C&S Engineers, Inc.
499 Col. Eileen Collins Blvd
Syracuse, New York 13212

Remedial Investigation Work Plan

UR-ban Villages PFA, LLC
Former Will & Baumer Candle Co., Inc.

100 Buckley Road
Town of Salina, Onondaga County, New York
Site No. C734154

April 2022

Remedial Investigation Work Plan

for

UR-ban Villages PFA, LLC
Former Will & Baumer Candle Co., Inc.
100 Buckley Road
Town of Salina, Onondaga County, New York
Site No. C734154

Prepared by:

C&S Engineers, Inc.
499 Colonel Eileen Collins Blvd
Syracuse, New York 13212

Prepared on Behalf of:

UR-ban Villages PFA, LLC
925 7th North Street
Liverpool, New York 13088

April 2022

CERTIFICATION

I, H. Nevin Bradford, III, certify that I am currently a NYS Registered Professional Engineer and that this Remedial Investigation 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).

H. Nevin Bradford III

H. Nevin Bradford, III, P.E.
State of New York Professional Engineer No. 086008

April 28, 2022

HENRY NEVIN BRADFORD III
No. 086008
Henry Nevin Bradford III

Table of contents

FIGURES

TABLES

APPENDICES

ACRONYM LIST

AAR	Alternatives Analysis Report
AMSL	Above Mean Sea Level
ASP	Analytical Services Protocol
BGS	Below Ground Surface
CAMP	Community Air Monitoring Plan
CPP	Citizen Participation Plan
DER	Division of Environmental Remediation
DUSR	Data Usability Summary Report
EDD	Electronic Data Deliverable
ELAP	Environmental Laboratory Approval Program
HASP	Health and Safety Plan
HFM	Historic Fill Material
IRM	Interim Remedial Measure
MS/MSD	Matrix Spike / Matrix Spike Duplicate
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
PAH	Polycyclic Aromatic Hydrocarbons
PART 375	6 NYCRR Part 375
PCB	Polychlorinated Biphenyl
PID	Photo-ionization Detector
PPM	Parts-per-million
RI	Remedial Investigation
RIWP	Remedial Investigation Work Plan
RWP	Remedial Work Plan
SCO	Soil Cleanup Objectives
SVI	Soil Vapor Intrusion
SVOC	Semi-volatile Organic Compound(s)
TAL	Target Analyte List
TCL	Target Compound List
U.S. EPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOC	Volatile Organic Compound(s)

Executive Summary

This document presents the Remedial Investigation (RI) Work Plan for the UR-ban Villages PFA, LLC Brownfield Cleanup Program Site located at 100 Buckley Road in the Town of Salina, New York (the "Site"). The project details are summarized below:

Contaminant Source and Constituents

Environmental information currently exists for the site from a Phase I Environmental Site Assessment (ESA) dated April 2020, a Limited Phase II ESA completed in May 2020, and a supplemental investigation conducted in May 2021. The subsurface investigations identified volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), PCBs, pesticides, and metals at elevated concentrations in soil. Elevated concentrations of VOCs and, potentially, SVOCs, were found in groundwater beneath the site. The elevated concentrations appear to be related to the following sources:

- Historical manufacturing operations and past on-site petroleum and chemical storage and handling.

- The placement of historic fill material (HFM) across the site.

Extent of Known Contamination

Based on the information gathered to date, the elevated concentrations of contaminants generally exist within surface soils and the underlying HFM that extends to depths up to five feet across the site. Elevated concentrations of VOCs and, potentially, SVOCs, were also found in groundwater beneath the site.

Proposed Site Redevelopment

The project will consist of the rehabilitation and reuse of the eleven abandoned industrial buildings on the 11.68-acre parcel. The new site will see the transformation of the above-mentioned parcel from its former industrial use into a mixed-use multi-family / commercial site. The redeveloped site will house approximately 250 apartment units, indoor and covered parking, site offices, recreational facilities, a banquet house, a brew house, and common areas. The construction will happen in three (3) phases, the first of which will accommodate all site improvements, the second of which will encompass rehabilitation of the existing structures, and the third of which will include the construction of two (2) to three (3) new buildings.

Remedial Investigation

To characterize site conditions, a RI will be implemented. The RI will include the collection and analysis of surface soil, historic fill material, native soil, groundwater, soil vapor, and sub-slab soil vapor samples.

Interim Remedial Measures

No Interim Remedial Measure (IRM) activities are planned at this time, but may be proposed at a later date, based on the findings of the RI.

