD*. IRM objectives with respect to groundwater discharge to Onondaga Lake and human and ecological impacts have been achieved. In addition, the 2002 *ROD* groundwater remedy addressed exposures to Site groundwater through institutional controls.

Since the Site is not anticipated to be suitable as ecological habitat, potential risks related to terrestrial ecological receptor exposures to soil/fill material were not considered for this FS. Accordingly, the following RAOs were developed.

RAOs for Public Health Protection

Based on consideration of potential chemical-specific ARARs, nature and extent of contamination, potentially unacceptable risks, and the current, intended and reasonably anticipated future use of the Site and its surroundings, the following RAOs for soil/fill material and shallow and intermediate groundwater were developed for the protection of human health:

- Prevent, or reduce to the extent practicable, ingestion/direct contact with contaminated soil/fill material

- Prevent, or reduce to the extent practicable, inhalation of or exposure to contaminants volatilizing from contaminated soil/fill material and unacceptable inhalation threat associated with soil vapor

RAOs for Environmental Protection

Based on consideration of potential chemical-specific ARARs, nature and extent of contamination, potentially unacceptable risks, and the current, intended and reasonably anticipated future use of the Site and its surroundings, the following RAOs for soil/fill material were developed for protection of the environment:

- Prevent, to the extent practicable, migration of contaminants in soil/fill material that could result in groundwater, sediment or surface water contamination.
- Prevent, or reduce, to the extent practicable, the release of site-related contaminants to surface water and sediment that may cause unacceptable adverse effects on surface water or sediment quality in Tributary 5a and Onondaga Lake.

As presented in NYSDEC and New York State Department of Health's (NYSDOH) *New York State Brownfield Cleanup Program Development of Soil Cleanup Objectives Technical Support Document* (NYSDEC and NYSDOH 2006), the document that presents the assumptions, rationale, algorithms and calculations utilized to develop the SCOs, the SCOs were developed by NYSDEC and NYSDOH based on health effects to human and ecological receptors, rural soil background concentrations, and maximum acceptable soil concentrations. Thus, the promulgated SCOs for the protection of human health were used to ascertain acceptable concentrations for a given anticipated site use. Attainment of these SCOs was assumed to constitute acceptable protectiveness and, therefore, the SCOs were used as a measure for achievement of the corresponding RAOs.

4.2 DEVELOPMENT OF GENERAL RESPONSE ACTIONS

GRAs are media-specific actions which may, either alone or in combination, form alternatives to satisfy the RAOs and SCOs. GRAs identified for soil/fill material, based on the RAOs, are summarized below.

Soil/Fill Material

- ***No further action.*** No further action must be considered in the FS, as specified in the NCP [40 Code of Federal Regulations (CFR) Part 300.430], as a baseline against which other actions are evaluated.
- ***Institutional controls/limited actions.*** Actions that provide site access and use restrictions and provisions for continued operation of the remedy.
- ***Natural recovery actions.*** Actions that rely on natural processes to attenuate organic contaminants in soil/fill material.
- ***Containment actions.*** Actions that minimize the potential for direct contact with and erosion of surface soil/fill material.
- ***In situ treatment actions.*** Actions that treat soil/fill material in place to reduce mobility or toxicity.
- ***Removal actions.*** Actions to excavate soil/fill material.
- ***Ex situ treatment actions.*** Actions that treat soil/fill material following removal, to reduce mobility or toxicity.
- ***Disposal actions.*** Actions that dispose of soil/fill material on-site or off-site.

4.3 IDENTIFICATION OF VOLUMES OR AREAS OF MEDIA

Volumes and areas of soil/fill material were estimated based on Site conditions, the nature and extent of contamination, RAOs, and potential chemical-specific ARARs. The areal extents and estimated volumes are described below.

Soil/Fill Material

The Semet Residue Ponds Site includes a total area of approximately 49 acres including approximately 4.2 acres of berms. Soil/fill material concentrations of VOCs, SVOCs and/or metals were detected above the respective Part 375 SCOs for industrial and commercial use over much of this area.

As described in **Section 2.3**, soil/fill material over much of the area also exhibits concentrations of Site-related contaminants that are greater than NYCRR Part 375 SCOs for unrestricted use. A review of analytical results and TarGOST® responses documented in the *Data Summary Document* indicates that soil exhibiting concentrations greater than unrestricted SCOs generally extend to 25 ft in the area west of the BCA. Based on the limited data for the BCA, a depth of impact of approximately 5 ft is being assumed for estimation purposes. Based on this information, it is estimated that across the entire 49 acres at the Site approximately 1.16 million cubic yards (cy) (1.4 million tons) of soil/fill material exceed the NYCRR Part 375 SCOs for unrestricted use.

Targeted Material

As described in **Section 3**, it is anticipated that following removal of Semet Residue to the maximum extent practicable for beneficial reuse in accordance with the 2002 *ROD* and 2017 *ESD*, there will be Semet Residue remaining at the Site that is unsuitable for off-site thermal processing for beneficial reuse. Semet Residue unsuitable for off-site thermal processing either exhibits unacceptable sulfur or moisture content, insufficient heat content and/or exhibits unacceptable soil/rock content, as documented in demonstration reports (OBG 2016c; OBG 2017i).

The portion of remaining Semet Residue at the bottom of certain ponds that cannot be beneficially reused and contains free aqueous phase will be considered targeted material and will be evaluated separately in the technology screening. Such material has only been encountered in Ponds 3 and 4 during demonstration programs. Specifically, as documented in the 2013 *Expanded RSTS Report* Semet Residue in Ponds 3 and 4 was identified as exhibiting free aqueous phase (thus, requiring dewatering prior to loading), while Ponds 1, 2, and 5 did not exhibit free aqueous phase and were suitable for direct loading (OBG 2014a). For FS cost estimating purposes, the estimated volume of targeted material is approximately 7,000 cy.

4.4 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS

Potentially applicable remedial technologies and process options for each GRA were identified and then screened on the basis of technical implementability. Technical implementability for each identified process option was evaluated with respect to contaminant information, physical characteristics, and areas and volumes of affected media summarized in **Section 4.3**. For clarity, technologies and process options were evaluated separately for the soil/fill material and the targeted material described above in **Section 4.3**. Descriptions for technologies and process options identified for the FS are presented in **Tables 4-2 and 4-3**. Technologies and process options that were viewed as not implementable were not considered further in the FS. The technologies and process options retained for further consideration for Site soil/fill material and targeted material are presented below.

Soil/Fill Material

- No further action
- Access/use restrictions/administrative control(s) (institutional controls)
- Site controls (Site management plan [SMP])
- Periodic reviews (periodic site reviews)
- Natural attenuation
- Cover system (engineered cover, enhanced engineered cover)

- Excavation (mechanical excavation)
- Off-site treatment/disposal (commercial treatment/disposal facility).

Targeted Material

- No further action
- Access/use restrictions/administrative control(s) (institutional controls)
- Site controls (SMP)
- Periodic reviews (periodic site reviews)
- Cover system (engineered cover, enhanced engineered cover)
- Physical treatment [*in situ* solidification/stabilization (ISS)]
- Excavation (mechanical excavation)
- Semet Residue recovery (passive recovery wells)
- Off-site treatment/disposal (commercial treatment/disposal facility).

4.5 EVALUATION OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS

The remedial technologies and process options remaining after the initial screening were evaluated further with respect to the criteria of effectiveness, implementability, and cost. The effectiveness criterion included the evaluation of:

- Potential effectiveness of the process option in meeting the RAOs and accommodating the estimated lengths, areas and/or volumes of media summarized in **Section 4.3**
- Potential effects on human health and the environment during implementation (including, as appropriate, construction and operation)
- Reliability of the process options for Site-related contaminants and conditions.

Technical and institutional aspects of implementing the process options were assessed for the implementability criterion. The capital and operation and maintenance (O&M) costs of each process option were evaluated as to whether they were high, medium, or low relative to the other process options of the same technology type. Based on the evaluation, the more favorable process options of each technology type were chosen as representative process options. The selection of representative process options simplifies the assembly and evaluation of potential alternatives, but does not eliminate other process options for consideration. The representative process option provides a basis for conceptual design during the FS, without limiting flexibility during the remedial design phase. An alternative process option may be selected during the remedial design phase as a result of design evaluations or testing. The screening and evaluation of technologies is summarized in **Tables 4-2 and 4-3**.

Soil/Fill Material

As a result of the screening and evaluation of technologies, the following technologies/process options addressing soil/fill material were not retained as listed:

- *In situ* chemical treatment via *in situ* chemical oxidation (ISCO), *in situ* chemical reduction (ISCR) and enhanced dissolution
- *In situ* physical treatment via solidification/ stabilization (ISS), soil vapor extraction and dual-phase extraction
- *In situ* thermal treatment via soil heating

- *In situ* biological treatment via enhanced bioremediation
- *Ex situ* on-site chemical treatment via chemical oxidation and extraction/washing
- *Ex situ* on-site biological treatment via biopiles and landfarming
- *Ex situ* on-site thermal treatment via incineration and low temperature thermal desorption
- Ex situ off-site thermal treatment via incineration, low temperature thermal desorption, beneficial reuse (cement kiln) and plasma gasification
- Disposal via commercial off-site landfill

As it pertains to soil/fill material at the Site, there are several Site-specific conditions that are relevant in connection with the technology screening and evaluation. Specifically, Solvay waste (the largest component of the soil/fill material at the Site) presents significant challenges for the effective implementation of *in situ* remedial technologies. Solvay waste is composed of fine grained calcium carbonate that varies from hard and friable to toothpaste-like reflecting the fact that it was deposited as a slurry in the wastebed. The result of this type of deposition is that the Solvay waste has a low density, high moisture content, low hydraulic conductivity (ranging over about 2 orders of magnitude from 10^{-4} to 10^{-6} cm/sec), and low structural stability (as demonstrated by the shear and compressibility test results).

The high moisture content and low permeability inhibit the successful use of *in situ* technologies such as SVE and dual phase extraction. The low permeability of the Solvay waste limits the ability of air to flow through the subsurface. Subsurface air flow is further restricted by the high moisture content because much of the pore space in the Solvay waste is occupied by water that is held in place by the fine grained texture of the material. Also, SVE and dual phase extraction are not considered effective for remediating SVOCs, which are a significant component requiring remediation.

The low permeability of the Solvay waste, along with its heterogeneity, make the use of injection remedial techniques only partially effective and difficult to implement. Injection technologies, such as *in situ* chemical oxidation and chemical reduction, require the direct contact of the injected fluids with the VOCs/SVOCs for the chemical reactions to remediate these constituents. The low permeability of the Solvay waste limits the radial distribution of the injected fluids. The permeability heterogeneity causes the heterogeneous distribution of the injected fluids resulting in incomplete contact of the injected fluids with the VOCs/SVOCs. Without direct contact of the injected fluids with the VOCs/SVOCs the desired chemical reactions to remediate the VOCs/SVOCs will be limited to only those locations were contact has occurred. Closely spaced injection points and fracturing technology have been used at sites to address low permeable injection limitations, however closely spaced injection locations become increasingly less implementable. Closely spaced injection locations also do not address the heterogeneous permeability and fracturing creates even greater heterogeneity. Therefore, in addition to decreasing the implementability of injection technologies, the effectiveness of the technologies remains limited.

The injection limitations described above present the same implementation and effectiveness challenges to the use of *in situ* bioremediation. In addition, results of a site-specific microcosm study performed on similar nearby wastebed soil/fill material showed a lack of live microorganisms in microcosms constructed using groundwater and soil/fill material.

For some low permeable and heterogeneous sites, *in situ* mixing is a viable alternative to injection because it results in more complete mixing of the treatment fluid with the VOCs/SVOCs. However, this mixing technology can result in the release of volatiles to the atmosphere during the mixing process. A result of using the mixing process on Solvay waste would be that the geotechnical properties of the site for future use would be further reduced below their already low structural stability. In addition, some areas of the Site may exhibit insufficient structural stability to support equipment required in the mixing process.

The high moisture content and low geotechnical structural stability of the Solvay waste make for poor *in situ* thermal treatment implementability. Heating the Solvay waste will remove much of the water content and result in a significant reduction in the volume of the material causing settlement and fracturing of the Solvay waste. This settlement and fracturing would disrupt the thermal treatment infrastructure and create uncontrolled pathways for the migration of vapors to the atmosphere. Settlement and fracturing could also limit the options for future site use.

The geochemistry of Solvay waste adds to the effectiveness and implementability challenges for *in situ* remedial technologies. The high concentration of dissolved calcium creates conditions where the precipitation of calcite can readily occur and affect the permeability of the Solvay waste or foul the remedial technology infrastructure. The compatibility of injection fluids with the unique Solvay waste geochemistry may limit use of certain chemicals for *in situ* treatment. Heating of Solvay waste may cause the breakdown of calcium carbonate resulting in CO2 emissions and a reduction in the geotechnical stability of the material. The chloride concentrations in the Solvay waste groundwater have the potential to adversely affect *in situ* remedial infrastructure, due to corrosion.

A description of the representative process options for retained technologies, by GRA and technology for soil/fill material, is presented in **Section 4.5.1** below.

Targeted Material

As a result of the screening and evaluation of technologies, the following technologies/process options addressing targeted material were not retained as listed:

- Natural attenuation
- *In situ* chemical treatment via ISCO
- *In situ* biological treatment via enhanced bioremediation
- *Ex situ* on-site chemical treatment via chemical oxidation
- *Ex situ* on-site thermal treatment via incineration, low temperature thermal desorption and plasma gasification
- Ex situ off-site thermal treatment via beneficial reuse (cement kiln)
- Disposal via commercial off-site landfill.

The tar-like nature of the targeted material is not suited for *in situ* treatments such as biological treatment. Difficulty mixing tar with reagents limits effectiveness of chemical and biological treatments. In addition, *in situ* application would likely result in mixing of targeted material with soil/fill material, resulting heterogeneous mixture that would limit effective distribution of reagents. Significant odors/emissions could occur from gas generation/volatilization of contaminants due to the generation of heat from mixing with reagents such as oxidants with targeted material that contains carbonates. Post-treatment, the treated area could limit future site use/redevelopment.

Targeted material pH and high carbonate levels may reduce treatment efficiency. Potential exists for production of hazardous intermediates if incomplete oxidation occurs. Large quantities of oxidant would be potentially required, as well as a potential need for multiple applications of oxidant over time. A treatability study would be necessary to evaluate effectiveness of various oxidants on Site-related contaminants in targeted material.

A description of the representative process options for retained technologies, by GRA and technology for targeted material, is presented in **Section 4.5.1** below.

4.5.1 Representative Process Options

A description of the representative process options for retained technologies, by GRA and technology for soil/fill material and targeted material is presented in the following sections.

No Further Action

No further action was identified as a representative process option for soil/fill material and targeted material. The no action alternative must be considered in the FS, as required by the NCP (40 CFR Part 300.430) and DER-10 Section 4.4(b)3 (NYSDEC 2010a). Under this alternative, no further remedial actions addressing Site soil/fill material would be conducted beyond removal of the Semet Residue, to the extent practicable, and currently ongoing IRM.

Institutional Controls/Limited Actions

Institutional controls, SMP, and periodic reviews were identified as representative process options associated with the institutional controls/limited actions GRA for soil/fill material and targeted material.

- ***Institutional controls.*** Access/use limitations (*e.g.,* institutional controls) would be recorded for the Site documenting land use restrictions, and requiring that activities that would potentially expose contaminated materials (and require health and safety precautions) be performed in accordance with the SMP. The institutional controls would also provide provisions to evaluate and address, if necessary, potential soil vapor intrusion if buildings are constructed at the Site.
- ***Site management plan.*** A SMP would document Site institutional and engineering controls and any physical components of the selected remedy requiring operation and maintenance and monitoring to provide for continued effectiveness of the remedy. The SMP would also present provisions for periodic site reviews.
- ***Periodic site reviews***. Periodic reviews are required by 6 NYCRR Part 375 where institutional and engineering controls, monitoring and/or O&M activities are required at the Site. The purpose of the periodic reviews is to evaluate the Site with regard to the continuing protection of human health and the environment and to document remedy effectiveness. In accordance with 6 NYCRR Part 375-1.8(h)(3), the frequency of periodic reviews should be annual, unless a different frequency is approved by NYSDEC. Periodic site review would also include the performance of Five Year Reviews in accordance with 40 CFR 300.430(f)(4)ii.

Containment

Engineered soil cover and enhanced engineered cover were identified as representative process options associated with the containment GRA for soil/fill material and targeted material. Containment systems provide a sustainable means of minimizing erosion of soil/fill material on the Site resultant from surface water flow, minimize the potential for contact with the soil/fill material and targeted material on the Site, and would also serve to reduce infiltration.

- ***Engineered soil cover***. An engineered cover would consist of a soil layer of an appropriate thickness, or other surface such as gravel, pavement or buildings, over existing soil/fill material. Grading and cover installation would be performed such that drainage is promoted, erosion is minimized, and cover integrity is protected. This cover would be considered for areas where surface soils exhibit concentrations above applicable NYCRR Part 375 SCOs. This cover is effective at preventing erosion of, and contact with, exposed surface soil and soil/fill material. Routine cover maintenance, consisting of mowing of vegetation or repairs to paving and inspections for integrity, would be necessary.
- ***Enhanced Engineered cover***. An enhanced engineered cover could include a low permeability clay or a geomembrane system. Vegetation, asphalt, or gravel may be utilized as the top layer based upon site use and restoration requirements within the covered area. The effectiveness would be dependent on maintaining the integrity of the cover system. Grading and cover installation would be performed such that drainage is promoted, erosion is minimized, and cover integrity is protected. Routine cover maintenance, consisting of mowing of vegetation or repairs to paving and inspections for integrity, would be necessary.

In Situ Treatment

Solidification/stabilization was identified as the representative process option associated with the *in situ* treatment GRA for targeted material.

- ***Solidification/stabilization.*** Reagent addition and mixing to physically bind (solidify) and/or chemically react with (stabilize) compounds in soil, resulting in a solidified or stabilized mass. Additives can consist of cement or fly ash reagents. This process is impractical to address Site-wide soil/fill material; however, this process may be implementable for targeted material remaining following removal, to the extent practicable, of Semet Residue being removed for beneficial reuse as part of the OU-1 remedial action at the Site. A targeted material demonstration was implemented at the Site in 2017 and demonstrated effective treatment using lime kiln dust (LKD) and cement kiln dust (CKD).

Removal

Mechanical excavation was identified as the representative process option associated with the removal GRA for soil/fill material. Passive extraction wells were identified as representative process options for monitoring or removing recoverable remaining Semet Residue.

- ***Mechanical excavation***. Mechanical excavation of soil is generally implemented using construction equipment such as backhoes and front-end loaders. Excavated areas are backfilled, graded, and restored based on restoration requirements. Sloping techniques, benching, and/or engineering controls (*i.e.*, sheet piling) would be necessary during excavation to maintain stability of excavation walls. Geotechnical stability evaluations would need to be conducted to evaluate implementability and safe methods for excavation of soil/fill material. Dewatering of excavations and management of water would also be necessary.
- ***Passive extraction wells.*** Removal of recoverable Semet Residue remaining following removal, to the extent practicable, under the OU-1 remedial action from wells using recovery methods such as bailers, pumps, or absorbent media. In the event that recoverable Semet Residue were encountered, recovery would be evaluated and implemented using bailers.

Disposal

Disposal at an off-site commercial facility and on-site consolidation were identified as representative process options associated with the disposal GRA for soil/fill material.

- ***Off-site commercial facility***. Coupled with mechanical removal, excavated soil/fill material would be transported to regulated, commercial off-site facilities for subsequent treatment/disposal. Excavated soil/fill material identified as non-hazardous waste would be disposed at an off-site facility, while excavated soil/fill material identified as hazardous waste may require treatment to meet land disposal restrictions (LDRs) prior to disposal. Waste characterization sampling and analysis would be completed, and waste manifests would be submitted to, and approved by the off-site facilities prior to disposal or treatment of associated wastes. Due to the exceedingly large volume of soil/fill material, multiple transportation mechanisms and off-site disposal and waste treatment facilities may need to be identified. Disposal of soil/fill material exhibiting RCRA characteristics for benzene would require appropriate management.

4.6 ASSEMBLY OF REMEDIAL ALTERNATIVES

Six remedial alternatives were developed by assembling GRAs and representative process options into combinations that address RAOs for soil/fill material. A summary of the alternatives and their components is presented below.

Table 2: Semet Residue Ponds Site FS Remedial Alternatives		**Alternative 1** No Further Action (with Continued O&M of IRM)	**Alternative 2** Grading and Backfill
Alternative 3 Engineered Soil Cover	**Alternative 4** Enhanced Engineered Cover	**Alternative 5** *In Situ* Treatment of Targeted Material and Enhanced Engineered Cover	**Alternative 6** Removal

Table 3: Components of Remedial Alternatives

Remedial Component	Remedial Alternative 1	2	3	4	5	6
No further action	●					
Institutional controls/limited actions ▪ Institutional controls, SMP, periodic reviews		●	●	●	●	●
Continued O&M of existing IRM ▪ *Alternatives 1 through 5:* Willis-Semet Berm Site Improvement cap)	●	●	●	●	●	
Grading and backfill of ponds	●	●	●	●	●	
Engineered soil cover (Site-wide)			●			
Engineered soil cover (BCA)				●	●	
Enhanced engineered cover (Geomembrane or asphalt; west of BCA)				●	●	
In situ treatment of targeted material					●	
Passive Semet Residue recovery wells, if necessary and effective		●	●	●	●	
Site-wide soil/fill material excavation						●
Removal and off-site treatment/disposal of site-wide soil/fill material						●

A description of each alternative is included in the following subsections.

4.6.1 Common Elements of Remedial Alternatives

In addition to the currently selected OU-1 remedy consisting of Semet Residue excavation and off-site beneficial use, groundwater hydraulic control (using the Tributary 5A groundwater collection system (including the State Fair Boulevard Collection System) and the Willis-Semet Hydraulic Containment System), and groundwater use restrictions, continued maintenance of the Willis-Semet Berm Improvement IRM is anticipated at the Site. Thus, this IRM is included as common element in each remedial alternative. This IRM is further described in **Section 3**.

4.6.2 Alternative 1 – No Further Action

Alternative 1 is the no further action alternative. A no action alternative is required to be considered by the NCP and NYSDEC's *Division of Environmental Remediation Technical Guidance for Site Investigation and Remediation* (DER-10) Section 4.4(b)3 (NYSDEC 2010a) and serves as a benchmark for the evaluation of action alternatives. This alternative provides for an assessment of the environmental conditions if no further remedial actions are implemented. Under Alternative 1, O&M of the Berm Improvement IRM described above in **Section 4.6.1** would

continue. This alternative would result in contaminants remaining above levels that allow for unlimited use and unrestricted exposure, thus, CERCLA requires that the Site be reviewed at least once every five years. If justified by the review, remedial actions may be implemented to remove, treat, or contain the contaminated soil/fill material. Alternative 1 could be implemented immediately.

4.6.3 Alternative 2 – Grading and Backfill

Alternative 2 includes backfill of the Semet Residue ponds once the Semet Residue has been removed to the maximum extent practicable for off-site thermal beneficial reuse and grading of the surface of the site in preparation for commercial or industrial development. This alternative also includes the common elements described above in **Section 4.6.1**. If deemed necessary and effective, passive recovery of Semet Residue would be included in this alternative. The conceptual extent of site grading is depicted on **Figure 4-1**.

This alternative would also include institutional controls, a SMP, and periodic reviews. Elements other than those described under Alternative 1 are described below in this section. Based on the descriptions and assumptions below, it is anticipated that Alternative 2 would be constructed in one construction season.

Site Grading and Preparation for Commercial or Industrial Development

Consistent with the current and reasonably anticipated future land uses for the Site, emptied Semet Residue ponds at the Site would be backfilled and the property would be graded in preparation for development, as illustrated on **Figure 4-1**. The existing soil pile located on the BCA would be beneficially reused as backfill during grading.

For the purposes of cost estimation in this FS, grading of the BCA was assumed to consist of clearing and grubbing with light rough grading. Grading of the area west of the BCA was assumed to be accomplished with maximum use of on-site berm materials and soil pile, and minimum imported fill to achieve an approximately flat grade, at a lower elevation than the current elevation in the center of the area. Final grade of this area would depend in part on future use.

It is estimated that greenhouse gas emissions associated with grading, import of materials and on-site construction for the 44.5-acre area under this alternative would be approximately 395 metric tons of carbon dioxide equivalent (MtCO2e). This represents the annual emission of approximately 80 cars.

Passive Recovery of Semet Residue

Prior to pond backfill activities, an assessment for the need to address remaining Semet Residue that could contribute to potential seepage during or following these construction activities will be performed. The effectiveness and implementability of passive recovery wells to minimize or monitor the potential for future Semet Residue seeps from ponds, will be evaluated. Should passive recovery of Semet Residue be deemed necessary, effective and implementable, these will be considered during the remedial design.

Institutional Controls

Under Alternative 2, administrative control(s) such as an institutional control (*e.g.*, environmental easements, deed restrictions, and environmental notices) would be recorded for the Site to require the continued protectiveness of human health and the environment. The institutional controls would limit Site use and require placement and/or maintenance of final site surfaces that would serve as covers. Evaluation and possible mitigation of potential vapor intrusion would be required under provisions specified in the institutional controls. Where necessary, preventative measures may be included in the design and construction of buildings at the Site to mitigate the potential for exposure to constituents that may be present in soil vapor. Such measures may include the use of a vapor barrier or the installation of a venting system. Restrictions would preclude activities that would potentially expose soil/fill material and soil vapor that might cause vapor intrusion, or impair the integrity of surfaces that would serve as cover systems without prior review and

approval by NYSDEC. As described above in **Section 4.1.2**, the reasonably anticipated future land use for the Site is industrial and/or commercial. The institutional controls would reflect these Site uses.

