GTE Operations Support Incorporated

CORRECTIVE ACTION WORK PLAN

Former Philips Display Components Facility
Seneca Falls, New York
USEPA ID No. NYD002246015
NYSDEC Site No. 850003

May 2020

CORRECTIVE ACTION WORK PLAN

Former Philips Display Components Facility
Seneca Falls, New York
USEPA ID No. NYD002246015
NYSDEC Site No. 850003

Prepared for:

GTE Operations Support Incorporated

Prepared by:

Arcadis of New York, Inc.
855 Route 146
Suite 210
Clifton Park
New York 12065
Tel 518 250 7300
Fax 518 371 2757

Our Ref.:

30002755 - 04563003.0001

Date:

May 2020

Mark Flusche

Mark Flusche, P.G.
Project Manager

Michael Higgins Jr.

Michael Higgins, P.E.
Principal Environmental Engineer

I, Michael Higgins, to the best of my knowledge, and based on my inquiry of the persons involved in preparing this document under my direction, certify that I am currently a NYS registered professional engineer and that this Corrective Action Work Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

CONTENTS

Acronyms and Abbreviations iv

1 Introduction 1

- **1.1** Site Description 1
- **1.2** Site Operational History 2
- **1.3** Remedial and Investigative History 3
  - **1.3.1** RCRA Corrective Actions 3
  - **1.3.2** RCRA Facility Assessment and Investigation 3
  - **1.3.3** Interim Corrective Measures 4
  - **1.3.4** Corrective Measure Study Investigations 5
    - 1.3.4.1 Historical Outfall Soil and Sediment Sampling 5
    - 1.3.4.2 Monitored Natural Attenuation Investigation 6
    - 1.3.4.3 Building 2, 7, and 11 Investigation 6
    - 1.3.4.4 Building 10 Investigation 6
    - 1.3.4.5 Fish and Wildlife Resource Impact Assessment 6
    - 1.3.4.6 Sub-Slab Vapor Investigation 7
    - 1.3.4.7 Multi-Phase Extraction Pilot Test 7
- **1.4** Nature and Extent of Remaining Impacts 7
  - **1.4.1** Soil 8
  - **1.4.2** Groundwater 8
  - **1.4.3** Sediment 8
  - **1.4.4** Dense Non-Aqueous Phase Liquid 9
  - **1.4.5** Soil Vapor and Indoor Air 10
- **1.5** Remedial Action Objectives 11
- **1.6** Selected Remedy Overview 12

2 Project Management 14

3 Pre-Design Investigation 15

- **3.1** PDI Task 1 – Site Survey 15
- **3.2** PDI Task 2 – Subsurface Utility Location 15
- **3.3** PDI Task 3 – OU1 Limited Soil Excavation Area Investigation 16

3.4 PDI Task 4 – OU2 Limited Soil Excavation Area Investigation 17

3.4.1 Historical Outfall Ditch Investigation 17

3.4.1.1 Sampling Locations – Historical Outfalls HO2 through HO5 18

3.4.1.2 Sampling Locations – Historical Outfalls HO6 and HO7 18

3.4.1.3 Sampling Methodology 19

3.4.1.4 Historical Outfall Ditch Soil Excavation 20

3.4.2 Floodplain Investigation 20

3.5 PDI Task 5 – DNAPL Delineation 22

3.5.1 Soil Boring Locations 22

3.5.2 Multiple Lines-of-Evidence Approach for Evaluating the Presence of DNAPL 22

3.5.3 Additional Data Collection 25

3.6 PDI Summary Letter Report 26

4 Remedial Design Activities 27

4.1 Design Task 1 – Soil Excavation and Handling 27

4.2 Design Task 2 – In Situ Thermal Remediation 28

4.2.1 In Situ Thermal Remediation Technology 28

4.2.2 Remedial Design Components 30

4.2.3 Post-ISTR Sampling 31

4.3 Design Task 3 – Waste Management 31

4.4 Design Task 4 – Backfilling and Site Restoration 31

5 Permits and Approvals 33

6 Remedial Design Documents 34

7 Remedial Design Schedule 36

8 Post-Construction Activities 37

8.1 Final Engineer Report 37

8.2 Institutional Controls 37

8.3 Site Management Plan 37

8.4 Operations and Maintenance Plan 38

9 References 39

TABLES

Table 1 Applicable or Relevant and Appropriate Requirements

Table 2 Proposed Pre-Design Investigation Sampling and Gauging Summary

FIGURES

Figure 1 Site Location

Figure 2 Site Plan

Figure 3 Trichloroethene Concentrations and Historical Dense Non-Aqueous Phase Liquid Locations in AOCs 1 & 3

Figure 4 Proposed Historical Outfall Ditch Sampling Locations

Figure 5 Historical Outfall Ditch Sample Collection Procedure

Figure 6 DNAPL Delineation Flowchart

APPENDICES

Appendix A Field Activities Plan / Quality Assurance Project Plan

ACRONYMS AND ABBREVIATIONS

%	percentage
amsl	above mean sea level
AOCs	Areas of Concern
ASTM	American Society for Testing and Materials
bgs	below ground surface
CAMP	Community Air Monitoring Plan
canal	Cayuga-Seneca Canal
CAO	Cleanup Action Objectives
CAWP	Corrective Action Work Plan
CCR	Construction Completion Report
cis-1,2-DCE	cis-1,2-dichloroethene
CMS	Corrective Measures Study
CMS Addendum	Corrective Measures Study Report Addendum
CMS Work Plan	*Corrective Measures Study Work Plan*
COPC	constituent of potential concern
DER-10	DER-10 Technical Guidance for Site Investigation and Remediation
DNAPL	dense non-aqueous phase liquid
ERH	Electrical Resistance Heating
FAP/QAPP	Field Activities Plan / Quality Assurance Project Plan
FER	Final Engineering Report
GAC	granular activated carbon
GTEOSI	GTE Operations Support Incorporated
ICM	Interim Corrective Measure
ISTR	in situ thermal remediation
ITO	interceptor trench outfall
LIF	laser-induced fluorescence
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MNA	monitored natural attenuation
MPE	multi-phase extraction
NAPL	non-aqueous phase liquid

NYCRR	New York Codes, Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O&M Plan	Operations and Maintenance Plan
OU	Operable Unit
PDI	pre-design investigation
PID	photoionization detector
PMP	pressure monitoring point
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
Remedial Design	final remedy design
RFI Report	*RCRA Facility Investigation, Former Phillips Display Components Facility, Seneca Falls, New York for GTE Operations Support Incorporated*
SCGs	standards, criteria, and guidance
SCO	soil cleanup objective
SGVs	Standards and Guidance Values
site	former Philips Display Components Facility in Seneca Falls, New York
SMP	Site Management Plan
SPDES	State Pollutant Discharge Elimination System
SSD	sub-slab depressurization
TCE	trichloroethene
TCH	Thermal Conductive Heating
TCL	Target Compound List
TMP	temperature monitoring point
TOC	Total organic carbon
µg/L	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
USEPA	United States Environmental Protection Agency
UV	ultraviolet
VC	vinyl chloride
VOC	volatile organic compound
WWTP	wastewater treatment plant
XRF	x-ray fluorescence

1 INTRODUCTION

This Corrective Action Work Plan (CAWP) describes the activities to be performed by GTE Operations Support Incorporated (GTEOSI) to prepare the final remedy design (Remedial Design) for the former Philips Display Components Facility in Seneca Falls, New York (site). The remedy selected is outlined in the Statement of Basis dated March 2018 and issued by the New York State Department of Environmental Conservation (NYSDEC). The following documents were used to develop this CAWP:

- *Corrective Measures Study Report* (*CMS Report*, Arcadis 2013)
- *Corrective Measures Study Report Addendum* (*CMS Addendum*, Arcadis 2016b)
- Section 5.2 of the NYSDEC document titled DER-10 Technical Guidance for Site Investigation and Remediation (DER-10) issued on May 3, 2010
- Statement of Basis (NYSDEC 2018)

The corrective action approach includes the completion of a pre-design investigation (PDI) to support the Remedial Design. Additional data required to delineate the treatment areas, facilitate efficient designs, and identify utilities or other features that could be affected by remedial activities will be collected as part of the PDI. The PDI is described further in Section 3.

In accordance with the requirements for a Remedial Design Work Plan listed in Section 5.2 of DER-10, this CAWP is organized to:

- Summarize the site, remedial, and investigative history, the nature and extent of contamination identified in the CMS Report, remedial action objectives, and the selected remedy to be implemented by the design (Section 1)
- Provide the project management structure (Section 2)
- Summarize the proposed pre-design investigations (Section 3)
- Describe the corrective action and the remedial technologies for which the design will be provided (Section 4)
- Identify permits or other authorizations to be addressed by the design (Section 5)
- Describe Remedial Design documents to be prepared (Section 6)
- Provide a schedule for the completion of the pre-design investigations and design (Section 7)
- Describe post-construction activities (Section 8)
- Provide a list of source documents cited in the text (Section 9)

1.1 Site Description

The 64.2-acre site at 50 Johnston Street in the Village of Seneca Falls, New York (Figure 1) includes an approximately 13-acre complex of interconnected buildings (Figure 2) constructed between 1914 and the 1970s. The remaining 51 acres are asphalt parking lots and roadways, grassy areas, and woods. Residential and undeveloped properties surround the site to the west, north, and east. The Cayuga-

Seneca Canal (canal), which includes Van Cleef Lake and portions of the Seneca River and is part of the New York State Barge Canal, is adjacent and south of the site. The first canal in the area opened in 1821. In the early 1900s, the mill area of Seneca Falls was submerged under what is now Van Cleef Lake after construction of the hydroelectric dam south of the site.

1.2 Site Operational History

The following list summarizes the site history:

- Prior to 1914 – The site was undeveloped.
- 1914 through the 1930s – Water pumps were manufactured in Buildings 1A through 5. Roof drainage, stormwater, and wastewater were managed in a combined system of floor drains that discharged to Van Cleef Lake via outfall pipes (historical outfalls HO1 and HO2).
- 1930s through the early 1950s – Black-and-white television components were manufactured on site. Buildings 6 through 10 were added to expand the complex of interconnected buildings. Terra cotta pipe under-drains were laid beneath Buildings 7 and 9 during construction. As manufacturing processes expanded, floor drains were cut into the concrete floors and connected to the under-drains. Roof drainage, stormwater, and wastewater from Buildings 7, 8, and 9 were combined into historical outfall pipe HO3 and discharged to a ditch that ran to the canal.
- Mid-1950s through the early 1970s – Manufacturing was converted to color-television components in the early 1950s. Buildings 10A, 11, 11A, 12, 13, and 13A were added to the building complex. Similar to the drainage structures in Buildings 7 and 9, reinforced concrete pipe under-drains were constructed beneath Buildings 10, 10A, 11, 11A, 13, and 13A. Floor drains were connected to these under-drains, and combined roof drainage, stormwater, and process wastewater discharged to historical outfall pipes HO4, HO5, HO6, and HO7 with overland flow to the canal. Building 12 housed laboratories and corporate offices.
- 1970s to 1986 – Waste-handling practices changed when an interceptor sewer and wastewater treatment plant (WWTP) were constructed in the early 1970s. Historical outfall pipes HO2 through HO5 were rerouted to the interceptor sewer and wastewater flow was conveyed to the WWTP for treatment. Historical outfall pipes HO1, HO6, and HO7 were modified to convey stormwater only. A network of aboveground interior piping in the ceiling rafters was also installed to carry process wastes to the WWTP. Manufacturing operations ceased in 1986.
- 1986 to 1989 – With the cessation of manufacturing, the WWTP was decommissioned and the interceptor sewer was rerouted to convey roof drainage and stormwater directly to the canal at an interceptor trench outfall (ITO). In 1989, the Seneca County Industrial Development Agency acquired the site.
- 1989 to present – H.P. Neun Company, Inc., later Viva Foam Products, Inc. and later Seneca Fall Specialties and Logistics Company, Inc., leases the building complex from the Seneca County Industrial Development Agency for warehousing. Only roof drains and stormwater discharge to the ITO.

1.3 Remedial and Investigative History

Environmental investigations and Interim Corrective Measures (ICMs) conducted at the site during the past three decades include the following activities:

- Resource Conservation and Recovery Act (RCRA) Corrective Actions
- RCRA Facility Assessment and Investigation
- ICMs (sub-slab depressurization [SSD] systems and crawl space/sump ventilation systems)
- Corrective Measures Study (CMS)

These activities are summarized in the following subsections.

1.3.1 RCRA Corrective Actions

To comply with RCRA hazardous waste management regulations regarding the WWTP operation, a RCRA Part B Permit application was submitted in 1984. After receiving interim status under RCRA, the permit application was withdrawn when a decision was made to cease manufacturing. Withdrawing the permit application did not release the site from RCRA interim status; therefore, the WWTP decommissioning (e.g., treatment plant, process tanks, settling lagoons) proceeded as RCRA closure activities.

Various investigations and corrective actions have occurred since 1986. Interim status hazardous waste management units (incinerator, incinerator feed tanks, and container storage areas) were closed in 1987. H.P. Neun Company, Inc. began operating its warehousing and distribution business in 1989. Floor drains and under-drains were grouted and sealed in the early 1990s. Between 1987 and 1992, surface impoundments and the WWTP were closed following the facility *Closure Plan* (Chester Engineers 1987) and the *RCRA Facility Investigation Work Plan* (Secor 1996).

1.3.2 RCRA Facility Assessment and Investigation

A RCRA Facility Assessment was completed in 1994 (Chester Environmental 1994). Twenty-one areas were investigated, including the interim drum storage, satellite storage, underground fuel oil tank, polychlorinated biphenyl, capacitor storage, and open burn areas. Following the RCRA Facility Assessment, the nature and extent of contaminants were evaluated in multiple phases. NYSDEC conditionally approved the *RCRA Facility Investigation, Former Phillips Display Components Facility, Seneca Falls, New York for GTE Operations Support Incorporated* (*RFI Report*, URS 2002) on June 5, 2003, pending evaluation of the historical outfalls and preparation of a CMS Work Plan.

A *Soil Vapor Intrusion Pathway Investigation Work Plan* (Malcolm Pirnie 2003a) was submitted on May 7, 2003 and approved by NYSDEC on June 17, 2003. Three rounds of indoor and outdoor air samples were collected (summer 2003, fall 2003, and winter 2004). A *Soil Vapor Intrusion Pathway Investigation Report* (Malcolm Pirnie 2004a), detailing the analytical results of more than 100 soil vapor and indoor air samples, was submitted to NYSDEC, the New York State Department of Health (NYSDOH), and the United States Environmental Protection Agency (USEPA) on September 13, 2004. The report findings suggest the buildings share common sub-slabs and indoor air; therefore, soil vapor intrusion pathways could not be ruled out in the buildings except Building 12. On April 6, 2005, NYSDEC approved the *Soil Vapor Intrusion Pathway Investigation Report* (Malcolm Pirnie 2004a).

Based on the conclusions of the *RFI Report* and the *Historic Outfall Evaluation Report* (URS 2002 and Malcolm Pirnie 2004b, respectively) and the *Corrective Measures Study Work Plan* (*CMS Work Plan*, Malcolm Pirnie 2005a), Solid Waste Management Units retained for further evaluation were grouped into the following Areas of Concern (AOCs):

1. **Building 2 area –** Volatile organic compounds (VOCs) in soil and groundwater to the south of Building 2 and Building 5.
2. **Building 7 area –** VOCs in soil and groundwater south of Buildings 7 and 9.
3. **Building 11 area –** VOCs in soil and groundwater south of Building 11A.
4. **Soil Vapor Intrusion Pathways –** VOCs in sub-slab vapor beneath Buildings 1, 2, 3, 4, 6, 7, 8, 9, 10, 10A, 11A, 13, and 13A.
5. **Historical Outfalls** – Metals, primarily cadmium, in historical outfall ditch soils both on and offsite.

The *CMS Work Plan* (Malcolm Pirnie 2005a) included the following supplemental investigations and assessment to support the corrective measures evaluation:

- Soil and sediment sampling was conducted in August 2004 and May 2005 to further investigate the historical outfalls.
- In 2005, soil and groundwater samples were collected in the Building 2, 7, and 11 areas to further delineate the horizontal and vertical extent of VOCs.
- An assessment was performed to evaluate monitored natural attenuation (MNA) as a potential corrective measure.

1.3.3 Interim Corrective Measures

As discussed in the *Soil Vapor Intrusion Pathway Investigation Report* (Malcolm Pirnie 2004a) and the *CMS Work Plan* (Malcolm Pirnie 2005a), ICMs were implemented between 2004 and 2006 to improve indoor air quality in Buildings 7, 9, and 11. In September 2005, the Current Human Exposure Under Control Environmental Indicator was achieved through the ICMs (USEPA 2005). Additional ICMs were implemented in 2010 in Buildings 10 and 1A. The ICMs consist of ventilation and SSD systems used to mitigate VOCs, primarily trichloroethene (TCE), in sub-slab vapor and indoor air. Data collected during implementation of the ICMs were used to evaluate corrective measures for soil vapor intrusion pathways (AOC 4) in the *CMS Report* (Arcadis 2013).

After the 2003 to 2004 soil vapor intrusion pathway investigation and subsequent investigations, the following five ICMs were implemented between 2004 and 2011 in occupied buildings with the highest indoor air concentrations:

ICM	Design Plan Title	Design Plan Reference	Month Installed
Building 9 office area crawl space ventilation system	*Proposed Ventilation System – Building 9 Office Area*	Malcolm Pirnie 2003b	November 2004
Building 11 area SSD system	*Building 11 Area Sub-slab Depressurization System Design Plan*	Malcolm Pirnie 2005c	November 2005

ICM	Design Plan Title	Design Plan Reference	Month Installed
Building 7 area SSD system	*Building 7 Area Sub-slab Depressurization System Design Plan*	Malcolm Pirnie 2006	October 2006
Building 10 area SSD system	*Building 10 Area Sub-slab Depressurization System Design Plan*	Malcolm Pirnie 2009	September 2010
Building 1A sump and pit ventilation and SSD system	ICM components discussed during June 4, 2012 NYSDEC site walk	Not Applicable	December 2010, modified April 2011

The *Sub-Slab Depressurization System Conceptual Design Report* (Arcadis 2016a) identified vapor mitigation enhancements designed to increase SSD and further reduce TCE concentrations in indoor air at the site. The new Building 2 and 8 ICMs, expanded Building 1 and 7 ICMs, and reinstalled Building 9 ICM were installed in June 2015 and January through April 2017. The expanded Building 10/10A and 11 ICMs were installed in June 2015 and November 2017 through September 2018. The new Building 9 ICM was installed in March 2019. Information on the above ICMs (and any additional or further expanded ICMs) will be reported in a Construction Completion Report (CCR) to be submitted to NYSDEC.

The ICMs have been monitored since each system was installed. Indoor air samples have been collected quarterly since 2006, and sub-slab vapor samples have been collected annually since 2006, to evaluate SSD and ventilation system performance. The ICMs have operated as designed, and sub-slab vapor concentrations have decreased in the buildings where ICMs are operating. The soil vapor intrusion ICMs will become the final remedy for AOC 4 (soil vapor intrusion pathways) after the Final Engineering Report for the site is submitted and approved by NYSDEC and will be discussed in detail in the CCR and Operations and Maintenance Plan (O&M Plan); therefore, soil vapor intrusion mitigation is not a component of the Remedial Design.

1.3.4 Corrective Measure Study Investigations

CMS investigations, pilot tests, and ICMs were completed at the site between May 2005 and October 2018. The data collected from these activities have been submitted to NYSDEC in more than 25 semi-annual groundwater sampling reports, 50 quarterly indoor air sampling reports, and six ICM design plans. The data were used to further define and evaluate the magnitude and extent of VOC concentrations and to develop the corrective measure alternatives described herein. CMS investigation activities and results were detailed in the *CMS Report* (Arcadis 2013) and are briefly summarized below along with associated observations and recommendations.

1.3.4.1 Historical Outfall Soil and Sediment Sampling

The 2004 historical outfall soil analytical results were provided in the December 2004 *Historic Outfall Evaluation Report* (Malcolm Pirnie 2004b). Sediment sampling was completed in 2005 following the *CMS Work Plan*, (Malcolm Pirnie 2005a) to establish background conditions in Van Cleef Lake and the canal. Corrective measures (limited excavation) for metals (primarily cadmium) in the historical outfall ditches have been developed and are discussed in Sections 1.6 and 4. Except for the post-construction activities described in Section 8, no further action is proposed for sediment.

1.3.4.2 Monitored Natural Attenuation Investigation

An investigation was conducted following the *CMS Work Plan* (Malcolm Pirnie 2005a) to evaluate MNA as a potential corrective measure for groundwater. MNA relies on natural attenuation processes (biodegradation, dispersion, dilution, sorption, volatilization, chemical or biological stabilization, transformation, or destruction of contaminants) to achieve site-specific cleanup action objectives (CAOs). Natural attenuation was evaluated using the June 1993 to October 2011 data collected from 12 groundwater monitoring wells.

Degradation byproducts of the reductive dechlorination of TCE, including cis-1,2-dichloroethene (cis-1,2-DCE) and vinyl chloride (VC), were present in some groundwater samples collected between 1993 and 2011. VOC concentrations have generally decreased site wide. Additionally, as presented in the *CMS Addendum*, monitoring of natural attenuation and source removal (discussed in Sections 4.1 and 4.2) is expected to be effective in achieving the Standards and Guidance Values (SGVs) for site-wide groundwater before VOCs concentrations in groundwater greater than applicable SGVs reach the site boundary (Arcadis 2016b). As discussed in Section 8, controls will be implemented after remedial construction activities to mitigate potential hazards from VOCs in groundwater on site.

1.3.4.3 Building 2, 7, and 11 Investigation

The *RFI Report* (URS 2002) and the *Soil Vapor Intrusion Investigation Report* (Malcolm Pirnie 2004a) concluded that a TCE source may be present beneath the southeastern portion of Building 11 and adjacent to Buildings 2 and 7. Direct-push soil borings were advanced in the Building 2, 7, and 11 areas following the *CMS Work Plan (Malcolm Pirnie 2005a)*. Soil and groundwater sample analytical data from these borings were used to delineate areas with residual VOC concentrations.

The 2005 Building 2, 7, and 11 Investigation results support the *RFI Report* conclusions (URS 2002). TCE, the primary constituent of potential concern (COPC), was reported at concentrations in soil ranging from less than laboratory reporting limits to 1,500 milligrams per kilogram (mg/kg). As discussed in Section 1.4.4, evidence of dense non-aqueous phase liquid (DNAPL) was observed at two borings in each of the Building 2 and Building 11 areas (Figure 3). The VOC concentrations in the Building 7 area may be attributed to an unrelated diffuse area of residual VOC concentrations.

1.3.4.4 Building 10 Investigation

In November 2008, five direct-push soil borings were advanced through the Building 10 concrete floor slab to assess the potential presence of VOCs in subsurface soil. TCE was reported in the soil samples collected from these borings at concentrations ranging from 0.56 to 37 mg/kg.

1.3.4.5 Fish and Wildlife Resource Impact Assessment

Steps I and IIA of a fish and wildlife resource impact assessment were completed in 2006 and updated in 2012. No threatened or endangered species live on or near the site. Subsequent steps of the NYSDEC *Fish and Wildlife Impact Analysis for Inactive Hazardous Waste sites* (NYSDEC 1994) are not proposed as discussed in the *CMS Report* (Arcadis 2013).

1.3.4.6 Sub-Slab Vapor Investigation

In August and September 2012, a soil vapor intrusion investigation was conducted to assess preferential pathways, delineate sub-slab vapor VOC concentrations, evaluate SSD as a mitigation technique, and evaluate methods to minimize COPC mass flux into the building (Arcadis 2012a). The investigation included evaluating historical drains, installing sub-slab vapor extraction and monitoring points, screening sub-slab vapor, testing SSD diagnostics, and evaluating ICMs. The sub-slab vapor VOC screening results indicated VOCs were in the sub-slab vapor beneath the buildings, and that Buildings 1, 2, 3, 4, 6, and 8 were candidates for SSD.

1.3.4.7 Multi-Phase Extraction Pilot Test

A multi-phase extraction (MPE) investigation and a bench-scale soil resistivity test were conducted in October 2012 following the *Multi-Phase Extraction Investigation Work Plan* (Arcadis 2012b). The MPE investigation concluded that hydraulic and vapor control can be established and sustained with relatively low extraction rates. Therefore, in situ thermal remediation (ISTR) implemented with an MPE system to control, collect, and treat COPCs that would volatilize or dissolve into groundwater during heating was retained as an option for treating site soil and groundwater. ISTR was later selected as a corrective action in the Statement of Basis.

1.4 Nature and Extent of Remaining Impacts

The key findings of the *RFI Report*, *Historic Outfall Evaluation Report*, and *CMS Report* are that COPC concentrations greater than commercial soil cleanup objectives (SCOs) in soil are limited to three isolated areas (i.e., soil immediately downgradient of a portion of Building 2, DNAPL immediately downgradient of a portion of Building 11, and cadmium in certain soils within the historical outfall ditches) (URS 2002, Malcom Pirnie, 2004b, and Arcadis 2013). Sediment and soil data indicate that inorganic COPCs (primarily cadmium) are isolated in soil in former historical outfall drainage ditches or are buried in the canal beneath a natural cap of more recent sediment and therefore have negligible potential for exposure. Soil data indicate that organic COPCs (primarily TCE) in unsaturated soil are in an isolated area near Building 2. The total area in which COPC concentrations are greater than Class GA Groundwater Standards is approximately 25 acres. COPC concentrations in soil vapor generally coincide with groundwater concentrations. These COPC distributions, combined with historical site use and hydrogeologic conditions, form the basis for developing and evaluating corrective measure alternatives.

The nature and extent of COPC concentrations in soil, groundwater, soil vapor, and sediment are organized into two Operable Units (OUs) subdivided into five AOCs. OU1 contains AOCs 1, 2, 3, and 4 and OU2 contains AOC 5. Details regarding sample depths, locations, and concentrations, and comparison to the applicable standards, criteria, and guidance (SCGs), were provided in the June 28, 2013 *CMS Report* (Arcadis 2013) and the *CMS Addendum* (Arcadis 2016b), and are summarized as follows:

- AOCs 1, 2, and 3 (Building 2, 7, and 11 areas) – Concentrations of VOCs, including TCE and its breakdown products, were reported in soil and groundwater. TCE concentrations up to 3,100 milligrams per liter (mg/L) and cis-1,2-DCE concentrations up to 21,000 mg/L were reported in groundwater. TCE concentrations up to 8,100 mg/kg were reported in soil.

- AOC 4 (Soil Vapor Intrusion Pathways) – Concentrations of VOCs were reported in sub-slab vapor and indoor air. Indoor air and sub-slab VOCs are being addressed by existing ICMs.
- AOC 5 (Historical Outfalls) – Metal concentrations (primarily for cadmium) were reported in historical outfall drainage ditch soil at up to 78.3 mg/kg.

1.4.1 Soil

Cadmium and chlorinated VOC concentrations in soil are associated with liquid waste disposal activities when manufacturing was conducted at the site. Those disposal activities resulted in the distribution of COPCs. Soil samples were collected during the CMS to further define the nature and extent of residual concentrations of COPCs. Soil samples were collected in and around AOCs 1, 2, 3, and 5.

As outlined in the *CMS Addendum*, the CAO for unsaturated soils in AOC 1, 2, and 3 is achieving the Protection of Groundwater SCOs (Arcadis 2016b). The CAO of minimizing exposure to soils greater than the Restricted Use – Commercial SCOs also applies to unsaturated soils, because of the potential for exposure to unsaturated soils during construction activities such as subsurface utility maintenance. Depending on the specific zoning of parcels, commercial or residential SCOs apply to unsaturated soils in AOC 4.

The primary COPCs in soil to be addressed by the remedy are TCE, cis-1,2-DCE, and cadmium, which are believed to be associated with historical releases at the site. VOC concentrations exceeding applicable SCOs are limited to TCE in AOC 1 immediately downgradient of where TCE was historically used. The extent of soil exceeding cadmium SCOs is limited to soil deposited in the historical outfall ditches in AOC 5. As required by the Statement of Basis and further discussed in Sections 1.6 and 4.1, only unsaturated soils will be excavated during the final remedy and the COPCs in soil will be delimited in unsaturated soils (i.e., to a depth of approximately 3 to 6 feet below ground surface [bgs]).

1.4.2 Groundwater

The primary groundwater constituents to be addressed by the remedy are TCE, cis-1,2-DCE, and VC in AOCs 1, 2, and 3. Groundwater samples have been collected from a network of overburden, weathered bedrock, and bedrock monitoring wells and analyzed annually to semiannually to establish trends in VOC concentrations. VOCs have been reported at concentrations greater than NYSDEC Class GA Standards in an area at the site approximately 25 acres in size. The upper water-bearing zone is in a low-permeability glacial till geologic unit, and groundwater VOCs migrate very slowly (about 2 to 3 feet per year). The very low permeability of the glacial till and the extent of groundwater with concentrations greater than Class GA standards make it infeasible to remediate groundwater to cleanup standards within a reasonable amount of time. However, reductions in VOC concentrations over time and the presence of degradation products indicate natural attenuation is occurring.