Cleanup Track

UR-ban Villages PFA, LLC proposes to remediate the site by pursuing a Track 4 cleanup to Restricted-Residential Use criteria using the Soil Cleanup Objectives at 6 NYCRR Part 375-6.

1. Introduction

This Remedial Investigation Work Plan (RIWP) provides a description of the procedures that will be implemented to characterize the nature and extent of contamination at the UR-ban Villages PFA, LLC Site No. C734154 (the "site") and the proposed methods to address that contamination. This RIWP has been prepared consistent with Division of Environmental Remediation "*Technical Guidance for Site Investigation and Remediation*" (DER-10). To effectively characterize the environmental conditions, this RIWP discusses the following:

- Current and historic site conditions
- Contaminants of concern and the extent of the contamination
- Extent of Remedial Investigation (RI) activities
- Quality controls and protocols for analytical sampling
- Health and safety procedures and work practices to protect site workers and the local community
- Community participation activities

An RI will be implemented to further evaluate the extent of the contamination and to aid in the preparation of an Alternatives Analysis Report (AAR). The scope of the investigation is described in **Section 4, Remedial Investigation**.

1.1 Site Description and Existing Development

The 11.68-acre site is located on the eastern side of Buckley Road and the northern side of Park Street, at the southern edge of the Town of Salina, immediately north of its border with the City of Syracuse.

Interstate Route 81 is located immediately east of the site, and Onondaga Lake is located approximately 750 feet southwest of the site. The site is bordered to the north by medical offices, to the south and southwest by the convergence of several roadways (Buckley Road, Park Street, Old Liverpool Road, and Onondaga Lake Parkway), followed by Onondaga Lake, to the east by Interstate Route 81 and its Exit 22/23A/23B interchange, and to the northwest by Buckley Road, followed by single-family residential parcels. Properties surrounding the site are a mix of residential and commercial in nature.

The site is currently occupied by eleven former industrial buildings that were associated with the operations of Will & Baumer Candle Co., Inc. (Will & Baumer) throughout its history at the property. In general, these buildings are concentrated on the western two-thirds of the parcel. The eastern remainder once contained rail lines, storage tanks, and other buildings, but that area generally consists of open space at this time. Except for one building that is leased by a local furniture retailer and used for temporary storage of office furniture inventory, the buildings are currently vacant and unused.

Figure 1 shows the location of the site and **Figure 2** shows the project area and site boundaries.

1.2 Site History

The historic ownership of the site is as follows:

Owner of Record	Period of Ownership
UR-ban Villages PFA, LLC	June 21, 2021 to Present
PDM Estates, LLC	April 7, 2021 to June 21, 2021
Syracuse Gateway Holdings, LLC, c/o Syracuse Gateway Holdings Canada, Inc.	September 24, 2010 to April 7, 2021
Will & Baumer, Inc.	April 4, 1984 to September 24, 2010
W & F Mfg. Co., Inc.	March 30, 1984 to April 4, 1984
Onondaga County Industrial Development Agency	March 28, 1980 to March 30, 1984
W & F Mfg. Co., Inc.	March 2, 1979 to March 28, 1980
Syracuse China Company (in interest to Will & Baumer Candle Co., Inc. by merger)	March 26, 1976 (merger) to March 2, 1979
The Will & Baumer Co. (name changed to Will & Baumer Candle Co., Inc. on January 25, 1963)	March 29, 1904 to March 26, 1976
Louis & Augusta Will and Anthony & Matilda Will	Prior to March 29, 1904

Available historical information was compiled during a Phase I Environmental Site Assessment conducted by LaBella in April 2020. The available information indicates that the site has historically been used as a bees wax and candle manufacturing facility by Will & Baumer (and/or its predecessors and successors) since prior to 1911. Will & Baumer acquired the site in 1904 and continued operations there until 2010.

The Will & Baumer operations encompassed numerous buildings that contained offices; wax melting, pressing, and molding areas; a laboratory; press and pan rooms; multiple sheds; a digester house; a still house; a store room; a machine shop; bleach houses; a bleach yard; an oil house; and packaging and decorating areas. A rail line extended from the northeast to the southeast corners of the parcel, traversing the eastern portion of the site in a general north-to-south orientation. Several railroad spurs were located on the eastern portion of the Site from at least 1911 until at least 1990. These rail spurs were located between the former boiler house (west) and a storage building (east) that was previously situated on the southeast corner of the site. Up to eleven aboveground storage tanks are known to have existed to the north and east of the former storage building, at the eastern edge of the site. Available historic maps indicate that these tanks contained grease, oil, tar, and acid. An aboveground fuel oil storage tank also previously existed near the southeast corner of the boiler house.