Site Management Plan

A SMP would guide future activities at the Site by documenting institutional controls and by developing requirements for periodic site reviews, the implementation of required O&M activities for the selected remedy, and future development on the Site. In addition, consistent with 6 NYCRR Part 375-1.8(h)(3), annual certification of institutional and engineering controls would be required in the SMP.

Periodic Site Reviews

Periodic site reviews would be conducted in accordance with the SMP to evaluate the Site with regard to continuing protection of human health and the environment as evidenced by information such as documentation of field inspections. 6 NYCRR Part 375-1.8(h)(3) specifies that the frequency of periodic Site reviews and certification of institutional and engineering controls should be annual, unless a different frequency is approved by NYSDEC. It is assumed that annual reviews would be conducted at the Site. This alternative would result in contaminants remaining above levels that allow for unlimited use and unrestricted exposure, thus, CERCLA (40 CFR 300.430(f)(4)ii) requires that the Site be reviewed at least once every five years. If justified by the review, remedial actions may be implemented to further remove, treat, or contain the contaminated soils.

4.6.4 Alternative 3 – Engineered Soil Cover

Alternative 3 includes implementation of an engineered cover system based on potential chemical-specific ARARs and reasonably anticipated future land uses at the Site for industrial or commercial use. This alternative includes the common elements described above in **Section 4.6.1**. The conceptual extent of the cover system is depicted on **Figure 4-2**.

This alternative would include site grading, passive recovery of Semet Residue, institutional controls, a SMP, and periodic reviews, as described above under Alternative 2. The engineered soil cover would require routine maintenance and inspection to maintain cover system integrity. The engineered soil cover is described below in this section. Based on the descriptions and assumptions below, it is anticipated that Alternative 3 would be constructed in one construction season.

Engineered Soil Cover

Consistent with the current and reasonably anticipated future land uses for the Site, an engineered soil cover would be implemented in areas at the Site where surface soil concentrations are above SCOs for industrial or commercial use, as illustrated on **Figure 4-2**. Consistent with NYSDEC's DER-10, the engineered soil cover would include a 1-ft thick soil/granular cover (or maintained paved surfaces) for the purposes of mitigating potentially unacceptable exposure risks and surface erosion in support of the reasonably anticipated future use of the Site and its surroundings. The existing soil pile at the BCA would be beneficially reused as backfill during grading and incorporated under the proposed cover system.

Development plans would be prepared in the future, thus, the boundaries of the vegetated covers and seed application mixes within the anticipated footprint illustrated below are conceptual. However, for the purposes of cost estimation in this FS, a 1-ft thick vegetated soil cover is assumed over 49 acres. Grading of 44.5 acres of the site for preparation of the cap would occur. The extent of covers would be revisited during the design and construction phases to allow for consideration of the configuration of future development and verification of thickness and location of existing cover materials (*e.g.*, prior soil placement at the Willis-Semet Berm Improvements IRM).

It is estimated that greenhouse gas emissions associated with grading, import of materials and on-site construction of a 49-acre soil cover system under this alternative would be approximately 3,630 MtCO2e. This represents the annual emissions from approximately 760 cars.

4.6.5 Alternative 4 – Enhanced Engineered Cover

Alternative 4 includes implementation of an enhanced engineered cover system based on potential chemical-specific ARARs and reasonably anticipated future land uses at the Site for industrial or commercial use. This alternative includes the common elements described above in **Section 4.6.1**. The conceptual extent of the cover system is depicted on **Figure 4-3**.

This alternative would include site grading, passive recovery of Semet Residue, institutional controls, a SMP and periodic reviews, as described above under Alternative 2. The enhanced engineered cover system would require routine maintenance and inspection to maintain cover system integrity. The enhanced engineered cover is described below in this section. Based on the descriptions and assumptions below, it is anticipated that Alternative 4 would be constructed in two construction seasons.

Enhanced Engineered Cover

Consistent with the current and reasonably anticipated future land uses for the Site, an engineered soil cover would be implemented in areas at the Site where surface soil concentrations are above SCOs for industrial or commercial use, as illustrated on **Figure 4-3**. Consistent with NYSDEC's DER-10, the engineered soil cover would include a 1-ft thick soil/granular cover (or maintained paved surfaces) over the BCA and steep outer berms of the Site for the purposes of mitigating potentially unacceptable exposure risks and surface erosion in support of the reasonably anticipated future use of the Site and its surroundings. The area west of the BCA would receive an 18-inch thick soil/granular cover incorporating a geomembrane for the purposes of mitigating potentially unacceptable exposure risks and surface erosion in support of the reasonably anticipated future use of the Site and its surroundings. This membrane would also address potential for mobility of remaining Semet Residue. The cover systems would also include an engineered component to enhance structural stability, ranging from geofabric to geogrid depending on the needs of the final cover system uses. Grading of 44.5 acres of the site for preparation of the cap would occur. The existing soil pile at the BCA would be beneficially reused as backfill during grading and incorporated under the proposed cover system with addition clean fill material imported as necessary to achieve grades and slopes. The final surface of the cover system may be restored in whole or in part as a parking lot surface to accommodate future land use.

Development plans will be prepared in the future, thus, the boundaries of the vegetated covers and seed application mixes within the anticipated footprint illustrated on **Figure 4-3** are conceptual. However, for the purposes of cost estimation in this FS, a 1-ft thick vegetated soil cover is assumed over 17.2 acres, and an 18-inch thick vegetated soil cover with geomembrane is assume over 31.5 acres. The extent of covers will be revisited during the design and construction phases to allow for consideration of the configuration of future development and verification of thickness and location of existing cover materials (*e.g.*, prior soil placement at the Willis-Semet Berm Improvements IRM).

It is estimated that greenhouse gas emissions associated with grading, import of materials and on-site construction of a 49-acre enhanced cover system under this alternative would be approximately 3,790 MtCO2e. This represents the annual emission of approximately 800 cars.

4.6.6 Alternative 5 – *In Situ* Treatment of Targeted Material and Enhanced Engineered Cover

Alternative 5 includes implementation of *in situ* targeted material treatment and an enhanced engineered cover system based on potential chemical-specific ARARs and reasonably anticipated future land uses at the Site for industrial or commercial use. This alternative includes the common elements described above in **Section 4.6.1**.

This alternative would include site grading, passive recovery of Semet Residue, institutional controls, a SMP, and periodic reviews, as described above under Alternative 2. The enhanced engineered cover system would require routine maintenance and inspection to maintain cover system integrity. The enhanced engineered cover system is described above under Alternative 4. The conceptual extent of the cover system is depicted on **Figure 4-4**. The *in situ* treatment of targeted material is described below in this section. Based on the descriptions and

assumptions below (and the enhanced engineered cover descriptions above for Alternative 4), it is anticipated that Alternative 5 would be constructed in two construction seasons.

In Situ Treatment of Targeted Material

Targeted material described **Section 4.3** will be treated *in situ* by solidification/stabilization. Specifically, the treatment would consist of the addition of recycled amendments (*e.g.*, CKD, LKD or blast furnace slag) to alter the physical characteristics to a granular material. The estimated volume of targeted material is approximately 7,000 cy.

It is estimated that greenhouse gas emissions associated with import of materials, on-site *in situ* treatment and on-site construction of a 49-acre enhanced cover system under this alternative would be approximately 3,800 MtCO2e. This represents the annual emission of approximately 800 cars.

4.6.7 Alternative 6 – Removal

Alternative 6 includes mechanical excavation of soil/fill material exhibiting concentrations above NYCRR 375 Unrestricted SCOs. Excavated soil/fill material would be transported off-site for management and/or disposal. This alternative also includes the common elements described above in **Section 4.6.1**

Alternative 6 is intended to evaluate restoration to pre-disposal conditions through full removal and replacement of soil/fill material at the Site exhibiting concentrations above NYCRR 375 Unrestricted SCOs. Based on existing data, removal to depths of 5-ft in the BCA and up to 25 ft west of the BCA are assumed. Excavated material would be managed off-site. The conceptual extent of excavation for this alternative is depicted on **Figure 4-5**. Implementation of Alternative 6 is estimated to require 6 to 7 construction seasons. The remedial elements for Alternative 6 are described below.

Mechanical Excavation of Soil/Fill Material

Following removal of the Semet Residue from the ponds, mechanical excavation would be conducted to remove Site-wide soil/fill material.

For cost estimating purposes, it was assumed that soil/fill material would be removed from existing grade to the top of marl (a native material), approximately a 5-ft thickness would be removed from the BCA area, and generally between 10 and 25 ft thickness would be removed from the area west of the BCA. Based on these approximate depths, the total volume of soil/fill material in Alternative 6 is estimated at approximately 1.16 million cy excavated *in situ*, with an additional 20,000 cy removed from the material piled on the BCA. Sloping techniques, benching, and/or engineering controls (*i.e.,* sheet piling) would be necessary during excavation to maintain stability of excavation walls. Excavation activities are anticipated to impact State Fair Boulevard to the north of the Site and the adjacent Tributary 5A remedial action.

It has been assumed that dewatering of some of the soil/fill material would be required prior to off-site transportation. Treatment of construction water is anticipated to be necessary. For purposes of this FS, a temporary water treatment facility would be utilized to treat this construction water, as it is assumed the existing Willis-Semet GWTP would not have sufficient treatment capacity.

Off-Site Transportation and Disposal

Excavated material would be transported for disposal off-site. For remedial alternative cost estimation purposes, it was assumed a total of 1.16 million cy of excavated soil/fill material would be transported off-site for disposal as described below.

Based upon VOC concentrations , it was assumed that a portion of the soil/fill material would be transported for hazardous waste treatment/disposal at an off-site permitted facility. For remedial alternative cost estimate purposes, a volume of approximately 957,000 cy was assumed (approximately 1.15 million tons). This volume was assumed to be transported by truck to facilities within 600 miles of the Site. The remaining volume, 242,000 cy of excavated soil/fill material would be suitable for disposal at a non-hazardous waste landfill. This

volume was assumed to be transported by truck within 300 miles of the Site. The extent of hazardous material would be revisited during design and construction phases.

Site Restoration

Clean backfill would be transported via trucks from off-site borrow sources to the Site for restoration. Given the elevated grade of the BCA and area west of the BCA, backfill would be placed to match surrounding grade features, such as State Fair Boulevard, the railway elevation, and to restore the Tributary 5A bank. For purposes of cost estimation, it is assumed that backfill thicknesses would range between 2 and 20 feet, resulting in approximately 1.03 million cy to restore excavated areas to elevations approximately ranging from 374 to 380 ft above mean sea level (MSL). Excavated areas would be restored with vegetation.

It is estimated that greenhouse gas emissions associated with excavation, transportation and disposal and import of materials under this alternative would be approximately 127,000 MtCO2e. This represents the annual emission of approximately 27,000 cars.

5. DETAILED ANALYSIS OF ALTERNATIVES

This section documents the detailed analysis of the six remedial alternatives that were developed during the assembly of remedial alternatives. The detailed analysis of the remedial alternatives was conducted consistent with *NYSDEC's DER-10 Technical Guidance for Site Investigation and Remediation* (NYSDEC 2010a) and the *Guidance for Developing Remedial Investigation and Feasibility Studies under CERCLA* (USEPA 1988). This section describes the individual and comparative analysis of the remedial alternatives with respect to ten evaluation criteria that embody the specific statutory requirements that must be evaluated to satisfy the CERCLA remedy selection process.

5.1 INDIVIDUAL ANALYSIS OF ALTERNATIVES

NYSDEC DER-10 Section 4.2 indicates that, during remedy selection, ten evaluation criteria should be categorized into three groups: threshold criteria, primary balancing criteria, and modifying criteria. The threshold criteria must be satisfied in order for an alternative to be eligible for selection. The primary balancing criteria are used to balance the differences between alternatives. The modifying criteria are formally considered during NYSDEC development of, and public comment on, the Proposed Plan. The criteria are described below.

Table 4: Remedial Alternative Evaluation Criteria

Criterion	Considerations
Threshold Criteria	
Overall protectiveness of human health and the environment	■ Achievement and maintenance of adequate protection ■ Elimination, reduction, or control of site risks through treatment, engineering, or institutional controls ■ Assessment relative to the current, intended, and reasonably anticipated future use of the Site and its surroundings.
Compliance with ARARs	■ Attainment of chemical-, location-, and action-specific ARARs ■ Grounds for invoking a waiver, if necessary.
Primary Balancing Criteria	
Long-term effectiveness and permanence	■ Magnitude of potential residual risk from materials remaining at the conclusion of the remedial activities. ■ Adequacy and reliability of controls necessary to manage materials left on Site.
Reduction of toxicity, mobility, or volume through treatment	■ Treatment or recycling processes employed and materials treated ■ Amount of hazardous substances, pollutants, or contaminants treated or recycled ■ Degree of expected reduction of mobility, toxicity, or volume of the waste due to treatment or recycling ■ Degree to which treatment would be irreversible ■ Type and quantity of residuals that would remain following treatment, considering the persistence, toxicity, mobility, and propensity to bioaccumulate ■ Degree to which treatment would reduce the inherent hazards posed by the Site.

Table 4: Remedial Alternative Evaluation Criteria

Criterion	Considerations
Short-term effectiveness	■ Short-term potential risks to the community during implementation ■ Potential impacts to workers and effectiveness/reliability of protective measures ■ Potential environmental impacts and the effectiveness/reliability of mitigative measures ■ Time until protection would be achieved.
Implementability	■ Technical difficulties and unknowns ■ Reliability of the technology ■ Ease of undertaking additional remedial actions ■ Ability to monitor the effectiveness of the remedy ■ Activities needed to coordinate with other offices and agencies ■ Ability and time required to obtain any necessary agency approvals and permits ■ Availability of adequate off-site treatment, storage, and disposal capacity/services ■ Availability of necessary equipment and specialists ■ Provisions to obtain necessary additional resources ■ Availability of prospective technologies.
Cost	■ Capital costs ■ Annual O&M costs ■ Periodic O&M costs ■ Present worth cost.
Land Use[6]	■ Consistency with land use
Modifying Criteria	
State acceptance	■ Indicates whether, based on its review of the RI/FS reports and the Proposed Plan, the state supports, opposes, and/or has identified any reservations with the preferred response measure.
Community acceptance	■ Summarizes the public's general response to the response measures described in the Proposed Plan and the RI/FS reports. Community acceptance will be assessed in the ROD and includes determining which of the response measures the community supports, opposes, and/or has reservations about.

The objective of the detailed analysis of alternatives was to analyze and present sufficient information to allow the alternatives to be compared and a remedy selected. The individual analysis consisted of an assessment of

[6] Land use is not a criterion under the NCP; however, it is a primary balancing criterion under NYSDEC's guidance entitled *DER-10/Technical Guidance for Site Investigation and Remediation* (NYSDEC 2010a). For this reason, it is retained as a primary balancing criterion for the detailed analysis of alternatives at this Site.

each alternative with respect to the evaluation criteria that encompass statutory requirements and overall feasibility and acceptability. The summary of this analysis is presented in **Table 5-1**.

5.2 COMPARATIVE ANALYSIS OF ALTERNATIVES

The detailed analysis of alternatives also included a comparative evaluation designed to consider the relative performance of the alternatives and identify major trade-offs among them. The comparative evaluation of alternatives is presented in the following subsections. In the comparative analysis of alternatives, the performance of each alternative relative to the others was evaluated for each criterion.

As discussed in the following subsections, with the exception of Alternatives 1 and 2, each alternative would satisfy the threshold criteria by providing protection to human health and the environment, and by addressing the identified ARARs as it relates to soil/fill material. Therefore, Alternatives 3 through 5 would be eligible for selection as the final remedy. The relative comparison based on the primary balancing criteria (long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost) concludes that Alternative 6 is not implementable, and presents significant short-term impacts, and is the least cost-effective means of achieving the objectives. Alternative 5 would best satisfy the primary balancing criteria. As described in **Section 5.1**, the detailed evaluation with respect to the FS criteria for each of the alternatives is presented in **Table 5-1**.

5.2.1 Overall Protection of Human Health and the Environment

Alternative 1, the no further action alternative, does not include any additional engineering or institutional controls and therefore is not expected to provide protection of human health due to unacceptable risk related to potential hypothetical exposure to soil/fill material. Alternative 1 would not provide additional protection of the environment beyond what is offered through continued O&M of the IRMs, because potential for erosion and infiltration is not addressed. Alternative 2, the Grading and Backfill alternative, is expected to provide some protection of human health and the environment. However, subsequent development components such as parking lots would address potential unacceptable risks to human health associated with continued potential for exposure to soil/fill material. Alternatives 3 through 6 would be protective of human health and the environment following implementation. Alternative 3 provides protectiveness though institutional controls and an engineered soil cover. Alternatives 4 and 5 provide protectiveness through institutional controls and an enhanced engineered cover, with Alternative 5 also including *in situ* treatment of targeted material. Alternative 6 provides protectiveness though removal of soil/fill material.

Consistent with 6 NYCRR-1.8(f) and DER-10 4.2(i), the current, intended, and reasonably anticipated future use of the Site was considered when selecting SCOs. The engineered cover system in Alternatives 2 through 5 would address soil/fill material exceeding SCOs consistent with current, intended, and reasonably anticipated future use of the Site, however, Alternative 2 relies on development of the property for full protection from exposures to soil/fill material. Alternative 1 would not be consistent with current, intended, and reasonably anticipated future use of the Site. Specifically, while Alternative 1 would be protective of the environment through continued operation of the IRMs, effects from soil/fill material on human health and the environment would not be controlled under this alternative.

Alternatives 3 through 5 would be protective of human health and the environment upon implementation through the use of engineered cover systems, which would control erosion of, and direct contact with, soil/fill material as well as control the inhalation of dust. A SMP and continued maintenance of the existing IRMs would provide for continued protection of the environment. Subsequent development components in Alternative 2 such as parking lots, as described above, would address potential for exposure to soil/fill material. Alternative 6 would be protective of the environment through removal of soil/fill material upon implementation and would allow for unrestricted use of the Site by addressing soil/fill material exceeding SCOs for unrestricted use. However, development of the Site would be delayed several construction seasons longer than the other

alternatives, thus this alternative is less consistent with anticipated land use. Institutional controls, a SMP, and continued maintenance of the existing IRMs would provide for continued protection of the environment.

In summary, Alternatives 3 through 6 would be protective of human health and the environment, would address RAOs, and are consistent with current, intended, and reasonably anticipated future use of the Site upon implementation of the remedies. Alternatives 4 and 5, through the enhanced cover provide greater protectiveness than Alternative 3. The targeted material treatment in Alternative 5 provides added protectiveness over Alternative 4. Alternatives 3, 4 and 5 provide adequate and reliable protection of human health and the environment without the risks to workers/community/environment and environmental footprint associated with Alternatives 6. These added impacts are further described below under the effectiveness and implementability criteria. Alternative 2 relies on development of the Site subsequent to implementation to afford similar protectiveness to Alternatives 3, 4 and 5.

5.2.2 Compliance with ARARs

Chemical-, location-, and action-specific ARARs identified for consideration in the FS are summarized in **Table 4-1**. Alternative 1 does not actively address chemical-specific ARARs relative to potential erosion of, or exposure to, soil/fill material in areas not addressed by IRMs. Alternative 2, relies on subsequent development components such as parking lots, as described above, to address potential for exposure to soil/fill material exceeding ARARs. For Alternatives 3 through 5, chemical-specific ARARs are addressed through limiting potential for exposures to soil/fill material exceeding chemical-specific ARARs through the use of engineered cover systems, a SMP, and institutional controls. Alternative 6 addresses chemical-specific ARARs through removal of soil/fill material.

With the exception of transportation and disposal requirements associated with GWTP treatment residuals from the IRM discharge and compliance with Occupational Safety and Health Administration (OSHA) requirements during O&M activities, no action- or location-specific ARARs were identified for Alternative 1, the no further action alternative. Construction methods and safety procedures would be implemented to adhere to the location- and action-specific ARARS identified for Alternatives 2 through 6. Specifically, institutional controls would be implemented in Alternatives 2 through 6 in general conformance with NYSDEC's guidance DER-33 (NYSDEC 2010b) and EPA guidance (see https://www.epa.gov/superfund/superfund-institutional-controls-guidance-and-policy). Engineered cover systems would be implemented in general conformance with NYSDEC's guidance DER-10. Construction and O&M activities in Alternatives 2 through 6 would be conducted in compliance with OSHA requirements. Procedures would be implemented to adhere to the location-specific ARARs related to federal and state requirements for cultural, archeological, and historical resources. With respect to action-specific ARARs, proposed engineered cover system and excavation activities would be conducted consistent with applicable standards; earth moving/excavation activities would be conducted consistent with air quality standards; transportation and disposal activities would be conducted in accordance with applicable State and Federal requirements (including land disposal restrictions (LDRs)), by licensed and permitted haulers; and Site construction activities would be conducted in accordance with OSHA safety requirements.

5.2.3 Long-term Effectiveness and Permanence

Alternative 1 would not provide long-term effectiveness and permanence. With the exception of continued operation of the IRMs, no controls are included in Alternative 1, thus, with respect to the magnitude of residual risk, potentially unacceptable human health risks associated with soil/fill material exceeding SCOs would remain in Alternative 1. Alternative 2 would not provide long-term effectiveness and permanence until development components such as parking lots that would address potential unacceptable risks to human health associated with continued potential for exposure to soil/fill material are implemented. With the exception of Alternatives 1 and 2, each remaining alternative provides an effective means of addressing RAOs upon implementation. For Alternatives 2 through 5, potential passive recovery of recoverable Semet Residue, if any, would provide added control of potential risks associated with potential for Semet Residue seeps. The low

permeability components of the cover in Alternatives 4 and 5 would more effectively address migration of contaminants than the engineered soil cover under Alternative 3. *In situ* treatment of targeted material provides added control of potential risks associated with remaining Semet Residue in Alternative 5. Potentially unacceptable human health risk associated with soil/fill material exceeding ARARs would be addressed in Alternatives 3 through 5 through engineered cover systems, institutional controls, SMP, and periodic reviews. Removal of soil/fill material in Alternative 6 does not result in added effectiveness relative to addressing potential human health risks. Hence, implementation of Alternative 6 requires significantly more effort with limited additional benefit.

Each alternative offers long-term sustainability, though construction of Alternatives 2 through 6 would result in greater greenhouse gas impacts than Alternative 1, and construction of Alternative 6 would result in significantly greater greenhouse gas impacts than the other alternatives. Long-term O&M requirements in Alternatives 2 through 6 would result in minimal impact to the environment. Consistent with NYSDEC and USEPA policies on green remediation, sustainability considerations alone should not be used to justify implementation of a no further action alternative or a less comprehensive alternative.

In summary, Alternatives 3 through 6 would provide long-term effectiveness and permanence upon implementation, while Alternative 1 and 2 would not. Residual risks associated with Alternatives 3, 4, and 5 are adequately and reliably addressed through institutional controls. Residual risk associated with Alternative 6 is less than residual risk associated with Alternatives 3, 4, and 5. Each alternative would result in minimal long-term fuel/energy consumption, greenhouse gas emissions, and impacts to water, ecology, workers or the community associated with long-term maintenance of the remedies.

5.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

There would be no reduction in toxicity, mobility, or volume in soil/fill material through treatment provided in Alternative 1. Alternative2 would result in some reduction in mobility (*i.e.*, erosion) of Site-related contaminants in soil/fill material through grading. Alternatives 3 and 4 would result in a reduction in mobility (*i.e.*, erosion) of Site-related contaminants in soil/fill material through engineered cover systems. Alternative 5 would provide for reduction in toxicity, mobility and volume through an enhanced engineered cover system and *in situ* treatment of targeted materials. *In situ* treatment in Alternative 5 would provide the greatest level of treatment. Alternative 6 would result in the greatest reduction in volume of soil/fill material at the Site.

5.2.5 Short-term Effectiveness

Alternative 1 does not include physical measures in areas of contamination and, therefore, would not prevent potential adverse impacts to remediation workers or the community as a result of its implementation. Alternative 2 through 6 would be constructed using proper protective equipment to manage potential risks to on-Site workers, and proper precautions to be protective of the general public and the environment. Alternative 2 relies on subsequent development to meet RAOs. Alternative 3 is anticipated to meet RAOs upon implementation within one construction season. Alternatives 4 and 5 are anticipated to meet RAOs upon implementation within approximately 2 construction seasons. Alternative 6 is anticipated to meet RAOs upon implementation which is anticipated to take 6 to 9 construction seasons.

Impacts to the community resulting from the construction of Alternative 2 would primarily be due to increased truck traffic and increased noise for the 1-year duration of construction. Alternatives 3, 4 and 5 result in slightly increased truck traffic and noise due to the placement of engineered soil cover. Short-term impacts, as a result of continued O&M of IRMs and remedial action under Alternatives 1 through 6, are not anticipated as the remedial measures are currently constructed and operating. Impacts to the community resulting from the construction of Alternative 6 would include substantially increased traffic, as well as increased noise for the 6 to 9-year duration of construction. In addition, Alternative 6 would involve temporary rerouting of a portion of State Fair Boulevard due to potential geotechnical destabilization, as well as potential for geotechnical destabilization of adjacent railways and the Tributary 5A remedial action. As it relates to traffic, transportation of excavated

materials in Alternative 6 is anticipated to result in approximately 220,000 trucks trips to and from the Site as compared to 5,600 to 7,300 large trucks necessary for cover construction included in Alternatives 3, 4 and 5.