1.4.3 Sediment

Cadmium is the primary metal in sediment to be addressed by the remedy. Sediment samples were collected during the CMS from the historical outfall drainage ditches within the floodplain, and from locations along the canal (including Van Cleef Lake) upstream and adjacent to the site. The samples were collected to assess the potential for site-related impacts to historical outfall drainage ditch sediments located within the floodplain, and to lake and canal sediment. In this context, sediment refers to soils deposited in the 100-year floodplain as well as subaqueous sediment in the canal (including Van Cleef Lake). The *CMS Report* concluded that metals concentrations in surface sediments of Van Cleef Lake and both upstream and downstream sections of the canal routinely exceeded NYSDEC Lowest Effects Level sediment criteria (Arcadis 2013). However, sediment in the north-eastern portion of Van Cleef Lake and on the northern shore of the canal downgradient of the Seneca Falls dam contained cadmium at concentrations greater than the NYSDEC Severe Effects Level. The results indicate that a metals source is upstream of the site, although cadmium found downgradient of the site may have also originated from the site. Cadmium concentrations in certain soil in historical outfall ditches HO2 through HO7, and certain sediment in the adjacent lake and canal, exceed NYSDEC SCGs for cadmium.

Cadmium, the primary COPC in sediment at the site, is associated with the historical wastewater outfalls and surface soil in the historical outfall ditches. Concentrations of cadmium in sediment at concentrations greater than SCGs are found in the floodplain portions of historical outfall drainage ditches within AOC 5 and the canal downstream of the ditch discharge points. Sediment data indicate that inorganic COPCs (primarily cadmium) are buried in the canal beneath a natural cap of more recent sediment and therefore have negligible potential for exposure.

1.4.4 Dense Non-Aqueous Phase Liquid

During manufacturing of television tube components from the 1940s to 1986, fluids and chlorinated solvents containing TCE may have been used in industrial processes. Non-aqueous phase TCE is the primary COPC in AOCs 1 and 3 and is the driver for soil and groundwater remediation in these AOCs (Arcadis 2013). TCE breakdown products (cis-1,2-DCE and VC) have also been reported in groundwater samples collected from AOCs 1 and 3 and are secondary COPCs.

A hierarchical lines-of-evidence approach (Kueper and Davies 2009) was used to identify DNAPL at the site. The lines of evidence used to identify DNAPL were:

- The observation of DNAPL in monitoring wells or soil cores
- Groundwater TCE concentrations near or greater than the solubility in water of 1,280,000 micrograms per liter (µg/L)
- Soil TCE concentrations near or above the soil saturation limit of 492 mg/kg

Using equilibrium partitioning relationships for saturated zone soil, the site-specific soil saturation limit for TCE was calculated following the *USEPA Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (USEPA 2002; Arcadis 2013). The calculated site-specific soil saturation limit for TCE at which DNAPL may be present is 492 mg/kg.

DNAPL was reported in soil cores from four borings drilled in 2001 and 2005: two in AOC 1 (B2-PH-05 and MW-BI-01) and two in AOC 3 (B11-PH-07 and B11-PH-08) (Figure 3). DNAPL was observed using an ultraviolet (UV) light field-screening tool (URS 2002) in a soil sample collected from 25 to 30 feet bgs at MW-BI-01. Globules of DNAPL were observed in soil cores between 29 and 30 feet bgs at B2-PH-05, 28 and 30 feet bgs at B11-PH-07, and 21 and 24 feet bgs at B11-PH-08 (Arcadis 2013).

TCE concentrations in soil samples co-located with observed DNAPL were greater than the soil saturation limit at MW-BI-01 (930 mg/kg at 25 feet bgs and 1,200 mg/kg at 30 feet bgs), B2-PH-05 (1,500 mg/kg at 29.5 feet bgs), and B11-PH-08 (8,100 mg/kg at 22 feet bgs), confirming the visual observations of DNAPL at these locations.

Groundwater samples were collected from temporary monitoring wells installed at borings B11-PH-07 and B11-PH-08, where DNAPL was observed. A groundwater sample from B11-PH-07 contained a dissolved-phase TCE concentration of 1,000,000 µg/L, near the TCE aqueous solubility limit of 1,280,000 µg/L. Laboratory analysis of a DNAPL sample collected from the temporary monitoring well installed at B11-PH-08 indicated that TCE comprised approximately 100% of the DNAPL (Arcadis 2013).

Potential TCE source areas are confined to four locations where DNAPL was observed (B2-PH-05, MW-BI-01, B11-PH-07, and B11-PH-08), and adjacent borings where DNAPL was potentially present (B2-06 and B11-PH-09). The tight and dense nature of the till and slow groundwater velocity have limited the migration of COPCs. The dissolved-phase TCE and cis-1,2-DCE concentrations in AOC 1, 2, and 3 wells are decreasing, as indicated by the reductions in concentrations in groundwater during the past two-plus decades of monitoring as presented in semi-annual groundwater monitoring reports submitted to NYSDEC. Dissolved-phase TCE concentrations show decreasing trends in monitoring locations across the site. TCE breakdown products (cis-1,2-DCE, VC) have been measured, indicating that natural attenuation is occurring, and total molar concentrations of COPCs are decreasing, demonstrating complete degradation of COPCs at the site. However, as previously noted, the MNA assessment completed as part of the CMS suggested that an integrated corrective measure approach (source control and ongoing attenuation half-life calculations) is needed to achieve corrective measure goals.

1.4.5 Soil Vapor and Indoor Air

Collection and analysis of soil vapor, sub-slab vapor, indoor air, and outdoor air samples have been conducted since 2003, and results have been compared to the applicable New York State Department of Health (NYSDOH) guidance values. In addition, NYSDOH's decision matrices (NYSDOH 2006), as updated, have been used as a guide for evaluating the potential for soil vapor intrusion and the application of mitigating measures.

One sub-slab vapor, one soil vapor, and three indoor/outdoor air sampling events were conducted during the soil vapor intrusion pathway investigation performed in 2003 and 2004. Six additional sampling events were completed between March 2004 and March 2006. Indoor air samples have also been collected quarterly from up to 11 buildings (Buildings 1, 1A, 7, 8, 9, 10, 10A, 11, 11A, 13, and 13A) since June 2006, and sub-slab vapor samples have been collected annually from Buildings 7, 10, 10A, 11A, 13, and 13A since 2006. Air and vapor sampling results were summarized in the *CMS Report* and in quarterly air monitoring reports submitted to NYSDEC (Arcadis 2013).

VOCs, primarily TCE, have been identified in the sub-slab vapor and indoor air samples. Concentrations of TCE in sub-slab vapor ranged between 2.7 and 160,000 micrograms per cubic meter (µg/m^3). In the indoor air, TCE concentrations were measured between the reporting limit of 0.21 µg/m^3 and 210 µg/m^3 during the 2003 and 2004 soil vapor intrusion pathway investigation.

SSD systems were installed at Buildings 1, 1A, 7, 8, 9, 10, 10A, 11, and 11A and continue to operate. In addition, ventilation of the indoor air in the Building 9 crawl space and Building 2 basement area is ongoing. Buildings 2, 2A, 3, 4, 5, and 6 are unoccupied; therefore, measures to address potential exposure in these buildings are being deferred until occupancy changes. Concentrations of TCE in indoor air in Buildings 1, 1A, and 8 have remained less than the guideline value for approximately the last 2 years and mitigation systems in some buildings have recently been expanded. The CCR will describe in detail recent modifications to soil vapor intrusion mitigation systems in Buildings 1, 2, 7, 8, 9, 10, and 11 and will be submitted to NYSDEC in 2019.

1.5 Remedial Action Objectives

Remedial action objectives (RAOs) established for OU1 and OU2 are outlined in the Statement of Basis. The RAOs were developed with consideration of Applicable or Relevant and Appropriate Requirements (Table 1). The RAOs in the Statement of Basis consist of:

OU1 Groundwater

RAOs for Public Health Protection:

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

RAOs for Environmental Protection:

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

OU1 Soil

RAOs for Public Health Protection:

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

RAOs for Environmental Protection:

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

OU1 Soil Vapor

RAOs for Public Health Protection:

- Mitigate impacts to public health resulting from soil vapor intrusion into buildings at the site.

OU2 Soil

RAOs for Public Health Protection:

- Prevent ingestion/direct contact with contaminated soil.

RAOs for Environmental Protection:

- Prevent impacts to biota from ingestion/direct contact with soil causing toxicity or impacts from bioaccumulation through the terrestrial food chain.

OU2 Sediment

RAOs for Public Health Protection:

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

RAOs for Environmental Protection:

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

1.6 Selected Remedy Overview

The NYSDEC-selected remedy proposed in the Statement of Basis includes the following components:

- The Remedial Design program will consider green remediation and sustainability principles and techniques including: (1) using renewable energy sources; (2) reducing greenhouse gas emissions; (3) encouraging low-carbon technologies; and (4) recycling and reusing clean materials.
- A site cover will be maintained during site redevelopment. Where a soil cover is required, it will be at least 1 foot of soil, meeting the SCOs for cover material in 6 New York Codes, Rules, and Regulations (NYCRR) Part 375-6.7(d) for commercial use. The soil cover will be placed over a demarcation layer, with the upper 6 inches of the soil of sufficient quality to maintain a vegetation layer.
- ISTR will be implemented to destroy or volatilize DNAPL within AOCs 1 and 3.
- Unsaturated soils within AOCs 1, 2, and 3 with concentrations that exceed the Commercial SCOs will be excavated and transported off site for disposal.
- VOCs in groundwater (remaining after active remediation) will be addressed by monitoring the attenuation of COPCs (select VOCs) in groundwater in AOCs 1, 2, and 3.
- SSD systems or other acceptable measures will be used to mitigate vapor intrusion at on-site buildings, except at Buildings 12, 13, and 13A.
- COPCs concentrations in soils within the on-site historical outfall drainage ditches that exceed the Commercial SCOs will be excavated and transported off site for disposal. COPCs concentrations in soils within off-site historical outfall drainage ditches that exceed the Residential SCOs will also be excavated and transported off site for disposal. The volume of soil/sediment to be removed will be determined from the results of sampling completed during a design phase (pending access to off-site areas).

- Unsaturated soil within the 100-year floodplain where discharge from the historical outfall drainage ditches entered the canal will be sampled and COPCs concentrations in soil exceeding Residential SCOs will be removed. Restoration of the excavation will be completed if the removal will leave the soil or canal bank unstable.
- Institutional controls will be implemented in the form of an environmental easement, a site management plan (SMP), and an O&M Plan to protect public health and the environment.

2 PROJECT MANAGEMENT

GTEOSI has the responsibility of implementing the activities described in this CAWP. The PDI activities will be implemented by Arcadis following this CAWP. Key personnel for GTEOSI, USEPA, NYSDEC, NYSDOH, Arcadis, and PDI subcontractors are identified below.

Name/Affiliation	Address	Phone/Email
GTEOSI		
Mr. Matthew Walsh, PG Manager - Corporate Environment, Health and Safety	One Verizon Way (VC 33E039) Basking Ridge, NJ 07920-1097	T: 908 559 3691 matthew.walsh@verizon.com
USEPA		
Mr. Ernst Jabouin	290 Broadway 22th Floor New York, NY 10007-1866	Jabouin.Ernst@epa.gov
NYSDEC		
Ms. Danielle Miles	6274 East Avon-Lima Rd Avon, NY 14414	danielle.miles@dec.ny.gov
NYSDOH		
Mr. Eamonn O'Neil	Empire State Plaza Corning Tower, Room 1787 Albany, NY 12237	Eamonn.ONeil@health.ny.gov
Arcadis		
Mr. Michael Higgins, PE Engineer of Record	50 Fountain Plaza, Suite 600 Buffalo, NY 14202	Michael.Higgins@arcadis.com
Mr. Mark Flusche, PG Project Manager	855 Route 146, Suite 210 Clifton Park, NY 12065	T: 518 250 7322 Mark.Flusche@arcadis.com
PDI Subcontractors (Subcontractors to Arcadis)		
Surveyor Driller Analytical/Geotechnical Laboratories Private Utility Locator Earthwork Contractor	Arcadis will select subcontractors to implement the PDI activities.	

3 PRE-DESIGN INVESTIGATION

This section describes PDIs to be conducted during the Remedial Design phase. Detailed descriptions of the work activities necessary to facilitate the development of the Remedial Design are presented in this section. Activities during the PDI will be conducted following the Field Activities Plan/Quality Assurance Project Plan (FAP/QAPP) included as Appendix A. The PDI limits referred to in this section include the areas of the site to be investigated during the PDI and include the DNAPL delineation areas in AOCs 1 and 3, the area defined by the proposed shallow excavation delineation soil borings in AOC 1, and ditches associated with HO2 through HO7. PDI activities will include:

- PDI Task 1 – Site Survey
- PDI Task 2 – Subsurface Utility Location
- PDI Task 3 – OU1 Limited Soil Excavation Area Investigation
- PDI Task 4 – OU2 Limited Soil Excavation Area Investigation
- PDI Task 5 – DNAPL Investigation
- PDI Summary Letter Report

A summary of the proposed samples to be collected and monitoring wells to be gauged is presented in Table 2. A description of each task associated with the PDI is presented below.

3.1 PDI Task 1 – Site Survey

Field survey activities will be performed as part of the PDI by a New York State-licensed Land Surveyor. The survey activities will be performed to update the site base map and other drawings for use during the Remedial Design efforts. Survey activities will include:

- Verify that site maps show correct locations for fence lines, roadways/sidewalks, and other site features.
- Prepare topographic maps that show ground surface elevation contours (1-foot contours) in and around the anticipated remedial limits (in AOCs 1 and 3 and historical outfall ditches and floodplain) to support the Remedial Design and for use on Contract Drawings.

Most of the survey work will be performed before field investigation activities. Follow-up survey work will be performed, as needed, to document final soil boring locations.

3.2 PDI Task 2 – Subsurface Utility Location

Locating and mapping subsurface utilities is necessary to support the design and implementation of remedial activities and to clear proposed PDI boring locations.

Utilities known to be in AOCs 1 and 3 include natural gas lines, overhead electric lines, communications cables, storm sewer lines, an interceptor trench, sanitary sewer lines, historical outfall pipes, and associated manholes and vaults. Before implementing intrusive PDI activities, the following activities will be conducted to identify overhead and subsurface utilities/structures at and near the proposed DNAPL delineation area (see Figure 3 and discussions in Sections 3.3, 3.4, and 3.5):

- Review available utility plans for AOCs 1, 3, and 5.
- Perform a detailed visual site inspection to identify utilities in each area compared to the site survey and site utility plans.
- Contact Dig Safely New York to identify and mark underground utilities at and in the immediate vicinity of the proposed PDI limits (i.e., the DNAPL delineation areas in AOCs 1 and 3, the area defined by the proposed shallow excavation delineation soil borings in AOC 1, and ditches associated with HO2 through HO7).

In addition to the above utility locating activities, private utility locating and geophysical services will be subcontracted as needed to identify and mark underground utilities at and in the immediate vicinity of the proposed PDI limits, to the extent practicable. Geophysical methods that may be used include electromagnetic surveys and ground-penetrating radar.

The subsurface utility locations, orientation, elevations, size, materials of construction, and condition (to the extent feasible) within the DNAPL delineation areas in AOCs 1 and 3 will be documented.

The above-referenced techniques will be used to assess the potential presence and location/alignment of utilities, and to evaluate the potential for utilities to be affected by remedial activities. Data gathered during the subsurface utility investigation will be used to determine whether any utilities must be rerouted or capped prior to remedial activities.

3.3 PDI Task 3 – OU1 Limited Soil Excavation Area Investigation

As presented in the Statement of Basis and summarized in the *CMS Report* and *CMS Addendum*, TCE concentrations in shallow unsaturated soil exceeding the commercial SCO (200 mg/kg) were identified in only boring B2-PH-04 in AOC 1 (Figure 3, Arcadis 2013, Arcadis 2016b). These data were sufficient for selecting excavation as the unsaturated soil remedy in OU1; however, additional soil investigation is required to delineate the excavation area and depth. Soil borings will be advanced at approximately 12 locations to define the vertical and horizontal limits of shallow soil excavation around boring B2-PH-04. The PDI soil boring data from OU1 will define the excavation limits and eliminate the need for post-excavation confirmatory sampling.

Prior to drilling the soil borings, underground and overhead utilities will be located following the procedures outlined in Section 3.2. The soil boring locations will be adjusted to avoid subsurface utilities and structures.

The soil borings will be advanced to the top of the saturated zone, which is between approximately 2 and 4 feet bgs. Therefore, the borings will be drilled to the top of the observed water table or to a depth of up to 6 feet bgs, whichever is encountered first.

The borings will be completed using direct-push drilling methods. Continuous soil sampling will be performed using Macro-Core® samplers, or equivalent.[1] Soil recovered from each sample interval will be

---

[1] The term “Macro-Core® sampler” is used throughout this document to refer to any equivalent direct-push sampling liner.

described and logged to document color, texture, moisture content, VOC screening (by photoionization detector [PID]), and evidence of non-aqueous phase liquid (NAPL). Samples will be selected for laboratory analysis based on visual, olfactory, and PID screening results. Samples will be submitted for laboratory analysis from approximately 1 foot and 4 feet bgs within each boring unless field screening [i.e., staining or other visual evidence of potential impacts, PID readings greater than background, or olfactory evidence] indicates potential VOCs at another depth. If evidence of impacts is observed at depths other than 1 foot or 4 feet bgs, sample(s) will be collected from within that interval instead of the closest of the planned sampling depths. OU1 unsaturated soil excavation delineation samples will be analyzed for USEPA Target Compound List (TCL) VOCs.

Soil borings will be advanced in a 5-foot horizontal step-out grid pattern from boring B2-PH-04. Samples will be collected such that samples with commercial SCO exceedances are physically bracketed by samples without exceedances. The borings outside the limits of SCO exceedances along each grid line will define the outer extent of the shallow (i.e., unsaturated zone) soil excavation area in OU1.

Upon completion of each boring, holes will be filled to slightly below grade with hydrated bentonite and finished to match surrounding grade with cold patch asphalt or topsoil and grass seed. Soil cuttings and other investigation-derived wastes (e.g., plastic sheeting, decontamination rinse water, etc.) will be containerized in 55-gallon drums for off-site disposal. Investigation-derived waste disposal will be completed following the procedures described in the FAP/QAPP (Appendix A). As noted in Section 3.1, soil boring locations will be surveyed after they are advanced.

3.4 PDI Task 4 – OU2 Limited Soil Excavation Area Investigation

As presented in the Statement of Basis and summarized in the *CMS Report* and *CMS Addendum*, shallow soil impacts were sufficiently identified by previous investigations for the purpose of selecting excavation as the shallow soil remedy in OU2 (Arcadis 2013, Arcadis 2016b). However, additional shallow soil investigation is required to determine the limits of excavation. A shallow soil investigation will be conducted to delineate the vertical and horizontal extent of unsaturated soil to be excavated in AOC 5 (i.e., the historical outfalls), and within the 100-year floodplain adjacent to the canal. Delineation will be performed during the design phase, and the results will be used to define the extent of excavation such that post-excavation confirmatory sampling will not be necessary.

The *CMS Report*, *CMS Addendum*, and documents referenced within those reports indicated that cadmium is the primary COPC for soil in the two areas in OU2 subject to limited soil excavation – soils within the historical outfall ditches and soils within the 100-year floodplain adjacent to the canal (referred to as “sediment” in the Statement of Basis) (Arcadis 2013, Arcadis 2016b). As noted in the Statement of Basis, the SCOs for on-site and off-site soil are commercial and residential SCOs, respectively. Analytical data for soil in the historical outfall ditches and adjacent to the canal indicate that cadmium is the primary metal with concentrations exceeding the respective commercial SCO. In samples where other metals have exceeded commercial SCOs, so has cadmium.

3.4.1 Historical Outfall Ditch Investigation

During the PDI, soil samples will be collected from the ditches associated with HO2 through HO7 to delineate the extent of shallow (i.e., unsaturated zone) excavation within the ditches from the head of the ditches to the edge of embankment upgradient of the floodplain.[2] No sampling or excavation will occur at HO1 because process wastewater from this outfall discharged directly to Van Cleef Lake and no overland flow within the ditch occurred. The sampling methodology is described in Section 3.4.1.3, and generally consists of an iterative approach using a portable x-ray fluorescence (XRF) analyzer to field screen soils. The results of field screening will be confirmed with laboratory-analyzed samples. The sampling plan is conservative with a sampling frequency of at least one boring location per ditch segment. Ditches are divided into segments based on changes in ditch slope, width, and soil characteristics (i.e., each ditch segment will exhibit the same general soil type and morphological characteristics throughout the entirety of the segment).

Proposed approximate sampling locations are shown on Figure 4, based on an initial reconnaissance of the ditches conducted in 2018. Additional samples may be collected along the historical flow path in the outfall ditches to delineate the extent of excavation (e.g., to define the extent of an excavation area, an additional location may be sampled between the most downgradient location with an exceedance of an applicable SCO and the adjacent SCO-compliant location). Additional sampling locations, if any, are anticipated to be identified using an iterative approach.

3.4.1.1 Sampling Locations – Historical Outfalls HO2 through HO5

The ditches at HO2 through HO5 are on a steep hillslope, and the former overland flow path is clearly defined by sizable ditches beneath each historical outfall except for the shallow HO3 ditch. The depth of process water flow in historical outfall ditches HO2 through HO5 was likely relatively shallow because the ditches are steep and primarily conveyed only process water (along with runoff from precipitation in the immediate area surrounding the ditches). Deposition of metals from process water was most likely concentrated at the bottom/center of the ditch channels as that was where process water flow would have occurred. Delineation sampling locations in HO2 through HO5 will be positioned in the center of the ditch cross-sections (i.e., the base of the channel where historical outfall discharge flowed). One boring will be advanced per segment in the center bottom of the ditch. Borings will be advanced in approximately the middle of each segment, as determined in the field. The approximate sampling locations are shown on Figure 4. Additional samples may be collected along the center of the outfall ditches to delineate excavation extents.

3.4.1.2 Sampling Locations – Historical Outfalls HO6 and HO7

Prior to the confluence of the HO6 and HO7 ditches, soil samples will be collected from each ditch following the methodology described in Section 3.4.1.1. The combined HO6 and HO7 ditch follows a gradual slope through a wooded area northeast of the site (Figure 4). For the combined HO6 and HO7 ditch, borings will be advanced and samples will be collected at 0, 250, 500, and 750 feet downstream from the 30-inch-diameter concrete culvert under Johnson Street. If delineation sampling indicates that cadmium is not present at concentrations greater than the applicable SCO at the two locations farthest downstream of the culvert, sampling in the combined outfall ditch segment will not proceed farther

---

[2] Excavation will extend as far down the length of the outfall ditches as SCO exceedances exist and up to the edge of the embankment upgradient of the floodplain. However, because of the steep and potentially unstable nature of the embankment and the location of overhead powerlines, the extent of excavation may be modified to ensure the health and safety of workers. The final extent of excavation will be presented in the Remedial Design.

downstream. If delineation sampling results indicate one or both downstream locations contain cadmium at a concentration greater than the applicable SCO, sampling will continue downstream at 250-foot intervals until delineation sampling indicates that two consecutive locations do not contain cadmium at a concentration greater than the applicable SCO. The delineation sampling methodology is discussed below. As with historical outfalls HO2 through HO5, sidewall delineation samples will not be collected.

3.4.1.3 Sampling Methodology

Before collecting soil samples in the historical outfall ditches, rocks, debris, and vegetation will be removed to expose native soil at each sampling location.

Bottom-of-ditch soil borings will be advanced using manual methods (e.g., shovel or hand auger) in 6-inch depth intervals to 24 inches bgs. A slide hammer or other mechanical method will push a Macro-Core® or other soil sampling device to collect soil samples deeper than 24 inches bgs if a hand auger is not capable of doing so. Samples will not be collected from water-saturated soils; saturated soils will not be excavated during implementation of the final remedy. However, in some portions of historical outfall ditches (such as immediately downstream of the 30-inch-diameter concrete culvert under Johnson Street along the combined HO6/HO7 outfall ditch segment), standing water is believed to be seasonal. If standing water is in a planned historical outfall sampling location, that sampling location will be relocated immediately downstream of the standing water.

Soil samples for each 6-inch interval will be collected and field-screened with a portable XRF analyzer calibrated for cadmium with a detection limit below the commercial SCO (9.3 mg/kg). Soil borings will be advanced to refusal, the water table, or until XRF screening at 6-inch intervals indicates cadmium concentrations are less than the commercial SCO. If XRF screening indicates an interval contains cadmium concentrations less than the commercial SCO (the “delineation sample”), the soil boring will be advanced 6 inches deeper, if possible, and an additional soil sample will be collected. Each 6-inch interval composite soil sample will be sent to the laboratory to be either held or analyzed.

For each soil boring, only the delineation sample, and the sample from the 6-inch interval directly above, will be initially analyzed at the laboratory. Other samples will be analyzed if the initial results do not vertically delineate cadmium concentrations greater than the commercial SCO. A flowchart illustrating the process of sample collection, screening, and selection for laboratory analysis is included as Figure 5. Sampling equipment will be decontaminated between each sampling interval and sampling location following the procedures in the FAP/QAPP (Appendix A). As noted in Section 3.1, soil boring locations will be surveyed.

Laboratory-analyzed historical outfall soil samples will be analyzed for cadmium by USEPA SW846 Method 6010B. Of 75 historical outfall soil samples analyzed during the RCRA facility investigations and CMS, cadmium was the only metal reported at concentrations greater than commercial or residential SCOs in more than one soil sample.

Upon completion of each boring, holes will be filled to slightly below grade with hydrated bentonite and finished to match surrounding grade with topsoil and grass seed. Soil cuttings and other investigation-derived wastes (e.g., plastic sheeting, decontamination rinse water, etc.) will be containerized in 55-gallon drums for off-site disposal. Investigation-derived waste disposal will be completed following the procedures described in the FAP/QAPP (Appendix A).

3.4.1.4 Historical Outfall Ditch Soil Excavation

Remedial excavations will be designed to remove soil to at least the depth of SCO attainment in each ditch. The bases of the excavations will be the same uniform depth below ground surface (independent of elevation change) for each ditch segment as SCO attainment in the associated sampling location. Excavation will extend horizontally along the historical flow path in the ditches to a depth determined by the analytical results from the closest soil boring. The horizontal extent of each ditch segment excavation will be defined by the midpoint between two SCO attainment locations. Delineation sampling, and thus excavation, will not extend past the head of the ditch or the edge of embankment upgradient of the floodplain.

The historical outfall pipes were 2 feet or less in diameter, and therefore, it is estimated that outfall discharge rose a maximum of 2 feet above the bottom of the ditches. Excavations will extend outward at the same base elevation as the excavation at the center of the ditch until soils 2 feet above the center of the ditch have been removed. In this way, soil within the maximum vertical extent of historical outfall flow within the ditch will be removed. However, as a practical matter (e.g., digging to angle of repose to maintain sidewall stability), additional sidewall materials will likely be removed. If the top of the sidewall of a ditch is less than 2 feet higher than the ground surface at the center of the ditch, excavations will not extend past the top of the sidewall. Sidewall delineation sampling will not be performed because of this conservative excavation strategy.

Soils below ephemeral standing water in historical outfall ditches will be excavated, as needed, to the depth of the deepest SCO exceedance in the immediately downgradient sample. Soils that are persistently saturated with water will not be excavated.

3.4.2 Floodplain Investigation

The Statement of Basis calls for the excavation of unsaturated soil in the floodplain adjacent to the canal with concentrations of metals greater than residential SCOs. GTEOSI will contact New York State Canal Corporation (owner of the off-site floodplain property) and request access and permission to conduct investigative and remedial actions. If access for investigation and remedial excavations is not granted, GTEOSI cannot complete PDI and remedial field work at the off-site floodplain property. The corrective measures for AOC 5 floodplain soils depend largely on the physical extents of the historical outfall ditches. No wastewater discharge to the historical outfall ditches has occurred since 1972. The off-site path of historical discharge flow from HO3, HO4, and HO5 may not be well-defined (unlike the HO2, HO6, and HO7 ditches, which are still present on site). Visual inspection of conditions and analysis of historical aerial photographs will be used to identify the most likely discharge flow pathways between the historical outfall ditches and the canal where ditches are not well-defined in the floodplain.

Delineation sampling will be performed in persistently unsaturated soil (i.e., higher than the typical annual high-standing elevation of the canal) within ditches inside the 100-year floodplain. For well-defined ditches in the floodplain, the sampling methodology will be the same methodology used for historical outfall ditches on site. If ditches are not well-defined, delineation sampling will be conducted along cross-sectional transects (centered over the estimated historical outfall flow path, and oriented perpendicular to the estimated flow direction). The floodplain area is defined as the land between the edge of the canal and the edge of the 100-year floodplain. The edge of the 100-year floodplain will be marked by a New

York State-licensed Land Surveyor. The elevation of the 100-year floodplain downgradient of the dam at Van Cleef Lake is the topographic line at 386 feet above mean sea level (amsl), according to the Federal Emergency Management Agency Flood Insurance Rate Map for Seneca Falls, which is dated August 3, 1981.

If needed, cross-sectional sampling transects will be completed and would likely consist of approximately five sampling locations spaced 5 to 10 feet apart and centered across the estimated flow path. Each transect would likely be spaced 10 feet apart between the edge of the canal and the 100-year floodplain. The exact sampling locations will be determined after mapping of the estimated historical outfall flow paths, ditch extents in the floodplain, and the edge of the 100-year floodplain.

Floodplain delineation sampling methods will generally follow the procedures described in Section 3.4.1 for historical outfall ditch sampling. Soil borings will be advanced using manual methods (e.g., shovel or hand auger) at 6-inch depth intervals to 24 inches bgs. A slide hammer or other mechanical method will push a Macro-Core® or other soil sampling device to collect soil samples deeper than 24 inches bgs if a hand auger is not capable of doing so. Based on the 100-year floodplain elevation (386 feet amsl) and the approximate canal stage (which is dam-regulated and typically between 382 and 383 feet amsl), the unsaturated zone within the 100-year floodplain is approximately 3 to 4 feet thick during the spring and summer, when sampling will be performed.