With respect to sustainability, there is an environmental footprint inherent in implementation of each alternative as it relates to construction and operation as well as impacts to the community (as described above). The implementation of the excavation and off-site disposal included in Alternative 6 would result in far greater direct emissions and fuel consumption, as compared to importing construction materials and/or construction of cover included in Alternatives 2 through 4 and cover and treatment in Alternative 5. It is estimated that greenhouse gas emissions associated with construction and transportation needs for Alternative 6 would be approximately 127,000 million $MtCO_2e$, as compared to an estimated 3,800 $MtCO_2e$ for cover construction included in Alternatives 4 and 5, or 3,600 $MtCO_2e$ for cover construction included in Alternative 3. Cover construction included in Alternatives 3 through 5 would represent the equivalent of the annual emissions of approximately750 – 800 cars, however, excavation of materials in Alternative 6 would represent adding annual emissions of an additional 27,000 cars. Consistent with NYSDEC and USEPA policies on green remediation, sustainability considerations should not be used to justify implementation of a no action alternative or a less comprehensive alternative.

The engineered cover systems included in Alternatives 3 through 5 would be consistent with current and reasonably anticipated future use. Alternative 1 would not be consistent with current and reasonably anticipated future use since it would not be protective and would therefore not be consistent. Alternative 2 was assembled in anticipation of development, including components such as parking lots, and is consistent with current and reasonably anticipated future use.

Green remediation techniques, as detailed in NYSDEC's Green Remediation Program Policy - DER-31 (NYSDEC 2011) and USEPA's Region 2 Clean and Green Policy (USEPA 2010), would be considered for each alternative to reduce short-term environmental impacts. Green remediation best practices such as the following may be considered:

- Use of renewable energy and/or purchase of renewable energy credits to power energy needs during construction and/or O&M of the remedy
- Reduction in vehicle idling, including both on and off road vehicles and construction equipment during construction and/or O&M of the remedy
- Design of cover systems, to the extent possible, to be usable for alternate uses, require minimal maintenance (*e.g.*, less mowing), and/or be integrated with the planned use of the property
- Beneficial reuse of material that would otherwise be considered a waste
- Use of Ultra Low Sulfur Diesel (ULSD).

In summary, each alternative would provide short-term effectiveness. Worker and community risks during remedy implementation are similar for Alternatives 2 through 5. The added risks to workers and the community and the additional significant traffic impacts to the community make Alternative 6 a much less effective means of attaining RAOs as compared to the containment Alternatives 3 and 4, or the containment and *in situ* treatment Alternative 5.

5.2.6 Implementability

Alternatives 1 through 5 are implementable. Alternatives 2 through 5 can be readily constructed and operated; the materials necessary for the construction of these alternatives are reasonably available. Alternative 1 does not include physical measures in areas of contamination and, therefore, would not present potential adverse impacts to remediation workers or the community as a result of its implementation. The IRMs in Alternatives 1 through 6 are constructed and continued operation would be readily implementable. Cover systems in Alternatives 3 through 5 would incorporate constructible and reliable technologies. The necessary equipment and specialists would be available for these alternatives. Monitoring the effectiveness of Alternatives 3 through

5 would be accomplished through cover system inspections and maintenance to verify continued cover integrity, visual signs of erosion, and condition of the cover. Alternatives 2 and 6 would require coordination with other agencies, including NYSDEC, New York State Department of Transportation (NYSDOT), NYSDOH, and USEPA.

Alternative 6 is not implementable for the following reasons:

- Excavation and off-site management of 1,160,000 cy of soil/fill material associated with Alternative 6 would be substantially more difficult to implement than the cover placement contemplated in Alternatives 3 and 4, or cover and *in situ* targeted treatment in Alternatives 5. Specifically, there are significant implementability limitations associated with excavation, transportation, and obtaining appropriate disposal capacity for this large volume of material.
- Excavation considerations that limit the implementability of Alternative 6 include challenging construction water management and slope stability concerns. Construction water management is anticipated to be significant during excavation since large volumes are anticipated due to the presence of permeable fill and excavations in proximity of Tributary 5A. Construction water treatment capacity is not likely to be available at the Willis-Semet GWTP, therefore, a temporary treatment system would be required. Excavations in the vicinity of active railroads are anticipated to limit the implementability of excavations in certain areas. Excavations along Tributary 5A in the vicinity of the groundwater collection system are anticipated to further limit implementability of Alternative 6, relative to potential for damage or need to replace the collection systems. Transportation considerations that severely limit the implementability of Alternative 6 include significantly increased traffic, fuel usage and adverse effects on both air quality and community safety. Based on a daily production rate of 1,000 cy per day for 10 months of the year, it is estimated that up to approximately 240,000 cy of material would be shipped off-site each year in 16,800 truckloads (70 truckloads per day) with an approximately equivalent number of trips being required for restoration. During a 10-hour work day, this would equate to approximately 1 truck entering or leaving the Site every 4 minutes. In addition to the potentially significant adverse effects on local air quality and community traffic patterns, traffic of this magnitude is anticipated to result in significant adverse effects on conditions of roadways.

In summary, Alternatives 1 through 5 are readily implementable. Alternative 6 is not practical or implementable for the reasons cited above.

5.2.7 Cost

Detailed cost estimates to address soil/fill material and Site O&M for Alternatives 1 through 6 are included as **Tables 5-2** through **5-7.** The costs associated with Alternatives 1 through 6 are summarized as follows:

Table 5: Summary of Remedial Alternative Cost Estimates

Alternative	Total Estimated Capital Present Worth Cost	Total Estimated Present Worth of O&M (30 years)	Total Estimated Net Present Worth Cost
1 – No Further Action (with Continued O&M of IRMs)	$0	$0	$ 0
2 – Grading and Backfill	$4.8 M	$0.28 M	$ 5.1 M
3 – Engineered Soil Cover	$10.9 M	$0.56 M	$ 11.5 M
4 – Enhanced Engineered Cover	$22.6 M	$0.56 M	$23.2 M
5 – *In Situ* Treatment of Targeted Material and Enhanced Engineered Cover	$24.0 M	$0.56 M	$24.6 M
6 – Removal	$814 M	$ 0.25 M	$ 814.2M

6. CONCLUSIONS

To provide long-lasting protection to human health and environment, six remedial alternatives were developed and evaluated in this FS Report. Specifically, this FS Report documents the development and evaluation of alternatives for soil/fill material at the Site. Consistent with DER-10 and the NCP, the six remedial alternatives developed for the Site were evaluated based on required evaluation criteria and in sufficient detail such that risk management decision makers may select a remedy for the site.

As discussed in **Section 5**, Alternative 6 is not implementable. Also, Alternatives 1 and 2 would not satisfy the threshold criteria upon implementation. Alternatives 3 through 5 would satisfy the threshold criteria by providing protection to human health and the environment, and by addressing the identified ARARs. Alternative 2 would be protective once development components were constructed that would serve as protection from exposure to and erosion of soil/fill material. Therefore, Alternative 2 coupled with development, and Alternatives 3 through 5 would be eligible for selection as the final remedy. The relative comparison based on the primary balancing criteria (long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; land use; and cost) concludes that Alternatives 3, 4, and 5 would satisfy the primary balancing criteria, as these alternatives would provide for adequate and reliable means of mitigating potentially unacceptable risks to human health and the environment. Alternatives 4 and 5 provide added effectiveness and permanence by incorporating enhanced covers that provide added isolation from soil/fill material at the Site.

Thus, Alternatives 4 and 5 are identified as providing the best balance amongst the primary balancing criteria. Coupled with the OU-1 remedy that includes Semet Residue excavation and off-site beneficial reuse, groundwater hydraulic containment and groundwater institutional controls, Alternatives 4 and 5 would provide for overall protection of human health and the environment as follows:

- Groundwater discharging to Tributary 5A has been addressed by the collection trench that was installed as part of the Semet Ponds Shallow Groundwater Remedial Action. Collected groundwater is treated at the Willis-Semet GWTP.
- Shallow and intermediate groundwater discharging to Onondaga Lake has been addressed by the Willis-Semet Hydraulic Containment System IRM and the LHCS through groundwater collection trenches and barrier walls that have been installed along the lakeshore downgradient of the Semet Residue Ponds Site. Collected groundwater is treated at the Willis-Semet GWTP.
- Groundwater infiltrating into storm water sewers has been addressed by rehabilitation or sewer pipe replacement as part of the State Fair Boulevard Collection Trench.
- Potential migration of Site-related contaminants from soil/fill material that could impact surface water and groundwater water outside the WMA is addressed through groundwater control.
- Approximately 30,500 tons of Semet Residue in ponds at the Site have been addressed by removal and thermal processing for beneficial reuse as part of the OU-1 remedy. Semet Residue will continue to be removed and beneficially reused, to the maximum extent practicable.
-
- Direct exposures to, and erosion of, soil/fill material at the Site would be addressed with a cover system
- Continued O&M of the groundwater collection systems and cover system would provide for integrity of these remedial systems.
- Institutional controls and periodic reviews would preclude contact with soil/fill material, require evaluation and possible mitigation of potential vapor intrusion should buildings be built, preclude groundwater use, and require continued maintenance of the integrity of remedial systems.

As part of the process established for remedial alternatives under the ACO, following review of the evaluations documented in this FS Report, NYSDEC and USEPA will identify an alternative to propose as the preferred remedy to be documented in a Proposed Plan for the Site. Following receipt of public comments on the Proposed Plan, the selected remedial alternative will be documented in a ROD for the Site.

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Tables

TABLE 4-1. POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) AND TO BE CONSIDERED (TBC) MATERIALS

Medium Location/Action	Citation	Requirements	Comments	Potential ARAR	Potential TBC
Potential Chemical-Specific ARARs and TBCs					
Soil/Fill Material	6 NYCRR Part 375-6 Remedial Program Soil Cleanup Objectives (SCOs)	Promulgated state regulation that provides guidance for SCOs for various restricted property uses (industrial, commercial, restricted residential, and residential), for the protection of groundwater and ecological resources, and for unrestricted property use. Commercial use includes passive recreational use that refers to recreational uses with limited potential for soil contact, such as: (1) artificial surface fields; (2) outdoor tennis or basketball courts; (3) other paved recreational facilities used for roller hockey, roller skating, shuffle board, etc.; (4) outdoor pools; (5) indoor sports or recreational facilities; (6) golf courses; and (7) paved (raised) bike or walking paths [DER-10 (NYSDEC 2010)]. Industrial use includes land use for the primary purpose of manufacturing, production, fabrication or assembly processes and ancillary services. The industrial use category allows the use of the site only for industrial purposes with access to the site limited to workers and occasional visitors [DER-10 (NYSDEC 2010)].	SCOs for restricted use (industrial, commercial) are potentially relevant and appropriate to site soil/fill material given the current and reasonably anticipated future land use as a commercial or industrial property. SCOs for the protection of groundwater may not be applicable, or relevant and appropriate because migration of Site groundwater is currently being controlled.	Yes	No
	USEPA Regional Screening Levels	Guidance that provides human health risk-based screening values for soil at industrial sites. Screening levels are calculated based on human health exposure assumptions and toxicity data.	Industrial soil screening levels are potentially applicable TBC for the screening of soil/fill material.	No	Yes
Potential Location-Specific ARARs and TBCs					
Construction of Buildings	NYSDOH's October 2006 Guidance for Evaluating Soil Vapor Intrusion in the State of New York	Guidance document that provides thresholds for indoor air and subslab soil vapor above which vapor mitigation is required.	Not currently applicable or relevant and appropriate because no buildings are present on the Site. Potentially applicable if future buildings are constructed at the Site.	No	Yes
	OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air, OSWER Publication 9200.2-154, June 2015	Technical guidance that provides recommendations on assessment of vapor intrusion pathways that pose an unacceptable risk to human health.	Not currently applicable or relevant and appropriate because no buildings are present on the Site. Potentially applicable if future buildings are constructed at the Site.	No	Yes
Water Bodies	33 CFR 320 - 330 - Navigation and Navigable Waters	Regulatory policies and permit requirements for work affecting waters of the United States and navigable waterways.	Substantive, non-administrative requirements potentially relevant or appropriate to work near Tributary 5a that may affect Onondaga Lake.	Yes	No
	16 USC 661 - Fish and Wildlife Coordination Act	Requires protection of fish and wildlife in a stream or other water body when performing activities that modify a stream or river.	Not applicable or relevant and appropriate since no streams present on the Site.	No	No
Potential Location-Specific ARARs and TBCs (Cont'd)					
Wetlands	6 NYCRR 663 - Freshwater wetland permit requirements	Actions occurring in a designated freshwater wetland (within 100 feet) must be approved by NYSDEC or its designee. Activities occurring adjacent to freshwater wetlands must: be compatible with preservation, protection, and conservation of wetlands and benefits; result in no more than insubstantial degradation to or loss of any part of the wetland; and be compatible with public health and welfare.	Not applicable or relevant and appropriate since the Site is not within 100 feet of a designated freshwater wetland regulated by NYSDEC.	No	No
	Clean Water Act Section 404 33 CFR Parts 320 - 330	Regulatory policies and permit requirements for work affecting waters of the United States, including wetlands.	Not applicable or relevant and appropriate. There are no delineated wetlands on Site.	No	No
	Clean Water Act Section 404 40 CFR Parts 230-231	Provides for restoration and maintenance of integrity of waters of the United States, including wetlands, through the control of dredged or fill material discharge.		No	No
	Executive Order 11990 - Protection of Wetlands	Executive order requires federal agencies to avoid, to the extent possible, the long- and short-term adverse impacts associated with the destruction or loss of wetlands if a practical alternative exists.		No	No

TABLE 4-1. POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) AND TO BE CONSIDERED (TBC) MATERIALS

Medium Location/Action	Citation	Requirements	Comments	Potential ARAR	Potential TBC
Wetlands & Floodplains	Policy on Floodplains and Wetland Assessments for CERCLA Actions (OSWER Directive 9280.0-2; 1985)	Policy and guidance requiring Superfund actions to meet substantive requirements of Executive Orders 11988 and 11990. Describes requirements for floodplain assessment during remedial action planning.	Not applicable or relevant and appropriate since there are no delineated wetlands on Site. Not applicable or relevant and appropriate for floodplains as there are no floodplains on Site.	No	No
	40 CFR Part 6, Appendix A - Statement of Procedures on Floodplains Management and Wetlands Protection (January 5, 1979, https://www.epa.gov/nepa/floodplain-management-and-wetland-guidance-national-environmental-policy-act-reviews)	Policy and guidance for implementing Executive Orders 11988 and 11990. Requires federal agencies to evaluate the potential effects of action proposed in wetlands and floodplains to avoid, to the extent possible, adverse effects. Federal agencies are required to evaluate alternatives to actions in wetlands or floodplains and to avoid or minimize adverse impacts if not practical alternatives exist.		No	No
Floodplains	6 NYCRR 373-2.2 - Location standards for hazardous waste treatment, storage, and disposal facilities -100-yr floodplain	Hazardous waste treatment, storage, or disposal facilities located in a 100-yr floodplain must be designed, constructed, operated and maintained to prevent washout of hazardous waste during a 100-year flood.	Not applicable or relevant and appropriate. A portion of the Site is within the 100-year floodplain.; however, no hazardous waste treatment, storage, or disposal facilities are planned to be located on Site.	No	No
	40 CFR Part 264.18(b) - Location Standards - Floodplains	Hazardous waste treatment, storage, or disposal facilities located in a 100-yr floodplain must be designed, constructed, operated and maintained to prevent washout of hazardous waste during a 100-year flood.	Not applicable or relevant and appropriate. A portion of the Site is within the 100-year floodplain; however, no hazardous waste treatment, storage, or disposal facilities are planned to be located on Site.	No	No
	Executive Order 11988 - Floodplain Management	USEPA is required to conduct activities to avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupation or modification of floodplains. The procedures also require USEPA to avoid direct or indirect support of floodplain development wherever there are practicable alternatives and minimize potential harm to floodplains when there are no practicable alternatives.	Not applicable or relevant and appropriate as there are no floodplains on Site.	No	No
Potential Location-Specific ARARs and TBCs (Cont'd)					
Floodplains (Cont.)	Executive Order 13690 - Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input	Executive order establishes a Federal Flood Risk Management Standard (FFRMS), a Process for Further Soliciting and Considering Stakeholder Input, and amends Executive Order 11988. The FFRMS establishes a construction standard and framework for Federally funded projects constructed in, and affecting, floodplains, to reduce the risks and cost of floods. Under the FFRMS, federal agency management is expanded from the current base flood level to a higher vertical elevation and corresponding horizontal floodplain to address current and future flood risk to increase resiliency of projects funded with federal funds. The Executive Order also sets forth a process for solicitation and consideration of public input, prior to implementation of the FFRMS.	Not applicable or relevant and appropriate as there are no floodplains on Site.	Yes	No
	6 NYCRR 500 - Floodplain Management Regulations Development Permits	Promulgated state regulations providing permit requirements for development in areas of special flood hazard (floodplain within a community subject to a one percent or greater chance of flooding in any given year).	Not applicable or relevant and appropriate as there are no floodplains on Site.	No	No
	Town of Geddes Flood Protection Ordinance	Permit requirements for work in areas of special flood hazard.	Not applicable or relevant and appropriate as there are no floodplains on Site.	No	No
Within 61 meters (200 feet) of a Fault Displaced in Holocene Time	40 CFR Part 264.18(a) - Location Standards - Seismic considerations	New treatment, storage, or disposal of hazardous waste is not allowed.	Not applicable or relevant and appropriate. Site is not located within 200 feet of a fault displaced in Holocene time, as listed in 40 CFR 264 Appendix VI. None listed in New York State.	No	No

TABLE 4-1. POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) AND TO BE CONSIDERED (TBC) MATERIALS

Medium Location/Action	Citation	Requirements	Comments	Potential ARAR	Potential TBC
Within Salt Dome or Bed Formation, Underground Mine, or Cave	40 CFR Part 264.18 (c) - Location standards; salt dome formations, salt bed formations, underground mines and caves.	Placement of non-containerized or bulk liquid hazardous waste is not allowed.	Not applicable or relevant and appropriate. No salt dome formations, salt bed formations, underground mines or caves present at Site.	No	No
Habitat of an Endangered or Threatened Species	6 NYCRR 182	Promulgated state regulation that provides requirements to minimize damage to habitat of an endangered species.	Not applicable or relevant and appropriate. No endangered or threatened wildlife species, rare plants or significant habitats were identified at the site. One threatened plant within 2 miles of Site on north shore of Onondaga Lake not anticipated to be impacted by Site activities.	No	No
	Endangered Species Act	Provides a means for conserving various species of fish, wildlife, and plants that are threatened with extinction.		No	No
	50 CFR Part 17 - Endangered and Threatened Wildlife and Plants and 50 CFR Part 402 - Interagency Cooperation	Promulgated federal regulation that requires that federal agencies ensure authorized, funded, or executed actions will not destroy or have adverse modification of critical habitat.		No	No
Historical Property or District	National Historic Preservation Act 36 CFR 800- Preservation of Historic Properties Owned by a Federal Agency	Remedial actions are required to account for the effects of remedial activities on any historic properties included on or eligible for inclusion on the National Register of Historic Places.	Potentially applicable. A draft Phase 1 assessment identified the potential for prehistoric and historic resources in and in the vicinity of the Site.	Yes	No
	National Historic Preservation Act 36 CFR Part 65 - National Historic Landmarks Program	Promulgated federal regulation requiring that actions must be taken to preserve and recover historical/archeological artifacts found.		Yes	No
	New York State Historic Preservation Act of 1980 9 NYCRR Parts 426 - 428	State law and regulations requiring the protection of historic, architectural, archeological and cultural property.		Yes	No
Wilderness Area	Wilderness Act 50 CFR Part 35 - Wilderness Preservation and Management	Provides for protection of federally-owned designated wilderness areas.	Not applicable or relevant and appropriate. Site not located in wilderness area.	No	No
Potential Location-Specific ARARs and TBCs (Cont'd)					
Wild, Scenic, or Recreational River	Wild and Scenic Rivers Act	Provides for protection of areas specified as wild, scenic, or recreational.	Not applicable or relevant and appropriate. Site not located near wild, scenic or recreational river.	No	No
Coastal Zone	Coastal Zone Management Act	Requires activities be conducted consistent with approved State management programs.	Not applicable or relevant and appropriate. Site not located in coastal zone.	No	No
Coastal Barrier	Coastal Barrier Resources Act	Prohibits any new Federal expenditure within the Coastal Barrier Resource System.	Not applicable or relevant and appropriate. Site not located in coastal barrier.	No	No
Protection of Waters	33 U.S.C. 1341 - Clean Water Act Section 401, State Water Quality Certification Program	States have the authority to veto or place conditions on federally permitted activities that may result in water pollution.	Potentially relevant and appropriate to Site.	Yes	No
Potential Action-Specific ARARs and TBCs					
Institutional Controls	NYSDEC DER-33 Institutional Controls: A Guide to Drafting and Recording Institutional Controls, December 2010	Technical guidance document that provides guidelines for proper development and recording of institutional controls as part of a site remedial program.	Potentially applicable TBC when institutional controls are implemented as a component of the selected remedy.	No	Yes

TABLE 4-1. POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) AND TO BE CONSIDERED (TBC) MATERIALS

Medium Location/Action	Citation	Requirements	Comments	Potential ARAR	Potential TBC
Cover Systems	NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation, May 2010	Technical guidance document that provides guidelines for cover thicknesses as they relate to property use in areas where exposed surface soil exceeds NYCRR Part 375 SCOs. Specifically, where the exposed surface soil at the site exceeds the applicable soil cleanup objective for protection of human health and/or ecological resources, the soil cover for restricted residential use, is to be two feet; for commercial or industrial use, is to be one foot; or when an ecological resource has been identified is to be a minimum of two feet; and when such a concern is identified by NYSDEC, consideration should be given to supplementing the demarcation layer to serve as an impediment to burrowing.	Potentially applicable TBC for cover alternatives.	No	Yes
Landfill	40 CFR Part 257 - Criteria for Classification of Solid Waste Disposal Facilities and Practices	Promulgated federal regulation that provides criteria for solid waste disposal facilities to protect health and the environment.	Potentially applicable for treatment residuals or soil/fill material consolidated on-Site in a containment unit.	Yes	No
	40 CFR Parts 264 and 265, Subpart N - Landfills	Promulgated federal regulation that provides requirements for hazardous waste landfill units.		Yes	No
Generation and Management of Solid waste	6 NYCRR 360 - Solid Waste Management Facilities	Promulgated state regulation that provides requirements for management of solid wastes, including disposal and closure of disposal facilities.	Potentially applicable to alternatives including disposal of residuals generated by treatment processes.	Yes	No
Land Disposal	6 NYCRR 376 - Land Disposal Restrictions	Promulgated federal and state regulations that provide treatment standards to be met prior to land disposal of hazardous wastes.	Potentially applicable to residuals generated by treatment processes if found to be hazardous wastes and disposed at a landfill. Potentially applicable for off-site treatment and disposal of soil/fill material.	Yes	No
	40 CFR Part 268 - Land Disposal Restrictions				
	62 CFR 25997 - Phase IV Supplemental Proposal on Land Disposal of Mineral Processing Wastes				
Green Remediation	NYSDEC DER-31 Green Remediation Program Policy, January 2011	State and federal technical guidance documents that provide guidelines for the development of site remediation strategies in a manner that minimizes environmental impacts and applies green remediation concepts (e.*g.*, reduction in greenhouse gas emissions, energy consumption and resource use, promotion of recycling of materials and conservations of water, land and habitat).	Potentially applicable TBC.	No	Yes
	Superfund Green Remediation Strategy, September 2010				
Potential Action-Specific ARARs and TBCs (Cont'd)					
General Excavation	6 NYCRR 200-203, 211-212 - Prevention and Control of Air Contamination and Air Pollution	Provides requirements for air emission sources.	Portions potentially applicable to volatile emissions during excavation	Yes	No
	6 NYCRR 257 - Air Quality Standards	Promulgated state regulation that provides specific limits on generation of SO_2, particulates, CO_2, photochemical oxidants, hydrocarbons (non-methane), NO_2, fluorides, beryllium and H2S from point sources.	Not applicable or relevant and appropriate. Dust emissions would not be generated from a point source. Potentially applicable TBC during dust generating activities such as earth moving, grading and excavation.	No	Yes
	40 CFR Part 50.1 - 50.12 - National Ambient Air Quality Standards	Promulgated federal regulation that provides air quality standards for pollutants considered harmful to public health and the environment. The six principle pollutants are carbon monoxide, lead, nitrogen dioxide, particulates, ozone, and sulfur oxides.	Potentially applicable to alternatives during which dust generation may result, such as during earth moving, grading, and excavation.	Yes	No
	NYS TAGM 4031 - Dust Suppressing and Particle Monitoring at Inactive Hazardous Waste Disposal Sites	State guidance document that provides limitations on dust emissions.	Potentially applicable TBC where more stringent than air-related ARARs.	No	Yes

TABLE 4-1. POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) AND TO BE CONSIDERED (TBC) MATERIALS

Medium Location/Action	Citation	Requirements	Comments	Potential ARAR	Potential TBC
Construction	29 CFR Part 1910.120 - Occupational Safety and Health Standards - Hazardous Waste Operations and Emergency Response	Promulgated federal regulation requiring that remedial activities must be in accordance with applicable OSHA requirements.	Potentially applicable for construction activities.	Yes	No
	29 CFR Part 1926 - Safety and Health Regulations for Construction	Promulgated federal regulation requiring that remedial construction activities must be in accordance with applicable OSHA requirements.	Potentially applicable for construction activities.	Yes	No
Transportation	6 NYCRR 364 - Waste Transporter Permits	Promulgated state regulation requiring that hazardous waste transport must be conducted by a hauler permitted under 6 NYCRR 364.	Potentially applicable for off-site transport of hazardous waste.	Yes	No
	49 CFR 107, 171-174 and 177-179 - Department of Transportation Regulations	Promulgated federal regulation requiring that hazardous waste transport to off-site disposal facilities must be conducted in accordance with applicable Department of Transportation requirements	Potentially applicable for off-site transport of hazardous waste to off-site treatment/disposal facilities.	Yes	No

Notes:

ARARs - Applicable or Relevant and Appropriate Requirements

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act

CFR - Code of Federal Regulations

DER - Division of Environmental Remediation

FFRMS - Federal Flood Risk Management Standard

NYCRR - New York Code of Rules and Regulations

NYS - New York State

NYSDEC - New York State Department of Environmental Conservation

NYSDOH - New York State Department of Health

OSHA - Occupational Safety and Health Administration

OSWER - Office of Solid Waste and Emergency Response

SCOs - Soil Cleanup Objectives

TAGM - Technical and Administrative Guidance Memorandum (NYSDEC)

TBC - To be Considered

USC - United States Code

USEPA or EPA - United States Environmental Protection Agency

Shaded cells - not identified as Potential ARARs or TBCs

TABLE 4-2. SCREENING AND EVALUATION OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL/FILL MATERIAL

General Response Action	Remedial Technology	Process Option	Description	Implementability	Effectiveness	Relative Cost	Screening Comments	Retained for Further Consideration
No Further Action	None	No further action*	No further remedial action would be conducted beyond current remedial actions and IRMs.	Readily implementable.	Not effective at mitigating potential for erosion of, or human receptor contact with, exposed contaminated soil/fill material.	No capital No O&M	Potentially applicable. Retained for further consideration. No action required for consideration by the NCP (40 CFR Part 300.430) and NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation.	Yes
Institutional Controls/ Limited Actions	Access/use restrictions/ administrative control(s)	Institutional controls*	Implementation and documentation of access and land use restrictions that would require activities that could potentially disturb or expose contaminated soil/fill material (and require health and safety precautions) be conducted in accordance with the site management plan. Institutional controls would also include provisions to address potential soil vapor intrusion if a new building(s) is constructed at the Site.	Readily implementable.	Effective means of controlling site use for protection of human health.	Low capital No O&M	Potentially applicable. Retained for further consideration.	Yes
	Site controls	Site management plan*	Documentation of site restrictions and provisions for continued operation and maintenance of the remedy. Presents site engineering and institutional controls and physical components of the selected remedy requiring operation and maintenance to provide continued effectiveness. The site management plan would also present provisions for periodic site reviews.	Readily implementable.	Effective means of controlling site use for protection of human health. Effective means of communicating soil management/handling procedures and documenting remedy components, including operation and maintenance requirements.	Low capital No O&M	Potentially applicable. Retained for further consideration.	Yes

TABLE 4-2. SCREENING AND EVALUATION OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL/FILL MATERIAL

General Response Action	Remedial Technology	Process Option	Description	Implementability	Effectiveness	Relative Cost	Screening Comments	Retained for Further Consideration
Institutional Controls/ Limited Actions (continued)	Periodic reviews	Periodic site reviews*	Periodic reviews are required by 6 NYCRR Part 375 and DER-10 where institutional and engineering controls, monitoring plans, and/or operations and maintenance activities are implemented at a site. The purpose of periodic reviews is to evaluate the site with regard to the continuing protection of human health and the environment and to provide documentation of remedy effectiveness. In accordance with 6 NYCRR Part 375-1.8(h)(3), the frequency of periodic reviews should be annual, unless a different frequency is approved by NYSDEC. Periodic site reviews would include the performance of Five Year Reviews in accordance with 40 CFR 300.430(f)(4)ii.	Readily implementable.	Effective means of evaluating continued protection to human health and the environment.	No capital Low O&M	Potentially applicable. Retained as effective and readily implementable.	Yes
Natural Recovery	Natural attenuation	Natural attenuation	The natural degradation of contaminants by *in situ* physical, chemical and/or biological processes. Over time, contaminants' toxicity, mobility, concentration and/or volume can be reduced by processes that include biodegradation, desorption, dilution, volatilization, and/or transformation.	Potentially implementable. Long-term sampling and analysis of media would be required to demonstrate natural attenuation.	Results of site-specific microcosm study performed on similar nearby wastebed soil/fill material showed a lack of live microorganisms in microcosms constructed using groundwater and soil/fill material. Attenuation processes potentially effective for reduction of contaminant concentrations over the long-term; however, existing Site data is inconclusive.	No capital Low O&M	Not retained for further consideration. Naturally occurring attenuation processes are likely occurring; however, not anticipated to effective at addressing soil/fill concentrations.	No
Containment	Cover system	Engineered soil cover*	Use of vegetated, soil/granular material, gravel, asphalt, and/or building surface cover to promote surface water runoff, reduce erosion and prevent direct contact with soil/fill material. Final restoration cover would be selected based upon intended site use and restoration requirements within the covered area. Grading and cover installation would be performed such that drainage is promoted, erosion is minimized, and cover integrity is protected.	Implementable. Routine cover maintenance and inspection would be necessary to maintain cover system integrity.	Effective means of minimizing direct contact with exposed soil/fill material. Effective means of minimizing erosion of soil/fill material that could result in surface water contamination. Could be designed to provide an effective means of controlling volatile emissions. Building floors could be designed to be integrated with cover systems and may require soil vapor control systems. Effectiveness relies on maintaining integrity of cover system.	Medium capital Low O&M	Potentially applicable. Retained for further consideration where surface soils exhibit concentrations above NYCRR Part 375 SCOs corresponding to site use.	Yes

TABLE 4-2. SCREENING AND EVALUATION OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL/FILL MATERIAL

General Response Action	Remedial Technology	Process Option	Description	Implementability	Effectiveness	Relative Cost	Screening Comments	Retained for Further Consideration
		Enhanced engineered cover*	Use of low permeability cover to minimize surface water infiltration, encourage runoff and control erosion, and isolate and contain impacted soil/fill material. Low permeability cover components may consist of low permeability clay and/or a geomembrane system. Vegetation, asphalt, or gravel may be utilized as the top layer based upon intended site use and restoration requirements within the covered area.	Implementable. Routine cover maintenance and inspections would be necessary to maintain cover system integrity.	Effective means of minimizing erosion of, and contact with exposed soil/fill material. Effective means of minimizing erosion of soil/fill material that could result in surface water contamination. Results in reduction in infiltration that could reduce leaching of contaminants in soil/fill material to groundwater, and reduce mobilization of Site-related contaminants. Could be designed to provide an effective means of controlling volatile emissions. Building floors could be designed to be integrated with cover systems and may require soil vapor control systems. Effectiveness relies on maintaining integrity of cover system.	High capital Low O&M	Potentially applicable. Retained for further consideration where surface soils exhibit concentrations above NYCRR Part 375 SCOs corresponding to site use.	Yes
In situ Treatment	Chemical treatment	Chemical oxidation (ISCO)	*In situ* treatment using oxidants such as ozone, catalyzed hydrogen peroxide, hypochlorites, permanganate, and/or sodium persulfate. Oxidation reactions chemically convert constituents to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert. Oxidation agents can be applied to the subsurface via injection points, deep soil mixing, or soil fracturing.	Not practical for site-wide application. Implementability limited due to low permeability conditions at the Site and presence of heterogeneous subsurface conditions. Heterogeneous nature of soil/fill material and areas with soil/fill material and remaining Semet Residue would limit effective distribution of oxidants, likely requiring advanced oxidant delivery techniques. Significant odors/emissions could occur from gas generation/volatilization of contaminants due to the generation of heat from mixing oxidants with soil/fill material that contains carbonates. Post-treatment, the treated area could have potential geotechnical stability issues which could limit future site use/redevelopment. Potential health and safety concerns handling large volumes of oxidants and working in the vicinity of potentially aggressive reactions. A pilot study would be necessary to evaluate oxidant delivery methods.	Potentially effective for treatment of VOCs and SVOCs in soil/fill material. Not effective for treatment of metals. Effectiveness limited by low permeability and heterogeneous subsurface conditions. Heterogeneous nature of soil/fill material would result in uneven distribution of oxidants and reduced treatment efficiency. Low permeability and heterogeneity of soil/fill material would likely require advanced delivery techniques (*i.e., in situ* mixing, tight injection point spacing) to improve distribution and increase effectiveness. Not effective for treatment of areas exhibiting remaining Semet Residue because of inability to mix oxidants with and treat the tar-like Semet Residue. Soil/fill material pH and high carbonate levels may reduce treatment efficiency. Potential for production of hazardous intermediates if incomplete oxidation occurs. Large quantities of oxidant potentially required. Potential need for multiple injections/deliveries of oxidant over time. A treatability study would be necessary to evaluate effectiveness of various oxidants on VOCs and SVOCs in soil/fill material.	High capital Low to Medium O&M	Not retained for further consideration because of limited implementability and effectiveness.	No

TABLE 4-2. SCREENING AND EVALUATION OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL/FILL MATERIAL

General Response Action	Remedial Technology	Process Option	Description	Implementability	Effectiveness	Relative Cost	Screening Comments	Retained for Further Consideration
		Chemical reduction (ISCR)	Mixing of reactive media (*e.g.,* ZVI) and stabilizing agents (*e.g.*, clay) using conventional soil mixing equipment. The ZVI reactive media degrades contaminants while the clay stabilizing agent provides source containment by reducing hydraulic conductivity. Alternately, ZVI and an amendment to enhance biodegradation could be used.	Not practical for site-wide application. Implementability limited due to low permeability conditions at the Site and presence of heterogeneous subsurface conditions. Heterogeneous nature of soil/fill material and areas with soil/fill material and remaining Semet Residue would limit effective distribution of reagents. Implementation issues with staging the mixing equipment to perform *in situ* mixing, which may be necessary to achieve effective distribution of reductants. Significant implementability challenges associated with odor/emissions resulting from *in situ* mixing of soil/fill material, which may be necessary to improve distribution of ISCR reagents. Excavation of soil/fill material potentially required to account for volume increase with agent addition. Post-treatment, the treated area could have potential geotechnical stability issues which could limit future site use/redevelopment. A pilot study would be necessary to evaluate delivery methods.	Potentially effective for treatment of some VOCs, SVOCs, and metals in soil/fill material. Effectiveness limited by low permeability and heterogeneous subsurface conditions. Heterogeneous nature of soil/fill material would result in uneven distribution of oxidants and reduced treatment efficiency. Low permeability of soil/fill material and remaining Semet Residue would likely require advanced delivery techniques (*i.e., in situ* mixing, tight injection point spacing) to improve distribution and increase effectiveness. Not effective for treatment of areas exhibiting soil/fill material and remaining Semet Residue because of inability to mix reagents with and treat the heterogeneous material. Not effective for treatment of benzene, which is already a reduced compound. Compatibility of ISCR reagents in soil/fill material with high pH and high carbonates is unknown. Potential need for multiple injections/deliveries of reductant over time. A treatability study would be necessary to evaluate the effectiveness of ISCR reagents on VOCs and SVOCs in soil/fill material.	Medium capital Low to Medium O&M	Not retained for further consideration because not effective for treatment of benzene and because of limited implementability.	No
In situ Treatment (continued)	Chemical treatment (continued)	Enhanced dissolution	Water, aqueous solution, surfactants, or cosolvents are injected into the subsurface. The extraction fluid is utilized to enhance contaminant solubility. Contaminants are leached into the groundwater and subsequently removed through a collection system and treated *ex situ*.	Not practical for site-wide application. Implementability limited due to low permeability conditions at the Site and presence of heterogeneous subsurface conditions. Low permeability soil/fill material and areas of soil/fill material with remaining Semet Residue would present significant challenges related to injection, circulation and extraction of dissolution fluids. Significant implementability challenges associated with odor/emissions resulting from *in situ* mixing of soil/fill material to improve distribution of surfactants. Dissolution fluid collection and treatment would be necessary. Implementation issues with staging the mixing equipment to perform *in situ* mixing, which may be necessary to achieve effective distribution of surfactants. Post-treatment, the treated area could have potential geotechnical stability issues which could limit future site use. A pilot test would be necessary to evaluate implementability of surfactant distribution methods.	Potentially effective for treatment of VOCs, SVOCs, and metals in the saturated and unsaturated zones. Effectiveness limited by low permeability and heterogeneous subsurface conditions. Heterogeneous nature of soil/fill material would result in uneven distribution and recovery of the solution/surfactants and reduced treatment efficiency. Low permeability of soil/fill material would likely require advanced delivery techniques (*i.e., in situ* mixing, tight injection point spacing) to improve distribution and increase effectiveness. Not effective for treatment of areas with soil/fill material and remaining Semet Residue because of the high viscosity of Semet Residue and inability to effectively distribute solutions/surfactants. Surfactant action would be inhibited due to high pH of soil/fill material. A treatability study would be necessary to evaluate effectiveness of various surfactants on VOCs, SVOCs and metals in soil/fill material.	Medium capital Medium to High O&M	Not retained for further consideration because of limited implementability and effectiveness.	No

TABLE 4-2. SCREENING AND EVALUATION OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL/FILL MATERIAL

General Response Action	Remedial Technology	Process Option	Description	Implementability	Effectiveness	Relative Cost	Screening Comments	Retained for Further Consideration
	Physical treatment	Solidification/ stabilization (ISS)	Contaminants are physically bound or enclosed within a stabilized mass (solidification) and/or chemical reactions are induced between stabilizing agent and contaminants to reduce their mobility (stabilization), toxicity and leachability.	Not practical for site-wide application. Significant implementability challenges associated with odor/emissions resulting from *in situ* mixing to improve distribution of ISS reagents limit technology for site-wide use. A pilot test would be necessary to evaluate implementability of amendment distribution methods.	Long-term effectiveness of ISS for inorganics has been demonstrated at many sites. Potentially effective for VOCs and SVOCs. Low permeability of soil/fill material would likely require advanced delivery techniques (*i.e., in situ* mixing) to improve distribution and increase effectiveness. A treatability study would be necessary to evaluate the suitability and effectiveness of ISS.	Low to Medium capital No O&M	Not practical for site-wide treatment due to implementability and effectiveness limitations, and excessive volumes.	No
		Soil vapor extraction (SVE)	Vacuum is applied through extraction wells within the vadose zone to create a pressure/concentration gradient that induces organics sorbed on the soil/fill material, dissolved in pore water and/or present as vapor to volatilize. Extracted vapors are removed through extraction wells and treated *ex situ* as needed.	Not practical for site-wide application. Not implementable for saturated zone without dewatering. Off-gas treatment likely required. Implementation of SVE and associated dewatering (if necessary) not practical due to low permeability of soil/fill material, and resulting limited radius of influence of SVE points. A pilot/pumping test would be necessary to identify radius of influence and implementability in low permeability soil/fill material.	Effective for treatment of VOCs. Limited effectiveness for treatment of SVOCs. Not effective for treatment of metals. Effective in the unsaturated zone; however, effectiveness is limited due to low permeability and high moisture content of soil/fill material. Not effective for soil/fill material in the saturated zone. Not effective for treatment of areas with soil/fill material with high viscosity tar-like remaining Semet Residue. A treatability study would be necessary to evaluate effectiveness of VOC and SVOC removal in soil/fill material.	High capital High O&M	Not retained for further consideration. Subsurface conditions likely to limit implementability and treatment effectiveness.	No
		Dual-phase extraction (DPE)	A high-pressure vacuum is applied through extraction wells to simultaneously extract groundwater and vapors from the subsurface. Extracted groundwater and vapors are separated and treated *ex situ*.	Not practical for site-wide application. Implementation of DPE not practical due to low permeability of soil/fill material, and resulting limited radius of influence of DPE points. Off-gas treatment likely required. A pilot/pumping test would be necessary to identify radius of influence and implementability in low permeability soil/fill material.	Limited effectiveness for treatment of SVOCs. Not effective for treatment of metals. Potentially effective for treatment of VOCs in saturated and unsaturated zones; however effectiveness is limited due to low permeability and high moisture content of soil/fill material. Not effective for treatment of areas of soil/fill material with high viscosity remaining Semet Residue. A treatability study would be necessary to evaluate effectiveness of VOC and SVOC removal in soil/fill material.	High capital High O&M	Not retained for further consideration. Subsurface conditions likely to limit implementability and treatment effectiveness.	No

TABLE 4-2. SCREENING AND EVALUATION OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL/FILL MATERIAL

General Response Action	Remedial Technology	Process Option	Description	Implementability	Effectiveness	Relative Cost	Screening Comments	Retained for Further Consideration
In situ Treatment (continued)	Biological treatment	Enhanced *In Situ* Bioremediation (EISB)	Injection of amendments (nutrient sources/electron donors) and microbial populations into subsurface to enhance biological degradation of organic constituents.	Significant implementability challenges associated with odor/emissions resulting from *in situ* mixing to improve distribution of amendments and microbes limit technology for site-wide use. Implementability limited due to low permeability conditions at the Site and presence of heterogeneous subsurface conditions. Heterogeneous nature of soil/fill material and areas with soil/fill material and remaining Semet Residue would limit effective distribution of reagents. Implementation issues with staging the mixing equipment to perform *in situ* mixing of soil/fill material, which is necessary to achieve effective distribution. Potential geotechnical issues related to staging of mixing equipment. Post-treatment, the treated area could have potential geotechnical stability issues which could limit future site use/redevelopment. A pilot test would be necessary to evaluate implementability of distribution of amendments and microbial populations. Significant implementability challenges associated with identifying and sustaining a microbial population that could survive site conditions.	Potentially effective for treatment of VOCs and certain SVOCs in soil. Not effective for treatment of metals. Not effective for treatment of soil/fill material with remaining Semet Residue. Effectiveness limited by low permeability and heterogeneous subsurface conditions. Heterogeneous nature of soil/fill material would result in uneven distribution of EISB amendments and reduced treatment efficiency. Low permeability of soil/fill material would likely require advanced delivery techniques (*i.e., in situ* mixing, tight injection point spacing) to improve distribution and increase effectiveness. Results of site-specific microcosm study performed on similar nearby wastebed soil/fill material showed a lack of live microorganisms in microcosms constructed using groundwater and soil/fill material; therefore, a treatability study would be necessary to identify a microbial population that could survive site conditions; and to implement EISB, microbial addition (bioaugmentation) would be required. Significant reduction in contaminant mass would not be expected in the near future. High pH of soil/fill material and groundwater does not provide favorable conditions to sustain organisms capable of biodegradation. EISB generally requires multiple injections/deliveries over time.	High capital Medium O&M	Not retained for further consideration because not an effective treatment method for soil/fill material and because of limited implementability.	No

TABLE 4-2. SCREENING AND EVALUATION OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL/FILL MATERIAL

General Response Action	Remedial Technology	Process Option	Description	Implementability	Effectiveness	Relative Cost	Screening Comments	Retained for Further Consideration
	Thermal treatment	Soil heating	Heating of subsurface materials using various techniques, including heating wells, thermal blankets, injection points, electrodes, or electromagnetic energy to heat and volatilize organic contaminants. Volatilized contaminants are removed by vapor extraction and treated *ex situ* as needed.	Not practical for site-wide application. Significant implementability challenges associated with availability of adequate electrical power supplies, odor/emissions resulting from potential for gas generation/volatilization of contaminants due to heating of soil/fill material and loss of geotechnical structural integrity of wastebed. Heating of soil/fill material could result in breakdown of calcium carbonate, resulting in significant CO2 emissions. An off-gas collection and treatment system would be required to be constructed on-site. Structural integrity of soil/fill material would very likely be affected as the moisture content of the soil/fill material decreases, resulting in settlement, subsidence, and/or fracturing potentially resulting in uncontrolled emissions, damage to heater wells, and potential impacts to the structural integrity of the wastebed, which could limit future site use/redevelopment. High pH and salinity of groundwater would likely result in corrosion of heater wells over time. Tight heater well spacing would be required to treat soil/fill material. Energy efficiency limited by high moisture content of soil/fill material. Management of hazards associated with high voltage and on-site fuel/power source would be required. A pilot test would be required to evaluate implementability of soil heating at the Site.	Potentially effective for treatment of VOCs and SVOCs in the saturated and unsaturated zones. Not effective for treatment of metals. Effectiveness limited by low permeability and heterogeneous subsurface conditions. Effectiveness potentially limited by remaining Semet Residue and high organic concentrations, elevated sulfur levels, and high moisture content of soil/fill material. Potentially requires implementation in conjunction with SVE or DPE for vapor recovery. Off-gas treatment likely required. A treatability study would be necessary to evaluate effectiveness of thermal treatment of Site-related contaminants.	Very high capital No - Low O&M	Not retained for further consideration. Subsurface conditions likely to limit implementability and treatment effectiveness. Implementation not practical due to risk of odor/emissions and potential loss of geotechnical stability.	No
Removal	Excavation	Mechanical excavation*	Use of construction equipment to remove soil/fill material. Due to physical characteristics of soil/fill material and presence below groundwater table, dewatering would likely be required. It is anticipated that in addition to dewatering, stabilization may also be required to render the excavated material sufficiently dry for management and transportation. Excavated areas would be backfilled, graded and restored based on restoration requirements.	Not practical for site-wide application. Implementability of soil/fill material excavation is limited by depth of materials, need for sloping or shoring, and large quantities of soil/fill material. Geotechnical stability evaluations would be required. Dewatering of excavations and subsequent water management/treatment would also be required. Significant implementability challenges associated with odor/emissions resulting from potential for gas generation/volatilization of contaminants during excavation activities. Further management of excavated soil/fill material required. Backfilling and/or re-grading would be required to accommodate future site use/development.	Effective means of reducing the toxicity, mobility and volume of impacted soil/fill material. It is anticipated that dewatering and/or stabilization would be required prior to management, treatment and disposal. A treatability study would be necessary to evaluate effectiveness of stabilization on soil/fill material. Excavation/management of Semet Residue at the Site is on-going.	Very high capital No O&M	Potentially applicable. Retained for soil/fill material, though significant implementability issues are anticipated for removal of full wastebed. Excavation/ management of Semet Residue at the Site is on-going.	Yes

TABLE 4-2. SCREENING AND EVALUATION OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL/FILL MATERIAL

General Response Action	Remedial Technology	Process Option	Description	Implementability	Effectiveness	Relative Cost	Screening Comments	Retained for Further Consideration
Ex situ Treatment	On-site chemical treatment	Chemical oxidation	*Ex situ* treatment of excavated materials using oxidants such as ozone, hydrogen peroxide, hypochlorites, permanganate, and/or sodium persulfate using a chemical treatment system (*e.g.*, reactor cells). Oxidation reactions chemically convert constituents to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert.	Not practical for site-wide application. Significant implementability issues anticipated associated with emission control needs to address odors/emissions likely to occur during material handling and from gas generation and/or volatilization of contaminants due to the generation of heat from mixing oxidants with soil/fill material that contains carbonates. Potential community and local government acceptance issues related to truck traffic, noise, and odor/dust/emissions. The need for emission controls would limit size of treatment systems, potentially resulting in long durations for treatment. Design, construction and testing of a pilot system would be necessary to evaluate implementability.	Potentially effective for treatment of VOCs and SVOCs in excavated soil/fill material. Not effective for treatment of metals. A treatability study would be necessary to evaluate *ex situ* treatment technology effectiveness for Site-related contaminants in soil/fill material.	High capital Low O&M	Not practical for site-wide use due to excessive volumes. Not retained for further consideration due to limited implementability related to emissions and community acceptance of on-site treatment	No
		Extraction/ washing	Excavated materials and extractant are mixed in an extractor, thereby dissolving the contaminants. The extracted solution is then placed in a separator, where the contaminants and extractant are separated for further treatment or disposal.	Not practical for site-wide application. Potentially implementable for limited quantities of soil/fill material. Significant implementability issues anticipated associated with emission control needs to address odors/emissions likely to occur during material handling and treatment. Potential community and local government acceptance issues related to truck traffic, noise, and odor/dust/emissions. The need for emission controls would limit size of treatment systems, potentially resulting in long durations for treatment. Waste generated by the treatment system would require further management/disposal off-site. Extraction fluid may entrain soil/fill material due to fine nature and low permeability of soil/fill material, resulting in extractor fluid treatment challenges.	Potentially effective means of reducing the toxicity, mobility and volume of VOCs, SVOCs, and metals in excavated soil/fill material. Not effective for treatment of soil/fill material due to heterogenous properties. A treatability study would be necessary to evaluate *ex situ* treatment technology effectiveness.	Medium capital Medium O&M	Not practical for site-wide use due to excessive volumes. Not retained for further consideration due to limited implementability related to emissions and community acceptance of on-site treatment.	No