Soil samples for each 6-inch interval will be collected and field-screened with an XRF analyzer calibrated to analyze for cadmium with a detection limit at or below the residential SCO for cadmium (2.5 mg/kg). Soil borings will be advanced to refusal, the water table, or until XRF screening at 6-inch intervals indicates cadmium concentrations are less than the XRF detection limit. If XRF screening indicates an interval contains cadmium concentrations less than the XRF detection limit (“delineation sample”), the soil boring will be advanced 12 inches deeper and two additional 6-inch interval unsaturated soil samples will be collected. As with the historical outfall ditch delineation sampling, each 6-inch interval soil sample will be sent to the laboratory to be either held or analyzed. A flowchart illustrating the process of sample collection, screening, and selection for laboratory analysis is included as Figure 5.

If sampling is conducted along cross-sectional transects perpendicular to the estimated flow direction, for the middle three sampling locations in each transect, only the soil sample for the 6-inch interval with cadmium concentrations below the XRF detection limit (“delineation sample”) and the interval directly above will be analyzed for cadmium. Other soil samples, including those from the outer two locations of each transect, would be held by the laboratory and analyzed only if the initial results do not provide horizontal and vertical delineation. Transects may be extended laterally up to, but not past, the estimated edge of the historical outfall ditch (as determined based on topography and the location of the respective historical outfall ditch where it meets the edge of embankment upgradient of the floodplain and/or utility access road) if the “inner” sampling locations in a transect contain cadmium concentrations exceeding the residential SCO for cadmium.

Excavation extents are anticipated to be determined in the same manner as for the historical outfall ditches on the site where the ditches are well-defined in the floodplain. An alternate excavation delineation approach will be used if ditches are not well-defined in the floodplain – soil would be removed up to the midpoints between the outermost sampling locations with samples that exceed the SCO and the closest sampling locations outside of those exceedances where the SCO was attained (with distance determined perpendicular from the historical direction of flow). Excavation, and thus sampling, would not extend past the top of the sidewall of the estimated edge of the historical outfall ditch, except as needed to provide stable excavation slopes. The depth and downslope extent of excavation would be determined using the same methodology used for the onsite historical outfall ditches. The soil removal areas and depths will be finalized in the Remedial Design.

Sampling equipment will be decontaminated between each sampling interval and sampling location following the procedures in the FAP/QAPP (Appendix A). Sampling locations will be surveyed by a New York State-licensed Land Surveyor. Upon completion of each boring, holes will be filled to slightly below grade with hydrated bentonite and finished to match surrounding grade with cold patch asphalt or topsoil and grass seed. Soil cuttings and other investigation-derived wastes (e.g., plastic sheeting, decontamination rinse water, etc.) will be containerized in 55-gallon drums for off-site disposal. Investigation-derived waste disposal will be completed following the procedures described in the FAP/QAPP (Appendix A).

3.5 PDI Task 5 – DNAPL Delineation

An investigation will be conducted to determine the lateral and vertical extent of DNAPL in AOCs 1 and 3 that will require ISTR. Multiple lines of evidence will be used to delineate DNAPL at the site. Soil samples will be collected from direct-push borings, and multiple techniques will be used to evaluate the presence of DNAPL in soil samples.

3.5.1 Soil Boring Locations

The proposed DNAPL delineation areas are defined by the historical sampling locations outside of the buildings in AOCs 1 and 3 where TCE concentrations in groundwater exceeded 1% of solubility. The DNAPL delineation areas are depicted by dashed blue lines on Figure 3. Each DNAPL delineation area will be divided into a 10-foot interval grid with grid nodes on or adjacent to boring locations where DNAPL was observed in 2001 or 2005 (URS 2002; Arcadis 2013). Soil borings will be advanced first at the grid nodes closest to borings where DNAPL was previously observed. Borings will be stepped out horizontally along grid axes extending from the initial borings until boring data confirm the absence of DNAPL. DNAPL delineation borings will not extend into buildings or into the New York State Electric and Gas Corporation substation near AOC 1. The first boring outside the limits of detected DNAPL along each grid line, or the edge of buildings or the New York State Electric and Gas Corporation substation near AOC 1 if DNAPL is detected in borings immediately adjacent to these features, will delineate the ISTR area. Procedures for evaluating the presence of DNAPL in soil samples are described in Section 3.5.2.

Soil cuttings and other investigation-derived wastes (e.g., plastic sheeting, decontamination rinse water, etc.) will be containerized in 55-gallon drums and characterized for off-site disposal. Investigation-derived waste disposal will be completed following the procedures described in the FAP/QAPP.

3.5.2 Multiple Lines-of-Evidence Approach for Evaluating the Presence of DNAPL

During the PDI, soil from each boring will be evaluated for the presence of DNAPL using these procedures:

- Visual observations (appearance of globules, free product, staining, or sheens)
- PID soil screening measurements of VOCs
- Hydrophobic dye jar shake tests

- Scanning soil cores for UV fluorescence in a mobile dark room
- Scanning soil cores for dye-enhanced laser-induced fluorescence (LIF)[3]
- Laboratory TCL VOC analysis using USEPA Method 8260

The first borings to be advanced in AOCs 1 and 3 will be adjacent to historical boring locations where DNAPL was identified (see Figure 3). These initial boring locations will be targeted to verify the presence of DNAPL in these areas and to collect reference samples of DNAPL-impacted soil for the identification of DNAPL in step-out borings (as discussed in Section 3.5.1). The procedures identified in the bulleted list above (except for VOC analyses) will be applied to soil samples that contain free phase DNAPL at the reference locations – where DNAPL exists – to document a DNAPL reference response for each procedure. Such a reference sample is expected to be collected from at least one of the initial borings adjacent to historical DNAPL locations.

A sequential, multiple-lines-of evidence approach will be used to evaluate whether DNAPL is present at each new boring location advanced at the site following the steps on the DNAPL delineation flowchart provided as Figure 6. This evaluation process will be implemented for each Macro-Core® sample until the bedrock interface has been reached or direct-push drilling refusal is encountered at each boring location. Existing site drilling logs will be analyzed and used to select a direct-push drill rig capable of exerting the force required to reach bedrock at the site. The sequential approach is described further as follows:

1. Step 1: Visual Inspection/PID Screening: When each 4- to 5-foot Macro-Core® sample is split open, it will be visually inspected for the presence of DNAPL, screened with a PID, and soil characteristics (color, grain size/soil type, consistency, moisture content, staining, etc.) will be recorded. Visual evidence of DNAPL includes globules, free product saturation, dark or oily staining, or sheens. Based on previous site results, PID readings greater than 2,000 parts per million (ppm) indicate the potential for DNAPL to be present. Intervals with PID readings that saturate the sensor (greater than 9,999 ppm) will be further evaluated in Step 4. Steps 2 and 3 below will be completed for Macro-Core® samples with visual evidence of DNAPL, strong solvent odors, or PID readings greater than 2,000 ppm; these Macro-Core® samples may contain DNAPL. If the initial screening does not indicate that DNAPL is potentially present, screening of that section of core will cease at this step.
2. Step 2: Step two consists of two separate tests. Both tests will be completed for Macro-Core® samples flagged as potentially containing DNAPL in Step 1. If either or both tests indicate the potential presence of DNAPL in a particular Macro-Core® sample, that sample will be further

---

[3] Florescence-based NAPL detection technology (TarGOST, UVOST, etc.) has been used for on-site, real-time in-situ delineation of NAPLs that readily fluoresce when exposed to ultraviolet light (e.g., Einarson et al. 2016 and Einarson et al. 2018). A proprietary LIF technology called DyeLIF was developed by Dakota Technologies to detect chlorinated solvent DNAPLs that lack natural fluorescence in the subsurface. The DyeLIF technology uses hydrophobic dye that allows certain NAPLs previously invisible to LIF technology (including pure TCE) to be detected. DyeLIF is expected to be used because the site DNAPL is composed primarily of TCE and may not strongly naturally fluoresce in all cases. DNAPL composed primarily of TCE can naturally fluoresce if it contains sufficient fluorophores, such as residual grease from degreasing operations. The site DNAPL will be evaluated to determine whether traditional (dye-free) LIF or DyeLIF is the most appropriate LIF technology. In situ LIF is not proposed because of the dense and hard nature of site soils. Ex-situ LIF scanning will be conducted on split core faces.

evaluated in Step 3. If the screening conducted in both Steps 2a and 2b does not indicate that DNAPL is potentially present, screening of that section of core will cease:

a. Ex-Situ UV Scanning: Macro-Core® samples that may contain DNAPL based on the results of the inspection and screening in Step 1 will be scanned with UV light in a mobile dark room. UV screening will be conducted as a qualitative yes/no fluorescence test that will allow inspection of the entire split core face. Some NAPLs and natural materials such as limestone will fluoresce under UV light. Prior investigations (i.e., URS 2002) have confirmed that site DNAPL may fluoresce under UV light. Each split core face will be scanned with a UV lamp and the results will be photographed. Macro-Core® samples with visually apparent fluorescence will be identified as potentially containing DNAPL, unless that fluorescence is consistent with UV fluorescence seen in DNAPL-free soil that naturally fluoresces.[4] Color differences from the reference response(s) may be evidence of natural soil fluorescence.

b. Ex-Situ LIF/DyeLIF Scanning: Macro-Core® samples that do not fluoresce under UV light may contain DNAPL. Step 2b will determine whether DNAPL that does not fluoresce under UV light is potentially present. Macro-Core® samples that may contain DNAPL based on the results of the inspection and screening in Step 1 will be evaluated with LIF or DyeLIF scanning to determine fluorescence intensity and waveform signature. LIF/DyeLIF scanning will be conducted by an automated sensor that will scan laterally across the split core face as it simultaneously traverses the long axis of the Macro-Core® sample. This scanning method covers a larger area of the core than a simple linear traverse of the core interval. In the field, the detected fluorescence intensity will be compared to the known site DNAPL reference response(s). Intervals with fluorescence response intensity similar to the reference response(s) will be confirmed as potentially containing DNAPL.[5]

   As discussed previously, for at least one sample with DNAPL indicated by all procedures, except VOC analyses (which have a multiday turnaround time), LIF/DyeLIF scanning of DNAPL will be completed and used to define the site-specific DNAPL fluorescence intensity and waveform signature. The reference sample(s) is expected to be collected from one or more of the initial borings advanced adjacent to a known historical DNAPL detection. This site-specific positive DNAPL LIF/DyeLIF response will be used as a reference response during the analysis of LIF scanning results. For at least one sample with DNAPL not indicated by any field procedures, LIF/DyeLIF scanning will be completed and used to define a site-specific background fluorescence intensity and waveform signature. This background sample may need to be

---

[4] Certain minerals exhibit natural fluorescence (e.g., Modreski 1987). These minerals may fluoresce under UV light at a different wavelength (color) than the site DNAPL. Natural fluorescence of site soils, if seen, will be evaluated in the field.

[5] The field interpretations of LIF results will be quantitatively verified following fieldwork. Specifically, site DNAPL fluorescence will be separated from false positives such as limestone fragments and wood using non-negative least squares (NNLS) analysis conducted by Dakota Technologies. In some instances, DNAPL pore saturation can be low enough that the DNAPL response overlaps to some degree with un-solvated dye and other background fluorescence. However, because the fluorescent signature of un-solvated and solvated dye is significantly different and will be quantified with a site-specific reference and background analysis, NNLS analysis will be used to mathematically strip way all but the DNAPL-specific responses – yielding high-confidence logs of DNAPL detections based on LIF waveforms and fluorescence response intensity. The results of the NNLS analysis will be included in the PDI Summary Letter Report, discussed in Section 3.6.

collected outside the DNAPL delineation area shown on Figure 3, or from a shallow interval within that area.

3. <u>Step 3: NAPL Dye Shake Tests:</u> NAPL dye shake testing will be completed for the deepest interval in each soil boring location where DNAPL has been determined to potentially be present in Step 2 (i.e., only within the deepest Macro-Core® sample within the core with a positive UV or LIF/DyeLIF detection of potential DNAPL). Positive potential DNAPL detections within the entire soil boring will not be subjected to shake tests because ISTR will be targeted to the entire depth range above the deepest DNAPL detection. Dye tests will be completed at high resolution (approximately every 0.2 feet) within the target Macro-Core® samples where the deepest potential DNAPL in each soil boring was identified. If 2 or more linear feet of an individual Macro-Core® sample is determined to potentially contain DNAPL in Step 2, no more than 10 shake tests will be conducted on that 4- to 5-foot-long Macro-Core® sample; those shake tests will be conducted at the depth intervals with the greatest fluorescence response, as determined in Step 2. If all samples within a Macro-Core® sample result in negative shake test results, the next shallowest Macro-Core® sample with DNAPL potentially present based on the results of Step 2 will be evaluated. A negative dye shake test will indicate that DNAPL could be present, but that DNAPL cannot be confirmed with enough confidence to require ISTR based on that result. A positive dye shake test will indicate that DNAPL is likely present and that interval should be further evaluated as described in Step 4.

   If Step 1 or Step 2 does not indicate that DNAPL is potentially present at a particular boring location, a dye shake test will be conducted on three soil samples from that boring; these tests will be biased to intervals with strong solvent odors or the highest PID readings, if present. If there are no elevated PID results in the boring location, the three dye shake tests will be approximately evenly distributed by depth. If any of these three tests are positive, a sample from the interval(s) with a positive dye shake test result will be collected and analyzed for saturated soil VOCs and the results will determine whether that boring will be included in the ISTR zone, following the procedure discussed in Step 4.

4. <u>Step 4: VOC Analysis:</u> If the result of Step 3 indicates that DNAPL is likely present or if the PID sensor is saturated (greater than 9,999 ppm), at any depth in a soil boring, one to three soil samples will be collected from that soil boring location for saturated soil TCL VOC analysis using USEPA Method 8260. The laboratory soil samples will be biased to intervals with positive dye tests or the highest PID readings in each boring. A VOC concentration exceeding the calculated soil saturation limit (492 mg/kg) indicates that DNAPL is present (Arcadis 2016b).

This multiple lines of evidence method will result in a positive or negative determination regarding the presence of DNAPL in each boring. ISTR will be targeted to the entire unconsolidated interval from the deepest DNAPL detection and above in each AOC (assumed to be at or near the top of bedrock based on historical borings); therefore, it is unnecessary to correlate DNAPL detections between borings or to conduct additional investigations to describe small-scale variations in DNAPL presence or absence. Investigation will be limited to the grid line interval specified in Section 3.5.1.

3.5.3 Additional Data Collection

Certain data were collected to support the evaluation of ISTR as a potential remedy at the site during the MPE investigation conducted in 2012 as part of the CMS. However, now that ISTR has been selected as a corrective action for the site, additional data will be collected to facilitate the efficient design of the ISTR system(s). Following are the additional data to be collected and the reasons for inclusion in the PDI:

- Samples for analysis of total organic carbon (TOC) will be collected from a subset of approximately four soil borings in AOCs 1 and 3 (approximately two samples from each AOC). TOC samples will be collected at the same depth interval that DNAPL (if any) is observed and will be submitted for laboratory analysis of ash and organic matter content by ASTM International (ASTM) Method D2974. Generally, the higher the TOC content in soil, the more difficult it is to desorb TCE. Soil with significant TOC concentrations may subside (i.e., organic layers may shrink during treatment), although this is not expected at the site based on historical investigations.
- Moisture content in the vadose zone will be measured from approximately four of the borings drilled in AOCs 1 and 3 (approximately two samples from each AOC). Samples from these borings will be collected in the unsaturated zone and will be submitted for laboratory analysis of moisture content by ASTM Method D2216-90 and/or from dry weight corrections conducted as part of the USEPA Method 8260 analyses collected as described in Section 3.5.2. Elevated moisture content in soils may absorb heat during ISTR and thus may reduce the efficiency of ISTR.
- Hydraulic conductivity and porosity in the treatment zones will be estimated by conducting slug tests of nearby wells MW-26, MW-24, and MW-25. Hydraulic conductivity and porosity data will be used to estimate groundwater flow velocity and volume of vapor that may be generated during ISTR.

3.6 PDI Summary Letter Report

The results of the PDI will be documented in a PDI Summary Letter Report. The results, along with existing site information, will support the design for the remedy. The PDI Summary Letter Report will include:

- A summary of the PDI work activities and results, including field observations, sampling results, deviations in response to field conditions, issues encountered and resolved, the proposed limits (vertical and horizontal) of the limited shallow excavation and ISTR areas, and other pertinent information to document that site activities were performed pursuant to this CAWP.
- Updated figures showing the surveyed locations of aboveground and underground utilities in and around the proposed remedial areas and soil boring and soil sampling locations completed as part of the PDI.
- Figures and tables that define the extent of the proposed limited shallow excavation and ISTR areas, based on an initial evaluation of the PDI data. The delineation of the ISTR will be supported, in part, by the results of the NNLS analysis discussed in Section 3.5.2.
- A summary of final sampling locations and corresponding laboratory analyses.
- Soil boring logs.
- Laboratory analytical data reports.
- An updated schedule for preparing the Remedial Design.

4 REMEDIAL DESIGN ACTIVITIES

This section describes the key remedial activities to be conducted at the site. Work activities associated with preparing the Remedial Design will be conducted under these principal design tasks:

- Design Task 1 – Soil Excavation and Handling
- Design Task 2 – In Situ Thermal Remediation
- Design Task 3 – Waste Management
- Design Task 4 – Backfilling and Site Restoration/Soil Cover

The design tasks listed above represent major tasks associated with preparation of the Remedial Design. Other related tasks, including, site preparation, site security/control/access, erosion and sedimentation control, water management, noise/vapor/dust suppression, air monitoring, characterization/verification sampling, equipment decontamination, site restoration, etc. will be detailed in the Remedial Design.

Additional activities including monitoring of VOCs remaining in groundwater after active remediation and any required mitigation for soil vapor intrusion will be addressed in the SMP. Groundwater sampling is anticipated to consist of biannual (i.e., twice a year) monitoring of the existing well network. Soil vapor intrusion monitoring and mitigation will be discussed in detail in the CCR for the soil vapor intrusion mitigation systems in Buildings 1, 2, 7, 8, 9, 10, and 11. The soil vapor intrusion ICMs will become the final remedy for AOC 4 (soil vapor intrusion pathways) once the Final Engineering Report for the site is submitted and approved by NYSDEC. Post-construction activities, including institutional controls, are discussed in Section 8.

A description of the activities to be performed under each of the principal design tasks is presented below.

4.1 Design Task 1 – Soil Excavation and Handling

As indicated in the Statement of Basis and based on available information, about 15 cubic yards of shallow soil will be excavated from the unsaturated zone in AOCs 1, 2, and 3 (0 to approximately 5 feet bgs).

Additional removal of unsaturated shallow soils with COPC concentrations greater than commercial SCOs onsite and greater than the residential SCOs offsite will be completed in AOC 5 within the historical outfall discharge drainage ditches.

Additional limited excavation of unsaturated soils within historical outfall ditches between the high-water line and the 100-year floodplain that, based on PDI sampling, contain concentrations of COCs greater than the residential SCOs will be completed. Excavations within historical outfall ditches will be limited in horizontal extent as discussed in Section 3.4.1. The locations of shallow soil excavations within the AOC will be selected based on the PDI analytical data. The final soil removal volume and depth within each AOC will be refined based on the results of the PDI. Prior to excavation, additional utility location will be conducted, if needed.

For soil removal in AOC 1, existing asphalt pavement, sub-base materials, and concrete curbing above the excavation area will be removed. These materials will be staged on site for potential reuse as fill material or transported off site for reuse, recycling, or disposal (e.g., at a construction and demolition debris facility). Excavated soils exceeding applicable SCOs will be transported for proper off-site disposal. In addition, existing vegetation will be cleared for access into and excavation within AOC 5.

Subsurface utilities may be encountered within the proposed excavation areas and it is anticipated that they will be left in place. The proposed handling of utilities will be further evaluated during development of the Remedial Design based on the findings of the PDI.

If a sidewall support system (e.g., consisting of sloping, benching, and/or sheet pile) is needed to allow excavation to proceed to the target depths and prevent cave-ins, it shall comply with Occupational Safety and Health Administration requirements outlined in Title 29 of the Code of Federal Regulations Part 1926 Subpart P. The design of this system, if needed, will be included in the Remedial Design and will consider measures to address the stability of roadways or buildings adjacent to the excavation. However, a need for such support systems is not anticipated because of the relatively shallow depth of unsaturated soils at the site.

4.2 Design Task 2 – In Situ Thermal Remediation

The RAO for ISTR is to eliminate DNAPL in soil within AOCs 1 and 3, except DNAPL beneath buildings or the NYSEG substation. The treatment technology will be Electrical Resistance Heating (ERH) or Thermal Conductive Heating (TCH). These technologies and the evaluation for their selection as potentially appropriate technologies for the site are discussed in the *CMS Report*, *CMS Addendum,* and Statement of Basis (Malcolm Pirnie 2005a, Arcadis 2016b). Following the approval of this CAWP and completion of the PDI, GTEOSI will retain (or hire a contractor to subcontract) an ISTR contractor to design and implement ISTR via TCH or ERH. GTEOSI will submit the ISTR design as part of the Remedial Design. This section presents the remedial approach for ISTR in AOCs 1 and 3, general details for the ISTR implementation, and the basis of design for the ISTR system.

4.2.1 In Situ Thermal Remediation Technology

ISTR will generally involve heating impacted soil and groundwater within the treatment areas to volatilize or destroy DNAPL and adsorbed phase and dissolved phase COCs that may be present in the target treatment areas. Steam and COC vapors generated during heating will be recovered using vacuum extraction wells and treated on site. The major components of this technology will consist of:

- Installing a thermal wellfield (heater wells, extraction wells, monitoring points)
- Constructing a vapor cover (as necessary)
- Installing electrical control systems
- Installing aboveground liquid and vapor treatment systems
- Conducting ISTR
- Decommissioning the wellfield

ISTR will be conducted using one these technologies:

- TCH via an array of vertical heater wells (electrically powered or gas-fired heating elements placed into grouted borings within well casings); heat is transferred via thermal conduction.
- ERH via an array of subsurface electrodes; electrical current passes through wetted soil (between electrodes) and the resistance to the current flow releases energy in the form of heat, which increases the subsurface temperature.

Besides the heater wells/electrodes, the ISTR wellfield will consist of a network of vertical and/or horizontal vapor extraction wells, pressure monitoring points (PMPs), and temperature monitoring points (TMPs). Heater wells/electrodes will be installed spaced 8 to 15 feet apart and will extend approximately 5 feet beneath the deepest targeted treatment depth to adequately heat the source areas. Vertical and/or horizontal vapor extraction wells will extract vapors within the treatment limits. PMPs will be installed to monitor the soil gas pressure differential in the upper boundary of the treatment area, while TMPs will be installed to monitor the temperature at various depth intervals within the treatment limits. The final number of heater wells/electrodes, vertical and horizontal extraction wells, and PMPs and TMPs will be determined during the Remedial Design phase.

A vapor cover may be needed on the ground surface over the proposed treatment area(s) to prevent rainfall infiltration into the subsurface, limit heat losses, and facilitate the collection of vapors from the ISTR. The expected treatment areas are covered with asphalt pavement/concrete, which should be effective as a vapor cover during treatment. A final determination will be made during the Remedial Design phase. Treatment will generally be conducted at a target temperature of approximately 212°F in the following treatment phases:

- Startup phase – During the startup phase, operation of the vacuum extraction system and hydraulic control, if warranted, will be initiated.
- Heating to target temperature phase – The heating phase will involve steadily increasing subsurface temperatures until the target temperature is reached throughout the treatment area. During the heating phase, the volatilization of COCs (or in situ destruction) will be initiated.
- Holding target temperature phase – The holding target temperature phase will involve operating at target temperatures to complete the removal of COCs from impacted media.
- Cooling phase – The cooling phase will include continued operation of the vapor extraction system after active heating has been completed. Vapor extraction is necessary during this phase to remove remaining vapors and to limit pressure buildup while subsurface temperatures drop below steam-producing levels. Confirmation samples will be collected during this phase to verify that treatment goals are met.

Based on the nature and extent of the DNAPL, treatment will be conducted for an estimated total duration of 9 months, including system construction. The final treatment approach and duration will be evaluated during the Remedial Design phase.

Vapors generated during treatment will be collected and conveyed to an on-site treatment system comprised of a condensate recovery front-end unit followed by granular-activated carbon (GAC) vessels and/or a thermal oxidizer/scrubber system (as necessary) to remove volatilized COCs.

Liquids generated during treatment (e.g., via condensation) will be transported to an off-site facility for disposal. DNAPL collected via the groundwater extraction and/or vapor condensation systems will be containerized and transported to an off-site facility for recycling and/or disposal.

After treatment, above-grade infrastructure (i.e., conveyance piping, effluent treatment equipment, and control systems) will be dismantled, decontaminated, and removed from the site; the concrete vapor cover will be removed, as necessary, and the subsurface wellfield will be decommissioned.

4.2.2 Remedial Design Components

The ISTR remedial design will include the final design and technology approach (i.e., ERH or TCH) to address DNAPL at the site. The ISTR system will be designed to achieve the RAO. The ISTR design will, at a minimum, include:

- Written narrative outlining the assumptions used in preparing the ISTR remedial design.
- Assessment of existing asphalt/concrete pavement as vapor cover for the ISTR system. If the existing building slab/pavement cannot be a vapor cover (to be assessed during the Remedial Design phase), a design, rationale, and specifications for a vapor barrier/cover for the thermal wellfield and adjacent area as needed (e.g., R-value, extent of cover outside of the treatment footprint or the outer ring of heater wells/electrodes, etc.). Rationale for ISTR technology (i.e., TCH or ERH) selection.
- Field spacing and layout of wellfield elements, including number, locations, and depths of heater wells/electrodes; vertical/horizontal extraction wells; TMPs; and PMPs.
- Design/construction details for heater wells/electrodes, vertical/horizontal extraction wells, TMPs, and PMPs (e.g., soil boring depths and diameters, wellfield element construction details, vertical spacing for thermocouples, etc.).
- Design/construction details for aboveground vapor and liquid piping.
- Energy balance, including:
    - ISTR system energy input
    - Total energy anticipated to be required to complete treatment, including energy used for heating and energy required for liquid/vapor treatment and ancillary equipment
    - Energy density
    - Percentage (%) of water estimated to be removed as steam
    - Energy/heat losses (%)
    - Estimated heat-up rate
- Estimated total duration of operations (i.e., system shakedown/startup, heating to target temperature, heating at target temperature, confirmation sampling, and cooldown).
- Preferred approach for dewatering the treatment zones or pre-heating water entering the treatment zones to prevent the cooling effect of water, as necessary.

- Preferred approach for vapor and liquid extraction and treatment, including estimated treatment flow rates.
- Utility requirements and total usages (i.e., power, natural gas, fresh/potable water, discharge to sewer, etc.).
- A list of required permits and associated permit requirements.
- The total quantity of all waste streams anticipated to be generated during ISTR implementation.
- An ISTR implementation schedule with the estimated duration and sequencing.

4.2.3 Post-ISTR Sampling

At the end of remedial operations, the ISTR system will be shut down, although operation of the soil vapor extraction component system will continue. At least 2 days will pass before the soil confirmation samples are collected. Post-remediation confirmation sample locations will be co-located with historical sampling locations within AOCs 1 and 3 where DNAPL was historically observed. The confirmation soil samples will be collected following treatment using standard hot-soil sampling procedures (following the Confirmation Sampling Plan to be included in the ISTR design) and will be submitted to an analytical laboratory for VOC analysis on an expedited turnaround-time basis (e.g., 24-hour turnaround analyses). DNAPL treatment will be confirmed using soil analytical results that indicate TCE concentrations less than the calculated soil saturation limit of 492 mg/kg in all confirmation samples.

4.3 Design Task 3 – Waste Management

A section of the Remedial Design will be dedicated to waste management and will address the waste streams anticipated to be generated during implementation of the remedial action. The waste management plan will include these components:

- Applicable codes, standards, and specifications.
- Description of anticipated waste streams.
- Materials handling activities required for each waste stream.

4.4 Design Task 4 – Backfilling and Site Restoration

In accordance with the Statement of Basis, material brought on site for backfill for OUs 1 and 2 will meet SCOs for the Protection of Groundwater and for the Protection of Ecological Resources, respectively, as presented in 6 NYCRR Part 375-6.8(b). However, gravel, rock, or stone backfill that consists of virgin material from a permitted mine or quarry may be imported to the site without chemical testing (i.e., for use as backfill beneath pavement, buildings, or as part of the final site cover) provided that it contains less than 10% by weight material that would pass through a size 80 sieve.

The paved portions of the site to be removed for soil remedial activities will be restored to their original condition, to the extent practical. Pavement is anticipated to consist of base, binder, and top course layers, and details will be provided in the Remedial Design. A restoration plan for excavation performed within the historical outfall ditches and the 100-year floodplain, including erosion controls, will be included in the Remedial Design. Where soil cover is required, it will be a minimum of 1 foot of soil, meeting the requirements for cover material as set forth in 6 NYCRR Part 375-6.7(d) for commercial or residential use (matching the zoning of the parcel in which the cover is placed). The soil cover will be placed over a demarcation layer, with the upper 6 inches of the soil of sufficient quality to maintain a vegetation layer. Restoration of excavation areas within the floodplain will be completed only if the removal will leave unstable soil or canal bank. GTEOSI will not replant trees or shrubs, other than for erosion control.

5 PERMITS AND APPROVALS

The PDI will commence upon approval of this CAWP by NYSDEC. Necessary permits and approvals required for PDI activities will be obtained to perform subsurface investigations within AOCs 1, 3, and 5. If road lane closures are necessary to complete PDI activities, approvals will be received from the appropriate property owner or authoritative body. No permits are anticipated to advance soil borings at the site. Access agreements with New York State Canal Corporation, which owns certain land between the canal and the site, will also be established and modified, as necessary. Work will commence on New York State Canal Corporation property only after an access agreement is executed.

Regulatory and permitting requirements associated with implementing the soil corrective actions will be identified in the Remedial Design.

6 REMEDIAL DESIGN DOCUMENTS

The Remedial Design will be submitted in phases and will include a Pre-Final (95% Design) and Final Design (100% Design). The schedule for preparing the Remedial Design is discussed further in Section 7.

The Pre-Final and Final Remedial Design documents to be prepared for the remedy are described below. Consistent with the requirements set forth in DER-10, it is anticipated that the soil Remedial Design will include:

- A set of engineering design drawings that provide an accurate representation of existing site conditions and of the proposed work. It is anticipated that the engineering design drawings will include the following:
    - Title Sheet – to include the title of the project, key map, Arcadis name, date prepared, sheet index, and USEPA/NYSDEC project identification.
    - Existing Site Conditions – to include pertinent property data including owners of record for all properties for which remedial actions are planned as part of the Remedial Design; existing buildings and structures, wells, facilities, and equipment; a topographic survey of existing contours and spot elevations within the project limits of disturbance, known existing underground and aboveground utilities; and locations and identification of significant natural features such as wooded areas, water courses, and the 100-year floodplain.
    - Site Remediation Plan – to include requirements for erosion and sedimentation controls, site facilities (parking areas, decontamination area, equipment/material laydown area), limits of the excavation, and ISTR treatment area.
    - Restoration Plan – to include final topography (proposed contours and spot elevations) of the site, limits of any final surface covers, final surface restoration for disturbed adjacent properties, and other final restoration features.
    - Miscellaneous Details – to include details related to the surface cover profiles, and final surface water runoff and sedimentation controls.
- Technical Specifications for environmental controls, excavation, backfill/restoration, waste transportation and disposal, ISTR, and support facilities if needed.

The Final Remedial Design will include finalized (i.e., biddable quality) versions of the drawings and specifications. The Final Remedial Design will be stamped and signed by a Professional Engineer registered in the State of New York and submitted to NYSDEC. NYSDEC comments will be addressed in a response letter or a subsequent submittal of the Remedial Design.

In addition to drawings and specifications, the following documents will also be prepared in support of remedial construction activities:

- A corrective action schedule.
- A Community Air Monitoring Plan (CAMP) following the NYSDOH generic CAMP, identifying the perimeter air monitoring requirements during the implementation of remedial construction activities.

- A site-specific HASP for the protection of construction workers implementing the remedial construction activities.
- A Stormwater Pollution Prevention Plan (SWPPP) prepared in accordance with New York’s State Pollutant Discharge Elimination System (SPDES) requirements, as applicable.

7 REMEDIAL DESIGN SCHEDULE

The anticipated schedule for implementing the proposed PDI and preparing the Remedial Design for the site is presented in this table. The table includes work activities and estimated milestone dates (note that the CCR for the vapor intrusion mitigation corrective measures implemented at the site is anticipated to be submitted in 2019).

Activity	Milestones
CAWP	
Submit Draft CAWP to NYSDEC	-
NYSDEC review/comments on CAWP	Two months following submittal
Meeting between NYSDEC and GTEOSI to discuss CAWP comments (if necessary)	One month following receipt of NYSDEC comments
Submit Final CAWP to NYSDEC	One month following receipt of NYSDEC comments, or one month following CAWP meeting (if held)
NYSDEC review/approval of CAWP	One month following submittal of Final CAWP
PDI	
Access agreements and subcontracting completed	One month following approval of Final CAWP
PDI field activities completed	Two months following completion of access and subcontracting agreements
Submit PDI Report to NYSDEC	Four months following completion of PDI field activities
Soil Remedial Design	
Pre-Final (95% Design)	Six months following PDI report submittal
Final (100% Design)	Three months following 95% design

The project schedule is tentative and depends on NYSDEC response time for review/approval of this CAWP and review/approval of the design documents. The schedule for implementing the PDI activities could be impacted by weather conditions and/or unexpected field conditions requiring additional soil borings. In addition, the results of the initial PDI activities may warrant supplemental PDI activities, which could change the project schedule. Completion of utility investigation activities may require additional time to achieve project objectives and affect the project schedule. GTEOSI will notify NYSDEC of any delays that impact the schedule for completing the PDI and design-related activities.

8 POST-CONSTRUCTION ACTIVITIES

Anticipated post-construction activities to be performed following completion of the soil remedial action are described below and include preparation of a Final Engineering Report (FER), implementation of institutional controls, development of an SMP, and development of an O&M Plan.

8.1 Final Engineer Report

Following completion of remedial construction activities, a Final Engineer Report will be prepared and submitted to NYSDEC in accordance with DER-10 requirements and will include:

- A summary of the remedial activities completed.
- A set of as-built drawings depicting remedial activities completed.
- Deviations from the Remedial Design.

8.2 Institutional Controls

Following completion and approval by NYSDEC of soil remedial construction activities, institutional controls will be established for the site. An environmental easement for the site will be filed and periodic certifications of both institutional and engineering controls will be completed and submitted to NYSDEC following Part 375- 1.8 (h)(3). Institutional controls will limit the use of the site to commercial or industrial use as defined by Part 375-1.8 (g), as long as such use complies with local zoning laws. Institution controls will also restrict the use of groundwater as a source of potable or process water, unless treated, as determined by NYSDOH or Seneca Country Department of Health. Finally, institutional controls will require compliance with the SMP.

8.3 Site Management Plan

An SMP will be prepared in accordance with the Statement of Basis and submitted for NYSDEC approval. The SMP will include an Institutional and Engineering Control Plan that identifies the use restrictions and engineering controls for the site, and the requirements to assure all controls remain in place and effective. Engineering controls will control exposure to contaminants remaining at the site following remedial construction activities. The Institutional and Engineering Control Plan will identify institutional and engineering controls and associated requirements including, at a minimum:

- An Excavation Plan that details the management of potential future excavations in areas with remaining contamination.
- A provision for future investigations to refine the nature and extent of contamination and to conduct remediation prior to, or in association with, redevelopment in areas where access was hindered.
- Establishment of periodic sediment cover evaluations in Van Cleef Lake. Contingencies will be provided to address the possibility of unacceptable erosion or other changes to the lake bottom.
- Requirements for the management and inspection of site engineering controls.
- Requirements to maintain site access controls and notification of NYSDEC.

- Stipulations for the periodic review and certification of institutional controls.
- Stipulations for the management and inspection of site engineering controls.
- Requirements for an environmental easement. As part of the environmental easement, drawings, or other boundary descriptions of the areas subject to institutional controls will be prepared, included, and filed in the property records of Seneca County.

The SMP will specifically describe the environmental easement required as an institutional control, including any groundwater use restrictions. It will also contain a provision that the owners of adjacent properties may request to have their properties sampled and that NYSDEC, in consultation with NYSDOH, will evaluate such requests and take appropriate action. Finally, the SMP will include a Monitoring Plan. The Monitoring Plan will assess the performance and effectiveness of corrective measures and will include, at a minimum:

- Groundwater monitoring requirements to assess the performance and effectiveness of the remedy, including a provision for implementing actions recommended to address exposure. Groundwater monitoring is anticipated to be conducted biannually for the existing well network. The monitoring locations and frequency of monitoring at each location will be proposed in the Monitoring Plan. Groundwater concentrations will be compared over time to forecasted concentrations developed as part of the Monitoring Plan and will be used to assess the performance and effectiveness of corrective measures.
- A requirement for continued monitoring for soil vapor intrusion for existing buildings.
- A stipulation requiring monitoring for soil vapor intrusion for any buildings developed on the site, as may be required by the Institutional and Engineering Control Plan.
- Monitoring requirements for restoration areas.
- Provisions for monitoring to determine if soils remain contained and undisturbed.
- Provisions for monitoring to determine if sediments remain contained and undisturbed.
- A schedule of monitoring and frequency of submittals to NYSDEC.

8.4 Operations and Maintenance Plan

An O&M Plan will be prepared that describes the operation, maintenance, optimization, monitoring, inspection, and reporting for ongoing mechanical or physical components of the remedy and site access control. It is expected that the soil vapor intrusion ICMs will become the final remedy for AOC 4 (soil vapor intrusion pathways) once the Final Engineering Report for the site is submitted and approved by NYSDEC. The O&M Plan will contain O&M procedures for all mechanical or physical components of the remedy. Compliance monitoring of treatment systems will be detailed, including the frequency and specifics of tasks. The O&M Plan will describe the data to be collected during O&M activities and how data generated during these activities will be retained and shared with NYSDEC if requested.

9 REFERENCES

Arcadis. 2012. *Sub-Slab Vapor Investigation Work Plan*. Former Philips Display Components Facility, Seneca Falls, New York. August 2012.

Arcadis. 2012b. *Multi-Phase Extraction Investigation Work Plan*. Former Philips Display Components Facility, Seneca Falls, New York. September 2012.

Arcadis. 2013. *Corrective Measures Study Report*. Former Philips Display Components Facility, Seneca Falls, New York. June 2013.

Arcadis. 2016a. *Sub-Slab Depressurization System Conceptual Design Report.* Former Philips Display Components Facility, Seneca Falls, New York. January 2016.

Arcadis. 2016b. *Corrective Measures Study Report Addendum*. Former Philips Display Components Facility, Seneca Falls, New York. October 2016.

Arcadis. 2018. September 2018 Semi-Annual Groundwater Sampling Event. Former Philips Display Components Facility, Seneca Falls, New York. December 2018.

Chester Engineers. 1987. *Philips ECG Closure Plan*, Philips ECG, Inc. 50 Johnston Street, Seneca Falls, New York. Revised May 1987.

Chester Environmental. 1994. *RCRA Facility Assessment Sampling Visit Investigation Report*. Philips Display Component Company, Seneca Falls, New York. March 1994.

Einarson, M., A. Fure, R. St. Germain, S. Chapman, and B. Parker. 2016. Direct Push Optical Screening Tool for High-Resolution, Real-Time Mapping of Chlorinated Solvent DNAPL Architecture; Department of Defense Environmental Security Technology Certification Program Project ER-201121. April 2016.

Einarson, M., A. Fure, R. St. Germain, S. Chapman, and B. Parker. 2018. DyeLIF™: A New Direct-Push Laser-Induced Fluorescence Sensor System for Chlorinated Solvent DNAPL and Other Non-Naturally Fluorescing NAPLs. Groundwater Monitoring and Remediation 38, no. 3, Summer 2018. Pgs. 28-42.

Kueper, Bernard H. and Kathryn L. Davies. 2009. Assessment and Delineation of DNAPL Source Zones at Hazardous Waste Sites. USEPA Groundwater Issue. USEPA National Risk Management Research Laboratory Cincinnati, Ohio 45268. EPA/600/R-09/119. September 2009.

Malcolm Pirnie, Inc. 2003a. *Soil Vapor Intrusion Pathway Investigation Work Plan and Quality Assurance Project Plan*. Former Philips Display Components Facility, Seneca Falls, New York. May 2003.

Malcolm Pirnie, Inc. 2003b. *Proposed Ventilation System - Building 9 Office Area.* Former Philips Display Components Facility, Seneca Falls, New York. December 2003.

Malcolm Pirnie, Inc. 2004a. *Soil Vapor Intrusion Pathway Investigation Report.* Former Philips Display Components Facility, Seneca Falls, New York. September 2004.

Malcolm Pirnie, Inc. 2004b. *Historic Outfall Evaluation Report*. Former Phillips Display Components Facility, Seneca Falls, New York. December 2004.

Malcolm Pirnie, Inc. 2005a. *Corrective Measures Study Work Plan*. Former Philips Display Components Facility, Seneca Falls, New York. May 2005.

Malcolm Pirnie, Inc. 2005b. *Historic Outfall Sediment Sampling Preliminary Summary Report*. Former Phillips Display Components Facility, Seneca Falls, New York. August 2005.

Malcolm Pirnie, Inc. 2005c. *Building 11 Area Sub-Slab Depressurization System Design Plan*. Former Philips Display Components Facility, Seneca Falls, New York. November 2005.

Malcolm Pirnie, Inc. 2006. *Building 7 Area Sub-Slab Depressurization System Design Plan*. Former Philips Display Components Facility, Seneca Falls, New York. April 2006.

Malcolm Pirnie, Inc. 2008. *Building 10 Soil Sampling and Sub-Slab Depressurization Pilot Test Work Plan.* Former Philips Display Components Facility, Seneca Falls, New York. October 2008.

Malcolm Pirnie, Inc. 2009. *Building 10 Area Sub-Slab Depressurization System Design Plan*. Former Philips Display Components Facility, Seneca Falls, New York. May 2009.

Modreski, P.J. 1987. *Ultraviolet fluorescence of minerals: Examples from New Mexico*. New Mexico Geology, Vol. 9, No. 2. May 1987.

NYSDEC. 1994. Fish and Wildlife Impact Analysis for Inactive Hazardous Waste sites. October 1994.

NYSDEC. 2010. Final Program Policy DER-10 Technical Guidance for Site Investigation and Remediation. May 3, 2010.

NYSDEC. 2018. Statement of Basis. G.T.E. Products Corporation Seneca Falls, Seneca County Site No. 850003. March 2018.

NYSDOH. 2006. Guidance for Evaluating Soil Vapor Intrusion in the State of New York. October 2006.

Secor International, Inc. 1996. *RCRA Facility Investigation Work Plan for the Philips Display Components Company, Seneca Falls, New York*. July 16, 1996.

URS Corporation (URS). 2002. *RCRA Facility Investigation, Former Phillips Display Components Facility, Seneca Falls, New York for GTE Operations Support Incorporated, Volume 1*. June 2002.

USEPA. 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. December 2002.

USEPA. 2003. Documentation of Environmental Indicator Determination, RCRA Corrective Action, Environmental Indicator RCRIS code (CA750) Migration of Contaminated Groundwater Under Control, USEPA. September 2003.

USEPA. 2005. Documentation of Environmental Indicator Determination, RCRA Corrective Action, Environmental Indicator RCRIS code (CA725) Current Human Exposures Under Control, USEPA. September 2005.

TABLES

Table 1
Applicable or Relevant and Appropriate Requirements

Former Philips Display Components Facility
Seneca Falls, New York

Regulation/Authority	Citation	Requirement Synopsis
Chemical-Specific ARARs and Other Guidelines		
RCRA-Regulated Levels for Toxic Characteristics Leaching Procedure (TCLP) Constituents	42 U.S.C. §§ 6905, 6912, 6921-6922; 40 CFR Part 261	These regulations specify the TCLP constituent levels for identification of hazardous wastes that exhibit the characteristic of toxicity.
Universal Treatment Standards/Land Disposal Restrictions (UTS/LDRs), Solid Waste Disposal Act, as amended	42 U.S.C.§§6905, 6912(a), 6921, 6924; 40 CFR Part 268	Identifies hazardous wastes for which land disposal is restricted and provides a set of numerical constituent concentration criteria at which hazardous waste is restricted from land disposal (without treatment).
NYSDEC Soil Cleanup Objectives	New York State Environmental Conservation Law (ECL), Article 27; 6 NYCRR subpart 375-6	NYSDEC Remedial Program Soil Cleanup Objectives applicable to the execution of soil remedial programs.
New York State Surface Water and Groundwater Quality Standards	ECL §§3-0301[2][m], 15-0313, 17-0301, 17-0809; 6 NYCRR Part 703	Establishes water quality standards for surface water and groundwater.
NYSDEC Ambient Water Quality Standards and Guidance Values	ECL, Article 17; 6 NYCRR Parts 700-706; Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1 (6/98);	Provides a compilation of ambient water quality standards and guidance values for toxic and non-conventional pollutants (except for coliforms and dissolved oxygen) for use when there are no standards or regulatory effluent limitations in 6 NYCRR §703.5.
Identification and Listing of Hazardous Wastes	ECL Article 27; 6 NYCRR Part 371	Outlines criteria for determining if a solid waste is a hazardous waste and is subject to regulation under 6 NYCRR Parts 371-376.
Action-Specific ARARs and Other Guidelines		
Occupational Safety and Health Act (OSHA) - General Industry Standards	29 USC §553 and 42 USC§126; 29 CFR §1910.120	These regulations specify the 8-hour time-weighted average concentration for worker exposure to various compounds. Training requirements for workers at hazardous waste operations are specified in 29 CFR §1910.120.
OSHA – Safety and Health Standards	40 U.S.C. §333; 29 U.S.C. §§653, 655, 657; 29 CFR Part 1926	These regulations specify the type of safety equipment and procedures to be followed during site remediation.
OSHA – Recordkeeping, Reporting and Related Regulations	29 U.S.C. §§657, 658, 660, 669, 673; 29 CFR Part 1904	These regulations outline recordkeeping and reporting requirements for an employer under OSHA.
RCRA – Preparedness and Prevention	42 U.S.C. §§6905, 6912(a), 6924, and 6925; 40 CFR §§264.30 - 264.31	Outlines requirements for safety equipment and spill control when treating, handling and/or storing hazardous wastes.
RCRA – Contingency Plan and Emergency Procedures	42 U.S.C. §§6905, 6912(a), 6924, and 6925; 40 CFR §§ 264.50 - 264.56	Provides emergency procedures to be used following explosions, fires, etc. when storing hazardous wastes.
Superfund Green Remediation Strategy	www.epa.gov/superfund/greenremediation/sf-gr- strategy.pdf	Provides USEPA's strategy to clean up hazardous waste sites in ways that use natural resources and energy efficiently and reduces negative impacts on human health and the environment.

See Notes on Page 3.

Regulation/Authority	Citation	Requirement Synopsis
Action-Specific ARARs and Other Guidelines (cont.)		
RCRA 90-Day Accumulation Rule for Hazardous Waste	42 U.S.C.§§ 6906, 6912, 6922-6925, 6937, and 6938; 40 CFR Part 262	Allows generators of hazardous waste to store and treat hazardous waste at the generation site for up to 90 days in tanks, containers and containment buildings without having to obtain a RCRA hazardous waste permit.
Standards Applicable to Transporters of Applicable Hazardous Waste – RCRA	42 U.S.C.§§ 6906, 6912, 6922-6925, 6937, and 6938; 40 CFR Part 263	Establishes the responsibility of off-site transporters of hazardous waste in the handling, transportation and management of the waste. Requires manifesting, recordkeeping and immediate action in the event of a discharge.
RCRA – General Standards	42 U.S.C. §§6905, 6912(a), 6924, and 6925; 40 CFR Part 264	General performance standards requiring minimization of need for further maintenance and control; minimization or elimination of post- closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products. Also requires decontamination or disposal of contaminated equipment, structures and soils.
U.S. Department of Transportation (USDOT) Rules for Transportation of Hazardous Materials	49 CFR Parts 107 and 171.1-172.558	Outlines procedures for the packaging, labeling, manifesting and transporting of hazardous materials.
RCRA Hazardous Waste Permit Program	42 U.S.C. §6925; 40 CFR Part 270	Covers the basic permitting, application, monitoring and reporting requirements for off-site hazardous waste management facilities
Green Remediation	DER-31	Provides concepts and techniques of green remediation and guidance on how to apply them to remedial programs under DER.
New York Hazardous Waste Management System - General	ECL, Article 27; 6 NYCRR Part 370	Provides definitions of terms and general instructions for the Part 370 series of hazardous waste management.
Identification and Listing of Hazardous Wastes	ECL, Article 27; 6 NYCRR Part 371	Outlines criteria for determining if a solid waste is a hazardous waste and is subject to regulation under 6 NYCRR Parts 371-376.
Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities	ECL, Article 27; 6 NYCRR Part 372	Provides guidelines relating to the use of the manifest system and its recordkeeping requirements. It applies to generators, transporters and facilities in New York State.
New York Regulations for Transportation of Hazardous Waste	ECL, Article 27; 6 NYCRR Part 372.3 a-d	Outlines procedures for the packaging, labeling, manifesting and transporting of hazardous waste.
Waste Transporter Permits	ECL, Article 27, Titles 3, 9, and 15; 6 NYCRR Part 364	Governs the collection, transport and delivery of regulated waste within New York State.

See Notes on Page 3.

Table 1
Applicable or Relevant and Appropriate Requirements

Former Philips Display Components Facility
Seneca Falls, New York

Regulation/Authority	Citation	Requirement Synopsis
Action-Specific ARARs and Other Guidelines (cont.)		
New York Regulations for Hazardous Waste Management Facilities	ECL, Article 27; 6 NYCRR Part 373.1.1 - 373.1.8	Provides requirements and procedures for obtaining a permit to operate a hazardous waste treatment, storage and disposal facility. Also lists contents and conditions of permits.
Land Disposal of a Hazardous Waste	6 NYCRR Part 376	Restricts land disposal of hazardous wastes that exceed specific criteria.

Notes:
1. CFR = Code of Federal Regulations
2. DER = Division of Environmental Remediation
3. NYCRR = New York Codes, Rules, and Regulations
4. NYSDEC = New York State Department of Environmental Conservation
5. RCRA = Resource Conservation and Recovery Act
6. U.S.C. = United States Code
7. USEPA = United States Environmental Protection Agency

Table 2
Proposed Pre-Design Investigation Sampling and Gauging Summary

Former Philips Display Components Facility
Seneca Falls, New York

Location	Depth (feet bgs)	Cadmium Screening	Cadmium	TCL VOCs	TOC	Moisture Content	TCLP Parameters	DNAPL Screening	Conductivity Testing	Synoptic Fluid Level Gauging
Monitoring Wells										
MW-1	- -									X
MW-20	- -									X
MW-21	- -									X
MW-22	- -									X
MW-23	- -									X
MW-24	- -								X	X
MW-25	- -								X	X
MW-26	- -								X	X
MW-27	- -									X
MW-28	- -									X
MW-29	- -									X
MW-BR-01	- -									X
MW-BR-02	- -									X
MW-BR-03	- -									X
MW-BR-04	- -									X
MW-BR-05	- -									X
MW-BR-06	- -									X
OU1 Soil Borings										
Shallow Excavation Delineation Borings (exact number of borings to be advanced will depend on field conditions [e.g., distribution of constituents of potential concern])										
AOC1-S-01	0-2 & 4-6 or WT			X						
AOC1-S-02	0-2 & 4-6 or WT			X						
AOC1-S-03	0-2 & 4-6 or WT			X						
AOC1-S-04	0-2 & 4-6 or WT			X						
AOC1-S-05	0-2 & 4-6 or WT			X						
AOC1-S-06	0-2 & 4-6 or WT			X						
AOC1-S-07	0-2 & 4-6 or WT			X						
AOC1-S-08	0-2 & 4-6 or WT			X						
AOC1-S-09	0-2 & 4-6 or WT			X						
AOC1-S-10	0-2 & 4-6 or WT			X						
AOC1-S-11	0-2 & 4-6 or WT			X						
AOC1-S-12	0-2 & 4-6 or WT			X						
DNAPL Delineation Borings (exact number of borings to be advanced will depend on the distribution of DNAPL)										
AOC1-D-01	One or more samples			X				X		
AOC1-D-02	One or more samples			X				X		
AOC1-D-03	One or more samples			X				X		
AOC1-D-04	One or more samples			X	X	X		X		
AOC1-D-05	One or more samples			X				X		
AOC1-D-06	One or more samples			X				X		
AOC1-D-07	One or more samples			X				X		
AOC1-D-08	One or more samples			X				X		
AOC1-D-09	One or more samples			X				X		

See Notes on Page 3.

Table 2
Proposed Pre-Design Investigation Sampling and Gauging Summary

Former Philips Display Components Facility
Seneca Falls, New York

Location	Depth (feet bgs)	Cadmium Screening	Cadmium	TCL VOCs	TOC	Moisture Content	TCLP Parameters	DNAPL Screening	Conductivity Testing	Synoptic Fluid Level Gauging
OU1 Soil Borings (Cont.)										
DNAPL Delineation Borings (exact number of borings to be advanced will depend on the distribution of DNAPL) (Cont.)										
AOC1-D-10	One or more samples			X	X	X		X		
AOC1-D-11	One or more samples			X				X		
AOC1-D-12	One or more samples			X				X		
AOC3-D-01	One or more samples			X				X		
AOC3-D-02	One or more samples			X				X		
AOC3-D-03	One or more samples			X				X		
AOC3-D-04	One or more samples			X	X	X		X		
AOC3-D-05	One or more samples			X				X		
AOC3-D-06	One or more samples			X				X		
AOC3-D-07	One or more samples			X				X		
AOC3-D-08	One or more samples			X				X		
AOC3-D-09	One or more samples			X				X		
AOC3-D-10	One or more samples			X	X	X		X		
AOC3-D-11	One or more samples			X				X		
AOC3-D-12	One or more samples			X				X		
OU2 Soil Borings										
Ditch Borings (exact number of borings to be advanced will depend on field conditions [e.g., distribution of constituents of potential concern])										
HO2-DITCH-01	Approximately 0-2	X	X							
HO2-DITCH-02	Approximately 0-2	X	X							
HO2-DITCH-03	Approximately 0-2	X	X				X			
HO2-DITCH-04	Approximately 0-2	X	X							
HO2-DITCH-05	Approximately 0-2	X	X							
HO2-DITCH-06	Approximately 0-2	X	X							
HO3-DITCH-01	Approximately 0-2	X	X							
HO3-DITCH-02	Approximately 0-2	X	X				X			
HO3-DITCH-03	Approximately 0-2	X	X							
HO4-DITCH-01	Approximately 0-2	X	X							
HO4-DITCH-02	Approximately 0-2	X	X				X			
HO4-DITCH-03	Approximately 0-2	X	X							
HO4-DITCH-04	Approximately 0-2	X	X							
HO4-DITCH-05	Approximately 0-2	X	X							
HO5-DITCH-01	Approximately 0-2	X	X							
HO5-DITCH-02	Approximately 0-2	X	X				X			
HO5-DITCH-03	Approximately 0-2	X	X							
HO5-DITCH-04	Approximately 0-2	X	X							
HO5-DITCH-05	Approximately 0-2	X	X							
HO5-DITCH-06	Approximately 0-2	X	X							
HO6-DITCH-01	Approximately 0-2	X	X							
HO6-DITCH-02	Approximately 0-2	X	X				X			
HO6-DITCH-03	Approximately 0-2	X	X							

See Notes on Page 3.