TABLE 4-2. SCREENING AND EVALUATION OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL/FILL MATERIAL

General Response Action	Remedial Technology	Process Option	Description	Implementability	Effectiveness	Relative Cost	Screening Comments	Retained for Further Consideration
Ex situ Treatment (continued)	On-site biological treatment	Biopiles	Excavated materials are mixed with soil amendments and placed in aboveground enclosures. Compost is formed into piles and aerated with blowers or vacuum pumps using an aerated static pile composting process.	Not practical for site-wide application. Potentially implementable for limited quantities of soil/fill material. Significant implementability issues anticipated associated with emission control needs to address odors/emissions likely to occur during material handling and treatment. Potential community and local government acceptance issues related to truck traffic, noise, and odor/dust/emissions. The need for emission controls would limit size of treatment systems, potentially resulting in long durations for treatment. Waste generated by the treatment system would require further management/disposal off-site. Significant implementability challenges associated with identifying a microbial population that could survive site conditions.	Potentially effective means of reducing the toxicity, mobility and volume of VOCs and SVOCs in excavated soil/fill material. Not effective for treatment of metals. Not effective for treatment of soil/fill material due to heterogenous properties. Results of site-specific microcosm study performed on similar nearby wastebed soil/fill material showed a lack of live microorganisms in microcosms constructed using groundwater and soil/fill material; therefore, a treatability study would be required to identify a microbial population suitable for this material. High pH of soil/fill material does not provide favorable conditions to sustain organisms capable of biodegradation.	High capital Medium O&M	Not practical for site-wide use due to excessive volumes. Not retained for further consideration due to limited implementability related to emissions and community acceptance of on-site treatment, and limited effectiveness due to lack of microbial populations and conditions unsuitable for biological treatment.	No
		Landfarming	Excavated materials are placed in lined beds, and periodically turned over or tilled to aerate the waste.	Not practical for site-wide application. Potentially implementable for limited quantities of soil/fill material. Significant implementability issues anticipated associated with emission control needs to address odors/emissions likely to occur during material handling and treatment. Potential community and local government acceptance issues related to truck traffic, noise, and odor/dust/emissions. The need for emission controls would limit size of treatment systems, potentially resulting in long durations for treatment. Waste generated by the treatment system would require further management/disposal off-site. Significant implementability challenges associated with identifying a microbial population that could survive site conditions.	Potentially effective means of reducing the toxicity, mobility and volume of VOCs and SVOCs in excavated soil/fill material. Not effective for treatment of metals. Not effective for treatment of soil/fill material due to heterogenous properties. Results of site-specific microcosm study performed on similar nearby wastebed soil/fill material showed a lack of live microorganisms in microcosms constructed using groundwater and soil/fill material; therefore, a treatability study would be required to identify a microbial population suitable for this material. High pH of soil/fill material does not provide favorable conditions to sustain organisms capable of biodegradation.	High capital Medium O&M	Not practical for site-wide use due to excessive volumes. Not retained for further consideration due to limited implementability related to emissions and community acceptance of on-site treatment, and limited effectiveness due to lack of microbial populations and conditions unsuitable for biological treatment.	No

TABLE 4-2. SCREENING AND EVALUATION OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL/FILL MATERIAL

General Response Action	Remedial Technology	Process Option	Description	Implementability	Effectiveness	Relative Cost	Screening Comments	Retained for Further Consideration
Ex situ Treatment (continued)	On-site thermal treatment	Incineration	Combustion of organic contaminants present in excavated materials in an on-site commercial incinerator at temperatures generally between 1600° F and 2200 °F.	Not practical for site-wide application. Significant implementability issues anticipated, due to emission controls likely required to address odors/emissions from treatment. Significant permitting and potential community and local government acceptance issues related to truck traffic, noise and odor/dust/emissions. The need for emission controls would limit size of treatment systems, potentially resulting in long durations for treatment. Waste generated by the treatment system would require further management/disposal off-site.	Effective means of reducing the toxicity, mobility and volume of VOCs, SVOCs and metals in excavated soil/fill material. A treatability study would be required to evaluate *ex situ* treatment technology effectiveness for Site-related contaminants in soil/fill material.	High capital Medium O&M	Not practical for site-wide use due to excessive volumes. Not retained for further consideration due to limited implementability related to air permitting needs and community acceptance	No
	On-site thermal treatment (continued)	Low temperature thermal desorption	Use of direct or indirect heat to volatilize organic contaminants at temperatures generally between 90 and 300 °C, creating a physical separation (volume reduction) process. The volatilized contaminants from the thermal desorption process are typically directed to a secondary system for destruction via incineration, catalytic oxidation, adsorption on activated carbon, or recovery by condensation. If volatilized contaminants are incinerated, further treatment of acid gases and particulates would be required.	Not practical for site-wide application. Significant implementability issues anticipated associated with emission control needs to address odors/emissions likely to occur during material treatment. Significant permitting and potential community and local government acceptance issues related to truck traffic, noise and odor/dust/emissions. The need for emission controls would limit size of treatment systems, potentially resulting in long durations for treatment. Waste generated by the treatment system would require further management/disposal off-site.	Effective means of reducing the toxicity, mobility and volume of VOCs and SVOCs in excavated soil/fill material. A treatability study would be required to evaluate *ex situ* treatment technology effectiveness for VOCs and SVOCs in soil/fill material.	Medium capital Medium O&M	Not practical for site-wide use due to excessive volumes. Not retained for further consideration due to limited implementability related to air permitting needs and community acceptance	No
	Off-site thermal treatment	Incineration	Combustion of organic contaminants present in excavated materials in an off-site commercial incinerator at temperatures generally between 1600° F and 2200 °F.	Not practical for site-wide application. Treatment facility would require property permitting to accept D018 waste. A review of facilities within a reasonable distance (300 miles of the site) indicates no available adequately permitted facilities or anticipated difficulty shipping hazardous waste across international borders. In addition, implementability limited by facility acceptance criteria (e.g., pH, debris size, no free liquids)	Effective means of reducing the toxicity, mobility and volume of VOCs, SVOCs, and metals in excavated soil/fill material.	High capital, no O&M.	Not practical for site-wide use due to excessive volumes.	No

TABLE 4-2. SCREENING AND EVALUATION OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL/FILL MATERIAL

General Response Action	Remedial Technology	Process Option	Description	Implementability	Effectiveness	Relative Cost	Screening Comments	Retained for Further Consideration
		Low temperature thermal desorption	Use of direct or indirect heat to volatilize organic contaminants at temperatures generally between 90 and 300 °C, creating a physical separation (volume reduction) process. The volatilized contaminants from the thermal desorption process are typically directed to a secondary system for destruction via incineration, catalytic oxidation, adsorption on activated carbon, or recovery by condensation. If volatilized contaminants are incinerated, further treatment of acid gases and particulates would be required.	Not practical for site-wide application. Treatment facility would require property permitting to accept D018 waste. A review of facilities within a reasonable distance (300 miles of the site) indicates no available adequately permitted facilities or anticipated difficulty shipping hazardous waste across international borders.	Effective means of reducing the toxicity, mobility and volume of VOCs and SVOCs in excavated soil/fill material. Not effective for treatment of metals.	Medium capital, no O&M.	Not practical for site-wide use due to excessive volumes.	No
Ex situ Treatment (continued)	Off-site thermal treatment (continued)	Beneficial Reuse (Cement kiln fuel)	Raw or dewatered Semet residue would be addressed by thermal treatment when beneficially reused as fuel in RCRA-permitted cement kiln.	Not implementable due to Btu and solids content. Current remedy for Semet residue addresses Semet residue to the maximum extent practicable.	Potentially effective means of treating VOCs and SVOCs in excavated soil/fill material. Not effective for treatment of metals.	Medium capital, no O&M.	Not retained for further consideration because not implementable.	No
		Plasma gasification	Thermal process that uses high temperature (up to 10,000 ˚F) plasma arc technology to gasify organic materials into an energy rich fuel synthetic gas. During gasification, the organic matter is broken down via a number of complex solid-gas and gas phase reactions. The inorganic waste materials generated from the plasma furnace melt into liquid slag that is poured off and cooled, resulting in an inert vitrified slag material which can be used as construction materials.	Not practical for site-wide application. No available plasma gasification treatment facilities currently exist; therefore, a plant would need to be designed, commissioned, and constructed specifically for the Site.	Potentially effective means of treating VOCs and SVOCs in excavated soil/fill material. Not effective for treatment of metals.	High capital, no O&M.	Not practical for site-wide use due to excessive volumes.	No
Disposal	Off-site disposal	Commercial landfill	Excavated soil/fill material and remaining Semet Residue would be transported to approved commercial off-site landfill.	Not implementable. D018 classification of the soil/fill material at the Site would preclude direct landfilling.	Effective means of disposing soil/fill material.	High No O&M	Not retained for further consideration because not implementable.	No

TABLE 4-2. SCREENING AND EVALUATION OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL/FILL MATERIAL

General Response Action	Remedial Technology	Process Option	Description	Implementability	Effectiveness	Relative Cost	Screening Comments	Retained for Further Consideration
	Off-site treatment/ disposal	Commercial treatment/ disposal facility*	Excavated soil/fill material and remaining Semet Residue would be transported to approved commercial off-site facilities for subsequent treatment/disposal. Excavated soil/fill material identified as acceptable would be disposed at an off-site facility, while excavated soil/fill material identified as D018 waste may require treatment to meet land disposal restrictions (LDRs) prior to disposal.	Not practical for site-wide application. Potentially implementable for limited quantities of soil/fill material that does not meet land disposal restrictions.	Effective for treatment of soil/fill material. A treatability study would be required to evaluate treatment capabilities of off-site commercial treatment/disposal facilities. The facilities' disposal capacities would require evaluation.	Very high capital No O&M	Potentially applicable. Retained for further consideration, though not practical for site-wide use due to excessive volumes.	Yes

Notes:
* Representative Process Option
Shaded cells – Process option not retained for further consideration.

Abbreviations/Acronyms:
°C - degrees Celsius
CFR - Code of Federal Regulations
CO2 - Carbon dioxide
DPE – Dual phase extraction
DER - Division of Environmental Remediation
EISB - Enhanced *In Situ* Bio-remediation
°F - degrees Fahrenheit
ISCO – *In situ* chemical oxidation
ISCR - *In situ* chemical reduction
ISS - *In situ* solidification/ stabilization
NCP – National Contingency Plan
NYSDEC – New York State Department of Environmental Conservation
NYCRR - New York Code of Rules and Regulations
O&M – Operation and Maintenance
RCRA – Resource Conservation and Recovery Act
SCO – Soil Cleanup Objective
SVOC – Semi-volatile organic compound
SVE – Soil Vapor Extraction
VOC – Volatile organic compound
ZVI – Zero valent iron

TABLE 4-3. SCREENING AND EVALUATION OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR TARGETED MATERIAL

General Response Action	Remedial Technology	Process Option	Description	Implementability	Effectiveness	Relative Cost	Screening Comments	Retained for Further Consideration
No Further Action	None	No further action*	No further remedial action would be conducted beyond current remedial actions and IRMs.	Readily implementable.	Not effective at mitigating potential for human receptor contact with, exposed target material.	No capital Low O&M	Potentially applicable. Retained for further consideration. No action required for consideration by the NCP (40 CFR Part 300.430) and NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation.	Yes
Institutional Controls/ Limited Actions	Access/use restrictions/ administrative control(s)	Institutional controls*	Implementation and documentation of access and land use restrictions that would require activities that could potentially disturb or expose targeted material (and require health and safety precautions) be conducted in accordance with the site management plan. Institutional controls would also include provisions to evaluate and address potential soil vapor intrusion if a new building(s) is constructed at the Site.	Readily implementable.	Effective means of controlling site use for protection of human health.	Low capital No O&M	Potentially applicable. Retained for further consideration.	Yes
	Site controls	Site management plan*	Documentation of site restrictions and provisions for continued operation and maintenance of the remedy. Presents site engineering and institutional controls and physical components of the selected remedy requiring operation and maintenance to provide continued effectiveness. The site management plan would also present provisions for periodic site reviews.	Readily implementable.	Effective means of controlling site use for protection of human health. Effective means of communicating material management/handling procedures and documenting remedy components, including operation and maintenance requirements.	Low capital No O&M	Potentially applicable. Retained for further consideration.	Yes
Institutional Controls/ Limited Actions (continued)	Periodic reviews	Periodic site reviews*	Periodic reviews are required by 6 NYCRR Part 375 and DER-10 where institutional and engineering controls, monitoring plans, and/or operations and maintenance activities are implemented at a site. The purpose of periodic reviews is to evaluate the site with regard to the continuing protection of human health and the environment and to provide documentation of remedy effectiveness. In accordance with 6 NYCRR Part 375-1.8(h)(3), the frequency of periodic reviews should be annual, unless a different frequency is approved by NYSDEC. Periodic site reviews would include the performance of Five Year Reviews in accordance with 40 CFR 300.430(f)(4)ii.	Readily implementable.	Effective means of evaluating continued protection to human health and the environment.	No capital Low O&M	Potentially applicable. Retained as effective and readily implementable.	Yes

TABLE 4-3. SCREENING AND EVALUATION OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR TARGETED MATERIAL

General Response Action	Remedial Technology	Process Option	Description	Implementability	Effectiveness	Relative Cost	Screening Comments	Retained for Further Consideration
Natural Recovery	Natural attenuation	Natural attenuation	The natural degradation of contaminants by *in situ* physical, chemical and/or biological processes. Over time, contaminants' toxicity, mobility, concentration and/or volume can be reduced by processes that include biodegradation, desorption, dilution, volatilization, and/or transformation.	Potentially implementable. Long-term sampling and analysis of media would be required to demonstrate natural attenuation.	Not applicable to tar-like targeted material.	No capital Low O&M	Not retained for further consideration.	No
Containment	Cover system	Engineered soil cover*	Use of vegetated, soil/granular material, gravel, asphalt, and/or building surface cover to promote surface water runoff, prevent direct contact with targeted material. Final restoration cover would be selected based upon intended site use and restoration requirements within the covered area. Grading and cover installation would be performed such that drainage is promoted, erosion is minimized, and cover integrity is protected.	Implementable. Routine cover maintenance and inspection would be necessary to maintain cover system integrity.	Effective means of minimizing direct contact with exposed targeted material. Could be designed to provide an effective means of controlling volatile emissions. Building floors could be designed to be integrated with cover systems and may require soil vapor control systems. Effectiveness relies on maintaining integrity of cover system.	Medium capital Low O&M	Potentially applicable. Retained for further consideration.	Yes
		Enhanced engineered cover*	Use of low permeability cover to minimize surface water infiltration, encourage runoff, and isolate and contain impacted targeted material. Low permeability cover components may consist of low permeability clay and/or a geomembrane system. Vegetation, asphalt, or gravel may be utilized as the top layer based upon intended site use and restoration requirements within the covered area.	Implementable. Routine cover maintenance and inspections would be necessary to maintain cover system integrity.	Effective means of minimizing contact with exposed targeted material. Results in reduction in infiltration that could reduce leaching of contaminants in targeted material to groundwater, and reduce mobilization of Site-related contaminant Could be designed to provide an effective means of controlling volatile emissions. Building floors could be designed to be integrated with cover systems and may require soil vapor control systems. Effectiveness relies on maintaining integrity of cover system.	High capital Low O&M	Potentially applicable. Retained for further consideration.	Yes

TABLE 4-3. SCREENING AND EVALUATION OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR TARGETED MATERIAL

General Response Action	Remedial Technology	Process Option	Description	Implementability	Effectiveness	Relative Cost	Screening Comments	Retained for Further Consideration
In situ Treatment	Chemical treatment	Chemical oxidation (ISCO)	*In situ* treatment using oxidants such as ozone, catalyzed hydrogen peroxide, hypochlorites, permanganate, and/or sodium persulfate. Oxidation reactions chemically convert constituents to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert.	*In situ* application would likely result in mixing of targeted material with soil/fill material. Resulting heterogeneous nature of targeted material and soil/fill material would limit effective distribution of oxidants. Significant odors/emissions could occur from gas generation/volatilization of contaminants due to the generation of heat from mixing oxidants with targeted material that contains carbonates. Post-treatment, the treated area could have potential geotechnical stability issues which could limit future site use/redevelopment. Potential health and safety concerns handling large volumes of oxidants and working in the vicinity of potentially aggressive reactions. A pilot study would be necessary to evaluate oxidant delivery methods.	Not effective for treatment because of inability to mix oxidants with and treat the tar-like targeted materials. Targeted material pH and high carbonate levels may reduce treatment efficiency. Potential for production of hazardous intermediates if incomplete oxidation occurs. Large quantities of oxidant potentially required. Potential need for multiple applications of oxidant over time. A treatability study would be necessary to evaluate effectiveness of various oxidants on Site-related contaminants in targeted material.	High capital Low to Medium O&M	Not retained for further consideration because of limited implementability and effectiveness.	No
	Physical treatment	Solidification/ stabilization (ISS)*	Contaminants are physically bound or enclosed within a stabilized mass (solidification) and/or chemical reactions are induced between stabilizing agent and contaminants to reduce their mobility (stabilization), toxicity and leachability.	*In situ* treatment of targeted material potentially implementable. A pilot test would be necessary to evaluate implementability of amendment distribution methods.	Long-term effectiveness of ISS for inorganics has been demonstrated at many sites. Potentially effective for organic Site-related contaminants. A targeted material demonstration was implemented at the Site and demonstrated effective treatment using lime kiln dust (LKD) and cement kiln dust (CKD). Further treatability studies would be necessary to evaluate the design parameters for full-scale implementation of ISS.	Low to Medium capital No O&M	*In situ* treatment of targeted material potentially implementable. Retained for further consideration for treatment of targeted material.	Yes

TABLE 4-3. SCREENING AND EVALUATION OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR TARGETED MATERIAL

General Response Action	Remedial Technology	Process Option	Description	Implementability	Effectiveness	Relative Cost	Screening Comments	Retained for Further Consideration
In situ Treatment (continued)	Biological treatment	Enhanced *In Situ* Bioremediation (EISB)	Injection of amendments (nutrient sources/electron donors) and microbial populations into subsurface to enhance biological degradation of organic constituents.	Significant implementability challenges associated with odor/emissions resulting from *in situ* mixing to improve distribution of amendments and microbes. Potential geotechnical issues related to staging of mixing equipment. Post-treatment, the treated area could have potential geotechnical stability issues which could limit future site use/redevelopment. A pilot test would be necessary to evaluate implementability of distribution of amendments and microbial populations. Significant implementability challenges associated with identifying and sustaining a microbial population that could survive site conditions.	Not effective for treatment of targeted material (tar-like material).	High capital Medium O&M	Not retained for further consideration because not an effective treatment method for targeted material.	No
Removal	Excavation	Mechanical excavation*	Use of construction equipment to remove targeted material. Due to physical characteristics of targeted material and presence below groundwater table, dewatering would likely be required. Excavated areas would be backfilled, graded and restored based on restoration requirements.	Geotechnical stability evaluations would be required. Dewatering of excavations and subsequent water management/treatment would also be required. Implementability challenges associated with odor/emissions resulting from potential for gas generation/volatilization of contaminants during excavation activities. Further management of excavated targeted material required. Backfilling and/or re-grading would be required to accommodate future site use/development.	Effective means of reducing the toxicity, mobility and volume of impacted targeted material. Excavation/ management of Semet Residue at the Site is on-going.	Very high capital No O&M	Potentially applicable. Retained for targeted material, though significant implementability issues are anticipated for removal of large quantities. Excavation/ management of Semet Residue at the Site is on-going.	Yes
	Semet Residue recovery	Passive recovery wells*	Use of shallow wells to recover accumulated remaining Semet Residue from the subsurface vadose zone. Subsequent management of recovered Semet Residue.	Limited implementability. Likelihood for well screen fouling. Low pH of Semet Residue may limit durability of materials of construction. Recovered Semet Residue would require further off-site management.	Effectiveness may be limited by physical characteristics of Semet Residue (*e.g.*, low viscosity).	Low capital High O&M	Potentially applicable. Retained for monitoring and/or removal of accumulated remaining Semet Residue.	Yes
Ex situ Treatment	On-site chemical treatment	Chemical oxidation	*Ex situ* treatment of excavated materials using oxidants such as ozone, hydrogen peroxide, hypochlorites, permanganate, and/or sodium persulfate using a chemical treatment system (*e.g.*, reactor cells). Oxidation reactions chemically convert constituents to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert.	Significant implementability issues anticipated associated with emission control needs to address odors/emissions likely to occur during material handling and from gas generation and/or volatilization of contaminants due to the generation of heat from mixing oxidants with targeted material that contains carbonates. Potential community and local government acceptance issues related to truck traffic, noise, and odor/dust/emissions. The need for emission controls would limit size of treatment systems, potentially resulting in long durations for treatment. Design, construction and testing of a pilot system would be necessary to evaluate implementability.	Potentially effective for treatment of Site-related contaminants in excavated targeted material. A treatability study would be necessary to evaluate *ex situ* treatment technology effectiveness for Site-related contaminants in targeted material.	High capital Low O&M	Not retained for further consideration due to limited implementability related to emissions and community acceptance of on-site treatment	No

TABLE 4-3. SCREENING AND EVALUATION OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR TARGETED MATERIAL

General Response Action	Remedial Technology	Process Option	Description	Implementability	Effectiveness	Relative Cost	Screening Comments	Retained for Further Consideration
Ex situ Treatment (continued)	On-site thermal treatment	Incineration	Combustion of organic contaminants present in excavated materials in an on-site commercial incinerator at temperatures generally between 1600° F and 2200 °F.	Significant implementability issues anticipated, due to emission controls likely required to address odors/emissions from treatment. Significant permitting and potential community and local government acceptance issues related to truck traffic, noise and odor/dust/emissions. The need for emission controls would limit size of treatment systems, potentially resulting in long durations for treatment. Waste generated by the treatment system would require further management/disposal off-site.	Effective means of reducing the toxicity, mobility and volume of Site-related contaminants in excavated targeted material. A treatability study would be required to evaluate *ex situ* treatment technology effectiveness for Site-related contaminants in targeted material.	High capital Medium O&M	Not retained for further consideration due to limited implementability related to air permitting needs and community acceptance	No
		Low temperature thermal desorption	Use of direct or indirect heat to volatilize organic contaminants at temperatures generally between 90 and 300 °C, creating a physical separation (volume reduction) process. The volatilized contaminants from the thermal desorption process are typically directed to a secondary system for destruction via incineration, catalytic oxidation, adsorption on activated carbon, or recovery by condensation. If volatilized contaminants are incinerated, further treatment of acid gases and particulates would be required.	Significant implementability issues anticipated associated with emission control needs to address odors/emissions likely to occur during material treatment. Significant permitting and potential community and local government acceptance issues related to truck traffic, noise and odor/dust/emissions. The need for emission controls would limit size of treatment systems, potentially resulting in long durations for treatment. Waste generated by the treatment system would require further management/disposal off-site.	Effective means of reducing the toxicity, mobility and volume of Site-related contaminants in excavated targeted material. A treatability study would be required to evaluate *ex situ* treatment technology effectiveness for Site-related contaminants in targeted material.	Medium capital Medium O&M	Not retained for further consideration due to limited implementability related to air permitting needs and community acceptance	No
		Plasma gasification	Thermal process that uses high temperature (up to 10,000 ˚F) plasma arc technology to gasify organic materials into an energy rich fuel synthetic gas. During gasification, the organic matter is broken down via a number of complex solid-gas and gas phase reactions. The inorganic waste materials generated from the plasma furnace melt into liquid slag that is poured off and cooled, resulting in an inert vitrified slag material which can be used as construction materials.	No available plasma gasification treatment facilities currently exist; therefore, a plant would need to be designed, commissioned, and constructed specifically for the Site.	Potentially effective means of treating Site-related contaminants in excavated targeted material or targeted remaining Semet Residue. A treatability study would be required to evaluate treatment technology effectiveness for Site-related contaminants in targeted material.	High capital, no O&M.	Not retained for further consideration due to lack of available facilities.	No
	Off-site thermal treatment	Beneficial Reuse (Cement kiln fuel)	Raw or dewatered Semet Residue would be addressed by thermal treatment when beneficially reused as fuel in RCRA-permitted cement kiln.	Not implementable due to Btu and solids content. Current remedy for Semet Residue addresses Semet Residue to the maximum extent practicable.	Potentially effective means of treating Site-related contaminants in excavated targeted material or targeted remaining Semet Residue.	Medium capital, no O&M.	Not retained for further consideration for targeted treatment because not implementable.	No
Disposal	Off-site disposal	Commercial landfill	Excavated targeted material and remaining Semet Residue would be transported to approved commercial off-site landfill.	Not implementable. D018 classification of the targeted material at the Site would preclude direct landfilling.	Effective means of disposing targeted material.	High No O&M	Not retained for further consideration because not implementable.	No

TABLE 4-3. SCREENING AND EVALUATION OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR TARGETED MATERIAL

General Response Action	Remedial Technology	Process Option	Description	Implementability	Effectiveness	Relative Cost	Screening Comments	Retained for Further Consideration
Disposal (continued)	Off-site treatment/ disposal	Commercial treatment/ disposal facility*	Excavated targeted material would be transported to approved commercial off-site facilities for subsequent treatment/disposal. Excavated targeted material identified as acceptable would be disposed at an off-site facility, while excavated targeted material identified as D018 waste may require treatment to meet land disposal restrictions (LDRs) prior to disposal.	Potentially implementable for limited quantities of targeted material that does not meet land disposal restrictions.	Effective for treatment of targeted material. A treatability study would be required to evaluate treatment capabilities of off-site commercial treatment/disposal facilities. The facilities' disposal capacities would require evaluation.	Very high capital No O&M	Potentially applicable. Retained for further consideration.	Yes

Notes:
* Representative Process Option
Shaded cells – Process option not retained for further consideration.