Table 2
Proposed Pre-Design Investigation Sampling and Gauging Summary

Former Philips Display Components Facility
Seneca Falls, New York

Location	Depth (feet bgs)	Cadmium Screening	Cadmium	TCL VOCs	TOC	Moisture Content	TCLP Parameters	DNAPL Screening	Conductivity Testing	Synoptic Fluid Level Gauging
OU2 Soil Borings (Cont.)										
Ditch Borings (exact number of borings to be advanced will depend on field conditions [e.g., distribution of constituents of potential concern]) (Cont.)										
HO6-DITCH-04	Approximately 0-2	X	X							
HO7-DITCH-01	Approximately 0-2	X	X							
HO7-DITCH-02	Approximately 0-2	X	X				X			
HO7-DITCH-03	Approximately 0-2	X	X							
HO7-DITCH-04	Approximately 0-2	X	X							
HO67-DITCH-01	Approximately 0-2	X	X				X			
HO67-DITCH-02	Approximately 0-2	X	X							
HO67-DITCH-03	Approximately 0-2	X	X							
HO67-DITCH-04	Approximately 0-2	X	X				X			
HO67-DITCH-05	Approximately 0-2	X	X							
HO67-DITCH-06	Approximately 0-2	X	X							
HO67-DITCH-07	Approximately 0-2	X	X				X			
Summary		**35**	**35**	**36**	**4**	**4**	**9**	**24**	**3**	**17**

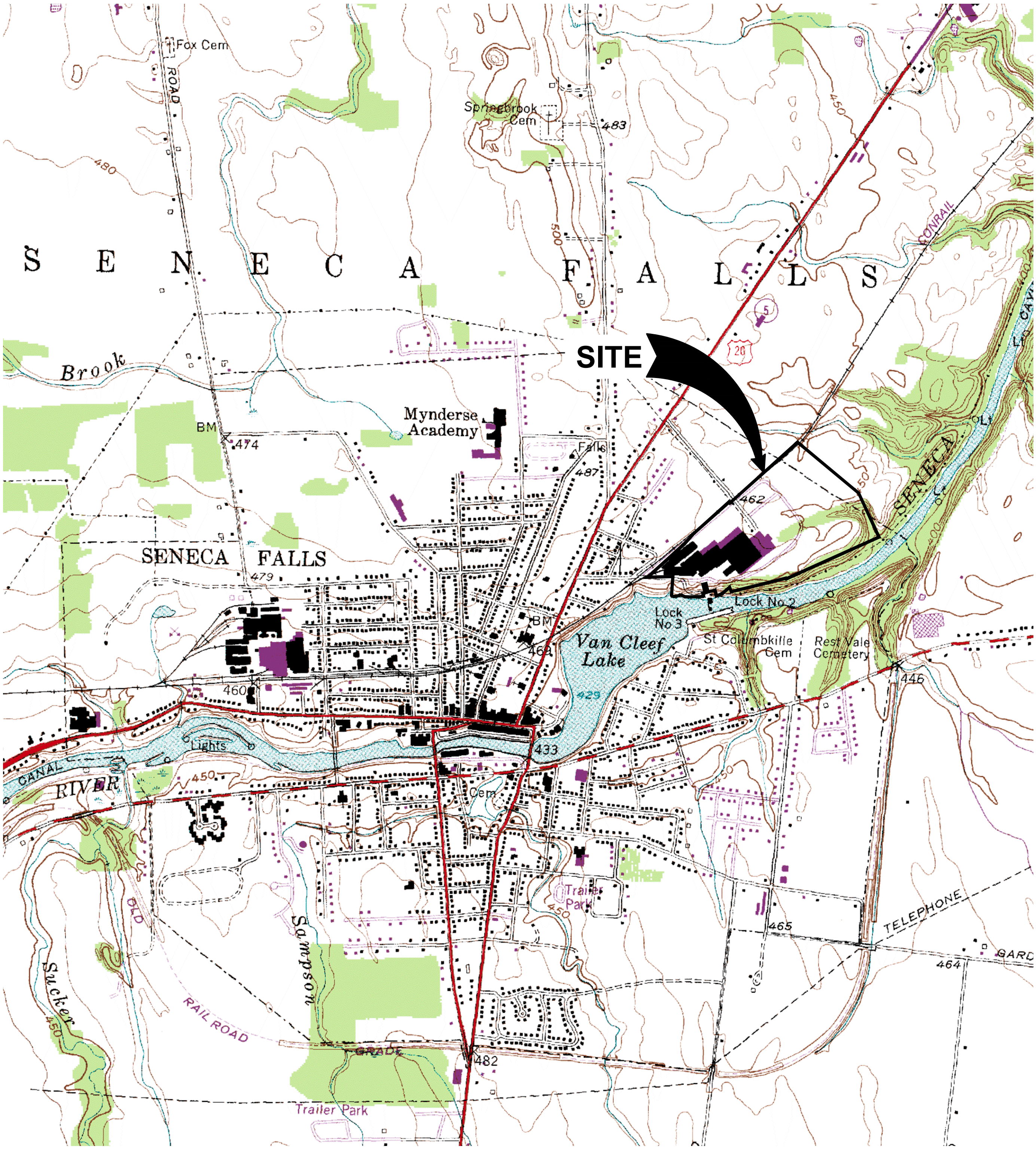
Notes:

1. PDI = Pre-Design Investigation.
2. bgs = below ground surface.
3. Cadmium Screening = Screening level analyses of cadmium with a portable X-Ray Fluorescence meter.
4. Cadmium = Cadmium by United States Environmental Protection Agency (USEPA) SW846 Method - 6000 series.
5. TCL VOCs = USEPA Target Compound List (TCL) Volatile Organic Compounds (VOC) by USEPA Method 8260.
6. 1,4-Dioxane = 1,4-Dioxane by USEPA Method 8270 will be analyzed from locations representative of overall thermal treatments areas. The locations indicated are subject to change.
7. TOC = Total organic matter content by American Society for Testing and Materials (ASTM) Method D2974 will be analyzed from locations representative of overall thermal treatments areas. The locations indicated are subject to change.
8. Moisture Content = Moisture content by ASTM Method D2216-90 and/or from dry weight corrections from USEPA Method 8260 will be analyzed for locations representative of overall thermal treatments areas. The locations indicated are subject to change.
9. Conductivity Testing = Conductivity testing by slug tests. This data will also be used to estimate porosity.
10. TCLP Parameters = VOCs, SVOCs, Metals, Pesticides, and Herbicides will be analyzed from locations representative of overall excavation areas. The locations indicated are subject to change. Samples will be submitted for laboratory analysis of:
    Toxic Characteristic Leaching Procedure (TCLP) extraction by USEPA SW-846 Method 1311 and analysis for one or more of the following:
    - Herbicides using USEPA SW-846 Method 8151.
    - VOCs using USEPA SW-846 Method 8260.
    - Semi Volatile Organic Compounds (SVOCs) using USEPA SW-846 Method 8270.
    - Metals using USEPA SW-846 Method 6010 and 7471.
    - Pesticides using USEPA SW-846 Method 8081.
11. DNAPL Screening = Dense Non-Aqueous Phase Liquid (DNAPL) screening by multiple lines of evidence.
12. WT = water table.
13. - - = A depth is not applicable for the sample.
14. A check-mark (X) indicates analysis will be conducted at that location. More than one sample may be collected for analysis at each location. Laboratory analysis will be conducted on soil samples.

FIGURES

CITY:SYRACUSE-NY DIV/GROUP:ENVCAD DB: LD: PIC: PM:C.DAVERN TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
C:\BIM\OneDrive - ARCADIS\BIM 360 Docs\GTE OPERATIONS SUPPORT INC\GTE-Former Philips Seneca Falls\2019\04563003.0003\01-DWG\GWMON-FIG01-SITE LOCATION.dwg LAYOUT: 1 SAVED: 5/6/2019 11:16 AM ACADVER: 23.0S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB
PLOTTED: 5/6/2019 11:17 AM BY: STEINBERGER, GEORGE

XREFS: IMAGES: PROJECTNAME: ----
GWMON-X-VICMAP.tif



REFERENCE: BASE MAP USGS 7.5 MINUTE QUADRANGLE., SENECA FALLS, NY., 1953, PHOTOREVISED 1978

0 1000' 2000'
GRAPHIC SCALE

NEW YORK

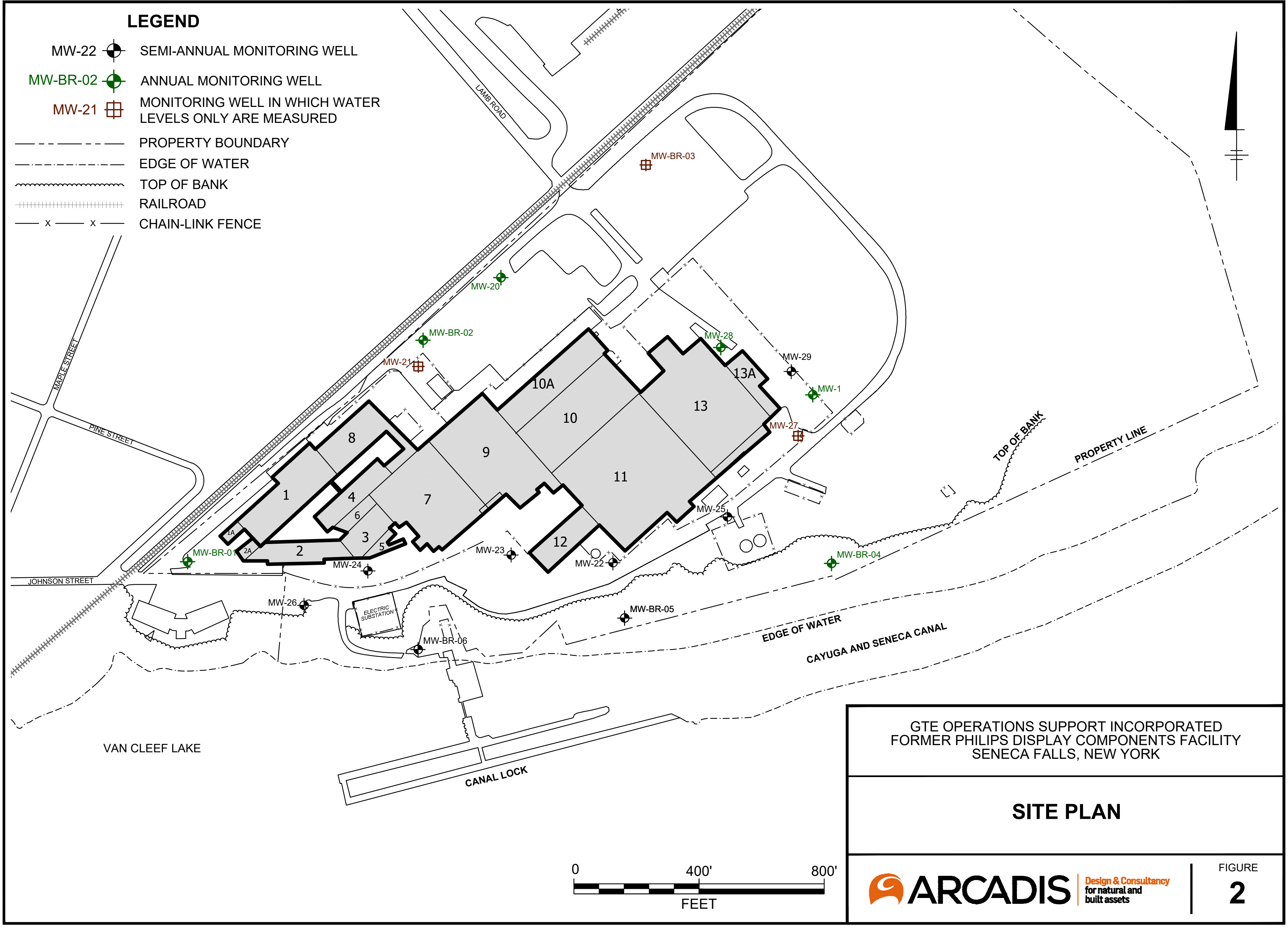
GTE OPERATIONS SUPPORT INCORPORATED
FORMER PHILIPS DISPLAY COMPONENTS FACILITY
SENECA FALLS, NEW YORK

SITE LOCATION

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1

C:\BIM\OneDrive - ARCADIS\BIM 360 Docs\GTE OPERATIONS SUPPORT INC\GTE-Former Philips Seneca Falls\2019\04563003.0003\01-DWG\GWMON-FIG02-SITE PLAN.dwg LAYOUT: 2 SAVED: 5/6/2019 11:29 AM PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 5/6/2019 11:29 AM BY: STEINBERGER, GEORGE

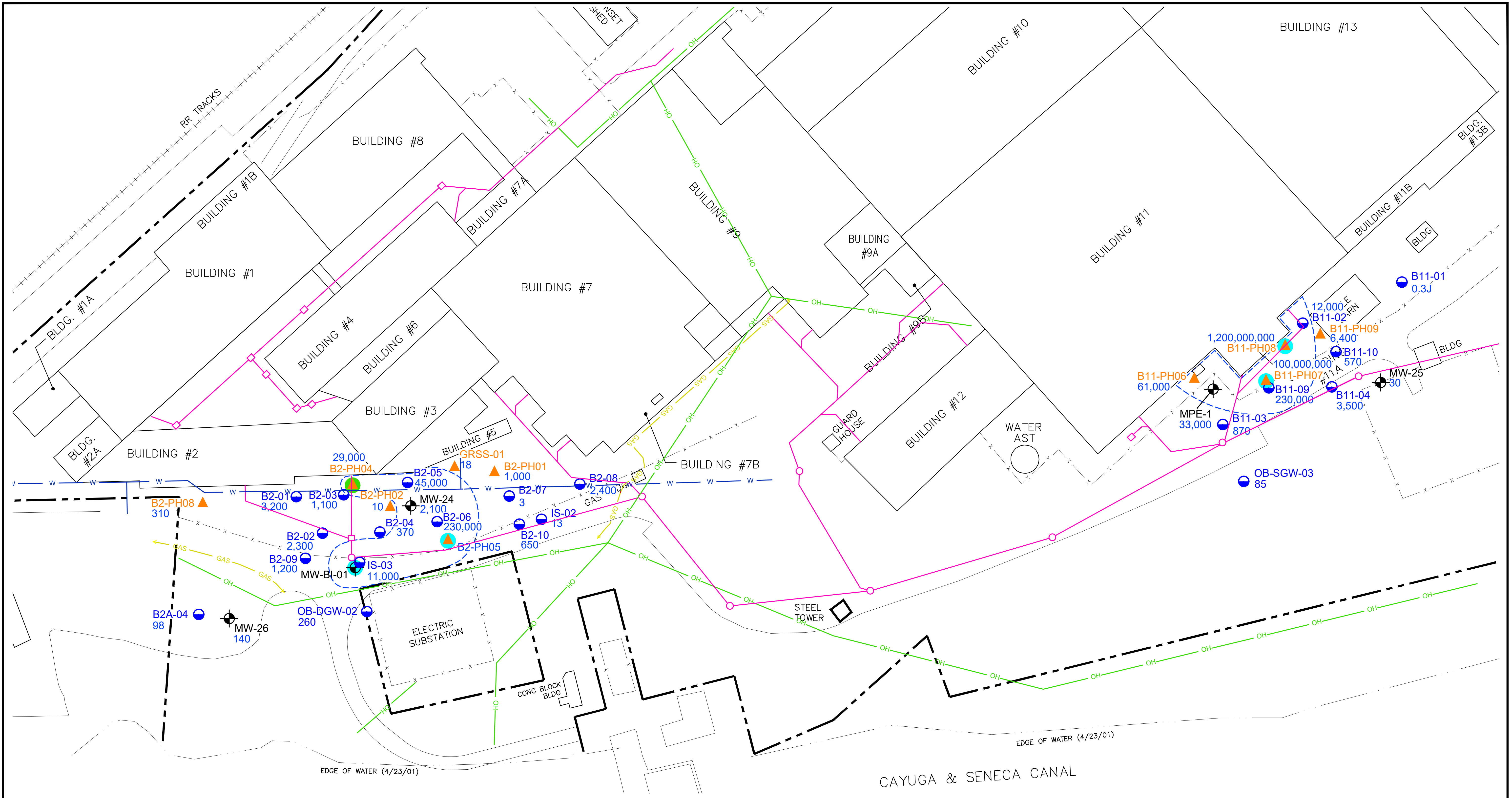


GTE OPERATIONS SUPPORT INCORPORATED
FORMER PHILIPS DISPLAY COMPONENTS FACILITY
SENECA FALLS, NEW YORK

SITE PLAN

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2



LEGEND

🔵	TEMPORARY MONITORING WELL SOIL BORING
⊕	MONITORING WELL LOCATION
▲	BORING LOCATION
●	LOCATION WITH HISTORICALLY OBSERVED DENSE NON-AQUEOUS PHASE LIQUID (DNAPL)
🟢	LOCATION WITH A HISTORICAL UNSATURATED SOIL TRICHLOROETHENE CONCENTRATION GREATER THAN THE COMMERCIAL SOIL CLEANUP OBJECTIVE (200 MILLIGRAMS/KILOGRAM)
-+-+-+-+-	RAILROAD TRACK
— - - —	PROPERTY BOUNDARY
——	INTERCEPTOR PIPE
— x — x —	FENCE
— OH —	ELECTRICAL OVERHEAD LINE
——	STORM SEWER PIPE
○ □	MANHOLE / CATCHBASIN
— W —	WATER LINE
— GAS —	GAS LINE
- - - - -	APPROXIMATE AREA BORINGS WILL BE ADVANCED TO DELINEATE DNAPL [APPROXIMATE AREA WITH CONCENTRATIONS EXCEEDING 12,800 MICROGRAMS PER LITER (1% OF THE TRICHLOROETHENE SOLUBILITY LIMIT)].
870	GROUNDWATER TRICHLOROETHENE CONCENTRATION IN MICROGRAMS PER LITER FROM SAMPLES COLLECTED IN 2000 OR 2005, EXCEPT FOR MPE-1 (2012).

NOTES:

1. PROJECTION: NAD83 STATEPLANE NEW YORK CENTRAL FIPS 3102- FEET.
2. THIS FIGURE ONLY DISPLAYS LOCATIONS IN AND DIRECTLY ADJACENT TO AOC 1 AND AOC 3 WITH GROUNDWATER DATA.
3. UTILITY LOCATIONS ARE APPROXIMATE.

0 100' 200'
GRAPHIC SCALE

GTE OPERATIONS SUPPORT INCORPORATED
FORMER PHILIPS DISPLAY COMPONENTS FACILITY
SENECA FALLS, NEW YORK

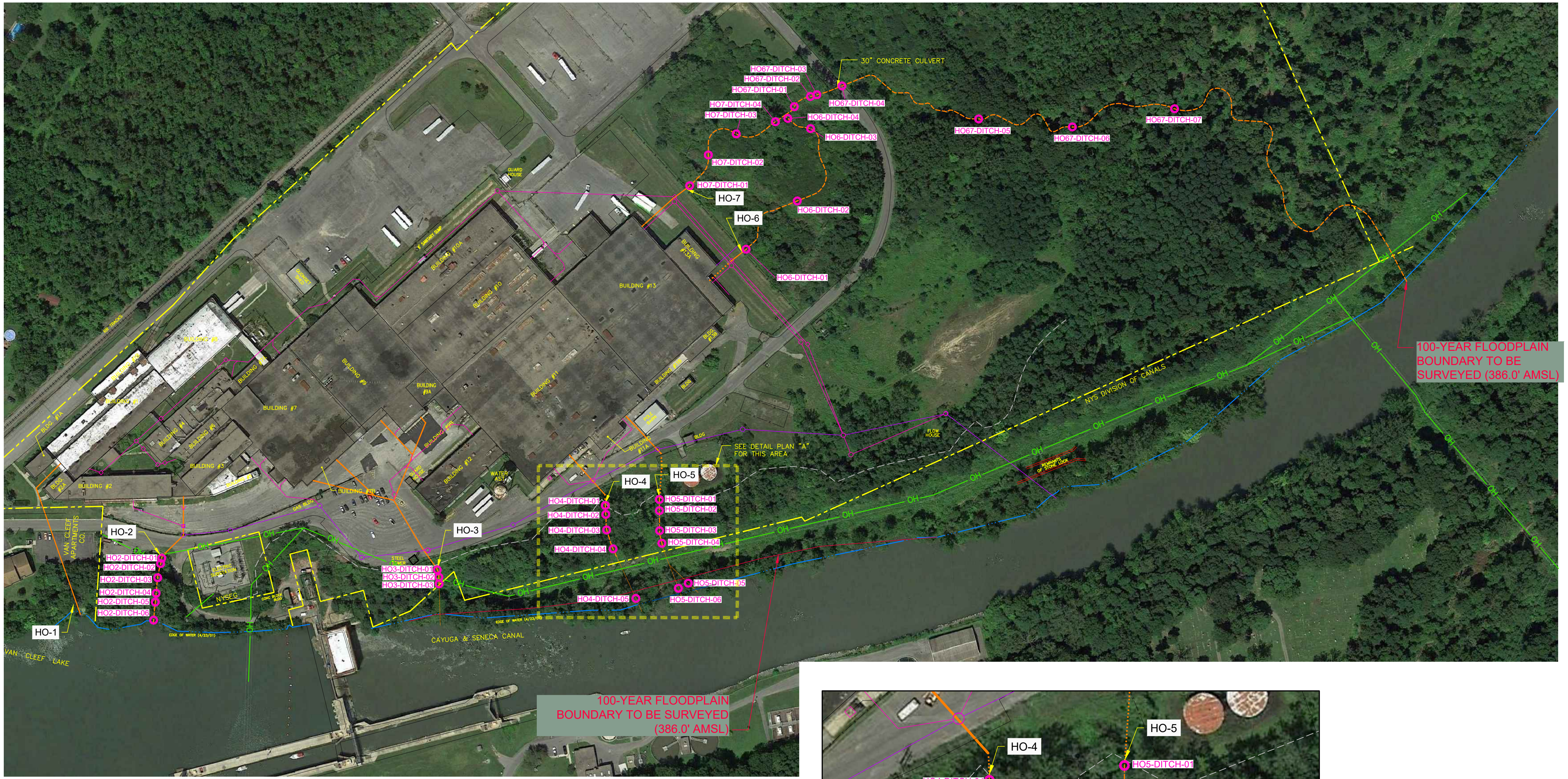
TRICHLOROETHENE CONCENTRATIONS AND HISTORICAL DENSE NON-AQUEOUS PHASE LIQUID LOCATIONS IN AOCS 1 AND 3

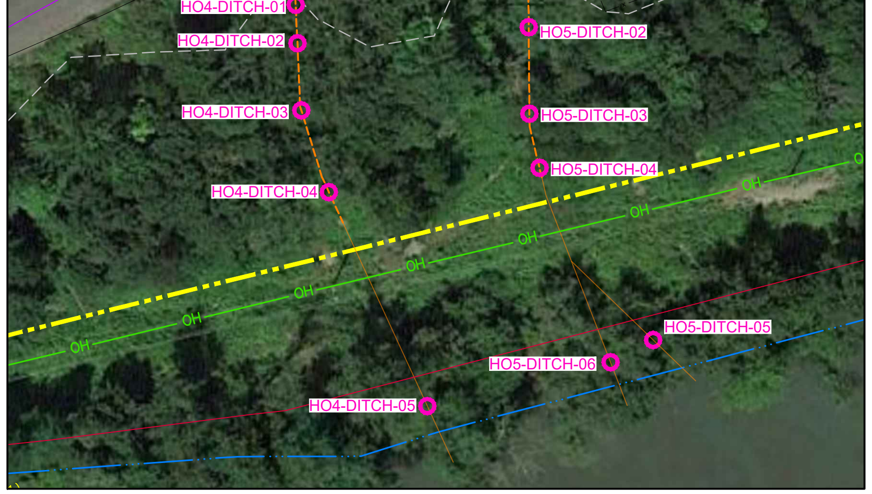
ARCADIS Design & Consultancy for natural and built assets

FIGURE
3

C:\Users\gsteinberger\BIM 360\Arcadis\ANA - GTE OPERATIONS SUPPORT INC\Project Files\GTE-Former Phillips Seneca Falls\2019\04563003.0000\01-DWG\GWMON-FIG03-TCE.dwg SAVED: 6/21/2019 3:40 PM BY: STEINBERGER, GEORGE

XREFS: IMAGES:
GWMON-X-TITLE-BSIZE
GWMON-X-BASEMAP





DETAIL PLAN "A"

0 50' 100'

SCALE: 1"=50'

LEGEND

▬	PROPERTY BOUNDARY
—x—x—x—	FENCING
——	STORMWATER SEWER
——	INTERCEPTOR PIPE
— — —	TOP OF BANK
——	HISTORICAL OUTFALL PIPE
······	OVERLAND HISTORICAL OUTFALL FLOW (NOW BURIED)
– – –	APPROXIMATE HISTORICAL OUTFALL DITCH
——	PRESUMED FORMER HISTORICAL OUTFALL FLOW PATH
—OH—	ELECTRIC OVERHEAD LINE
—··—	EDGE OF WATER (4/23/01)
——	100-YEAR FLOODPLAIN BOUNDARY (ACTUAL BOUNDARY TO BE SURVEYED)
○	APPROXIMATE HISTORICAL OUTFALL DITCH SAMPLE LOCATION (PROPOSED)
AMSL	ABOVE MEAN SEA LEVEL

0 125' 250'

GRAPHIC SCALE

GTE OPERATIONS SUPPORT INCORPORATED
FORMER PHILIPS DISPLAY COMPONENTS FACILITY
SENECA FALLS, NEW YORK

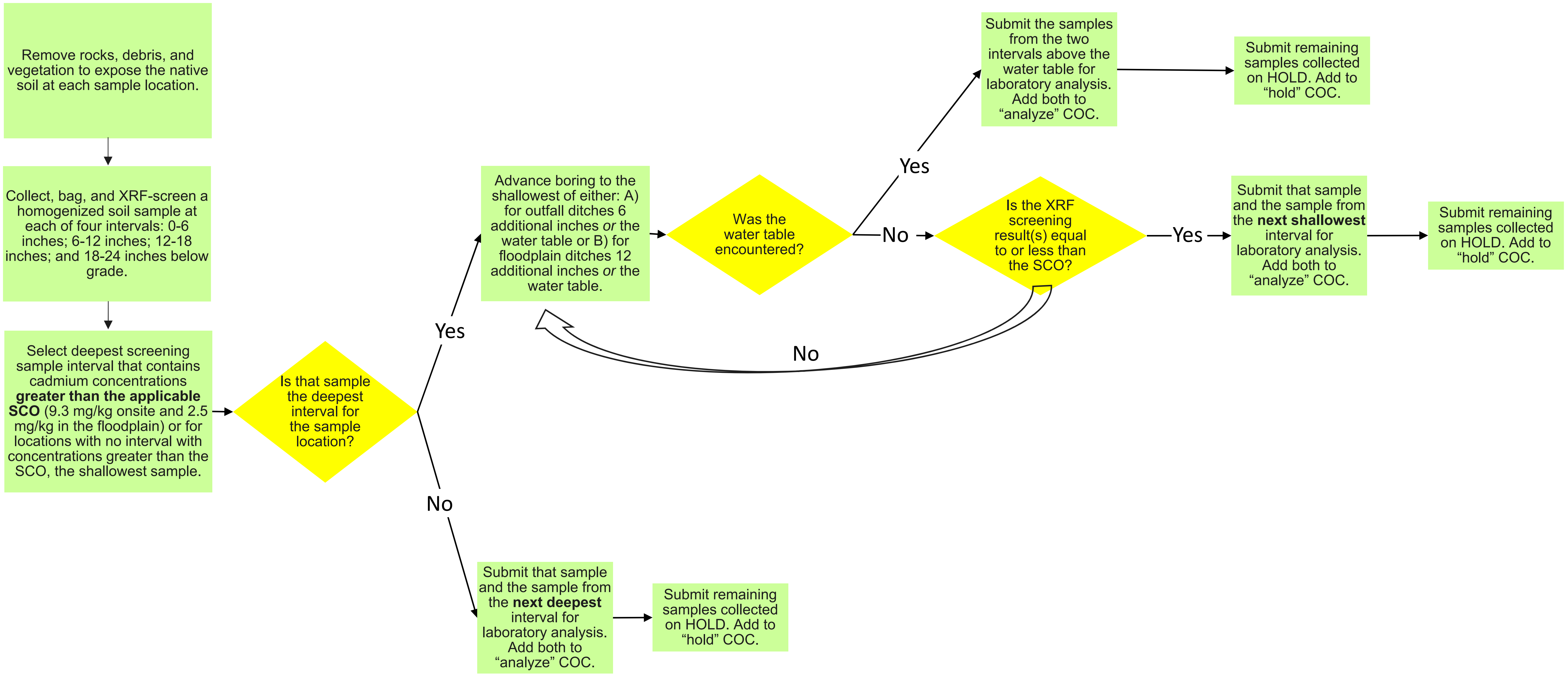
PROPOSED HISTORICAL OUTFALL DITCH SAMPLING LOCATIONS

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4

C:\Users\gsteinberger\BIM 360\Arcadis\ANA - GTE OPERATIONS SUPPORT INC\Project Files\GTE-Former Phillips Seneca Falls\2019\04563003.0000\01-DWG\GWMON-FIG04-SAMPLE LOCATIONS.dwg SAVED: 6/21/2019 3:28 PM BY: STEINBERGER, GEORGE

XREFS: IMAGES:
GWMON-X-TITLE GWMON-X-AERIAL2.jpg
GWMON-X-BASEMAP



Remove rocks, debris, and vegetation to expose the native soil at each sample location.

Collect, bag, and XRF-screen a homogenized soil sample at each of four intervals: 0-6 inches; 6-12 inches; 12-18 inches; and 18-24 inches below grade.

Select deepest screening sample interval that contains cadmium concentrations **greater than the applicable SCO** (9.3 mg/kg onsite and 2.5 mg/kg in the floodplain) or for locations with no interval with concentrations greater than the SCO, the shallowest sample.

Is that sample the deepest interval for the sample location?

Advance boring to the shallowest of either: A) for outfall ditches 6 additional inches *or* the water table or B) for floodplain ditches 12 additional inches *or* the water table.

Was the water table encountered?

Submit the samples from the two intervals above the water table for laboratory analysis. Add both to “analyze” COC.

Submit remaining samples collected on HOLD. Add to “hold” COC.

Is the XRF screening result(s) equal to or less than the SCO?

Submit that sample and the sample from the **next shallowest** interval for laboratory analysis. Add both to “analyze” COC.

Submit remaining samples collected on HOLD. Add to “hold” COC.

Submit that sample and the sample from the **next deepest** interval for laboratory analysis. Add both to “analyze” COC.

Submit remaining samples collected on HOLD. Add to “hold” COC.

Notes:

Upon completion of each boring, holes will be filled to slightly below grade with hydrated bentonite and finished to match surrounding grade with topsoil and grass seed.

COC = chain-of-custody

mg/kg = milligrams per kilogram

SCO = soil cleanup objective

XRF = x-ray fluorescence

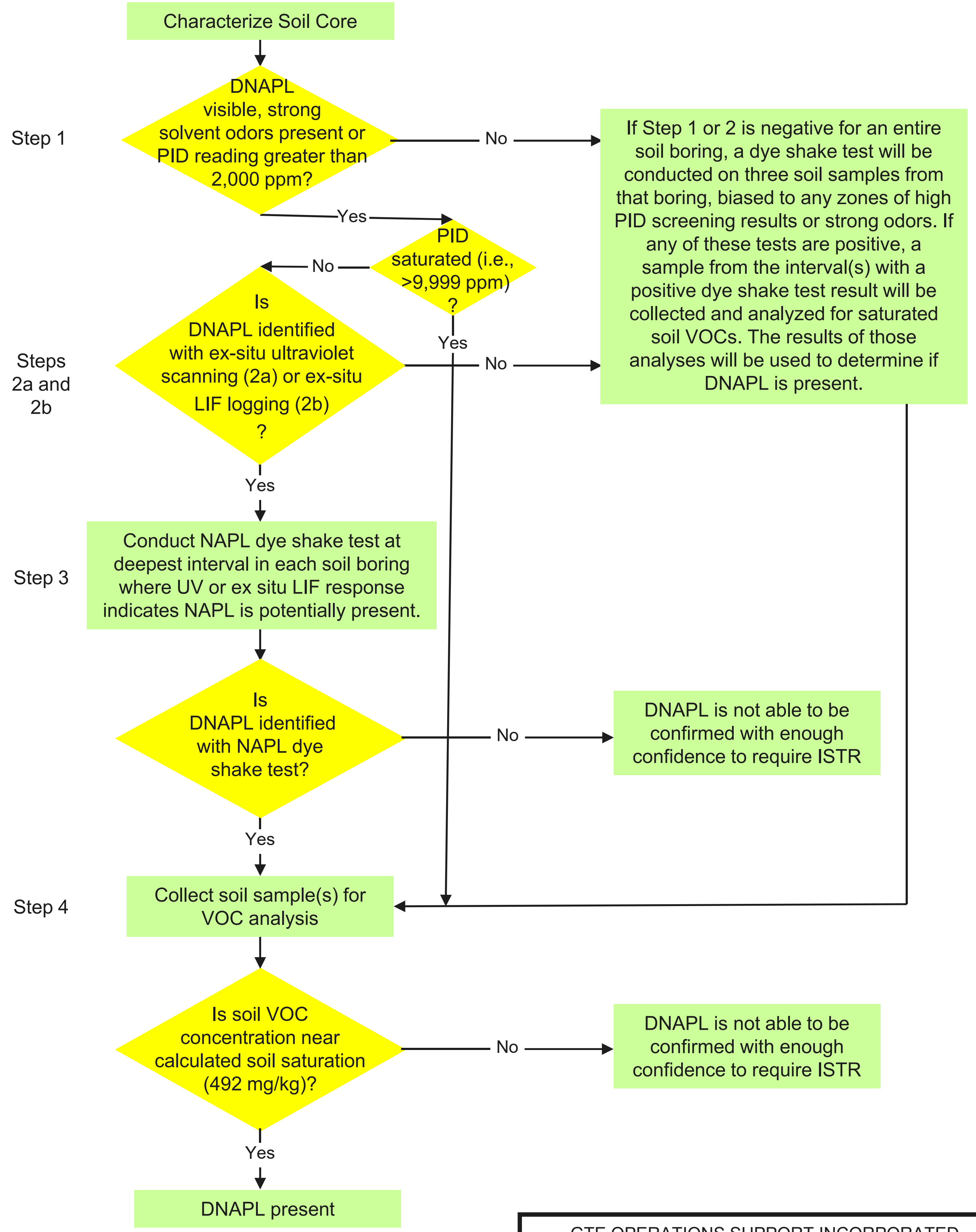
GTE OPERATIONS SUPPORT INCORPORATED
FORMER PHILIPS DISPLAY COMPONENTS FACILITY
SENECA FALLS, NEW YORK

HISTORICAL OUTFALL DITCH SAMPLE COLLECTION PROCEDURE

ARCADIS Design & Consultancy for natural and built assets

FIGURE
5

6/21/2019 9:54:36 AM



Characterize Soil Core

Step 1

DNAPL visible, strong solvent odors present or PID reading greater than 2,000 ppm?