Abbreviations/Acronyms:
°C - degrees Celsius
CFR - Code of Federal Regulations
CKD – Cement kiln dust
CO2 - Carbon dioxide
DPE – Dual phase extraction
DER - Division of Environmental Remediation
EISB - Enhanced *In Situ* Bio-remediation
°F - degrees Fahrenheit
ISCO –*In situ* chemical oxidation
ISS - *In situ* solidification/ stabilization
LKD – Lime kiln dust
NCP – National Contingency Plan
NYSDEC – New York State Department of Environmental Conservation
NYCRR - New York Code of Rules and Regulations
O&M – Operation and Maintenance
RCRA – Resource Conservation and Recovery Act
SVOC – Semi-volatile organic compound
VOC – Volatile organic compound
ZVI – Zero valent iron

TABLE 5-1. DETAILED ANALYSIS OF ALTERNATIVES

Criterion	Alternative 1 No Further Action (with Continued O&M of IRM)	Alternative 2 Grading and Backfill (Sub-base)	Alternative 3 Engineered Soil Cover	Alternative 4 Enhanced Engineered Cover	Alternative 5 *In Situ* Treatment of Targeted Material and Enhanced Engineered Cover	Alternative 6 Removal
	• No Further Action • Continued O&M of Berm Improvement IRM	• **Common Remedial Components for Alternatives 2 through 6:** • Continued O&M of Berm Improvement IRM • Institutional controls/limited actions (restrictions on site use, requirement for protection from soil gas) • Site Management Plan/periodic reviews • Redevelopment [TBD]				
		• Backfill and grading of Site for development • Passive recovery of mobile residual Semet residue	• Backfill and grading • 12-inch soil cover • Passive recovery of mobile residual Semet residue	• Backfill and grading • Engineered 12-inch soil cover (BCA) • Engineered 18-inch soil cover with geomembrane and/or asphalt cover (west of BCA) • Passive recovery of mobile residual Semet residue	• Backfill and grading • Engineered 12-inch soil cover (BCA) • Engineered 18-inch soil cover with geomembrane and/or asphalt cover (west of BCA) • *In situ* treatment of targeted material in ponds • Passive recovery of mobile residual Semet residue	• Complete excavation of soil/fill material • Off-Site disposal of soil/fill material • Removal and replacement of portions of State Fair Boulevard • Site restoration
Overall Protection of Human Health and the Environment						
Overall protection of human health	Not protective of human health. Alternative would not provide for mitigation of unacceptable risks to human health associated with exposure to contaminated soil/fill material.	Some protection of human health would be provided. Regrading, backfill of emptied ponds and site management plan would limit unacceptable risks to human health associated with inhalation of dust and direct exposure to soil/fill material. Development components such as parking lots would address potential unacceptable risks associated with inhalation of dust and direct exposure to soil/fill materials.	Protection of human health would be provided. Regrading, backfill of emptied ponds, and engineered cover system (and/or parking areas), would address unacceptable risks to human health associated with inhalation of dust and direct exposure to soil/fill material. Maintenance of engineered cover system, access restrictions, site management plan, and periodic reviews would limit site use and minimize potentially unacceptable risks to human health associated with soil/fill material exceeding SCOs.	Protection of human health would be provided. Regrading, backfill of emptied ponds and enhanced engineered cover system (and/or parking areas), would address unacceptable risks to human health associated with inhalation of dust and direct exposure to soil/fill material. Maintenance of enhanced engineered cover system, access restrictions, site management plan, and periodic reviews would limit site use and minimize potentially unacceptable risks to human health associated with soil/fill material exceeding SCOs.	Protection of human health would be provided. Regrading, backfill of emptied ponds, and enhanced engineered cover system (and/or parking areas), would address unacceptable risks to human health associated with inhalation of dust and direct exposure to soil/fill material. Maintenance of enhanced engineered cover system, access restrictions, site management plan, and periodic reviews would limit site use and minimize potentially unacceptable risks to human health associated with soil/fill material exceeding SCOs.	Protection of human health would be provided. Excavation of soil/fill material would address unacceptable risks to human health associated with inhalation of dust and direct exposure to soil/fill material.
Overall protection of the environment	Not protective of the environment relative to soil/fill material because potential for erosion and infiltration not addressed.	Limited protection of the environment would be provided by backfilling of ponds. Regrading and backfill of emptied ponds would provide protection of potentially unacceptable risks to the environment associated with dust and erosion of soil/fill material in pond footprints. Some impacted soil/fill material outside pond footprints is anticipated to remain susceptible to potential erosion under this alternative. Alternative does not include measures to reduce infiltration that could result in migration of contaminants from soil/fill material to groundwater.	Protection of the environment would be provided. Grading and backfill of the emptied ponds, and installation of soil cover would address potentially unacceptable risks to the environment associated with dust and erosion of soil/fill material. Grading and the soil cover would reduce infiltration that could result in migration and address potentially unacceptable ricks to the environment associated with impacted soil/fill material.	Protection of the environment would be provided. Regrading and backfill of emptied ponds and installation of enhanced soil covers would address potentially unacceptable risks to the environment associated with dust and erosion of soil/fill material. The geomembrane component of the enhanced soil cover would reduce infiltration and address potentially unacceptable risks to the environment associated with impacted soil/fill material.	Protection of the environment would be provided. Regrading and backfill of emptied ponds and installation of an enhanced soil cover would address potentially unacceptable risks to the environment associated with dust and erosion of soil/fill material. The geomembrane component of the enhanced soil cover would reduce infiltration and address potentially unacceptable risks to the environment associated with impacted soil/fill material.	Protection of the environment would be provided. Removal of soil/fill material would address potentially unacceptable risks to the environment associated with dust and erosion of soil/fill material.
Attainment of Remedial Action Objectives (RAOs)	Alternative 1 would not address soil RAO for the protection of human health, or soil RAO for protection of environment.	Alternative 2 would partially address RAOs for the protection of human health through regrading, backfill of emptied ponds, and a site management plan, however Alternative 2 does not address potential for erosion of soil/fill material. Alternative 2 would address RAOs for the protection of the environment by continued operation of the existing IRM.	Alternative 3 would address RAOs for the protection of human health through regrading, placement of an engineered soil cover system (and/or parking areas), through institutional controls and a site management plan. Alternative 3 would address RAOs for the protection of the environment by continued operation of the existing IRM and placement of a cover system.	Alternative 4 would address RAOs for the protection of human health through regrading, placement of an enhanced engineered soil cover (and/or parking areas), through institutional controls and a site management plan. Alternative 4 would address RAOs for the protection of the environment by continued operation of the existing IRM and placement of a cover system.	Alternative 5 would address RAOs for the protection of human health through regrading, placement of an enhanced soil cover system (and/or parking areas), *in situ* targeted material treatment, and through institutional controls and a site management plan. Alternative 5 would address RAOs for the protection of the environment by continued operation of the existing IRMs and placement of a cover system.	Alternative 6 would address RAOs for the protection of human health through removal of the soil/fill material, and through institutional controls and a site management plan. Alternative 6 would address RAOs for the protection of the environment through removal of soil/fill material.
Compliance with Site-Specific Applicable or Relevant and Appropriate Requirements						

TABLE 5-1. DETAILED ANALYSIS OF ALTERNATIVES

Criterion	Alternative 1 No Further Action (with Continued O&M of IRM)	Alternative 2 Grading and Backfill (Sub-base)	Alternative 3 Engineered Soil Cover	Alternative 4 Enhanced Engineered Cover	Alternative 5 *In Situ* Treatment of Targeted Material and Enhanced Engineered Cover	Alternative 6 Removal
Compliance with chemical-specific ARARs and Consideration of TBCs	Alternative 1 does not address chemical-specific ARARs for soil/fill material.	Site management plan and periodic reviews would address soil ARARs by minimizing the potential for direct contact with Site soil/fill material.	Chemical-specific ARARs are addressed in this alternative. Installation of the engineered soil cover system (and/or buildings/parking areas) over areas of surface soil/fill material that exhibit exceedances of SCOs, institutional controls, site management plan and periodic reviews would address soil ARARs by minimizing the potential for erosion of soil/fill material and the potential for direct contact with Site soil/fill material.	Chemical-specific ARARs are addressed in this alternative. Installation of the enhanced engineered cover system over areas of surface soil/fill material that exhibit exceedances of SCOs, institutional controls, site management plan and periodic reviews would address soil ARARs by minimizing the potential for erosion of soil/fill material and the potential for direct contact with Site soil/fill material.	Chemical-specific ARARs are addressed in this alternative. Installation of the enhanced engineered cover system over areas of surface soil/fill material that exhibit exceedances of SCOs, *in situ* treatment of targeted material, institutional controls, site management plan and periodic reviews would address soil ARARs by minimizing the potential for erosion of soil/fill material and the potential for direct contact with Site soil/fill material.	Chemical-specific ARARs are addressed in this alternative. Removal of soil/fill materials that exhibit exceedances of SCOs would address ARARs.
Compliance with location-specific ARARs and Consideration of TBCs	No location-specific ARARs triggered for this alternative.	Proposed actions would be conducted in a manner consistent with federal and state requirements for cultural, archeological, and historical resources.	Proposed actions would be conducted in a manner consistent with federal and state requirements for cultural, archeological, and historical resources.	Proposed actions would be conducted in a manner consistent with federal and state requirements for cultural, archeological, and historical resources.	Proposed actions would be conducted in a manner consistent with federal and state requirements for cultural, archeological, and historical resources.	Proposed actions would be conducted in a manner consistent with federal and state requirements for cultural, archeological, and historical resources.
Compliance with action-specific ARARs and Consideration of TBCs	Site O&M activities would be conducted in accordance with OSHA safety requirements.	Solid wastes, if any, would be managed in accordance with applicable Federal and State regulations. Earth moving activities would be conducted consistent with air quality standards. Transportation activities would be completed in accordance with applicable State and Federal requirements, by licensed and permitted haulers. Site construction activities would be conducted in accordance with OSHA safety requirements. Institutional controls would be implemented in general conformance with NYSDEC DER-33 and USEPA guidance and policy.	Proposed engineered soil cover system would be constructed consistent with applicable standards and DER-10. Soil piles and solid wastes, if any, would be managed in accordance with applicable Federal and State regulations. Earth moving activities would be conducted consistent with air quality standards. Transportation activities would be completed in accordance with applicable State and Federal requirements, by licensed and permitted haulers. Site construction activities would be conducted in accordance with OSHA safety requirements. Institutional controls would be implemented in general conformance with NYSDEC DER-33 and USEPA guidance and policy.	Proposed enhanced engineered cover system would be constructed consistent with applicable standards and DER-10. Solid wastes, if any, would be managed in accordance with applicable Federal and State regulations. Earth moving activities would be conducted consistent with air quality standards. Transportation activities would be completed in accordance with applicable State and Federal requirements, by licensed and permitted haulers. Site construction activities would be conducted in accordance with OSHA safety requirements. Institutional controls would be implemented in general conformance with NYSDEC DER-33 and USEPA guidance and policy.	Proposed enhanced engineered cover system would be constructed consistent with applicable standards and DER-10. Solid wastes, if any, would be managed in accordance with applicable Federal and State regulations. Earth moving activities would be conducted consistent with air quality standards. Transportation activities would be completed in accordance with applicable State and Federal requirements, by licensed and permitted haulers. Site construction activities would be conducted in accordance with OSHA safety requirements. Institutional controls would be implemented in general conformance with NYSDEC DER-33 and USEPA guidance and policy.	Excavated soil/fill material, would be managed in accordance with applicable Federal and State regulations (including LDRs). Earth moving activities would be conducted consistent with air quality standards. Transportation activities would be completed in accordance with applicable State and Federal requirements, by licensed and permitted haulers. Site construction activities would be conducted in accordance with OSHA safety requirements. Institutional controls would be implemented in general conformance with NYSDEC DER-33 and USEPA guidance and policy.
Long-Term Effectiveness and Permanence						
Magnitude of residual risk	Unacceptable residual risks associated with soil/fill material exceeding chemical-specific ARARs would remain.	Relies on institutional controls for long-term residual risks associated with soil/fill material.	Minimal residual risk. Residual risks associated with soil/fill material would be mitigated through the engineered soil cover, institutional controls, site management plan, periodic reviews, and O&M.	Minimal residual risk. Residual risks associated with soil/fill material would be mitigated through enhanced engineered cover system, institutional controls, site management plan, and periodic reviews,. Low permeability components of enhance engineered cover provided added protection over Alternative 2 due to minimized infiltration to groundwater.	Minimal residual risk. Residual risks associated with soil/fill material would be mitigated through enhanced engineered cover system, institutional controls, site management plan, and periodic reviews.	Minimal residual risk.
Adequacy and reliability of controls	Continue maintenance of the Berm Improvement provides control in this portion of the Site. No controls associated with this alternative for areas other than the northern berm.	Institutional controls are an adequate and reliable means of controlling site use and direct contact with soil/fill material.	Placement and maintenance of engineered soil cover system would provide adequate and reliable means of controlling erosion of and exposures to soil/fill material. Institutional controls are an adequate and reliable means of controlling site use and direct contact with Site soil/fill material.	Placement and maintenance of enhanced engineered cover system would provide adequate and reliable means of controlling erosion of and exposures to soil/fill material. Institutional controls are an adequate and reliable means of controlling site use and direct contact with soil/fill material.	Placement and maintenance of enhanced engineered cover system would provide adequate and reliable means of controlling erosion of and exposures to soil/fill material. Institutional controls are an adequate and reliable means of controlling site use and direct contact with soil/fill material.	Excavation and proper off-site management is an adequate and reliable means for controlling exposures to soil/fill material.
Long-term sustainability	Minimal fuel/energy use/greenhouse gas emissions associated with long-term maintenance.	Minimal fuel/energy use/greenhouse gas emissions associated with long-term maintenance.	Minimal fuel/energy use/greenhouse gas emissions associated with long-term maintenance.	Minimal fuel/energy use/greenhouse gas emissions associated with long-term maintenance.	Minimal fuel/energy use/greenhouse gas emissions associated with long-term maintenance.	No fuel/energy use/greenhouse gas emissions associated with long-term maintenance.

TABLE 5-1. DETAILED ANALYSIS OF ALTERNATIVES

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Reduction of Toxicity, Mobility, or Volume Through Treatment						
Treatment process used and materials treated	None.	Potential for recovery of residual Semet Residue in passive recovery wells.	Potential for recovery of residual Semet Residue in passive recovery wells.	Potential for recovery of residual Semet Residue in passive recovery wells.	*In situ* treatment of targeted material by stabilization/solidification would reduce mobility. Potential for recovery of residual Semet Residue in passive recovery wells.	None.
Amount of hazardous material destroyed or treated	None.	None.	None.	None.	Approximately 7,100 cy of targeted material would be treated by *in situ* stabilization/solidification, permanently treating this material.	Approximately 1.16 M cy of soil/fill material would be removed from the site.
Degree of expected reduction in toxicity, mobility, or volume	The mobility of Site-related contaminants (*i.e.*, associated with erosion) in surface soil/fill material along northern berm would be reduced by continued maintenance of the Berm Improvemetn IRM.	The mobility of Site-related contaminants (*i.e.*, associated with erosion) in surface soil/fill material along northern berm would be reduced by continued maintenance of the Berm Improvemetn IRM.	The mobility of Site-related contaminants (*i.e.*, associated with erosion) in surface soil/fill material would be reduced by installation of the engineered soil cover system.	The mobility of Site-related contaminants (*i.e.*, associated with erosion) in surface soil/fill material would be reduced by installation of the enhanced engineered cover system.	The mobility of Site-related contaminants (*i.e.*, associated with erosion) in surface soil/fill material would be reduced by installation of the enhanced engineered cover system. *In situ* treatment of targeted material would address potential mobility by altering viscous tar to granular material.	Toxicity, mobility, and volume of soil/fill material would be reduced through removal.
Degree to which treatment is irreversible	No treatment included in this alternative.	No treatment included in this alternative.	No treatment included in this alternative.	No treatment included in this alternative.	*In situ* solidification/stabilization are irreversible.	Excavation and off-site disposal are irreversible.
Type and quantity of residuals remaining after treatment	Minimal treatment residuals associated with continuing IRM.	Minimal treatment residuals associated with continuing IRM.	Minimal treatment residuals associated with continuing IRM.	Minimal treatment residuals associated with continuing IRM.	Minimal treatment residuals associated with continuing IRM. No residuals are anticipated related to *in situ* treatment of targeted material .	None
Short-term Effectiveness						
Protection of community during remedial actions	No active components beyond the IRM.	Dust and volatile emissions, if any, would be controlled during construction activities. Backfill and grading would result in impacts to the community relative to truck traffic and noise during the construction.	Dust and volatile emissions, if any, would be controlled during construction activities. Soil cover system construction would result in impacts to the community relative to truck traffic and noise during the construction.	Dust and volatile emissions, if any, would be controlled during construction activities. Enhanced engineered cover system construction would result in impacts to the community relative to truck traffic and noise during the construction.	Dust and volatile emissions, if any, would be controlled during construction activities. *In situ* treatment and enhanced engineered cover system construction would result in impacts to the community relative to truck traffic and noise during the construction.	Dust and volatile emissions, if any, would be controlled during construction activities. Excavation and off-site disposal would result in significant impacts to the community relative to truck traffic and noise during the construction during the six to seven-year duration of the project.
Protection of workers during remedial actions	No active components beyond O&M of the IRM are related to this alternative.	Proper health and safety measures would be established and implemented during remedial activities, and would be effective in protecting workers from exposure to contaminants.	Proper health and safety measures would be established and implemented during remedial activities, and would be effective in protecting workers from exposure to contaminants.	Proper health and safety measures would be established and implemented during remedial activities, and would be effective in protecting workers from exposure to contaminants.	Proper health and safety measures would be established and implemented during remedial activities, and would be effective in protecting workers from exposure to contaminants.	Proper health and safety measures would be established and implemented during remedial activities, and would be effective in protecting workers from exposure to contaminants.
Environmental impacts	No active components beyond the IRM are related to this alternative.	Dust, volatile emissions, and surface runoff controls would be instituted to minimize impacts to the environment during implementation of this alternative. Minimal clearing would be required prior to grading.	Dust, volatile emissions, and surface runoff controls would be instituted to minimize impacts to the environment during implementation of this alternative. Clearing would be required prior to engineered soil cover system installation.	Dust, volatile emissions, and surface runoff controls would be instituted to minimize impacts to the environment during implementation of this alternative. Clearing would be required prior to enhanced engineered cover system installation.	Dust, volatile emissions, and surface runoff controls would be instituted to minimize impacts to the environment during implementation of this alternative. Clearing would be required prior to enhanced engineered cover system installation.	Dust, volatile emissions, and surface runoff controls would be instituted to minimize impacts to the environment during implementation of this alternative. Clearing would be required prior to excavation.
Time until remedial action objectives are achieved	RAOs related to public health protection and migration of contaminants in soil/fill material would not be met with this alternative.	RAOs related to public health protection would not be achieved upon completion of the remedy. RAOs related to migration of contaminants in soil/fill material would not be met with this alternative.	RAOs related to public health protection and erosion would be achieved upon completion of the remedy. RAOs related to public health protection and migration of contaminants to groundwater would not be met with this alternative. The remedy would be completed in approximately one construction season.	RAOs would be achieved upon completion of the remedy. The remedy would be completed in approximately two construction seasons.	RAOs would be achieved upon completion of the remedy. The remedy would be completed in approximately two construction seasons.	RAOs would be achieved upon completion of the remedy. The remedy would be completed in approximately six to seven construction seasons.
Short-term sustainability	No active components result in no fuel/energy consumption, greenhouse	Greenhouse gas emissions associated with fuel/energy use by construction equipment and	Greenhouse gas emissions associated with fuel/energy use by construction equipment	Greenhouse gas emissions associated with fuel/energy use by construction equipment and	Greenhouse gas emissions associated with fuel/energy use by construction equipment	Greenhouse gas emissions associated with fuel/energy use by construction

TABLE 5-1. DETAILED ANALYSIS OF ALTERNATIVES

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	gas or pollutant emissions, no water or resource use, and no impacts to water or ecology from construction related activities.	transportation of materials for grading is estimated at approximately 395 $MTCO_2e$.	and transportation of materials on- and off-site during engineered soil cover system installation is estimated at approximately 3,630 $MTCO_2e$.	transportation of materials on- and off-site during enhanced engineered cover system installation is estimated at approximately 3,790 $MTCO_2e$.	and transportation of materials on- and off-site during enhanced engineered cover system installation and *in situ* treatment of targeted material is estimated at approximately 3,800 $MTCO_2e$.	equipment and transportation of materials on- and off-site during excavation and off-site management is estimated at approximately 127,000 $MTCO_2e$.
Implementability						
Ability to construct and operate the technology	There are no technologies to be constructed in this alternative.	Grading is readily constructible.	Engineered soil cover systems are readily constructible.	Enhanced engineered cover systems are readily constructible.	Enhanced engineered cover systems are readily constructible. Pilot testing would be necessary to refine soil mixing approach for *in situ* treatment.	Not considered implementable. Excavation and off-site disposal of 1.16 million cy of material is limited by landfill capacity and construction water management needs. Excavation to depths required in certain areas of Site is not implementable due to stability concerns. Specifically, excavation depths of 25 ft are likely to cause stability problems that could damage the Tributary 5A RA, and affect portions of the CSX railroad and State Fair Boulevard. Large volumes of construction water would require management. Off-Site management of soil/fill material is limited by disposal capacity and LDRs.
Reliability of technology	There are no technologies to be constructed in this alternative.	There are no technologies to be constructed in this alternative.	An engineered soil cover system is a reliable technology.	An enhanced engineered cover system is a reliable technology.	An enhanced engineered cover system is a reliable technology. *In situ* solidification/stabilization of targeted materials is a reliable technology.	Excavation and disposal are reliable technologies.
Ease of undertaking additional remedial actions, if necessary	Additional remedial actions, if necessary, would be implementable.	Additional remedial actions, if necessary, would be implementable.	Additional remedial actions, if necessary, would be implementable.	Additional remedial actions, if necessary, would be implementable.	Additional remedial actions, if necessary, would be implementable.	Additional remedial actions, if necessary, would be implementable.
Ability to monitor effectiveness of remedy	Effectiveness of IRM would continue to be monitored in accordance with existing approved plans.	Effectiveness of IRM would continue to be monitored in accordance with existing approved plans.	Effectiveness of remedy could be monitored through inspection and maintenance of graded surface, visual signs of erosion, and condition of the engineered soil cover Effectiveness of IRM would continue to be monitored in accordance with existing approved plans.	Effectiveness of remedy could be monitored through inspection and maintenance of the enhanced engineered cover system to verify continued cover integrity, visual signs of erosion, and condition of the engineered cover. Effectiveness of IRM would continue to be monitored in accordance with existing approved plans.	Effectiveness of remedy could be monitored through inspection and maintenance of the enhanced engineered cover system to verify continued cover integrity, visual signs of erosion, and condition of the engineered cover. Effectiveness of IRM would continue to be monitored in accordance with existing approved plans.	Verification of removal would be conducted as part of construction.
Coordination with other agencies and property owners	None required.	Coordination with other agencies including NYSDEC, USEPA, NYSDOH, NYSDOT, Town of Geddes, and Onondaga County would be necessary.	Coordination with other agencies including NYSDEC, USEPA, NYSDOH, NYSDOT, Town of Geddes, and Onondaga County would be necessary.	Coordination with other agencies including NYSDEC, USEPA, NYSDOH, NYSDOT, Town of Geddes, and Onondaga County would be necessary.	Coordination with other agencies including NYSDEC, USEPA, NYSDOH, NYSDOT, Town of Geddes, and Onondaga County would be necessary.	Coordination with other agencies including NYSDEC, USEPA, NYSDOH, NYSDOT, Town of Geddes, and Onondaga County would be necessary.
Availability of off-site treatment storage and disposal services and capacities	None required.	None required.	None required.	None required.	None required.	Potential inability to secure sufficient landfill capacity for large quantities of soil/fill material requiring off-site disposal may require use of multiple landfills and be limited by LDRs.
Availability of necessary equipment, specialists, and materials	None required.	Equipment, specialists, and materials are available.	Equipment, specialists, and materials are available.	Equipment, specialists, and materials are available.	Equipment, specialists, and materials are available.	Equipment, specialists, and materials are available.
Costs						
Total estimated capital cost	$. 0.0	$ 4.8M	$ 10.9M	$ 22.6M	$ 24M	$ 814M

TABLE 5-1. DETAILED ANALYSIS OF ALTERNATIVES

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Present worth of operation and maintenance cost (30 years, 7% discount factor)	$ 0.0	$ 0.28M	$ 0.56M	$ 0.56M	$ 0.56M	$ 0.25M
Total estimated net present worth cost	$ 0.0	$ 5.1M	$11.5 M	$ 23.2M	$ 24.6M	$ 814.2M
Land Use						
Consistency with proposed future use	Not protective for current, intended, and reasonably anticipated future uses of the Site.	Grading would be consistent with current, intended, and reasonably anticipated future uses of the Site.	Engineered soil cover system would be consistent with current, intended, and reasonably anticipated future uses of the Site.	Enhanced engineered cover system would be consistent with current, intended, and reasonably anticipated future uses of the Site.	Enhanced engineered cover system and *in situ* treatment would be consistent with current, intended, and reasonably anticipated future uses of the Site.	Following restoration, conditions would be consistent with current, intended, and reasonably anticipated future uses of the Site. However, anticipated timeframe required to implement this remedy would be incompatible with current anticipated future land use for the Site.