If Step 1 or 2 is negative for an entire soil boring, a dye shake test will be conducted on three soil samples from that boring, biased to any zones of high PID screening results or strong odors. If any of these tests are positive, a sample from the interval(s) with a positive dye shake test result will be collected and analyzed for saturated soil VOCs. The results of those analyses will be used to determine if DNAPL is present.

PID saturated (i.e., >9,999 ppm) ?

Steps 2a and 2b

Is DNAPL identified with ex-situ ultraviolet scanning (2a) or ex-situ LIF logging (2b) ?

Step 3

Conduct NAPL dye shake test at deepest interval in each soil boring where UV or ex situ LIF response indicates NAPL is potentially present.

Is DNAPL identified with NAPL dye shake test?

DNAPL is not able to be confirmed with enough confidence to require ISTR

Step 4

Collect soil sample(s) for VOC analysis

Is soil VOC concentration near calculated soil saturation (492 mg/kg)?

DNAPL is not able to be confirmed with enough confidence to require ISTR

DNAPL present

Note:

DNAPL = dense non-aqueous phase liquid
ISTR = in-situ thermal remediation
LIF = laser-induced fluorescence
mg/kg = milligrams per kilogram
NAPL = non-aqueous phase liquid
PID = photoionization detector
ppm = parts per million
VOC = volatile organic compound

GTE OPERATIONS SUPPORT INCORPORATED
FORMER PHILIPS DISPLAY COMPONENTS FACILITY
SENECA FALLS, NEW YORK

DNAPL DELINEATION FLOWCHART

ARCADIS Design & Consultancy for natural and built assets

FIGURE
6

\\Ny05fp01\data\PROJECT\4563003\FILE\Corrective Measures\CA Work Plan\Figure 8 - DNAPL Delineation Flow Chart.pptx
6/21/2019 9:58:04 AM

APPENDIX A

Field Activities Plan / Quality Assurance Project Plan

GTE Operations Support Incorporated

CORRECTIVE ACTION WORK PLAN

APPENDIX A – FIELD ACTIVITIES PLAN / QUALITY ASSURANCE PROJECT PLAN

Former Philips Display Components Facility
Seneca Falls, New York
EPA ID NYD002246015
NYSDEC Site No. 850003

May 2020

CORRECTIVE ACTION WORK PLAN

APPENDIX A – FIELD ACTIVITIES PLAN / QUALITY ASSURANCE PROJECT PLAN

Former Philips Display Components Facility
Seneca Falls, New York
EPA ID # NYD002246015

Prepared for:

GTE Operations Support Incorporated

Prepared by:

Arcadis of New York, Inc.
855 Route 146
Suite 210
Clifton Park
New York 12065
Tel 518 250 7300
Fax 518 371 2757

Our Ref.:

30002755 - 04563003.0001.00036

Date:

May 2020

CONTENTS

Acronyms and Abbreviations v
1 Purpose and Objectives 1
  1.1 Purpose 1
  1.2 FAP/QAPP Objectives 1
2 Project Organization and Responsibilities 2
  2.1 Project 2
  2.2 Analytical Laboratories 2
3 Data Measurement QA/QC Objectives 3
  3.1 Data Quality Objectives 3
    3.1.1 DQOs for Air and Effluent Vapor 3
    3.1.2 DQOs for Soil 3
    3.1.3 DQOs for Groundwater 3
  3.2 Field Measurement Quality Assurance Objective 4
  3.3 Laboratory Quality Assurance Objectives 4
4 Field Investigation Procedures 6
  4.1 Field Quality Control Samples 7
    4.1.1 Trip Blanks 7
    4.1.2 Field Blanks 7
    4.1.3 Matrix Spike/Matrix Spike Duplicates 7
    4.1.4 Field Duplicates 8
  4.2 Field Measurements 8
    4.2.1 Water Level Measurements 8
      4.2.1.1 Measurement Objectives 8
      4.2.1.2 Measurement Equipment 8
      4.2.1.3 Measurement Procedure 8
    4.2.2 Water Quality Parameters 9
      4.2.2.1 Instrument Operation 9
      4.2.2.2 Water Quality Measurement Procedures 10
    4.2.3 Field Screening of Soil Samples using a Photoionization Detector 10
      4.2.3.1 Field Screening Equipment 10
      4.2.3.2 Field Screening Procedures 11

4.2.4 Other Field Screening/Sampling Technologies 11
4.2.4.1 Portable X-ray Fluorescence Meters 11
4.2.4.2 Portable Gas Chromatographs 12
4.2.4.3 Procedures for Field Screening/Sampling Technologies 12
4.2.5 Site and Data Point Surveys and Basemap Preparation 12
4.2.6 Laser-Induced Fluorescence (LIF) 12
4.2.6.1 Personnel 13
4.2.6.2 LIF Procedures 13
4.3 Sampling Equipment Decontamination 13
4.3.1 Equipment and Supplies 13
4.3.2 Decontamination Guidelines 14
4.3.3 Decontamination Procedure 14
4.3.4 Reference 15
4.4 Groundwater Sampling 15
4.4.1 Sampling Equipment 15
4.4.2 Sampling Procedures (Permanent Monitoring Wells) 16
4.4.3 Sampling Procedures (Temporary Sampling Points) 19
4.5 Surface Soil Sampling 19
4.5.1 Sampling Equipment 20
4.5.2 Sampling Procedures 20
4.6 Subsurface Soil Sampling 21
4.6.1 Soil Sampling Equipment 21
4.6.2 Soil Sampling Procedures 22
4.6.2.1 Direct-push Soil Sampling 22
4.6.2.2 Split-barrel (Split-spoon) Sampling 22
4.7 Air and Soil Vapor Sampling 22
4.7.1 Air Sampling Equipment 23
4.7.2 Indoor and Ambient Air Sampling Procedures 23
4.7.3 Effluent Vapor Sampling Procedures 24
4.8 Community Air Monitoring Program 24
4.8.1 VOC Monitoring, Response Levels, and Actions 25
4.8.2 Particulate Monitoring, Response Levels, and Actions 25

4.9 Storage and Disposal of Investigation Derived Waste 26
4.10 Field Documentation 26
4.10.1 Sample Designation 27
4.10.2 Documentation of Field Activities 27
4.10.3 General Site Information 27
4.10.4 Sample Activities 28
4.10.5 Sample Dispatch Information 28
4.11 Sample Handling 28
4.11.1 Chain-of-Custody Record 29
4.11.2 Transferring to Common Carrier 30
4.11.3 Transferring Custody Directly to a Courier 30
5 Calibration Procedures 31
5.1 Calibration Procedures for Field Equipment 31
5.2 Laboratory Calibration Procedures 31
6 Analytical Procedures 33
7 Data Reduction, Validation, and Reporting 34
7.1 Data Reduction 34
7.2 Data Validation 34
7.2.1 Data Review 34
7.2.2 Data Usability Summary Report (DUSR) 35
7.3 Reconciliation with Data Quality Objectives 36
7.4 Data Reporting 36
8 Preventative Maintenance 38
8.1 Responsibilities 38
8.2 Preventative Maintenance Program 38
8.3 Laboratory Instrument Maintenance 39
8.4 Rental Equipment 39
9 Quality Assurance Procedures 40
9.1 Field Quality Control 40
9.2 Laboratory Quality Control 41

10 Corrective Actions 42
  10.1 Non-conformance Reports 42
  10.2 Stop Work Orders 42
    10.2.1 Stop Work Order Documentation 42
    10.2.2 Resumption of Work 42
  10.3 Course and Action to Prevent Recurrence 42
  10.4 Field Changes 43
11 Quality Assurance Reports 44
12 References 45

ACRONYMS AND ABBREVIATIONS

ASP	Analytical Services Protocol
CAWP	Corrective Action Work Plan
CRQLs	Contract Required Quantitation Limits
DCA	Dichloroethane
DCE	Dichloroethene
FAP	Field Activities Plan
FSP	Field Sampling Plan
GTEOSI	GTE Operations Support Incorporated
GW	Groundwater
gpm	gallons per minute
HASP	Site Specific Health and Safety Plan
IDL	Instrument Detection Limit
MDL	Minimum Detection Limit
Arcadis	Arcadis of New York, Inc.
MS	Matrix spikes
MSD	Matrix spike duplicate
NBS	National Bureau of Standards
NYSDEC	New York State Department of Environmental Conservation OSWER Office of Solid Waste and Emergency Response
PARCCS	Precision, Accuracy, Representativeness, Completeness, Comparability, and Sensitivity
PCE	Perchloroethene (Tetrachloroethene)
RCRA	Resource Conservation and Recovery Act
PID	Photoionization Detector
PPE	Personal protective equipment
RFI	RCRA Facility Investigation
RPD	Relative percent difference
SCG	Standards, Criteria, and Guidance Values
SOPs	Standard Operating Procedures
SVOCs	Semi-volatile organic compounds
SWMU	Solid Waste Management Unit

TAGM	Technical and Administrative Guidance Memorandum TCA Trichloroethane
TCE	Trichloroethene
VOA	Volatile Organic Analysis
VOCs	Volatile Organic Compounds
QA	Quality Assurance
QC	Quality Control
QAPP	Quality Assurance Project Plan
EPA	United States Environmental Protection Agency

1 PURPOSE AND OBJECTIVES

1.1 Purpose

This Field Activities Plan / Quality Assurance Project Plan (FAP/QAPP) provides both: A) field methods, procedures, and protocols for the collection of data; and B) quality assurance/ quality control (QA/QC) methods, procedures, and protocols for the collection, analysis, and evaluation of data collected during the Corrective Measures.

This FAP/QAPP is provided as a supplement to any other site-specific documents and may be supplemented by equipment or manufacturer specific documentation. Any deviations from, or additions to, the procedures and protocols provided in this FAP/QAPP would be provided as part of the Remedial Design(s).

1.2 FAP/QAPP Objectives

This FAP/QAPP ensures that data collected during Corrective Measure investigations are of suitable quality and quantity to meet the investigation objectives. To meet this objective, the following topics are presented and discussed in this FAP/QAPP:

- Project organization and responsibilities
- Data quality objectives
- Description and objective of field investigation procedures
- Calibration processes
- Analytical method requirements
- Data validation requirements
- Preventative maintenance
- Quality assurance procedures
- Corrective actions

The results of the field activities will support project decisions and meet overall project objectives. This FAP/QAPP ensures that the quality of the field data is legally and scientifically defensible and applies to its anticipated use and addresses laboratory analysis of samples and data evaluation of the laboratory sample results. In addition, this FAP/QAPP addresses components that influence these processes and provides a detailed plan to ensure that decisions made from the field and analytical data are valid, accurate, and defensible in support of subsequent recommendations.

2 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 Project

Arcadis will implement and coordinate the project, which will include subcontractor coordination and oversight, environmental monitoring and sampling, and evaluating analytical data collected. Arcadis will also be responsible for evaluation of analytical test results, which will be submitted to NYSDEC. Arcadis staff members managing the Corrective Actions will be identified in the Corrective Action Work Plan (CAWP). Health and safety procedures will be included in a project-specific health and safety plan.

2.2 Analytical Laboratories

Analytical laboratories subcontracted with Arcadis or GTE Operations Support Incorporated (GTEOSI) will analyze select environmental samples. Laboratories subcontracted by Arcadis or GTEOSI will be approved under United States Environmental Protection Agency (USEPA) and New York State Department of Health (NYSDOH) protocols. These laboratories will maintain their certification for the specific analyses to be performed by the NYSDOH Environmental Laboratory Approval Program (ELAP).

Each laboratory has their own provisions for performing internal QA/QC review of the data prior to transmittal to Arcadis. In addition, Arcadis will contract a data validation service to review the methods and protocols performed by the laboratory to validate the analytical results. A summary of the data validation results will be provided in a Data Usability Summary Report (DUSR) provided by the data validation service (Section 7.2.2).

3 DATA MEASUREMENT QA/QC OBJECTIVES

This section defines the QA/QC objectives for environmental sampling and analysis, including the data quality objectives (DQOs) for measurement data and the criteria for measuring performance within these objectives. Data collected for the Corrective Measures may include both field measurements and analytical samples. This Section discusses the various types of data anticipated and provides QA/QC objectives for data collected.

3.1 Data Quality Objectives

DQOs are qualitative and quantitative statements that specify the quality of the data to support decisions, and are developed to address specific procedures for collecting, analyzing, and evaluating results to meet overall project objectives. DQOs are developed and implemented to ensure that the quality of the data is legally and scientifically defensible and applies to its anticipated use. DQOs developed for each specific site, measurement, and media assume project objectives, data objectives, and data collection methods.

Site-specific DQOs have been developed based on the factors presented above and are presented below. These include the specific DQOs for each planned data collection task, which identifies the particular sampling protocols, analysis methods, and laboratory deliverables to be provided for each data type anticipated.

3.1.1 DQOs for Air and Effluent Vapor

The objective of the air and effluent sampling program is to evaluate the nature and extent of indoor air volatile organic compounds (VOC) concentrations exceeding the NYSDOH CEH BEEI air guideline values and to monitor the effluent of treatment systems. To be useful in meeting this objective, the data from the air and effluent vapor samples must be of known quality. To support the DQOs for air and effluent vapor, NYSDOH-approved analytical methodologies with NYSDEC ASP Category B deliverables have been chosen for air and effluent vapor analyses. These procedures and deliverables can produce high quality data characterized by rigorous QA/QC protocols and documentation.

3.1.2 DQOs for Soil

The objective of the soil sampling program is to evaluate the nature and extent of soil with contaminant concentrations exceeding the 6 NYCRR Subpart 375-6 Remedial Program cleanup objectives in surface and subsurface soil. To be useful in meeting this objective, the data from the soil samples must be of known quality. To support the DQOs for soil, USEPA SW-846 analytical methodologies with NYSDEC ASP Category B deliverables have been chosen for soil analyses. These procedures and deliverables can produce high quality data characterized by rigorous QA/QC protocols and documentation.

3.1.3 DQOs for Groundwater

Groundwater will be sampled and analyzed to evaluate the nature and extent of groundwater with VOC concentrations greater than NYSDEC Class GA Standards at the site. Field instrumentation (e.g. water quality meters) will be used during sampling activities to ensure the collection of representative samples. Data from the field instrumentation must be of sufficient quality to measure groundwater conditions prior to sampling. Analytical data will be used to identify the location of any groundwater contamination, to aid in evaluating contaminant source locations, and to assess if any standards, criteria, and guidance values (SCGs) have been exceeded. To meet these objectives, the groundwater sample analytical data must be of known quality. Therefore, USEPA SW-846 analytical methodologies with NYSDEC ASP Category B deliverables have been selected for all groundwater analyses. These deliverables are characterized by rigorous QA/QC protocols and documentation, which historically have provided high quality data to meet the DQOs for this media.

3.2 Field Measurement Quality Assurance Objective

Tasks requiring field measurements include field screening samples, evaluating the progress of monitoring well development, monitoring well sample collection, collection of soil conductivity data, in-situ measurements, surveying sampling locations, and field analysis of samples using other field screening technologies. To ensure the accuracy and quality of the data provided by field measurements, DQOs for the following are provided in Section 4 for recording field measurements during site investigations:

- Water Quality Parameters
- Field Screening Soil Samples Using Ionization Detectors
- Other Field Screening Technologies
- Data Collection Using GPS and Data Point Surveys
- Laser Induced Florescence

The DQOs developed for each method will ensure the data is appropriate and reliable for their use in the investigation. A summary of field measurement methods, documentation, DQOs, and QA/QC protocols is provided below. Specific field measurements anticipated for each data collection task are detailed in the CAWP or will be detailed in the Remedial Design document(s).

3.3 Laboratory Quality Assurance Objectives

Laboratory generated data are used to accurately identify and quantify hazardous substances, while the field generated data are used with the laboratory data for further investigation of contamination at the site. Both laboratory and field internal QC programs include steps to ensure the data are reliable for their use in the investigation. In general, laboratory QC programs are more rigorous than field QC programs.

The scope and description of QC samples and QC methods are well detailed in the applicable USEPA methodologies for the particular analyses. The methodologies for organic and inorganic analyses describe the type of QC samples and required QC methods, and the required frequency of analysis. QC limits have been established for standards, blanks, duplicates, matrix spikes, and surrogates, and are contained in the methodologies.

Laboratory QC data will be reviewed by Arcadis personnel and by a subcontracted third-party data validation service to assess the validity of the data and determine if the DQOs have been met. This objective will be met by implementing:

- *Evaluation of Laboratory Method Performance* – QC criteria for method performance will be reviewed and assessed for target analyses. Analysis methods will be performed based on documented procedures by certified laboratories.
- *Sample Matrix Effects* – QC samples will be collected and analyzed to determine measurement bias because of the sample matrix. If criteria are not met, matrix interferences will be confirmed by reanalysis or inspection of laboratory control samples to verify laboratory method performance is in control.
- *Planning and Management* – Laboratories will perform preventive maintenance and routine calibration of equipment. A managed program of internal and external QC checks will ensure data quality.
- *Corrective Actions* – If QC issues are detected during QA audits or QC checks, corrective actions will be taken to stop work and modify procedures to ensure data quality.

4 FIELD INVESTIGATION PROCEDURES

A summary of objectives, equipment, and procedures for the following field activities is provided in this section:

- Field quality control samples
    - Trip blanks
    - Field blanks
    - Matrix spike/matrix spike duplicates
    - Field duplicates
- Field measurements
    - Water level measurements
    - Water quality parameters
    - Field screening soil samples using a Photoionization Detector (PID)
    - Other field screening/sampling technologies
    - Data collection using GPS and data point surveys
    - Laser Induced Florescence
- Sample equipment decontamination
- Monitoring well installation and development
- Groundwater sampling
- Surface soil sampling
- Subsurface Soil sampling
    - Direct-push soil sampling
    - Split-barrel (split spoon) soil sampling
- Exploratory test pits and trenches
- Soil vapor and air sampling
- Community air monitoring program
- Storage and disposal of investigation derived waste
- Field documentation
- Sample handling

4.1 Field Quality Control Samples

Quality control procedures will ensure that sampling, transportation and laboratory activities do not bias sample analytical quality. Trip blanks, field blanks, duplicate samples, matrix spike samples and matrix spike duplicates will provide a quantitative basis for validating the analytical data.

4.1.1 Trip Blanks

The trip blanks will be prepared by the laboratory by filling 40 milliliter (ml) vials with a Teflon-lined septum with deionized, analyte-free water. The trip blank will accompany the sample containers at all times. One trip blank will be returned to the laboratory with each cooler containing aqueous samples for VOC analysis. The trip blank will be analyzed for VOCs to detect possible contamination during shipment. Trip blanks will remain in the shipping cooler from the time of packing, in the laboratory, to arrival back at the laboratory.

4.1.2 Field Blanks

A field blank consists of an empty set of laboratory-cleaned sample containers. At the field location, deionized, analyte-free water is passed through decontaminated sampling equipment and placed in the empty set of sample containers for analysis of the same parameters as the samples collected with the sampling equipment. One field blank will be collected per every 20 environmental samples sent to the analytical laboratory, per media.

4.1.3 Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) sample pairs are analyzed by the laboratory to provide a quantitative measure of the laboratory's precision and accuracy. When performing USEPA SW-846 volatile organic or organic extractable analysis with NYSDEC Category B deliverables, the laboratory must be supplied with triple sample volume for each Sample Delivery Group (SDG) to perform Matrix Spike/Matrix Spike Duplicate (MS/MSD) analyses. Blanks do not require separate matrix spike or duplicate analyses regardless of their matrix.

The limits on a SDG are:

- Each Case for field samples, or
- Each 20 field samples within a Case, or
- Each fourteen calendar day period during which field samples in a Case are received (said period beginning with receipt of the first sample in the SDG), whichever comes first.

Field personnel will specify samples for MS/MSD analysis. Extra volume is not required for aqueous samples for inorganic analysis. Non-aqueous samples (soils) do not require that any extra volume of sample be submitted to the laboratory for MS/MSD samples.

4.1.4 Field Duplicates

For each sample matrix, a field duplicate sample will be collected for the analytical laboratory at one sample per 20 environmental samples, per media. The duplicate sample is collected at the same location as the environmental sample. The field duplicate sample is identified using the sample designation system described in Section 4.12. The identity of the field duplicate is not revealed to the laboratory. The analytical results of the environmental sample will be compared to the field duplicate sample, to evaluate field sampling precision.

4.2 Field Measurements

Tasks requiring recording of field measurements include field screening samples using a PID, evaluating the progress of monitoring well development, monitoring well sample collection, collection of soil conductivity data, in-situ measurements, surveying sampling locations, and field analysis of samples. A summary of field measurements is provided below. Specific procedures for inspection and calibration of the related field equipment are provided in Section 5.

4.2.1 Water Level Measurements

4.2.1.1 Measurement Objectives

Water levels in monitoring wells will be measured and used with horizontal and vertical ground survey data to determine horizontal and vertical components of groundwater flow. Water level measurements will also be used to determine the volume of standing water in monitoring wells for development and purging activities. These measurements will be used to provide groundwater elevations and hydraulic gradient at the site.

4.2.1.2 Measurement Equipment

This equipment will be used for measuring water levels:

- Electronic water level indicator or interface probe
- Field logbook and pen
- Photoionization Detector
- Deionized Water
- Low Phosphate Detergent

4.2.1.3 Measurement Procedure

The first time measuring water levels at sites where VOCs are the contaminant of concern, at each monitoring well, the expansion cap will be removed and the head space and breathing zone's air quality will be monitored with a PID. This step may be omitted in later rounds of water level measurements in those monitoring wells that yielded no detectable amounts of vapors or gases from prior sampling rounds.

If air quality readings in the breathing space around the well exceed action levels set in the site-specific health and safety plan (HASP), appropriate measures will be taken as listed in the HASP.

The battery of the electric water level indicator will be checked by pushing the battery check button, and waiting for the audible signal to sound or the instrument light to come on. The water level indicator will be decontaminated before collecting a measurement in each monitoring well by using a suitable detergent (e.g., Alconox) wash and deionized water rinse. The instrument will then be turned on and the probe will be slowly lowered into the monitoring well, until the audible signal is heard or the instrument light goes on, indicating that the sensor in the probe has contacted the water surface in the monitoring well.

In the presence of non-aqueous phase liquid (NAPL), an interface probe, which can indicate and differentiate between the contact surfaces of NAPL and water, will be used in place of an electric water level indicator. The probe is checked, decontaminated, and used like an electric water level indicator. When the sensor probe contacts NAPL or water surfaces in a monitoring well, an audible signal will be heard. To distinguish between NAPL and water surfaces, a different audible signal is used for each medium (i.e., constant signal for NAPL, intermittent signal for water).

The depth to water will be recorded to the nearest one-hundredth of a foot, from the top of the measuring mark on the monitoring well riser. The date, time, monitoring well number, and depth to water will be recorded in the field book.

4.2.2 Water Quality Parameters

Water quality parameters, including pH, conductivity, dissolved oxygen (DO), oxidation-reduction potential (ORP), temperature, and turbidity may be measured during monitoring well development and groundwater sampling tasks, although are not required when sampling via passive diffusion bags. The parameters are typically measured using a multi- parameter water quality instrument equipped with a flow-through cell (e.g., Horiba U-53 or equivalent).

At a minimum, when used, multi-parameter water quality instruments will measure these field parameters:

- Temperature
- Conductivity
- DO
- ORP
- pH
- Turbidity

4.2.2.1 Instrument Operation

A thermistor is used by the instrument to measure temperature. The thermistor also measures the change in electrical resistance accompanying changes in temperature. The instrument uses the temperature data in conductivity temperature conversions, DO temperature compensation, and pH temperature compensation. The unit of measurement for temperature is degrees Celsius (ºC). The conductivity of water is determined by measuring the resistance of ion flow between charged plates because conductivity is inversely proportional to resistance. The instrument typically reports conductivity as mS/cm (milliSiemens / centimeter). The instrument typically uses the membrane-electrode method for DO. A reduction reaction in the cathode is caused by oxygen diffusing through the membrane of the sensor to create a current. This current is proportional to the concentration of oxygen dissolved in water. DO is reported as milligrams (mg) DO/L.

The instrument uses a glass-electrode method to determine pH. The known pH of a reference solution is determined by using two electrodes, a glass electrode and a reference electrode, and measuring the voltage (difference in potential) generated between the two electrodes. The difference in pH between solutions inside and outside the thin glass membrane creates electromotive force in proportion to this difference in pH. The unit for pH is dimensionless and a neutral pH is 7.00. ORP is determined by measuring the potential of a platinum electrode relative to the reference pH electrode. ORP is reported as millivolts (mV). The instrument measures turbidity using the light-transmission scattering method. The unit for turbidity is NTU (Nephelometric Turbidity Unit).

4.2.2.2 Water Quality Measurement Procedures

The water quality instrument uses a water flow-through cell during groundwater sampling, or can be used without the cell for measuring grab sample water parameters. Field personnel will follow all procedures outlined by the manufacturer for calibration and operation of the Horiba U-53 or equivalent instrument when collecting field parameter measurements.

For measuring DO, a YSI 550A Dissolved Oxygen Instrument (or equivalent) or optical DO sensor may be used with the water quality instrument. This instrument may provide greater accuracy in some situations and may be easier to use in surface water or grab sample applications. Field personnel will follow all procedures outlined by the manufacturer for calibration and operation of the YSI 550A (or equivalent) DO instrument or optical DO sensor when collecting field parameter measurements.

4.2.3 Field Screening of Soil Samples using a Photoionization Detector

Soil samples are screened using a PID to assess volatile organic vapors in soil samples from split-spoon samplers, direct-push core samples, and other soil sample types. The PID will be a MiniRAE 3000 or equivalent portable-type instrument that is programmable and contains the appropriate gas-discharge lamp (9.8, 10.6, or 11.7), measured in electron-volts (eV), based on the ionization potential of the target compound.

When field screening soil samples, field personnel will follow all procedures for calibration, operation, and preventive maintenance as specified in the operating manual provided by the manufacturer.

4.2.3.1 Field Screening Equipment

The following equipment may be used for field screening of soil samples:

- PID (MiniRAE 3000 or equivalent).
- Self-sealing quart-size polyethylene freezer bags, or 16-ounce glass jars. Jars must be decontaminated or certified as clean from a laboratory.

4.2.3.2 Field Screening Procedures

The polyethylene bag headspace method described below is one method to screen soil samples at the site. The collapse of the polyethylene bag during analysis allows uniform flow of contaminant vapors into the PID, giving accurate readings. However, a 16-ounce, decontaminated glass jar may be substituted or the soil in the split-spoon or macro-core may be screened directly.

1. Use a self-sealing quart-size polyethylene freezer bag. Half-fill the bag with sample (the volume ratio of soil to air is equal), then immediately seal it. Manually break up the soil clumps within the bag. Alternatively, soil in the split-spoon or direct-push macro-core may be screened directly immediately after opening the sampler.
2. When using glass jars:
   - Fill jars with a total capacity of 16 oz.
   - Seal each jar with one (1) or two (2) sheets of aluminum foil with the screw cap applied to secure the aluminum foil.

   Note: Headspace development decreases with temperature. When temperatures are below the operating range of the instrument, perform headspace development and analysis in a heated vehicle or building. Record the ambient temperature during headspace screening. Complete headspace analysis within approximately 20 minutes of sample collection.
3. After headspace development, introduce the instrument sampling probe through a small opening in the bag to a point about one-half of the headspace depth. Keep the probe free of water droplets and soil particles.
4. Record the highest meter response on a sampling form. Maximum response usually occurs within about two seconds. Erratic meter response may occur if high organic vapor concentrations or moisture is present. Note any unusual headspace measurements on the sampling form.

Do not collect analytical samples from the polyethylene bag.