Notes:

ARAR – Applicable or Relevant and Appropriate Requirement
BCA – Bushy Cleared Area
Cy – Cubic Yard
DER – Division of Environmental Remediation
GAC - Granular Activated Carbon
GWTP – Groundwater Treatment Plant

IRM – Interim Remedial Measure
NYSDEC – New York State Department of Environmental Conservation
NYSDOH – New York State Department of Health
NYSDOT – New York State Department of Transportation
O&M – Operation and Maintenance
OSHA – OccupationalSafety and Health Administration
RA – Remedial Action
RAOs – Remedial Action Objectives
SCO – Soil Cleanup Objectives
TBCs – To be considered material
TBD – To be determined
USEPA – United States Environmental Protection Agency

COST ESTIMATE SUMMARY

TABLE 5-2. ALTERNATIVE 1 COST ESTIMATE

Site: Honeywell Semet Residue Ponds Site
Location: Geddes, NY
Phase: Feasibility Phase (+50% / -25%)
Base Year: 2017
Conceptual Basis: No further action

ITEM	UNIT	ESTIMATED QUANTITY	ESTIMATED UNIT COST	ESTIMATED COST	NOTES
Direct Capital Costs					
			SUBTOTAL (rounded):	**$0**	
			TOTAL ESTIMATED DIRECT CAPITAL COST (rounded):	**$0**	
			ENGINEERING/MANAGMENT, CONSTRUCTION OVERSIGHT, OBG OH&P	**$0**	6%, 8%, and 5% respectively
			CONTINGENCY (30%)	**$0**	Scope Contingency
			TOTAL ESTIMATED CAPITAL COST (rounded):	**$0**	
Operation and Maintenance Costs					

Present Worth Analysis Years (1-30)		Discount Factor	**Present Worth ($)**	
Cost Type	Cost	Df=7	**(rounded)**	
Capital Cost - Year 0	$0	1.00	**$0**	
Annual O&M - Years 1-30	$0	0.41	**$0**	Average discount factor for years 1-30
Periodic O&M - Years 5, 10, 15, 20, 25, 30	$0	0.36	**$0**	Average discount factor for years 5, 10, 15, 20, 25 and 30
		TOTAL PRESENT WORTH ESTIMATED ALTERNATIVE COST (rounded):	**$0**	

COST ESTIMATE SUMMARY

TABLE 5-3. ALTERNATIVE 2 COST ESTIMATE

Site: Honeywell Semet Residue Ponds Site
Location: Geddes, NY
Phase: Feasibility Phase (+50% / -25%)
Base Year: 2017

Conceptual Basis: Backfill of emptied Ponds and Grading
Continued Operation of State Fair Boulevard Collection System IRM

ITEM	UNIT	ESTIMATED QUANTITY	ESTIMATED UNIT COST	ESTIMATED COST	NOTES
Direct Capital Costs - OU2					
General Conditions	WK	24	$18,000	$432,000	Trailer, fuel, small tools, consumables and safety
Air Monitoring	WK	24	15,000	$360,000	
Surveys	WK	4	$3,000	$12,000	for final documentation only
Environmental Easement	LS	1	$30,000	$30,000	
Site Management Plan	LS	1	$50,000	$50,000	
Site Preparation					
Clearing and Grubbing	AC	20.5	$3,000	$61,500	Clearing BCA only and portions of West of the BCA area
Rough Grading	AC	44.5	$1,100	$48,950	BCA and West of the BCA area exclusive of pond footprint
Construction Road Maintenance	LF	10,000	$33	$325,000	Resurface and grade existing roadways
Pre-design Investigation	LS	1	$200,000	$200,000	evaluate need for and effectiveness/implementability for passive recovery of remaining Semet Residue.
QA/QC					
Materials QA/QC Testing - Fill and Stone	EA	90	$400	$36,000	1/500 cy of imported materials
Performance QA/QC - Compaction	WK	24	$1,200	$28,800	
Grading and Grading Fill					
Erosion and Sediment Control	LF	15,500	$4.00	$62,000	Reinforced silt fence; one replacement
Place and Grade Soil Pile	CY	20,000	$3.85	$77,000	Move and grade stockpiled soils for use as pond fill
Grade Site Soils -cut/fill	AC	31.5	$4,300	$135,450	Cut and grade existing site soils above pond berm elevation for use as pond fill; inc. soil pile
Place Imported Fill	CY	45,000	$30.00	$1,350,000	
			SUBTOTAL (rounded):	**$3,210,000**	

TOTAL ESTIMATED DIRECT CAPITAL COST (rounded):	**$3,210,000**	
ENGINEERING/MANAGMENT, CONSTRUCTION OVERSIGHT, OBG OH&P	**$609,900**	6%, 8%, and 5% respectively
CONTINGENCY (30%)	**$963,000**	Scope Contingency
TOTAL ESTIMATED CAPITAL COST (rounded):	**$4,800,000**	

Operation and Maintenance Costs					
Annual					** State Fair Collection System discharges to Trib5A remedy therefore cost is not included here.*
Reporting and Recordkeeping	EA	1	$20,000	$20,000	
Years 5, 10, 15, 20, 25, 30					
Five Year Review	EA	1	$15,000	$15,000	

Present Worth Analysis Years (1-30)		Discount Factor	**Present Worth ($)**	
Cost Type	Cost	Df=7	**(rounded)**	
Capital Cost - Year 0	$4,800,000	1.00	**$4,800,000**	
Annual O&M - Years 1-30	$20,000	0.41	**$248,000**	Average discount factor for years 1-30
Periodic O&M - Years 5, 10, 15, 20, 25, 30	$15,000	0.36	**$32,000**	Average discount factor for years 5, 10, 15, 20, 25 and 30
TOTAL PRESENT WORTH ESTIMATED ALTERNATIVE COST (rounded):			**$5,080,000**	

COST ESTIMATE SUMMARY

TABLE 5-4. ALTERNATIVE 3 COST ESTIMATE

Site: Honeywell Semet Residue Ponds Site
Location: Geddes, NY
Phase: Feasibility Phase (+50% / -25%)
Base Year: 2017

Conceptual Basis: Backfill of emptied Ponds and Grading
Continued Operation of State Fair Boulevard Collection System IRM
1-ft Soil Cover

ITEM	UNIT	ESTIMATED QUANTITY	ESTIMATED UNIT COST	ESTIMATED COST		NOTES
Direct Capital Costs - OU2						
General Conditions	WK	30	$18,000	$540,000		Trailer, fuel, small tools, consumables and safety
Air Monitoring	WK	30	$15,000	$450,000		
Surveys	WK	30	$3,000	$90,000		During capping
Irrigation	WK	4	$5,000	$20,000		Following seeding; 4 wks per season
Environmental Easement	LS	1	$30,000	$30,000		
Site Management Plan	LS	1	$50,000	$50,000		
Site Preparation						
Clearing and Grubbing	AC	20.5	$3,000	$61,500		Clearing BCA only and portions of West of the BCA area
Rough Grading	AC	44.5	$1,100	$48,950		BCA and West of the BCA area
Construction Road Maintenance	LF	5,000	$33	$165,000		Resurface and grade existing roadways
Install New Access Roads	LF	5,000	$48	$240,000		Stone roadway over geofabric
Pre-design Investigation	LS	1	$200,000	$200,000		evaluate need for and effectiveness/implementability for passive recovery of remaining Semet Residue.
QA/QC						
Materials QA/QC Testing - Topsoil	EA	79	$500	$39,285		1/500 cy of imported materials
Materials QA/QC Testing - Fill and Stone	EA	76	$400	$30,460		1/500 cy of imported materials
Performance QA/QC - Compaction	WK	30	$1,200	$36,000		
Grading and Grading Fill						
Place and Grade Soil Pile	CY	20,000	$3.85	$77,000		Move and grade stockpiled soils to no less than 2% slope; pond fill
Grade Site Soils -cut/fill	AC	31.5	$4,300	$135,450		Cut and grade existing site soils above pond berm elevation for use as pond fill; inc. soil pile
Place Imported Fill	cy	7,000	$30	$210,000		Net Fill balance to achieve 2% site slopes
Engineered Cover, 1-ft - Brushy Cleared Area (BCA)						
Erosion and Sediment Control	LF	1,700	$4	$6,834		Reinforced silt fence; one replacement
Place Topsoil to 6-inch depth	CY	10,487	$58	$611,792		Placement by conventional equipment in 6-inch lifts
Place Imported Fill to 6-inch depth	CY	10,487	$43	$448,724		Placement by conventional equipment in 6-inch lifts
Seeding	AC	13.0	$18,000	$234,000		Modified old field successional with fertilizer and hydromulch
Engineered Cover, 1-ft - Western and Southern Outboard Berms						
Erosion and Sediment Control	LF	5,500	$4	$22,110		Reinforced silt fence; one replacement
Place Topsoil to 6-inch depth	CY	2,178	$58	$127,065		Placement by conventional equipment in 6-inch lifts
Place Imported Fill to 6-inch depth	CY	2,178	$43	$93,197		Placement by conventional equipment in 6-inch lifts
Stormwater Controls	LS	1	$25,000	$25,000		Perimeter swale (3,000 lf) and rip-rap discharge outlets (2) to Trib 5a
Seeding	AC	2.7	$18,000	$48,600		Modified old field successional with fertilizer and hydromulch
Engineered Cover, 6-in - State Fair Blvd Berm Area						
Erosion and Sediment Control	LF	4,000	$4	$16,080		Reinforced silt fence; one replacement
Place Topsoil to 6-inch depth	CY	1,210	$58	$70,591		Placement by conventional equipment in 6-inch lifts
Seeding	AC	1.5	$18,000	$27,000		Modified old field successional with fertilizer and hydromulch
Engineered Cover, 1-ft - West of the BCA						
Erosion and Sediment Control	LF	12,000	$4	$48,240		Reinforced silt fence; one replacement
Place Topsoil to 6-inch depth	CY	25,410	$58	$1,482,419		Placement by conventional equipment in 6-inch lifts
Place Imported Fill to 6-inch depth	CY	25,410	$43	$1,087,294		Barrier layer; placement by conventional equipment in 6-inch lifts
Seeding	AC	31.5	$18,000	$567,000	$4,915,946	Modified old field successional with fertilizer and hydromulch
			SUBTOTAL (rounded):	**$7,340,000**		

TOTAL ESTIMATED DIRECT CAPITAL COST (rounded):	**$7,340,000**	
ENGINEERING/MANAGMENT, CONSTRUCTION OVERSIGHT, OBG OH&P	**$1,394,600**	6%, 8%, and 5% respectively
CONTINGENCY (30%)	**$2,202,000**	Scope Contingency
TOTAL ESTIMATED CAPITAL COST (rounded):	**$10,900,000**	

COST ESTIMATE SUMMARY

TABLE 5-4. ALTERNATIVE 3 COST ESTIMATE

Site:	Honeywell Semet Residue Ponds Site	Conceptual Basis:	Backfill of emptied Ponds and Grading
Location:	Geddes, NY		Continued Operation of State Fair Boulevard Collection System IRM
Phase:	Feasibility Phase (+50% / -25%)		1-ft Soil Cover
Base Year:	2017		

ITEM	UNIT	ESTIMATED QUANTITY	ESTIMATED UNIT COST	ESTIMATED COST	NOTES
Operation and Maintenance Costs					
Annual					** State Fair Collection System discharges to Trib5A remedy therefore cost is not included here.*
Reporting and Recordkeeping	EA	1	$20,000	$20,000	
Cover inspection	LS	1	$6,240	$6,240	Assumes 2 scientists/engineers, 4 days, 8 hours/day, semi-annual inspections
Cap Maintenance					
Vegetation Maintenance	AC	5	$3,000	$15,000	Spot seeding; 10% of all areas annually
Soil Cover maintenance and incidental repairs	AC	5	$225	$1,125	Topsoil repair, 5 cy per acre annually
Years 5, 10, 15, 20, 25, 30					
Five Year Review	EA	1	$15,000	$15,000	

Present Worth Analysis Years (1-30)		Discount Factor	**Present Worth ($)**	
Cost Type	Cost	Df=7	**(rounded)**	
Capital Cost - Year 0	$10,900,000	1.00	**$10,900,000**	
Annual O&M - Years 1-30	$42,365	0.41	**$526,000**	Average discount factor for years 1-30
Periodic O&M - Years 5, 10, 15, 20, 25, 30	$15,000	0.36	**$32,000**	Average discount factor for years 5, 10, 15, 20, 25 and 30
	TOTAL PRESENT WORTH ESTIMATED ALTERNATIVE COST (rounded):		**$11,458,000**	

COST ESTIMATE SUMMARY

TABLE 5-5. ALTERNATIVE 4 COST ESTIMATE

Site: Honeywell Semet Residue Ponds Site
Location: Geddes, NY
Phase: Feasibility Phase (+50% / -25%)
Base Year: 2017

Conceptual Basis: Backfill of emptied Ponds and Grading
Continued Operation of State Fair Boulevard Collection System IRM
1-ft Soil Cover BCA and outer berms; 18-inch Low Permeability Engineered Cover West of the BCA

ITEM	UNIT	ESTIMATED QUANTITY	ESTIMATED UNIT COST	ESTIMATED COST		NOTES
Direct Capital Costs - OU2						
General Conditions	WK	47	$18,000	$846,000		Trailer, fuel, small tools, consumables and safety
Air Monitoring	WK	47	$15,000	$705,000		
Surveys	WK	47	$3,000	$141,000		During capping
Irrigation	WK	4	$5,000	$20,000		Following seeding; 4 wks per season
Environmental Easement	LS	1	$30,000	$30,000		
Site Management Plan	LS	1	$50,000	$50,000		
Site Preparation						
Clearing and Grubbing	AC	20.5	$2,600	$53,300		Clearing BCA only and portions of West of the BCA area
Rough Grading	AC	44.5	$3,000	$133,500		BCA and West of the BCA area exclusive of pond footprint
Construction Road Maintenance	LF	5,000	$33	$165,000		Resurface and grade existing roadways
Install New Access Roads	LF	5,000	$48	$240,000		Stone roadway over geofabric
Pre-design Investigation	LS	1	$200,000	$200,000		evaluate need for and effectiveness/implementability for passive recovery of remaining Semet Residue.
QA/QC						
Materials QA/QC Testing - Topsoil	EA	79	$500	$39,285		1/500 cy of imported materials
Materials QA/QC Testing - Fill and Stone	EA	141	$400	$56,388		1/500 cy of imported materials
Performance QA/QC - Compaction	WK	47	$1,200	$56,400		
Grading and Grading Fill						
Place and Grade Soil Pile	CY	20,000	$3.85	$77,000		Move and grade stockpiled soils to no less than 2% slope; pond fill
Grade Site Soils -cut/fill	AC	31.5	$4,300	$135,450		Cut and grade existing site soils above pond berm elevation for use as pond fill; inc. soil pile
Place Imported Fill	cy	7,000	$30	$210,000		Net Fill balance to achieve 2% site slopes
Engineered Cover, 1-ft - Brushy Cleared Area (BCA)						
Erosion and Sediment Control	LF	1,700	$4	$6,834		Reinforced silt fence; one replacement
Place Topsoil to 6-inch depth	CY	10,487	$58	$611,792		Placement by conventional equipment in 6-inch lifts
Place Imported Fill to 6-inch depth	CY	10,487	$43	$448,724		Placement by conventional equipment in 6-inch lifts
Seeding	AC	13.0	$18,000	$234,000		Modified old field successional with fertilizer and hydromulch
Engineered Cover, 1-ft - Western and Southern Outboard Berms						
Erosion and Sediment Control	LF	5,500	$4	$22,110		Reinforced silt fence; one replacement
Place Topsoil to 6-inch depth	CY	2,178	$58	$127,065		Placement by conventional equipment in 6-inch lifts
Place Imported Fill to 6-inch depth	CY	2,178	$43	$93,197		Placement by conventional equipment in 6-inch lifts
Stormwater Controls	LS	1	$40,000	$40,000		Perimeter swale (3,000 lf) and rip-rap discharge outlets (4) to Trib 5a
Seeding	AC	2.7	$18,000	$48,600		Modified old field successional with fertilizer and hydromulch
Engineered Cover, 6-in - State Fair Blvd Berm Area						
Erosion and Sediment Control	LF	4,000	$4	$16,080		Reinforced silt fence; one replacement
Place Topsoil to 6-inch depth	CY	1,210	$58	$70,591		Placement by conventional equipment in 6-inch lifts
Seeding	AC	1.5	$18,000	$27,000		Modified old field successional with fertilizer and hydromulch
Engineered Cover, 18-inch - West of the BCA						
Erosion and Sediment Control	LF	12,000	$4	$48,000		Reinforced silt fence; one replacement
Place Topsoil to 6-inch depth	CY	25,410	$58	$1,482,419		Placement by conventional equipment in 6-inch lifts
Place Imported Fill to 12-inch depth	CY	50,820	$43	$2,174,588		Barrier layer; placement by conventional equipment in 6-inch lifts
Geonet drainage layer	SF	1,372,140	$2	$2,552,180		
LLDPE Liner and Geofabric	SF	1,372,140	$2	$2,195,424		40 mil LLDPE and single layer geofabric
Geocushion	SF	1,372,140	$0.50	$686,070		
Perimeter underdrain	LF	6,000	$90.00	$540,000		Stone drain with perforated collection pipe; discharge to Trib 5a
Seeding	AC	31.5	$18,000	$567,000		Modified old field successional with fertilizer and hydromulch
			SUBTOTAL (rounded):	**$15,150,000**		

TOTAL ESTIMATED DIRECT CAPITAL COST (rounded):	**$15,150,000**		
ENGINEERING/MANAGMENT, CONSTRUCTION OVERSIGHT, OBG OH&P	**$2,878,500**	6%, 8%, and 5% respectively	
CONTINGENCY (30%)	**$4,545,000**	Scope Contingency	
			$3,787,500.00
TOTAL ESTIMATED CAPITAL COST (rounded):	**$22,600,000**		

COST ESTIMATE SUMMARY

TABLE 5-5. ALTERNATIVE 4 COST ESTIMATE

Site:	Honeywell Semet Residue Ponds Site	Conceptual Basis:	Backfill of emptied Ponds and Grading
Location:	Geddes, NY		Continued Operation of State Fair Boulevard Collection System IRM
Phase:	Feasibility Phase (+50% / -25%)		1-ft Soil Cover BCA and outer berms; 18-inch Low Permeability Engineered Cover West of the BCA
Base Year:	2017		

ITEM	UNIT	ESTIMATED QUANTITY	ESTIMATED UNIT COST	ESTIMATED COST	NOTES
Operation and Maintenance Costs					
Annual					** State Fair Collection System discharges to Trib5A remedy therefore cost is not included here.*
Reporting and Recordkeeping	EA	1	$20,000	$20,000	
Cover inspection	LS	1	$6,240	$6,240	Assumes 2 scientists/engineers, 4 days, 8 hours/day, semi-annual inspections
Cap Maintenance					
Vegetation Maintenance	AC	5	$3,000	$15,000	Spot seeding; 10% of all areas annually
Soil Cover maintenance and incidental repairs	AC	5	$225	$1,125	Topsoil repair, 5 cy per acre annually
Years 5, 10, 15, 20, 25, 30					
Five Year Review	EA	1	$15,000	$15,000	

Present Worth Analysis Years (1-30)		Discount Factor	**Present Worth ($)**	
Cost Type	Cost	Df=7	**(rounded)**	
Capital Cost - Year 0	$22,600,000	1.00	**$22,600,000**	
Annual O&M - Years 1-30	$42,365	0.41	**$526,000**	Average discount factor for years 1-30
Periodic O&M - Years 5, 10, 15, 20, 25, 30	$15,000	0.36	**$32,000**	Average discount factor for years 5, 10, 15, 20, 25 and 30
	TOTAL PRESENT WORTH ESTIMATED ALTERNATIVE COST (rounded):		**$23,158,000**	

COST ESTIMATE SUMMARY

TABLE 5-6. ALTERNATIVE 5 COST ESTIMATE

Site: Honeywell Semet Residue Ponds Site
Location: Geddes, NY
Phase: Feasibility Phase (+50% / -25%)
Base Year: 2017

Conceptual Basis: Backfill of emptied Ponds and Grading
Continued Operation of State Fair Boulevard Collection System IRM
1-ft Soil Cover BCA and outer berms; 18-inch Low Permeability Engineered Cover West of the BCA
In situ targeted treatment

ITEM	UNIT	ESTIMATED QUANTITY	ESTIMATED UNIT COST	ESTIMATED COST	NOTES
Direct Capital Costs - OU2					
General Conditions	WK	47	$18,000	$846,000	Trailer, fuel, small tools, consumables and safety
Air Monitoring	WK	47	$15,000	$705,000	
Surveys	WK	47	$3,000	$141,000	During capping
Irrigation	WK	8	$5,000	$40,000	Following seeding; 4 wks per season
Environmental Easement	LS	1	$30,000	$30,000	
Site Management Plan	LS	1	$50,000	$50,000	
Site Preparation					
Clearing and Grubbing	AC	20.5	$2,600	$53,300	Clearing BCA only and portions of West of the BCA area
Rough Grading	AC	44.5	$3,000	$133,500	BCA and West of the BCA area exclusive of pond footprint
Construction Road Maintenance	LF	5,000	$33	$165,000	Resurface and grade existing roadways
Install New Access Roads	LF	5,000	$48	$240,000	Stone roadway over geofabric
Pre-design Investigation	LS	1	$200,000	$200,000	evaluate need for and effectiveness/implementability for passive recovery of remaining Semet Residue.
QA/QC					
Materials QA/QC Testing - Topsoil	EA	79	$500	$39,285	1/500 cy of imported materials
Materials QA/QC Testing - Fill and Stone	EA	141	$400	$56,388	1/500 cy of imported materials
Performance QA/QC - Compaction	WK	47	$1,200	$56,400	
Grading and Grading Fill					
Place and Grade Soil Pile	CY	20,000	$3.85	$77,000	Move and grade stockpiled soils to no less than 2% slope; pond fill
Grade Site Soils -cut/fill	AC	31.5	$4,300	$135,450	Cut and grade existing site soils above pond berm elevation for use as pond fill; inc. soil pile
Place Imported Fill	cy	7,000	$30	$210,000	Net Fill balance to achieve 2% site slopes
Engineered Cover, 1-ft - Brushy Cleared Area (BCA)					
Erosion and Sediment Control	LF	1,700	$4	$6,834	Reinforced silt fence; one replacement
Place Topsoil to 6-inch depth	CY	10,487	$58	$611,792	Placement by conventional equipment in 6-inch lifts
Place Imported Fill to 6-inch depth	CY	10,487	$43	$448,724	Placement by conventional equipment in 6-inch lifts
Seeding	AC	13.0	$18,000	$234,000	Modified old field successional with fertilizer and hydromulch
Engineered Cover, 1-ft - Western and Southern Outboard Berms					
Erosion and Sediment Control	LF	5,500	$4	$22,110	Reinforced silt fence; one replacement
Place Topsoil to 6-inch depth	CY	2,178	$58	$127,065	Placement by conventional equipment in 6-inch lifts
Place Imported Fill to 6-inch depth	CY	2,178	$43	$93,197	Placement by conventional equipment in 6-inch lifts
Stormwater Controls	LS	1	$40,000	$40,000	Perimeter swale (3,000 lf) and rip-rap discharge outlets (4) to Trib 5a
Seeding	AC	2.7	$18,000	$48,600	Modified old field successional with fertilizer and hydromulch
Engineered Cover, 6-in - State Fair Blvd Berm Area					
Erosion and Sediment Control	LF	4,000	$4	$16,080	Reinforced silt fence; one replacement
Place Topsoil to 6-inch depth	CY	1,210	$58	$70,591	Placement by conventional equipment in 6-inch lifts
Seeding	AC	1.5	$18,000	$27,000	Modified old field successional with fertilizer and hydromulch
Engineered Cover, 18-inch - West of the BCA					
Erosion and Sediment Control	LF	12,000	$4	$48,000	Reinforced silt fence; one replacement
Place Topsoil to 6-inch depth	CY	25,410	$58	$1,482,419	Placement by conventional equipment in 6-inch lifts
Place Imported Fill to 12-inch depth	CY	50,820	$43	$2,174,588	Barrier layer; placement by conventional equipment in 6-inch lifts
Geonet drainage layer	SF	1,372,140	$2	$2,552,180	
LLDPE Liner and Geofabric	SF	1,372,140	$2	$2,195,424	40 mil LLDPE and single layer geofabric
Geocushion	SF	1,372,140	$0.50	$686,070	
Perimeter underdrain	LF	6,000	$90.00	$540,000	Stone drain with perforated collection pipe; discharge to Trib 5a
Seeding	AC	31.5	$18,000	$567,000	Modified old field successional with fertilizer and hydromulch
In Situ Targeted Treatment					
Stabilization in place	cy	7,000	$100	$700,000	bucket mixing of pond residuals; assumed 18-inch average treatment thickness.
Reagent Cost	ton	1,330	$200	$266,000	assumes reagent 20% by weight of stabilized materials; delivered.
			SUBTOTAL (rounded):	**$16,140,000**	