4.2.4 Other Field Screening/Sampling Technologies

Other field screening and or sampling technologies that provide real time or near real time analytical screening results may be used. Such technologies include portable X-ray fluorescence meters and portable gas chromatographs. Portable X-ray fluorescence (XRF) meters may provide screening level results with quantitation as low as 2-5 parts per million (ppm) feasible in soil with certain models for certain metals. Portable gas chromatographs may provide laboratory quality results in the field in air, water or, soil matrices for VOCs, and certain semi-volatile organic compounds, at sub-ppb concentrations or at high ppm concentrations depending on unit configuration.

4.2.4.1 Portable X-ray Fluorescence Meters

XRF meters function by ionizing target compounds with an X-ray, causing the target to fluoresce as electrons fall to lower atomic orbital positions to replace lost electrons. The resulting fluorescence is characteristic of the elements present in the target. Portable XRF meters may be used either for in situ testing whereby the meter is placed directly on the soil after removing plants/foreign objects or by testing samples in bags or sample cups. Either method is acceptable. Results are generally more accurate for samples with greater preparation (i.e., homogenous samples similar to those analyzed in laboratory settings will provide results most similar to laboratory analytical methods). Water in field screening samples may cause differing detected concentrations compared to laboratory analyses, which are dried and homogenized. Both in situ and bagged sample portable XRF testing are field-screening methods.

4.2.4.2 Portable Gas Chromatographs

Portable gas chromatographs operate on the same principles as laboratory gas chromatographs, but have a smaller form factor using specialized equipment designed for the field. Water and soil samples may be analyzed using the purge-and-trap method. For VOC analysis in soil the sample preparation for purge-and-trap may vary depending on the concentration of the target analytes in the soil and will require the addition of a known volume of either distilled water or a water miscible organic solvent such as methanol.

4.2.4.3 Procedures for Field Screening/Sampling Technologies

Field personnel will follow all procedures for use, calibration, and standard preparation provided by the manufacturer.

4.2.5 Site and Data Point Surveys and Basemap Preparation

Sampling locations, and other features will be surveyed. Measurement of sampling points will be recorded using either a portable Global Positioning System (GPS) unit suitable for field surveys, or appropriate land surveying equipment operated by a competent land surveyor under the supervision of a New York State Licensed Land Surveyor. Survey data will be used to develop or update site base maps, which will be prepared using geographic information system (GIS) or drafting software.

4.2.6 Laser-Induced Fluorescence (LIF)

LIF technology functions by emitting laser light absorbed by aromatic hydrocarbons and which may be absorbed or reflected by soil. Laser excited aromatic hydrocarbons fluoresce. This fluorescence is captured and transmitted by an optical fiber (for in-situ down-hole readings), or directly captured by detectors (for above ground screening of soil) where it is analyzed in real-time using data processing equipment. Specific variations of this technology have been developed to target various NAPLs. However, pure chlorinated solvents do not directly fluoresce (unless comingled with aromatic hydrocarbons). A LIF technology called DyeLIF has been developed to detect chlorinated solvent NAPLs that lack natural fluorescence[1]. The DyeLIF technology involves the injection of hydrophobic dye ahead of

---

[1] Additional information on DyeLIF is available from several resources including:

A) A technical paper published by the national groundwater association: DyeLIF™: A New Direct-Push Laser-Induced Fluorescence Sensor System for Chlorinated Solvent DNAPL and Other Non-Naturally Fluorescing NAPLs. Available online: https://onlinelibrary.wiley.com/doi/abs/10.1111/gwmr.12296

B) A technical paper published by the Department of Defense's environmental technology demonstration and validation program [Environmental Security Technology Certification Program (ESTCP)].: Direct Push Optical Screening Tool for High-Resolution, Real-Time Mapping of Chlorinated Solvent DNAPL Architecture, ESTCP Project ER-201121. Available online: https://serdp-stcp.org/content/download/40309/386525/file/ER-201121%20Final%20Report.pdf the LIF sensor in direct-push in-situ applications. When used ex situ on soil samples the hydrophobic dye is misted onto samples. DyeLIF allows some NAPLs previously invisible to LIF technology to be detected as the hydrophobic dye “tags” NAPL.

4.2.6.1 Personnel

Generally, three personnel are required to operate the drilling and LIF equipment- two crew members under the direction of the field scientist overseeing field activities. One crew member operates the direct-push drilling equipment, and the other operates the LIF controller, logging equipment, and detectors as directed by the field scientist.

The field scientist overseeing LIF operation and the assisting crew member will know the principals of equipment operation and QA/QC procedures. The field scientist should also be familiar with the expected output of the detectors and how this output is affected by the LIF system controls.

4.2.6.2 LIF Procedures

A subcontractor competent and trained in the operation and calibration of LIF equipment will provide LIF services and equipment at the site. The contractor will follow all requirements provided by the manufacturer of the equipment. Calibration and preparation of standards for the LIF will be performed in accordance with manufacturer specifications.

4.3 Sampling Equipment Decontamination

Cross contamination of samples from any source must be avoided. All sampling equipment must be clean and free from the residue of any previous samples. All non-dedicated sampling equipment must be cleaned initially and prior to reuse. The following is the procedure for decontamination and does not apply to heavy equipment or drilling equipment, except for split spoons or equivalent samplers. All heavy equipment and drilling equipment will be steam cleaned in a predesignated location prior to use and between locations.

4.3.1 Equipment and Supplies

The following equipment may be needed to decontaminate equipment and tools used to collect soil, sediment and water samples:

1. Tap water for initial cleaning and rinsing of equipment.
2. Distilled water for final rinsing of equipment after tap water or solvent rinse.
3. Suitable detergent (e.g., Alconox™) for general equipment cleaning.
4. Dishwashing or specialized detergent to remove oily or organic residue.
5. Nitric acid as a 1% or 10% solution for removing metal contaminants from equipment.
6. Isopropyl alcohol (for persistent NAPL not removable by other methods).
7. Organic solvent for final cleaning of equipment (e.g., hexane or equivalent) (for persistent NAPL not removable by other methods).

8. Personnel protective equipment (PPE) - including disposable gloves (Nitrile preferred), first aid kit, and waterproof outerwear (if necessary).
9. Re-sealable buckets approved for waste collection.
10. Squirt bottles for water, alcohol, and solvents.
11. Brushes for cleaning equipment.
12. Field notebooks, pens, pencils, and digital camera to document decontamination procedures.

4.3.2 Decontamination Guidelines

1. Non-dedicated soil and water sampling and processing equipment should be decontaminated between sampling intervals and between locations.
2. All solvents must be captured and disposed of in appropriate, labeled, soil or aqueous waste containers. All instruments that come into contact with the sample water must be cleaned in the same manner as the sampling device.
3. Liquids collected into the chemical waste container must be discarded in an appropriate waste stream.
4. Staff performing decontamination procedures must wear appropriate PPE, gloves (e.g., Nitrile) and eye protection.
5. Care should be taken during cleaning to prevent cleaning solution contact with clothing. If circumstances dictate that contact will occur (e.g., high wind), waterproof outer clothing (e.g., foul weather gear or rain gear) and face shields must be worn.
6. The project work plan may designate collection of equipment rinse samples to document effectiveness of cleaning.
7. This Work Plan does not address radioactive waste decontamination, PPE for radioactive waste, or disposal of radioactive contaminated waste material.

4.3.3 Decontamination Procedure

The following procedures will be followed for decontamination:

1. Disassemble item(s) (if necessary).
2. Rinse each item with tap water.
3. Scrub the item with a brush and soapy water, using a suitable detergent such as Alconox™ for non-oily residue, or a dishwashing or specialized detergent for items with oily or other sticky organic residue.
4. During the scrubbing process, bleed Alconox™ solution or equivalent through small passageways/nozzles/vents, etc.
5. Rinse the item with tap water to remove all residual soap. Bleed tap water through small passageways/nozzles/vents, etc.

6. Rinse the item with 1% to 10% nitric acid to remove residual metals (if deemed necessary). Bleed 1% to 10% nitric acid through small passageways/nozzles/vents, etc.
7. Rinse the item with de-ionized water. Bleed de-ionized water through small passageways/nozzles/vents, etc.
8. For persistent NAPL not removable by other methods (if deemed necessary):
    a. Rinse the item with isopropyl alcohol. Bleed isopropyl alcohol through small passageways/nozzles/vents, etc.
    b. Rinse the item with de-ionized water. Bleed de-ionized water through small passageways/nozzles/vents, etc.
    c. Rinse the item with organic solvent (e.g., hexane or equivalent) if deemed necessary. Bleed organic solvent through small passageways/nozzles/vents, etc.
    d. Rinse the item with de-ionized or analyte-free water and allow to air dry. Bleed de-ionized or analyte-free water through small passageways, nozzles, vents, etc.
9. Re-assemble item(s) (if necessary).
10. Wrap the item(s) in aluminum foil or a plastic bag to protect it until it is used.

Equipment used for sampling water from monitoring wells such as pneumatic bladder pumps will be decontaminated by washing all internal and external surfaces with soapy water and rinsing with deionized water prior to use. All tubing must be dedicated to individual monitoring wells (i.e., tubing cannot be reused). Field instrumentation will be cleaned per manufacturer's instructions. Probes, such as those used in pH and conductivity meters, and thermometers will be rinsed prior to and after each use with deionized water.

4.3.4 Reference

American Society for Testing and Materials (ASTM), 1994. Standard Practice for Decontamination of Field Equipment Used at Nonradioactive Waste Sites. Designation: D 5088 – 90.

4.4 Groundwater Sampling

Groundwater samples will be collected to evaluate the nature and extent of contaminant concentrations greater than NYSDEC Class GA standards in groundwater. Specific sampling objectives are outlined in the CAWP. Samples may also be collected from temporary monitoring points using a direct-push retractable screen sampler.

4.4.1 Sampling Equipment

The following equipment may be required for groundwater sampling:

- Electric water level indicator or interface probe
- Peristaltic pump
- Polyethylene or Teflon®-lined polyethylene tubing

- Silicone tubing
- Direct-push retractable screen sampler or equivalent for soil boring groundwater grab samples
- Temperature, pH, dissolved oxygen, ORP, specific conductivity, and turbidity meters
- PID
- Field logbook and field data sheets
- Laboratory prepared sample containers
- Roll of polyethylene tubing
- Decontamination equipment
- Disposable latex or nitrile gloves

4.4.2 Sampling Procedures (Permanent Monitoring Wells)

Groundwater samples will be collected with passive diffusion bags for VOC analyses. Groundwater sampling for analytes not compatible with PDB sampling (most non-VOC compounds and certain VOC compounds such as 1,4-Dioxane) will typically be conducted in accordance with the USEPA Low- Flow Sampling Protocol (USEPA, 1998). Alternative methods, such as collection of groundwater samples with passive diffusion bags or following purging of three well volumes, may be used based on project requirements and site conditions.

Water-filled passive diffusion bag (PDB) samplers can be an effective, simple and inexpensive alternative to traditional groundwater sampling methods for measuring concentrations of many VOCs in groundwater. A typical passive diffusion bag sampler consists of low-density polyethylene lay-flat tube closed at both ends containing deionized water. The samplers operate by chemical diffusion across the semipermeable polyethylene membrane until a chemical equilibrium exists on both sides of the membrane. General passive diffusion bag sampling procedures are summarized below.

Deployment

- Using the electronic water level probe, measure the depth to water and the total well depth. Compare these measurements with previous measurements from the well and the reported depth of the well screen from the well construction record. This is to check if sediment has accumulated on the bottom of the well and if the well construction records are accurate.
- Attach a stainless-steel weight to the end of the line. Sufficient weight should be added to overcome the buoyancy of the PDB sampler.
- Calculate the distance from the bottom of the well, to the depth where the PDB sampler is to be placed.
- At the designated point, secure the PDB sampler to the weighted line using the ring tabs on both ends of the sampler.
- Label PDB sampler(s) with well I.D. and depth (if using multiple PDBs in one well).

- The center point of the PDB sampler should be suspended at the vertical midpoint of the saturated well-screen length.
- With PDB sampler(s) attached, lower the weighted line to the bottom of the well. The weighted line should be taut when the PDB sampler(s) is at the target depth(s).
- Secure the assembly in place. Attach the weighted line with a hook to the well riser or well cap. The well should be covered to prevent surface water infiltration.
- Allow the system to remain undisturbed while the PDB sampler(s) equilibrate (minimum 14 days recommended; 6 months or more allowable if needed).

Sample Recovery

- Remove the PDB sampler from the well using the attached line. Avoid exposing the sampler to excessive agitation as it is removed from the well.
- Examine the surface of the PDB sampler for tears, algae, iron, or other coatings. If there are tears in the membrane, the sample should be discarded. If the outside of the sampler is coated with any material, it should be noted.
- Detach the sampler from the weighted line and remove excess fluids or materials from the exterior of the bag. This can be accomplished with paper towels.
- There are several acceptable methods for transferring water from the PDB sampler to the 40ml volatile organic analysis (VOA) vials:
  - If a discharge device is provided by the PDB sampler supplier, it can be inserted either in place of the fill plug or directly into the bag.
  - If no discharge device is provided, the PDB sampler can be cut at one end using scissors or a sharp probe. The water should then be poured gently from the PDB sampler to the 40 ml VOA vials.
- Samples should be preserved according to the analytical method and stored at approximately 4 °C in accordance with standard sampling protocol.
- Any unused water from the PDB samplers should be disposed in accordance with local, state, and federal regulations.

General low-flow sampling procedures are summarized below.

Clean, new tubing constructed of polyethylene, Teflon®-lined polyethylene, or other material compatible with target analytes will be lowered into the water column to a maximum depth of two feet above the bottom of the monitoring well. The tubing will be connected to a piece of silicone tubing inserted into the mechanical rollers of a peristaltic pump. By using the process of mechanical peristalsis, the peristaltic pump draws groundwater through the tubing to the surface, so a sample can be collected. Alternative pumping methods may be used depending on the depth of the water in the well or other specific sample requirements. The well will be purged at a rate to minimize drawdown. Field parameters, consisting of pH, specific conductance, temperature, dissolved oxygen, ORP, and turbidity will be measured in each sample collected from a monitoring point using individual meters. Both the pH and the specific conductivity meters will be calibrated for water temperature before each sampling event.

The volume of water removed from each monitoring well will depend on the time required for stabilization of the field parameters or on field conditions (i.e. if a well goes dry or low flow is not possible because of water level drawdown). The well has stabilized for sample collection when field parameters are stable for three consecutive readings as follows:

- pH: +/- 0.1 standard units
- Specific Conductance: +/- 3%
- Oxidation-Reduction Potential: +/- 10 millivolts
- Dissolved Oxygen: +/- 10%
- Turbidity: +/- 10%

When the field parameters have stabilized, the volume of water purged will be recorded, and the monitoring point will be sampled by purging the well. Once a groundwater sample is collected from the well, the polyethylene tubing will be disposed of as ordinary solid waste.

After recording field measurements, the analytical parameters and order of sample collection for groundwater samples will be:

1. VOCs.
2. SVOCs.
3. Other Parameters (Metals, Pesticides, PCBs, etc.).

PID screening may be omitted in monitoring wells that have demonstrated in the previous rounds of water level measurement that they contain no or insignificant amounts of volatile organic vapors. The PID will be calibrated before the start of each sampling event.

The sample bottles will be pre-preserved by the laboratory. The sample bottles will be immediately placed in a cooler held at 4°C after sample collection. Disposable latex or nitrile gloves will be worn by the sampling personnel and changed between sampling points. Data to be recorded in the field logbook will include sampling methods, depth to water, and PID readings.

Groundwater (without NAPL) that is purged from monitoring wells will be discharged to the ground surface within 50 feet of each monitoring well location if these criteria have been met:

1. A defined site is the source of the groundwater contamination.
2. There is no free product observed such as NAPLs.
3. The infiltrating groundwater is returned to the same water bearing zone from which it is purged.
4. Prior approval has been granted by the NYSDEC project manager.

Water requiring off-site disposal will be handled in accordance with Section 4.11.

4.4.3 Sampling Procedures (Temporary Sampling Points)

A direct-push retractable screen sampler or equivalent may be used to collect discrete groundwater samples at various depths at each location. A 1 ¾-inch hollow push rod with a steel drop off tip will be advanced to a designated depth and then retracted. When the push rod is retracted a filter screen is exposed, allowing groundwater to hydrostatically enter the inlet screen from the formation. Clean, new polyethylene or Teflon®-lined polyethylene tubing will be lowered into the water column to a maximum depth of two feet above the bottom of the monitoring well or borehole. The tubing will be connected to a piece of silicone tubing inserted into the mechanical rollers of a peristaltic pump. By using the process of mechanical peristalsis, the peristaltic pump draws groundwater through the tubing to the surface, so a sample can be collected. Field parameters, consisting of pH, specific conductance, temperature, dissolved oxygen, ORP, and turbidity will be measured in each sample collected from a monitoring point using a water quality meter.

The volume of water removed from each sampling point will depend on the time required to either purge a volume of water equal to the inside volume of the wetted tooling or to stabilize the field parameters, whichever is achieved first. The point is stabilized for sample collection when field parameters are stable for three consecutive readings as follows:

• pH:	+/- 0.1 standard units
• Specific Conductance:	+/- 3%
• Oxidation-Reduction Potential:	+/- 10 millivolts
• Dissolved Oxygen	+/- 10%
• Turbidity	+/- 10%

When the field parameters have stabilized or the inside volume of tooling has been purged, the volume of water purged will be recorded, and the sampling point will be sampled by purging the well. The purge water will be handled in accordance with Section 4.11.

After recording field measurements, the analytical parameters and order of sample collection for groundwater samples will be:

1. TCL VOCs.
2. Other Parameters (TAL Metals etc.) if required.

The sample bottles will be pre-preserved by the laboratory. The sample bottles will be immediately placed in an insulated cooler maintained at 4°C after sample collection. Disposable latex or nitrile gloves will be worn by the sampling personnel and changed between sampling points.

4.5 Surface Soil Sampling

Surface soil samples will be collected to evaluate the nature and extent of contaminants at concentrations greater than 6 NYCRR Subpart 375-6 Remedial Program cleanup objectives. The objectives of a surface soil sampling program are to assess the nature and extent of soil contamination and evaluate the need for remediation. The location of each surface soil sample will be measured relative to permanent site features or recorded using a GPS device and marked on a site diagram in the field logbook. Additionally, all sampling locations will be marked in the field with a survey stake and labeled with the sample I.D. to facilitate later surveying of the sampling location.

4.5.1 Sampling Equipment

This equipment may be required for surface soil sampling:

- Hand Augers (multiple size stainless steel buckets)
- Labels
- Power Auger (if required for 2+ foot depth)
- Cooler
- Stainless steel trowels
- Field logbook
- Shovels (to remove gravel and debris)
- Soils Data form, Daily QC form, etc.
- Plastic sheeting or aluminum foil
- Decontamination equipment as required
- Appropriate sample bottles
- Hand tools (for equipment or other needs)
- Plastic bags (sealable)
- Camera and film
- Compass
- 200 ft tape

4.5.2 Sampling Procedures

Surface soil samples may be collected at the same location as a soil boring, but is not required. If the surface soil sample is in the same location as a soil boring, a surface soil sample will be collected prior to initiation of boring and sampling.

Vegetation at the sample location is removed by cutting or scraping away with a stainless-steel trowel. Twigs, leaves roots, grass, and rocks are not considered part of the soil matrix and will be removed from the sample. Gravel or other debris will be removed from the surface before advancing the auger or trowel to a depth of approximately six inches. Using pre-cleaned stainless-steel equipment, soil will be extruded directly into the sampling containers. If dedicated sampling equipment is not used, sampling equipment must be decontaminated before collecting another sample.

Samples for VOC analysis must be collected first. Fill VOC sample containers as full as possible to minimize headspace losses. Fill separate containers with a sufficient quantity of soil for analyses of other required parameters. Samples will be immediately placed in an insulated cooler and maintained at a temperature of 4°C. Enter all data into a permanent field logbook. VOC samples will be collected as grab samples.

Other samples may be collected as grab samples or composite samples. For composite samples, a volume of soil 6 inches by 6 inches by 2 inches deep (72 cubic inches) will be collected using a stainless-steel trowel and transferred to a stainless-steel mixing bowl. Upon collection, the sample will be homogenized in a stainless-steel bowl and classified. Twigs, leaves roots, grass, and rocks are not considered part of the soil matrix and will be removed from the sample. After the soil is homogenized, a sample will be placed in laboratory-provided sample containers.

Qualified field personnel will describe the soil samples, screen the soil samples for VOCs with a PID, and record any observations in the field log. The location(s) for collection of field duplicates, field blanks, and matrix spike/matrix spike duplicate samples shall be determined in the field.

Sampling equipment will be decontaminated as discussed in Section 4.3. Disposable gloves will be worn by the sampling personnel and changed between sampling points.

4.6 Subsurface Soil Sampling

Soil samples will be collected at discrete depth intervals to evaluate the nature and extent of contaminants at concentrations greater than 6 NYCRR Subpart 375-6 Remedial Program cleanup objectives in subsurface soil and to document the underlying stratigraphy. Analytical data will be used to evaluate the need for remediation.

4.6.1 Soil Sampling Equipment

This equipment may be required to collect soil samples:

- PID
- Roll of polyethylene sheeting
- Stainless steel spatula or spoon
- Stainless steel trowel
- Stainless steel bowl
- Disposable nitrile or latex gloves
- Certified, pre-cleaned sample containers
- Aluminum foil
- Field logbook and pen
- Decontamination equipment

4.6.2 Soil Sampling Procedures

4.6.2.1 Direct-push Soil Sampling

A direct-push drill rig (e.g., Geoprobe® or equivalent) will drive a dual-tube sampler, blind probe, or similar direct push system into the subsurface to create a borehole approximately 1.5 to two inches in diameter. Subsurface soil samples will be removed from the borehole in four- or five-foot intervals in acrylic tubes. The total number of tubes collected from each soil boring will depend on the final depth of the boring.

Before the soil is characterized and the boring is logged, the plastic tube will be cut along its length and the soil core will be screened for VOCs using a PID. Qualified field personnel will characterize the soil samples and record observations in the field log.

Soil samples designated for VOC analysis shall be collected directly from the sampling device. Each grab sample will be placed in laboratory-provided sample containers. Samples will be immediately placed in a cooler and held at 4ºC until the samples are sent to a NYSDOH ELAP and NYSDEC ASP-certified laboratory and analyzed for the applicable analyses. The location(s) for collection of field duplicates, field blanks, and matrix spike/matrix spike duplicate samples shall be determined in the field based on subsurface soil conditions.

Other samples may be collected as grab samples or composite samples, directly from the sampling device. For composite samples, soil will be directly from the sampling tube and transferred to a stainless-steel mixing bowl, where it will be homogenized. After the soil is homogenized, a sample will be placed in laboratory-provided sample containers.

Sampling equipment will be decontaminated as discussed in Section 4.3. Disposable gloves will be worn by the sampling personnel and changed between sampling points.

4.6.2.2 Split-barrel (Split-spoon) Sampling

When direct-push sampling is not practical, a 24-inch long stainless-steel split-barrel sampler typically can be driven 24 inches into the undisturbed materials by dropping a 140-lb weight 30 inches. A 3- inch diameter split spoon may increase recovery for sampling. Split spoon samples will be collected in accordance with the American Society for Testing and Materials (ASTM) Method D 1586-99: Standard Test Method for Penetration Test and Split-barrel Sampling of Soils (ASTM, 1999).

Soil samples will be collected from the split-barrel sampler generally following the procedure described in Section 4.7.3.1.

4.7 Air and Soil Vapor Sampling

Air and effluent vapor sampling is intended to evaluate the potential exposure to VOCs in indoor air and to quantify effluent concentrations and mass. Indoor air, ambient air, and effluent vapor samples will be collected to evaluate the nature and extent of VOCs in these media. Ambient air samples will be collected from outside of the building to provide information on background VOC concentrations.

4.7.1 Air Sampling Equipment

Air and effluent soil vapor samples will be collected using a Summa canister sampling train. The typical Summa canister sampling train consists of:

- Summa canister
- Flow controller
- Particulate filter
- Pressure gauge
- Fittings and a sampling line

The laboratory will evacuate the canister to a minimum vacuum of negative 28 inches (± 2 inches) of mercury (in. Hg) prior to sampling. After sampling, the final vacuum will be recorded on a chain of custody form to confirm sample integrity. A pressure gauge will be used to measure the vacuum before, during, and after sampling. A seven-micron particulate filter will be used upstream of the flow controller to prevent blockage of the flow controller. The sampling line will consist of new, unused, ¼-inch diameter flexible Teflon® or stainless-steel tubing. All parts of the sampling train coming into direct contact with the sample will be made of stainless steel or Teflon®. The following general set-up procedure will be followed for each sampling location:

1. Place the Summa canister at the sampling location.
2. Note the environmental conditions in the sample area on the air sampling sheet.
3. Assemble the Summa canister sampling train. Follow the laboratory instructions for pressure measurement, particulate filter placement, and flow controller attachment.
4. Sample following the procedures described below.

4.7.2 Indoor and Ambient Air Sampling Procedures

Indoor and ambient air samples will be collected in accordance with the NYSDOH Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York (2006) and associated soil vapor intrusion updates. The procedures implemented for the collection of indoor and ambient air samples are summarized as follows:

1. Remove the brass plug fitting covering the 6-liter stainless steel Summa canister sampling port using a wrench.
2. Connect the pressure gauge or flow controller with integral pressure gauge to the Summa canister sampling port. Open the valve on the canister and quickly measure the vacuum within the canister. If the vacuum is greater than negative 25 inches of mercury, then the canister is acceptable for sampling. Any canisters with a vacuum less than negative 25 inches of mercury should not be used for sampling. Close the valve and record the measurement on the sampling sheet.
3. Assemble the sampling train. Each fitting should be hand tightened and then tightened with a wrench approximately ¼ turn.

4. Confirm that the sampling train is air tight by conducting a vacuum test. Place the brass cap at the end of the sampling train (particulate filter), quickly open and close the sampling valve and monitor the vacuum on the pressure gauge. If the vacuum decreases, there is a leak in the system. The fittings should be rechecked and the vacuum test redone.
5. Initiate sampling by opening the Summa canister valve. Record starting time on the sampling sheet.
6. During sampling, the pressure will be monitored periodically to ensure that the flow controller is operating properly.
7. When the time corresponding to the calibrated flow controller (for indoor air – 24 hours) has elapsed, close the canister valve. Disassemble the sampling train. Check the vacuum within the canister using the pressure gauge and record the measurement on the sampling sheet.
8. Since the flow rate into the canister can fluctuate because of variations in atmospheric conditions, the measured final vacuum may range from 4 to 12 in. Hg. If the measured vacuum is greater than 12 in. Hg or less than 3 in. Hg, the sample may be flagged and re-sampling may be needed.
9. Place the brass cap on the sampling port of the canister and tighten it. The air sampling is complete.
10. Place the air sample in the travel box and complete the chain-of-custody forms and identification tag on the canister.
11. Send the canister to the laboratory via next day airmail service for analysis of VOCs by USEPA Method TO-15.

4.7.3 Effluent Vapor Sampling Procedures

Effluent vapor sampling points will be orifice connections on treatment effluent lines.

To obtain representative samples that meet the data quality objectives, effluent vapor samples will be collected as follows:

- To ensure samples collected are representative, one to three volumes (i.e., the volume of the tube) will be purged using disposable syringes prior to collecting the samples.
- Samples will be collected, using conventional sampling methods as described in Section 4.8.3, in a laboratory-certified Summa canister consistent with the sampling and analytical methods.
- Summa canisters will be batch or individually certified as analyte free by the laboratory.

4.8 Community Air Monitoring Program

This community air monitoring program will be implemented to provide a measure of protection for any potential downwind receptors, and to confirm that work activities do not generate airborne contaminants. Arcadis will conduct continuous monitoring (e.g., 15-minute rolling average readings) for VOCs and particulate matter (dust) at the upwind and downwind perimeter of each work area during mechanized remedial soil excavation and well installation activities. During direct push and manual soil boring advancement dust monitoring will not be conducted due to the soil composition (wet clay that is not prone to creating dust during boring advancement). During all soil boring activities (including direct push), downwind VOCs will be continuously monitored, and upwind VOCs will be periodically monitored to establish a background level.

4.8.1 VOC Monitoring, Response Levels, and Actions

VOC monitoring will be conducted using a MiniRae 3000 PID or PPB Rae PID (or equivalent meter). The PID will be calibrated at least daily using the span calibration gas recommended by the manufacturer. The PID measurements will be compared to the action levels specified below.

Action Levels

- If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities will be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities will resume with continued monitoring.
- If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels exceeding 5 ppm over background but less than 25 ppm, work activities will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities will resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but never less than 20 feet, is below 5 ppm over background for the 15-minute average.
- If the organic vapor level is above 25 ppm at the perimeter of the work area, all work activities will be stopped and a re-evaluation of activities initiated. Work will resume provided that controls succeed in reducing the downwind organic vapor level to less than 5 ppm over background for the 15-minute average and less than 25 ppm at the perimeter of the work area.

4.8.2 Particulate Monitoring, Response Levels, and Actions

When particulate monitoring is conducted, it will be continuous. Real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over 15 minutes (or less) will be used for the particulate monitoring. The equipment will have an audible alarm to indicate exceedance of the action levels summarized below. Any fugitive dust migration will also be visually assessed during all work activities.

Action Levels

- If the downwind PM-10 particulate level is 0.1 milligrams per cubic meter (mg/m3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques will be employed. Work will continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 0.15 mg/m3 above the upwind level and provided that no visible dust is migrating from the work area.
- If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 0.15 mg/m3 above the upwind level, work will be stopped and a re-evaluation of

activities initiated. Work will resume provided that dust suppression measures and other controls succeed in reducing the downwind PM-10 particulate concentration to within 0.15 mg/m3 of the upwind level and in preventing visible dust migration.