COST ESTIMATE SUMMARY

TABLE 5-6. ALTERNATIVE 5 COST ESTIMATE

Site:	Honeywell Semet Residue Ponds Site	Conceptual Basis:	Backfill of emptied Ponds and Grading
Location:	Geddes, NY		Continued Operation of State Fair Boulevard Collection System IRM
Phase:	Feasibility Phase (+50% / -25%)		1-ft Soil Cover BCA and outer berms; 18-inch Low Permeability Engineered Cover West of the BCA
Base Year:	2017		*In situ* targeted treatment

ITEM	UNIT	ESTIMATED QUANTITY	ESTIMATED UNIT COST	ESTIMATED COST		NOTES
				TOTAL ESTIMATED DIRECT CAPITAL COST (rounded):	**$16,140,000**	
				ENGINEERING/MANAGMENT, CONSTRUCTION OVERSIGHT, OBG OH&P	**$3,066,600**	6%, 8%, and 5% respectively
				CONTINGENCY (30%)	**$4,842,000**	Scope Contingency
				TOTAL ESTIMATED CAPITAL COST (rounded):	**$24,000,000**	
Operation and Maintenance Costs						
Annual						** State Fair Collection System discharges to Trib5A remedy therefore cost is not included here.*
Reporting and Recordkeeping	EA	1	$20,000	$20,000		
Cover inspection	LS	1	$6,240	$6,240		Assumes 2 scientists/engineers, 4 days, 8 hours/day, semi-annual inspections
Cap Maintenance						
Vegetation Maintenance	AC	5	$3,000	$15,000		Spot seeding; 10% of all areas annually
Soil Cover maintenance and incidental repairs	AC	5	$225	$1,125		Topsoil repair, 5 cy per acre annually
Years 5, 10, 15, 20, 25, 30						
Five Year Review	EA	1	$15,000	$15,000		

Present Worth Analysis Years (1-30)		Discount Factor	**Present Worth ($)**	
Cost Type	Cost	Df=7	**(rounded)**	
Capital Cost - Year 0	$24,000,000	1.00	**$24,000,000**	
Annual O&M - Years 1-30	$42,365	0.41	**$526,000**	Average discount factor for years 1-30
Periodic O&M - Years 5, 10, 15, 20, 25, 30	$15,000	0.36	**$32,000**	Average discount factor for years 5, 10, 15, 20, 25 and 30
		TOTAL PRESENT WORTH ESTIMATED ALTERNATIVE COST (rounded):	**$24,558,000**	

COST ESTIMATE SUMMARY

TABLE 5-7. ALTERNATIVE 6 COST ESTIMATE

Site: Honeywell Semet Residue Ponds Site
Location: Geddes, NY
Phase: Feasibility Phase (+50% / -25%)
Base Year: 2017

Conceptual Basis: Removal and off-site disposal of impacted soils and restoration

ITEM	UNIT	ESTIMATED QUANTITY	ESTIMATED UNIT COST	ESTIMATED COST	NOTES
Direct Capital Costs - OU2					
General Conditions	WK	240	$31,000	$7,449,049	Trailer, fuel, small tools, consumables and safety
Air Monitoring	WK	101	$15,000	$1,508,791	during excavation only
Surveys	WK	240	$5,000	$1,201,460	During excavation and backfill
Irrigation	WK	28	$5,000	$140,000	Following seeding; 4 wks per season
Environmental Easement	LS	1	$30,000	$30,000	
Site Management Plan	LS	1	$50,000	$50,000	
Site Preparation					
Clearing and Grubbing	AC	20.5	$3,000	$61,500	Clearing BCA only and portions of West of the BCA area
Rough Grading	AC	44.5	$1,100	$48,950	BCA and West of the BCA area exclusive of pond footprint
Demolition State Fair Blvd	LM	0.50	$100,000	$50,000	Based on 0.5 linear miles of State Fair Blvd
Erosion and Sediment Control	LF	11,740	$2.75	$32,285	Reinforced silt fence; annual replacement
Sheeting	SF	30,000	$55	$1,650,000	Sheetpiling at Willis Ave Site, BCA/West of the BCA and State Fair Blvd boundaries
Dewatering	WK	157	$2,500	$392,500	Dewatering pumps and frac tanks
On-site Water Treatment	GAL	68,000,000	$0.50	$34,000,000	based on 50 gpm dewatering rate; treatment by temp plant
QA/QC					
Materials QA/QC Testing - Topsoil	EA	74	$500	$37,107	1/500 cy of imported materials
Materials QA/QC Testing - Fill and Stone	EA	1,999	$400	$799,483	1/500 cy of imported materials
Performance QA/QC - Compaction	WK	101	$1,700	$170,996	
DOT Inspection	LS	1	$145,000	$145,000	
Excavation					
West of the BCA	CY	957,000	$9.75	$9,330,750	Excavation up to 25 ft BGS
BCA	CY	125,000	$9.75	$1,218,750	Excavation to 5 ft BGS and existing soil pile
Berms	CY	77,000	$9.75	$750,750	Excavation up to 20 ft BGS
Backfill and Restoration					
Place Topsoil to 6-inch depth	CY	37,107	$58	$2,152,187	Placement by conventional equipment in 6-inch lifts to new grade (average 376 ft)
Place Imported Fill (depth vary)	CY	999,354	$43	$42,972,201	Placement by conventional equipment in 6-inch lifts to within 6-inch of new grade
Seeding	AC	46.0	$18,000	$828,000	Modified old field successional with fertilizer and hydromulch
Reinstall State Fair Blvd	LM	0.50	$770,000	$385,000	1 lane each direction, plus shoulder, and guardrail
Transportation and Disposal					
T&D by Truck - Non-Hazardous	TON	242,400	$110	$26,664,000	Excavated soils/fill BCA and Berm Area; 1.2 tons per cy; disposal at landfill as non-hazardous
T&D by Truck - Hazardous	TON	1,148,400	$350	$401,940,000	Excavated soils/fill Pond/SMA area; 1.2 tons per cy; disposal at landfill as hazardous
T&D by Truck - Incineration	TON	16,110	$720	$11,599,200	Characterized Materials Only; assume 1.0 T/cy
C&D Hauling by Truck	TON	11,251	$55	$618,794	Roadway demo debris; 1.5 tons per cy; disposal as C&D at landfill

SUBTOTAL (rounded):	**$546,230,000**	
TOTAL ESTIMATED DIRECT CAPITAL COST (rounded):	**$546,230,000**	
ENGINEERING/MANAGMENT, CONSTRUCTION OVERSIGHT, OBG OH&P	**$103,783,700**	6%, 8%, and 5% respectively
CONTINGENCY (30%)	**$163,869,000**	Scope Contingency
TOTAL ESTIMATED CAPITAL COST (rounded):	**$813,900,000**	

COST ESTIMATE SUMMARY

TABLE 5-7. ALTERNATIVE 6 COST ESTIMATE

Site: Honeywell Semet Residue Ponds Site
Location: Geddes, NY
Phase: Feasibility Phase (+50% / -25%)
Base Year: 2017

Conceptual Basis: Removal and off-site disposal of impacted soils and restoration

ITEM	UNIT	ESTIMATED QUANTITY	ESTIMATED UNIT COST	ESTIMATED COST	NOTES
Operation and Maintenance Costs					
Annual					
Reporting and Recordkeeping	EA	1	$20,000	$20,000	
Years 5, 10, 15, 20, 25, 30					
Five Year Review	EA	1	$15,000	$15,000	

Present Worth Analysis Years (1-30)		Discount Factor	**Present Worth ($)**	
Cost Type	Cost	Df=7	**(rounded)**	
Capital Cost - Year 0	$813,900,000	1.00	**$813,900,000**	
Annual O&M - Years 1-30	$20,000	0.41	**$248,000**	Average discount factor for years 1-30
Periodic O&M - Years 5, 10, 15, 20, 25, 30	$15,000	0.36	**$32,000**	Average discount factor for years 5, 10, 15, 20, 25 and 30
	TOTAL PRESENT WORTH ESTIMATED ALTERNATIVE COST (rounded):		**$814,200,000**	

Figures

MAP LOCATION

HONEYWELL INTERNATIONAL INC.
SEMET RESIDUE PONDS SITE
OU-2 FEASIBILITY STUDY
GEDDES, NEW YORK

SITE LOCATION

N

0 1,000 2,000 4,000
Feet

1:24,000

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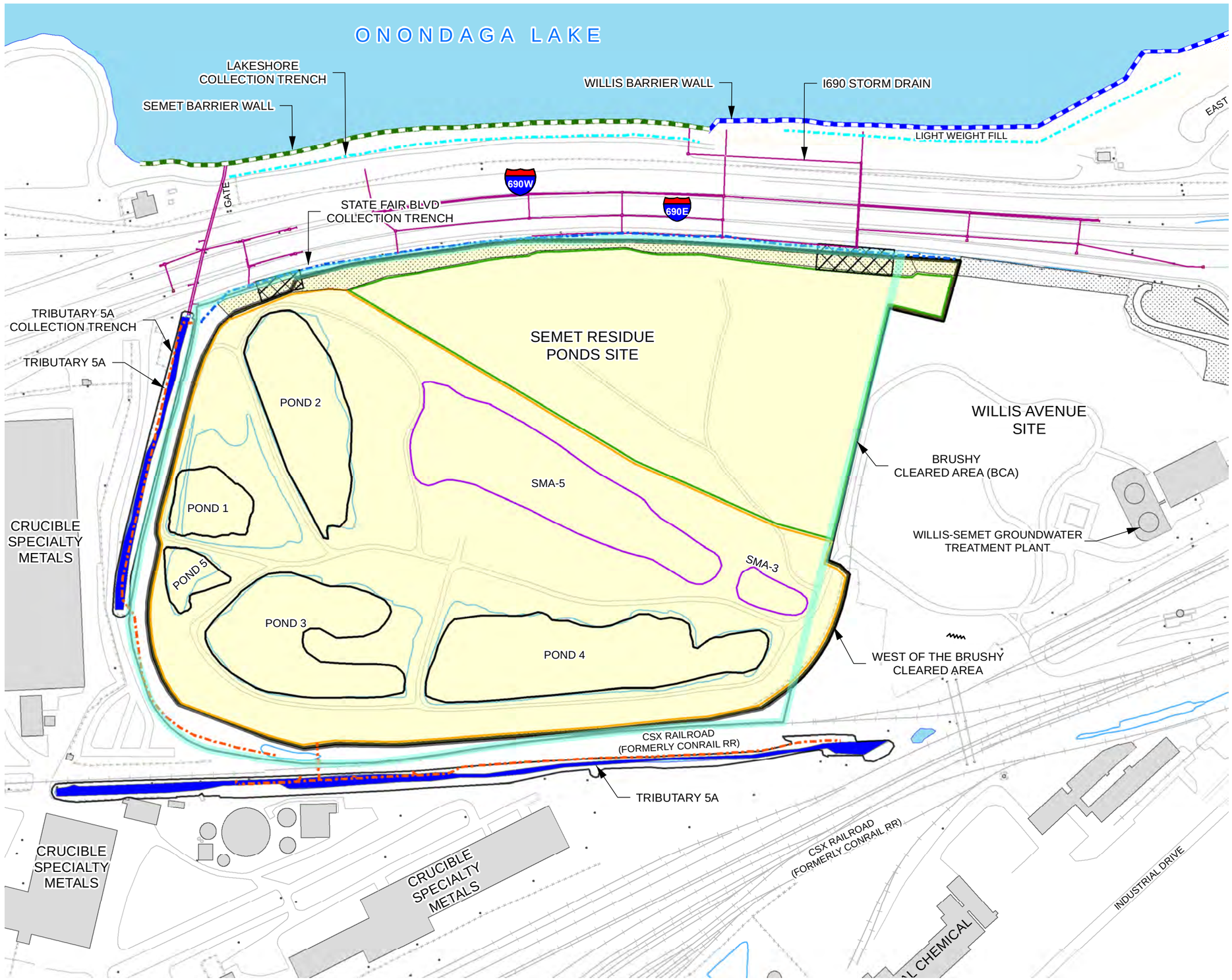

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LEGEND

IRMS & REMEDIAL

- STATE FAIR COLLECTION TRENCH
- LAKESHORE COLLECTION TRENCH
- TRIBUTARY 5A COLLECTION TRENCH AND CAP
- I-690 STORM DRAIN
- SEMET BARRIER WALL
- WILLIS BARRIER WALL
- WEST WALL
- TRIBUTARY 5A
- TRIBUTARY 5A SEDIMENT REMOVAL
- SOIL REMOVAL AREA
- BALLFIELD / WILLIS / SEMET BERM AREA

STUDY AREA

- SEMET PONDS SITE BOUNDARY
- WASTEBED A AREA
- SEMET RESIDUE PONDS SITE
- BRUSHY CLEARED AREA (BCA)
- WEST OF THE BCA
- SEMET BERM AREA

HONEYWELL INTERNATIONAL INC.
SEMET RESIDUE PONDS SITE
OU-2 FEASIBILITY STUDY
GEDDES, NEW YORK

SITE PLAN

0 125 250 500
Feet

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LEGEND

- SEMET PONDS SITE BOUNDARY
- BRUSHY CLEARED AREA (BCA)
- WEST OF THE BCA
- TRIBUTARY 5A
- STATE FAIR BOULEVARD COLLECTION TRENCH (IRM)
- SOIL REMOVAL AREA (IRM)
- BALLFIELD / WILLIS / SEMET BERM SITE IMPROVEMENTS AREA (IRM)

OU1 REMEDY

- LAKESHORE COLLECTION TRENCH
- SEMET BARRIER WALL
- WILLIS BARRIER WALL
- TRIB 5A COLLECTION TRENCH AND CAP
- TRIB 5A SEDIMENT REMOVAL

HONEYWELL INTERNATIONAL INC.
SEMET RESIDUE PONDS SITE
OU-2 FEASIBILITY STUDY
GEDDES, NEW YORK

ALTERNATIVE 2

0 125 250 500
Feet

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LEGEND

- SEMET PONDS SITE BOUNDARY
- BRUSHY CLEARED AREA (BCA)
- WEST OF THE BCA
- TRIBUTARY 5A
- 6-INCH TOP SOIL
- 1-FOOT ENGINEERED COVER
- STATE FAIR BOULEVARD COLLECTION TRENCH (IRM)
- SOIL REMOVAL AREA (IRM)
- BALLFIELD / WILLIS / SEMET BERM SITE IMPROVEMENTS AREA (IRM)

OU1 REMEDY

- LAKESHORE COLLECTION TRENCH
- SEMET BARRIER WALL
- WILLIS BARRIER WALL
- TRIB 5A COLLECTION TRENCH AND CAP
- TRIB 5A SEDIMENT REMOVAL

HONEYWELL INTERNATIONAL INC.
SEMET RESIDUE PONDS SITE
OU-2 FEASIBILITY STUDY
GEDDES, NEW YORK

ALTERNATIVE 3

0 125 250 500
Feet

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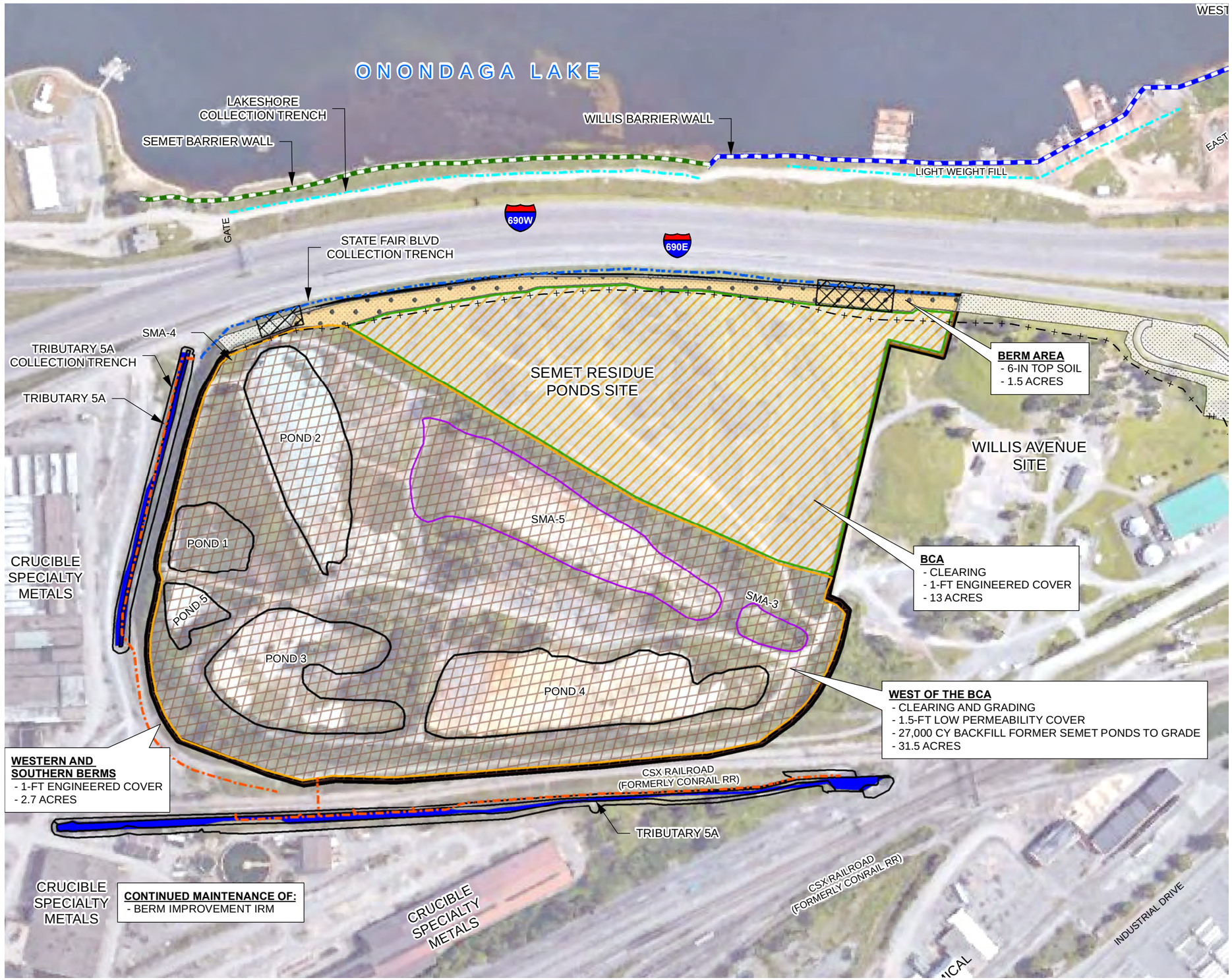

LEGEND

- SEMET PONDS SITE BOUNDARY
- BRUSHY CLEARED AREA (BCA)
- WEST OF THE BCA
- TRIBUTARY 5A
- 6-INCH TOP SOIL
- 1-FOOT ENGINEERED COVER
- 1.5-FOOT LOW-PERMEABILITY COVER
- STATE FAIR BOULEVARD COLLECTION TRENCH (IRM)
- SOIL REMOVAL AREA (IRM)
- BALLFIELD / WILLIS / SEMET BERM SITE IMPROVEMENTS AREA (IRM)

OU1 REMEDY

- LAKESHORE COLLECTION TRENCH
- SEMET BARRIER WALL
- WILLIS BARRIER WALL
- TRIB 5A COLLECTION TRENCH AND CAP
- TRIB 5A SEDIMENT REMOVAL

HONEYWELL INTERNATIONAL INC.
SEMET RESIDUE PONDS SITE
OU-2 FEASIBILITY STUDY
GEDDES, NEW YORK

ALTERNATIVE 4

0 125 250 500
Feet

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O'BRIEN & GERE ENGINEERS, INC.

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LEGEND

- SEMET PONDS SITE BOUNDARY
- BRUSHY CLEARED AREA (BCA)
- WEST OF THE BCA
- TRIBUTARY 5A
- 6-INCH TOP SOIL
- 1-FOOT ENGINEERED COVER
- 1.5-FOOT LOW-PERMEABILITY COVER
- IN-SITU TARGETED TREATMENT
- STATE FAIR BOULEVARD COLLECTION TRENCH (IRM)
- SOIL REMOVAL AREA (IRM)
- BALLFIELD / WILLIS / SEMET BERM SITE IMPROVEMENTS AREA (IRM)

OU1 REMEDY

- LAKESHORE COLLECTION TRENCH
- SEMET BARRIER WALL
- WILLIS BARRIER WALL
- TRIB 5A COLLECTION TRENCH AND CAP
- TRIB 5A SEDIMENT REMOVAL

HONEYWELL INTERNATIONAL INC.
SEMET RESIDUE PONDS SITE
OU-2 FEASIBILITY STUDY
GEDDES, NEW YORK

ALTERNATIVE 5

0 125 250 500
Feet

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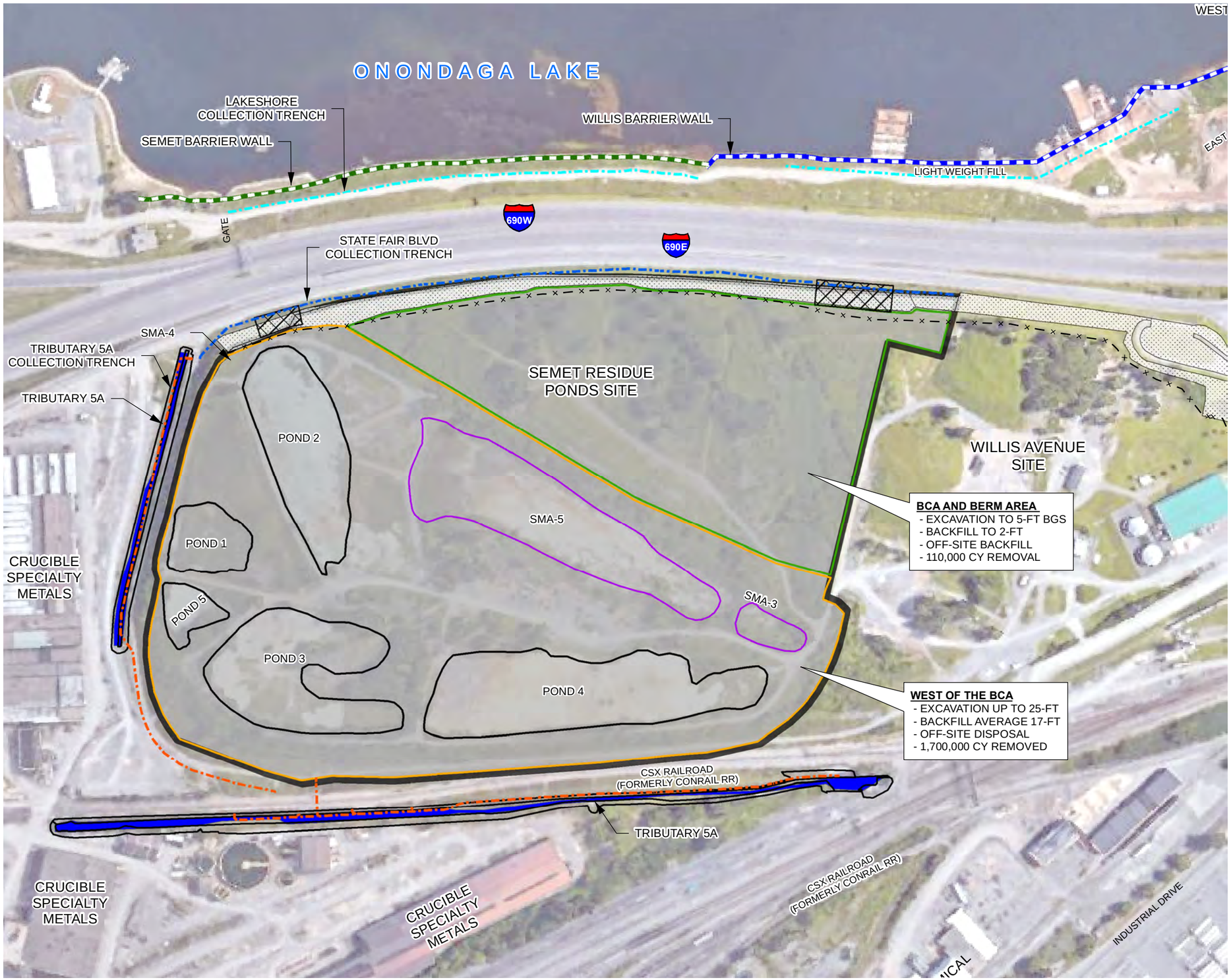
FIGURE 4-5



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LEGEND

- SEMET PONDS SITE BOUNDARY / EXCAVATION AREA
- BRUSHY CLEARED AREA (BCA)
- WEST OF THE BCA
- TRIBUTARY 5A
- STATE FAIR BOULEVARD COLLECTION TRENCH (IRM)
- SOIL REMOVAL AREA (IRM)
- BALLFIELD / WILLIS / SEMET BERM SITE IMPROVEMENTS AREA (IRM)

OU1 REMEDY

- LAKESHORE COLLECTION TRENCH
- SEMET BARRIER WALL
- WILLIS BARRIER WALL
- TRIB 5A COLLECTION TRENCH AND CAP
- TRIB 5A SEDIMENT REMOVAL

HONEYWELL INTERNATIONAL INC.
SEMET RESIDUE PONDS SITE
OU-2 FEASIBILITY STUDY
GEDDES, NEW YORK

ALTERNATIVE 6

0 125 250 500
Feet

DECEMBER 2017
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