All particulate monitoring measurements readings will be recorded and made available for NYSDEC and NYSDOH review upon request.

4.9 Storage and Disposal of Investigation Derived Waste

Investigation derived wastes (IDW) will be handled in accordance with Federal, State and local laws. Soil cuttings and purged water requiring off-site disposal will be containerized in UN-approved, 55-gallon steel drums or larger containers if needed. Some disposable PPE and decontamination fluids will be generated. Attempts will be made to wash surface contamination off so PPE (i.e., gloves and other disposable items) may be disposed of as ordinary solid waste. If contamination is suspected, these materials will be collected and containerized in UN-approved, 55-gallon steel drums (separately from contaminated soil and groundwater) and disposed of off-site. Excavated soils may be containerized in roll-off containers or shipped directly offsite as noted below.

Containerized materials will be labeled and staged at an appropriate location. Arcadis will maintain a log of the containers and their contents. The contents will be evaluated upon receipt of analytical results from the field investigations. Containerized IDW will be transported by a licensed waste hauler and disposed of at an approved facility in accordance with applicable regulations.

4.10 Field Documentation

Documentation of an investigative team's field activities often provides the basis for technical site evaluations and other such related written reports. All records and notes generated in the field will be controlled evidentiary documents and may be subject to scrutiny in litigation.

Personnel responsible for documenting field activities must be aware that all notes may provide the basis for preparing responses for legal interrogatories. Field documentation must provide sufficient information and data to enable reconstruction of field activities. Numerically serialized field logbooks provide the basic means for documenting field activities. The following information must be provided on the inside front cover of each field logbook:

- Project Name (Site Name)
- Site Location
- Site Manager
- Date of Issue

Control and maintenance of field logbooks is the responsibility of the Field Team Leader.

4.10.1 Sample Designation

A sample numbering system will identify each sample. This system will provide a tracking procedure to allow retrieval of information about a particular sample and will assure that each sample is uniquely numbered.

Duplicate samples will be numbered uniquely as if they were samples. A record of identification for duplicate samples will be maintained.

4.10.2 Documentation of Field Activities

Field logbook entries must be legibly written and provide an unbiased, concise, detailed picture of all field activities. Use of preformatted data reporting forms must be identifiable and referenced to field notebook entries.

Step-by-step instructions and procedures for documenting field activities are provided below and in following sub-sections. Instruction and procedures relating to the format and technique in which field logbook entries are made are:

- Leave the first two pages blank. They will provide space for a table of contents to be added when the field logbook is complete.
- The first written page for each day identifies the date, time, site name, location, Arcadis personnel and their responsibilities, other non-personnel and observed weather conditions. Additionally, during site activities, deviations from the work plan must also be documented.
- All photos must be traceable to field logbook entries. It is recommended to reference photo locations on the site sketch or map.
- All entries must be made in ink. Waterproof ink is recommended.
- All entries must be accompanied by the appropriate 24-hour time (such as 1530 instead of 3:30).
- Errors must be single line crossed out and initialed. Erroneous notes must remain legible under the single line cross out.
- The person documenting must sign and date each page as it is completed.
- Isolated logbook entries made by a team member other than the team member responsible for field documentation, must be signed and dated by the person making the entry.
- Additions, clarifications, or corrections made after completion of field activities must be dated and signed.

4.10.3 General Site Information

General site characteristics must be recorded. Information may include:

- Type of access into facility (locked gates, etc.).
- Anything that is unexpected on-site (e.g., appearance of drums not previously recorded).

- Information obtained from interview with access or responsible party personnel (if applicable), or other interested party contact onsite.
- Names of any community contacts onsite.
- A site map or sketch may be provided. It can be sketched into the logbook or attached to the book.

4.10.4 Sample Activities

A chronological record of each sampling activity must be kept that includes:

- Explanation of sampling at the location identified in the sampling plan (e.g., discolored soil, stressed vegetation)
- Exact sample location, using permanent recognizable landmarks and reproducible measurements
- Sample matrix
- Sample descriptions, i.e., color, texture, odor (e.g., soil type) and any other important distinguishing features
- Decontamination procedures, if used

As part of chain-of-custody procedures, recorded on-site sampling information must include sample designation, date, time, sampling personnel, sample type, designation of sample as a grab or composite, and any preservative used. Sample locations should be referenced by sample designation on the site sketch or map. The offer or act of providing sample splits to a thirty party (e.g., the responsible party representative; state, county, or municipal, environmental and/or health agency, etc.) must be documented.

4.10.5 Sample Dispatch Information

When sampling is complete, all sample documentation such as chain-of-custody forms shall be copied and copies placed in the project files. A notation of numbers of coolers shipped, carrier and time delivered to pick-up point should be made in a field notebook.

4.11 Sample Handling

The analytical laboratory will provide the sample containers for all soil, groundwater, air, and soil vapor samples. Container closures for all samples, except air and soil vapor, will be screw-on type and made of inert materials. Sample containers are cleaned and prepared by the laboratory prior to being sent to the site. Trip blanks will be used to check for false positives from laboratory cleaning procedures or cross contamination during sample shipment.

All samples collected will be identified with a sample label. A label will be attached to each bottle and each sample will be identified with a unique sample number.

Immediately following sample collection, each sample container will be marked with this information:

- Sample Code
- Project Number

- Date/Time
- Sample Type
- Requested Analysis
- Preservative, if used
- Sampler's Initials

The sample code will indicate the site location, media sampled, and the sample station.

After all sample identification information has been recorded, each sample label will be covered with waterproof clear plastic tape to preserve its integrity. All samples will be recorded and tracked under strict chain-of-custody protocols. In the field, each sample will be checked for proper labeling. The samples will then be packed into coolers with ice and shipped to the laboratory, if applicable. A chain-of-custody form will be completed for each cooler. The form will be signed and dated by the person who collected the samples, the person the samples were relinquished to for transport to the laboratory, and the laboratory sample controller/custodian who receives the samples.

4.11.1 Chain-of-Custody Record

A chain-of-custody record is a printed form that accompanies a sample or group of samples as custody is transferred from person to person and documents sample custody transfer from person to person and sample information recorded on bottle labels. A chain-of-custody record is a controlled document.

As soon as practicable after sample collection, preferably after decontamination, the following information must be entered on the chain-of-custody form in blue or black ink:

- Arcadis project number. Enter the alphanumeric designation assigned by Arcadis that uniquely identifies the project site.
- Project name. Enter site name.
- Samplers. Sign the name(s) of the sampler(s).
- Station number. Enter the sample number for each sample in the shipment. This number appears on the Arcadis sample identification label.
- Date. Enter a six-digit number, indicating the year, month, and day of sample collection; for example, 181125.
- Time. Enter a four-digit number indicating the military time of collection; for example, 1354.
- Composite or grab. Indicate the type of sample.
- Station location. Describe the location where the sample was collected.
- Number of containers. For each sample number, enter the number of sample bottles contained in the shipment.
- Remarks. Enter any remarks.

4.11.2 Transferring to Common Carrier

Instructions for Arcadis transferring custody of samples to a common carrier are:

1. Sign, date, and enter time under "Relinquished by" entry.
2. Place the original chain-of-custody form in the appropriate sample shipping package. Retain a copy with field records.
3. Sign and date the custody seal, which is part of the chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field.
4. Wrap the seal across filament tape that has been wrapped around the package at least twice.
5. Complete other carrier-required shipping papers.

Common carriers usually won’t accept responsibility for handling chain-of-custody forms; this necessitates packing the record in the sample package.

4.11.3 Transferring Custody Directly to a Courier

To transfer custody of samples from the Arcadis sampler directly to a courier, proceed as above, except have the courier complete the “received by” section.

5 CALIBRATION PROCEDURES

Instruments must be properly calibrated to produce technically valid data. Documented calibration and calibration check results verify that the instruments used for measurement work properly and the data produced is reliable. The calibration requirements described or referenced in this section are necessary to support the data quality objectives for this project. When calibration requirements are met, the data will support the focused investigation decisions dealing with the nature and extent of contamination and safety concerns.

5.1 Calibration Procedures for Field Equipment

The manufacturer specifications for operation and maintenance procedures for the field equipment used during these tasks must be followed. General calibration procedures and requirements include:

- All instruments will be calibrated at the manufacturer-specified frequency.
- All instruments will have the calibrations checked at least at the start of each day before measurements are made.
- The calibration and calibration checks will indicate that the sensitivity of the instrument (practical detection limit) is adequate to meet project needs and that the instrument is accurate over the working range.
- All calibration information will be recorded in the field logbook. This includes date and time, technician signature, calibration procedure, calibration results, calibration problems, recalibration and maintenance, and instrument serial numbers.

All calibration standards will be of National Bureau of Standards (NBS) quality and their sources listed and documented so standards are traceable. In addition, only technicians trained in using field instruments will operate them. If the instrument readings are incorrect at the time of the initial calibration, the instrument will either be calibrated by the technician or returned to the manufacturer for calibration. If the instrument readings are incorrect after a continuing calibration check, the preceding sample results will be reviewed for validity, and reanalyzed if necessary.

5.2 Laboratory Calibration Procedures

Samples analyzed according to the USEPA SW-846 analytical methodologies shall follow the laboratory calibration procedures described in SW-846. Laboratory instrument calibration standards will be selected using the guidance provided in the analytical methods. All calibration results shall be recorded and kept on file and will be reviewed and evaluated by the data validator as part of analytical data validation procedures. The standards used for calibration will be traceable to the NBS, and each calibration will be recorded in the laboratory notebook for the particular analysis. Any printouts, chromatograms, etc., generated for the calibration will be kept on file.

Calibration check standards analyzed within a particular analytical series provide insight regarding instrument stability. A calibration check standard will be analyzed at the beginning and end of an analytical series, or periodically throughout a series containing many samples. Calibration check standards will be analyzed after every 12 hours or more frequently, as specified in the applicable analytical method. If results of the calibration check standard exceed specified tolerances, samples analyzed since the last acceptable calibration check standard will be re-analyzed.

6 ANALYTICAL PROCEDURES

All groundwater, soil, and sediment samples collected for laboratory analysis will be analyzed by a NYSDEC ASP-certified laboratory for various analytes, including VOCs and metals, using USEPA SW-846 analytical methodologies with NYSDEC ASP Category B deliverables.

SW-846 analytical methodologies and their detection limits will support the DQOs for each project. The general SW-846 methods and procedures used for the analysis of VOCs (Method 8260B) and metals (Methods 6010B, 7470A, and 7471A) are summarized as follows:

- All instruments will have the calibrations checked at least at the start of each day before measurements are made.
- The calibration and calibration checks ensure that the sensitivity of the instrument (practical detection limit) is adequate to meet project needs and that the instrument is accurate over the working range.
- All calibration information will be recorded in the laboratory logbook. This includes date and time, technician signature, calibration procedure, calibration results, calibration problems, recalibration and maintenance, and instrument serial numbers.

All air and effluent vapor samples collected for laboratory analysis will be analyzed by a NYSDOH-approved laboratory for VOCs (USEPA Method TO-15) that can meet the required method detection limits determined for each Corrective Measure.

7 DATA REDUCTION, VALIDATION, AND REPORTING

This section ensures that the large amounts of data produced by the laboratory are presented in a clear and useable format. In addition, data quality and technical validity must be verified prior to data use. The samples collected at the site will be analyzed according to USEPA SW-846 analytical methodologies, in which data reduction and reporting schemes are well developed and clearly defined. The employment of this method ensures comparability with other similarly analyzed environmental samples. Reduction, validation and reporting specifications for these analyses are detailed below.

7.1 Data Reduction

Data reduction is the process by which raw analytical data generated from the analytical instrument systems is converted into useable concentrations. The raw data, which consists of area counts or instrument responses, is processed by the laboratory and converted into concentrations expressed in milligrams per kilogram (mg/kg), milligrams per liter (mg/L), micrograms per kilogram (ug/kg), micrograms per liter (ug/L), parts per million (ppm), parts per billion (ppb), or micrograms per cubic meter (ug/m3). These concentrations are the standard method for expressing the amount of contamination in environmental samples.

The process used to convert the instrument output into useable concentrations is defined in the USEPA SW-846 methodologies. The resulting concentrations are comparable to other environmental samples and will be comparable to data previously collected for each site.

7.2 Data Validation

Data validation identifies invalid data and qualifies the usability of the remaining data. The output of data validation is qualitative or quantitative statements of data quality. Once the quality of individual measurements is known, a compilation of all data points into a cohesive statement can be made. The confidence associated with a statement incorporates both the confidence in individual measurements and in the decision.

Although rigorous validation of the data generated by the laboratory will be performed by a third-party data validation subcontractor, the laboratory will be responsible for reviewing data to determine if any analytical problems exist. Specifically, the laboratory will develop a case narrative describing how closely the data meet the DQOs in this QAPP.

7.2.1 Data Review

The data review process consists of a contractual review and an evaluation of the analysis and specific requirements of the published method in addition to the laboratory SOP. Data qualification shall be performed following the intent of the National Functional Guidelines with the data validator’s professional judgment, where applicable, when there are no formal validation guidelines.

Data will be declared invalid if documented evidence demonstrates that a sample was not collected under representative conditions, such as an air sampling canister leaking to ambient pressure during shipment.

The laboratory will provide a data reporting package. One copy of the ASP Category B data packages will be delivered to a third-party data validation subcontractor for data assessment. The data packages will include the case narrative. A Data Usability Summary Report (DUSR) will be submitted to the NYSDEC. This package will include sampling analysis and summary forms.

Data validation will be performed using guidance from these documents:

- USEPA Region 2 *Validation of Metals for the Contract Laboratory Program based on SOW ILM05.3* (SOP# HW2 Rev. 13)
- USEPA Region 2 *Validating Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry SW-846 Method 8260B* (SOP# HW24 Rev. 2)

The QA/QC Task Leader will coordinate data set validation based on information from the field team and information from the laboratory on the analysis. The Validator shall review the submitted data package to determine compliance with those portions of this QAPP and site documents that pertain to the production of laboratory data. Compliance is defined by these criteria:

- The data package is complete.
- The data has been produced and reported in a manner consistent with the data requirements of the QAPP and the laboratory subcontract.
- All protocol-required QA/QC criteria have been met.
- All instrument tune and calibration requirements have been met for the time frame of the analyses.
- All protocol-required initial and continuing calibration data is documented.
- All data reporting forms are complete for all samples submitted, including all sample dilution/concentration factors and all pre-measurement sample cleanup procedures.
- All problems encountered during the analytical process have been reported in the case narrative with any actions taken by the laboratory to correct them.

The data validation task requires that the Data Validator conduct a detailed comparison of the reported data with the raw data submitted as part of the supporting documentation package.

Data are never declared invalid solely because they are unlikely to occur in nature, but may be flagged as suspect and be reviewed further until the cause for the apparent anomaly is determined. The results from all QA/QC checks are evaluated to determine if the DQOs for each measurement are being met. Evidence of overwhelming measurement bias, external influences on the representativeness of the data, or lack of reproducibility of the measurement data may be cause for the data to be invalid.

7.2.2 Data Usability Summary Report (DUSR)

The Data Validator shall submit a DUSR covering the results of the data review process. This report shall include:

- A general assessment of the data package.
- Detailed descriptions of any deviations from the required protocols. (These descriptions must include references to the portions of the protocols involved in the alleged deviations).

- Any failure in the Validator's attempt to reconcile the reported data with the raw data from which it was derived. (Again, specific references must be included). Telephone logs should be included in the validation report.
- A detailed assessment by the Validator of the degree to which the data has been compromised by any deviations from protocol, QA/QC breakdowns, lack of analytical control, etc., that occurred during the analytical process.
- As an attachment, a copy of the laboratory's case narrative including the NYSDEC required sample and analysis summary sheets.
- An overall appraisal of the data package.

The validation report shall include a chart in a spreadsheet format, consisting of site name, sample numbers, data submitted to the laboratory, year of analytical protocol used, matrix, fractions analyzed, e.g., volatiles, semi-volatiles, metals, cyanide, PCBs. Space should be provided for a reference to the NYSDEC ASP if there is non-compliance and for an explanation of such violation.

7.3 Reconciliation with Data Quality Objectives

Calculations and determinations for data precision, accuracy and completeness will be performed upon the receipt of the validated analytical data. Results will be compared to the project specifications discussed in the CAWP and site documents. If the results do not meet the project specifications, the data will be flagged and the cause of the failure (i.e., analytical methods, equipment failure, or sampling error) will be evaluated. The Project Manager and Quality Assurance Officer (QAO) will be responsible for decisions regarding use of flagged data. Potential outcomes of this evaluation will include limitations on using the data, rejection of the data, and/or re-sampling. Any limitations on using the data will be detailed in site reports. Corrective action procedures are discussed further in Section 10.

7.4 Data Reporting

The laboratory will report analytical data consistent with ASP reporting requirements. The QA reporting will include the following accuracy and precision protocols as performed on the appropriate QA samples.

If any of the data quality measures indicate performance outside the desired objective, the data associated with that result are not useless. The burden is on the project team to determine the extent to which a quality issue affects data, and ultimately how the issue impacts the fitness for use of the data.

Often, a single case in which a performance objective is not met does not mean the data is useless, but slightly reduces the confidence that the measurement is reliable and indicates that increased quality control measures are needed. Any potential limitations of the data set will be identified and communicated. The project team will present all known or potential limitations on the data in the final report.

Data quality is measured by how well the data meet the QA/QC goals for the project. QC elements include precision, accuracy, representativeness, completeness, comparability, and sensitivity:

- <u>Precision</u> is a measure of agreement among individual measurements of the same property, usually under prescribed conditions. Assessing precision is measuring the random error component of the data collection process. Precision is determined by measuring the agreement among individual measurements of the same property, under similar conditions. The degree of agreement, expressed as the Relative Percent Difference (RPD), is calculated using the formula below.

$$RPD(\%) = \frac{|V_1 - V_2|}{\left[\frac{(V_1 + V_2)}{2}\right]} \times 100$$

Where:
V1 = value 1
V2 = value 2

Analytical precision is assessed by analyzing MS/MSD pairs and laboratory duplicate samples. Field precision is assessed by measurement of field duplicate samples. The objective for precision is to meet or exceed the precision demonstrated for similar samples and should be within the established control limits for the methods. Precision control limits and QC RPD limits are noted within the laboratory SOP.

- Accuracy is the degree of agreement of a measurement with an accepted reference or true value. Accuracy measures the bias or systematic error of the entire data collection process. Sources of these errors include the sampling process, field and laboratory contamination, sample preservation and handling, sample matrix interferences, sample preparation methods, and calibration and analytical procedures. To determine accuracy, a reference material of known concentration is analyzed or a sample spiked with a known concentration is reanalyzed. Accuracy is expressed as a percent recovery (%R) and is calculated using this formula:

$$\%R = \frac{(A - B)}{C}\ X\ 100$$

Where:
A = The analyte concentration determined experimentally from the spiked sample.
B = The background level determined by a separate analysis of the unspiked sample.
C = The amount of the spike added. Completeness is calculated using this formula:

$$Completeness\ (\%) = \frac{Number\ of\ usable\ data}{Number\ of\ samples\ collected\ for\ each\ paramter\ analyzed}\ x\ 100$$

The objective is to generate a sufficient database with which to make informed decisions. To help meet the completeness objective, every effort must be made to avoid sample loss through accidents or inadvertence. The completeness goal for this project is 100%.

- Comparability expresses the confidence with which one data set can be compared to another.
- Sensitivity is the capability of a method or instrument to discriminate between small differences in analyte concentration.

8 PREVENTATIVE MAINTENANCE

The preventative maintenance program ensures that the sampling, field testing, and analytical equipment perform properly, avoiding erroneous results, and minimizing equipment downtime. The preventative maintenance program also ensures all instrument maintenance is documented and future maintenance is scheduled. This section describes the equipment maintenance program for field instruments and those responsible for implementation of the program at the Site. Specific field equipment maintenance procedures are in the manufacturer specifications and operating manuals. The laboratory preventative maintenance program is the responsibility of the laboratory and only the minimum requirements are mentioned here.

8.1 Responsibilities

Responsibilities of key project personnel are described below:

Personnel	Responsibilities
Field Team Leader	• Keeping all maintenance records. • Development and implementation of the preventative maintenance program.
Equipment Manager	• Tracking inventory of stored equipment within the Arcadis equipment inventory. • Carrying out all maintenance according to schedule. Informing field team members of specific maintenance requirements. • Keeping records of all maintenance performed under his or her care. Sending out equipment for service or repair. Maintaining adequate supply of spare parts.
Field Personnel	• Maintenance of all equipment located onsite regularly and after each use. Keeping supply of spare parts on-hand.

8.2 Preventative Maintenance Program

The preventative maintenance program consists of three parts: normal upkeep, service and repair, and formal recordkeeping. Normal upkeep consists of daily procedures that include cleaning, lubrication and checking the batteries of the equipment. The following is a partial list of normal upkeep procedures and a partial list of important spare parts:

- Normal upkeep for environmental monitoring equipment performed daily or after each use:
    - Cleaning
    - Lubricating moving parts
    - Checking and charging battery
    - Inspecting for damage
    - Checking for operation problems
    - Inspecting all hoses and lines

- Partial list of important spare parts for environmental monitoring instruments frequently used:
    - Fuses
    - Mini Rae-UV lamp
    - Spare battery

The normal upkeep is performed daily after each use and includes inspecting for damage, signs of problems, and charging the batteries if necessary. Specific equipment upkeep procedures are described in the manufacturer specifications and operation manuals for each instrument provided in the Generic Field Activities Plan.

Minor service and repair will be performed by the Equipment Manager experienced in the service and repair of field instruments. Equipment needing major or more complex repair and service will be sent to the manufacturer.

All maintenance, servicing and repair of equipment shall be recorded and kept on file. Field personnel shall record maintenance and instrument problems in the field logbooks. These will be kept on file by the Field Team Leader. The Equipment Manager shall keep a record of all equipment released to the field and a record of all maintenance and service.

8.3 Laboratory Instrument Maintenance

Preventative maintenance procedures will be defined and written for each measurement system. Maintenance activity, preventative or repair, will be documented on standard forms, which are maintained in logbooks. Written procedures will include maintenance schedules, problem identification procedures, space for describing problems and repair notes, and failure analysis protocols. Service contracts and regularly scheduled in-house maintenance will be included, along with a list of critical spare parts. Laboratory instrument maintenance and calibration and corrective action procedures are incorporated in the laboratory SOPs.

8.4 Rental Equipment

Rental equipment will be obtained only from known, reputable rental suppliers. The equipment will require a pre-receipt to verify accuracy, maintenance and upkeep of the equipment.

9 QUALITY ASSURANCE PROCEDURES

To monitor the quality of the analytical data generated, appropriate QC methods will be employed for all field and laboratory measurement systems. The employment of QC methods permits the validation of the analytical methodology used and provides a measure of the suitability of the methodology to meet the DQOs before measurement or analysis. Once the measurement and analysis has begun, the employment of QC methods permits the monitoring of the system output for quality. The QC results presented with the environmental sample data allow the data to be assessed for quality and indicates how well the data has met the DQOs.

Laboratory generated data is used to accurately identify and quantify hazardous substances, while the field generated data is used with the laboratory data for further investigation of contamination at the site. Both laboratory and field internal QC programs ensure the data are reliable for use in the focused investigation. Laboratory QC programs are generally more rigorous than field QC programs.

9.1 Field Quality Control

The intended data uses have been identified and the DQOs established for all field measurement activities in this QAPP. Section 4 contains SOPs, which describe the use of field instruments. Section 5 contains calibration procedures. QC methods will be used to demonstrate that the instruments can produce reliable data. The QC checks employed for field instruments are:

QC Method	Purpose	Frequency
Calibration Check Sample	• Ensures proper working order of instruments • Measures instrument accuracy and sensitivity	Daily
Background Sample	• Provides measure of instrument reliability	Daily
Duplicate Sample	• Measures instrument precision	5%
Trip Blanks	• Measures potential contamination from sample transport, the environment or shipping	Minimum of one per cooler of aqueous volatile samples.
Field Blanks	• Measures potential contamination from poor sampling device decontamination procedures	One per every 20 environmental samples per media.

The calibration check samples will be analyzed daily and duplicate samples will be analyzed at a minimum frequency of five percent. The calibration check verifies that the instrument can accurately identify and quantify contaminants of concern. The duplicates quantitatively measure the precision of the instrument.

Background samples are similar to blanks and provide information regarding instrument reliability. The information is recorded in field logbooks. The field technician uses the results from these QC methods to monitor the instrument during the analysis. If QC results indicate a problem with the instrument, corrective action will be taken and, if necessary, the samples will be reanalyzed. Because field measurements are generally easy to repeat, measurements should be repeated as necessary, so the data are as complete as possible. The QC results are an indication of data quality and reliability when the data are being reviewed.

9.2 Laboratory Quality Control

The scope and description of QC samples and QC methods are well detailed in the USEPA SW-846 methodologies for the particular analysis. The methodologies for organic and inorganic analyses describe the type of QC samples and required QC methods, and the required frequency of analysis. QC limits have been established for standards, blanks, duplicates, matrix spikes, and surrogates, and are contained in the methodologies. QC data will be reviewed by Arcadis personnel to assess the validity of the data and determine if the DQOs have been met.

10 CORRECTIVE ACTIONS

10.1 Non-conformance Reports

Corrective action will be taken when a non-conforming condition is identified. A non-conforming condition occurs when QA objectives for precision, accuracy, completeness, representativeness or comparability are not met, or when procedural practices or other conditions are not acceptable.

A non-conformance report will be prepared by the site QAO, approved by the Project Officer, and issued to the Project Manager and other appropriate parties including the laboratory and NYSDEC as necessary. The non-conformance report will describe the unacceptable condition and the nature of corrective measures recommended and will include a discussion of specific data involved, the impact to data quality, and data usability. A schedule for compliance will also be provided.

The non-conformance report will specify, the corrective action recommended including measures to prevent a recurrence of the original deficiency. Appropriate documentation of corrective action will also be prepared. The site QAO will monitor implementation of the corrective action and provide written record on whether the original problem has been resolved.

10.2 Stop Work Orders

A Stop-Work Order may be issued, upon authorization, by the site QAO, if corrective action does not adequately address a problem or if no resolution can be reached. To issue a Stop-Work Order, written authorization is required from the Project Manager and the NYSDEC Representative. If disagreement occurs among these individuals, it will be brought before successively higher levels of management until the issue is resolved.

10.2.1 Stop Work Order Documentation

The conditions and need for a Stop-Work Order will be documented in sufficient detail to permit evaluation of the deficiency and determination of proper corrective action. Pertinent communications will be attached to the Stop-Work Order and referenced in the appropriate spaces. Such communications include discussions, correspondences, or telephone conversations that pertain to evaluation of the problem and potential solutions, and implementation of the preferred solution.

10.2.2 Resumption of Work

For work to resume following a Stop-Work Order, the Project Manager and the NYSDEC Representative must rescind it in writing.

10.3 Course and Action to Prevent Recurrence

The site QAO tracks non-conforming conditions, evaluates the effectiveness of corrective measures, and ensures that steps have been taken to prevent recurrence of the original problem.

10.4 Field Changes

The Project Manager is responsible for all site activities. In this capacity the Project Manager will be required to modify site programs in response to changing site conditions. At such times the responsible Field Team Leader will notify the Project Manager of the anticipated change, and obtain the approval of the Project Manager and implement the changes. The Project Manager will notify in writing the site QAO, the Project Officer, and the NYSDEC Representative. A copy of the notification will be attached to the file copy of the affected document. If an unapproved action has been taken during a period of deviation, the action will be evaluated to determine the significance of any departure from established procedures.

11 QUALITY ASSURANCE REPORTS

Arcadis field staff will promptly report any quality issues to the Project Manager. The laboratory will provide a written description of quality assurance problems to Arcadis with submission of the analytical data packages.

Following quality assurance audits, the site QAO will submit a Quality Assurance report to the Project Manager describing the performance of the quality assurance program. Problems or issues that arise independent of audits may be brought to the attention of project management.

12 REFERENCES

NYSDEC, 1993. “Engineering Investigations and Evaluations of Inactive Hazardous Waste Disposal Sites – Preliminary Site Assessment Report”. New York State Department of Environmental Conservation, Division of Hazardous Waste Remediation, Bureau of Hazardous Site Control - Eastern Investigation Section.

NYSDEC, 2002. "Draft DER-10 Technical Guidance for Site Investigation and Remediation." New York State Department of Environmental Conservation, Division of Environmental Remediation. December 2002.

NYSDOH, 2006. “Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York”. New York State Department of Health Center for Environmental Health, Bureau of Environmental Exposure Investigation. October, 2006.

USEPA, 1986. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA Publication SW 846, Third Edition, Final Updates I (1993), II (1995, IIA (1994), IIB (1995), III (1997), IIIA (1999), IIIB (2005), IV (2008), and V (2015).

USEPA, 1987. Data Quality Objectives for Remedial Response Activities, CDM Federal Programs Corporation.

USEPA, 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final, 540G89004.

USEPA, 1989. Region II CERCLA Quality Assurance Manual, Final Copy, Revision 1. USEPA, 1989, Soil Sampling Quality Assurance User’s Guide, Second Edition, EPA-600/8-89/046.

USEPA, 2006. Validation of Metals for the Contract Laboratory Program based on SOW ILM05.3, SOP ID: HW-2, Revision 13, September 2006.

USEPA, 2006. Region II Validating Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry SW-846 Method 8260B, SOP ID: HW-24, Revision 2.

USEPA, 2006. Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4, February 2006.

Arcadis of New York, Inc.

855 Route 146

Suite 210

Clifton Park, New York 12065

Tel 518 250 7300

Fax 518 371 2757

www.arcadis.com