Records reviewed by LaBella in connection with preparing the 2020 Phase I ESA indicated that hazardous waste generation was identified at the site from at least 1982 through at least 2010. Wastes generated include spent non-halogenated solvents, ignitable wastes, corrosive wastes, chromium, methyl ethyl ketone, lead, benzene, chloroform, spent halogenated solvents, mercury, and cresol. Regulatory listings were also identified for the site, including four former aboveground storage tanks (ASTs) containing fuel oil, one former AST containing gasoline, and a chemical AST of unknown nature. These tanks are listed as having been removed from the site. An inactive NYSDEC spill associated with the site (Spill #9200872) indicates that soil contaminated by No. 6 fuel oil was found while decommissioning former ASTs. No additional information was available regarding this spill.

Eleven of the former Will & Baumer buildings remain on the property at this time. Will & Baumer ceased operations in 2010. Historic city directories indicate that CNY Logistics and Light Four Life Candles, LLC were present at the site address (100 Buckley Road) in 2014 and Light Four Life Candles, LLC was present in 2018. These are believed to have been lessees under the ownership of Syracuse Gateway Holdings, LLC. Other than the use of one building as an office furniture warehouse, the buildings and site are currently vacant and unused.

1.3 Site Geography, Geology, and Hydrogeology

The site is located at approximately 376 feet above mean sea level (amsl) and slopes gently to the south and southwest, in the direction of Onondaga Lake. The northeastern shore of Onondaga Lake lies approximately 750 feet south of the Site. The Lake receives approximately 70 percent of its inflow from Ninemile and Onondaga Creeks, which enter the Lake from the southwest and southeast, respectively. Ley Creek flows through the area approximately 1,250 feet east of the site, emptying into the northeastern corner of the Lake. Approximately 20 percent of the inflow to the Lake consists of from treated wastewater discharged from the Onondaga County municipal wastewater treatment system. The Lake discharges at its northern end to the Seneca River, which in turn meanders on a general northwesterly course to join the Oneida River approximately 6.5 miles northwest of the Lake. The Oswego River, formed by the convergence of the Seneca and Oneida Rivers, continues on a northwesterly course a distance of approximately 23 miles, where it empties to Lake Ontario at the City of Oswego.

According to the *Surficial Geology Map of New York, Finger Lakes Sheet* (Ernest H. Muller and Donald H. Cadwell, 1986), the overburden materials at and in the vicinity of the site are compromised of lacustrine silt and clay. This material is described as "generally laminated clay and silt deposited in pro-glacial lakes, generally calcareous, thickness variable (up to 50 meters).

The *Geologic Map of New York, Finger Lakes Sheet* (Lawrence V. Rickard and Donald W. Fisher, 1970) identifies the local bedrock beneath and in the immediate vicinity of the site as shale and dolostone of the Vernon Formation.

Previous field investigations revealed that the eastern portion of the site contains historic fill material (HFM) with observed thickness up to approximately five feet. 6 NYCRR Part 375 defines *historic fill material* as: *non-indigenous or non-native material, historically deposited or disposed in the general area of, or on, a site to create useable land by filling water bodies, wetlands or topographic depressions, which is in no way connected with the subsequent operations at the location of the emplacement, and which was contaminated prior to emplacement*. The HFM at the site contains gravel, sand, silt, brick, ash, metal, glass, and coal. During the previous investigations, native soil encountered beneath the fill material was found to consist of grey and brown silt and clay, which is consistent with the nature of deposits described in regional geologic mapping described above. Bedrock was not encountered or investigated during the prior investigation events.

Overburden groundwater was previously observed at depths ranging from 0.4 to 7.2 feet below grade within temporary wells installed at the site in 2020. Groundwater flow direction and gradient has not previously been studied, but groundwater flow is expected to be toward the south to southeast, in the direction of Onondaga Lake and Ley Creek.

1.4 Planned Future Use

The current property owner, UR-ban Villages PFA, LLC, plans to remediate and redevelop the property into a mixed-use development, combining multi-family apartments, tenant amenities, and varied commercial spaces. The project will consist of the rehabilitation and reuse of the eleven abandoned industrial buildings, upgrades to the site, and construction of additional structures. The redeveloped site will house approximately 250 apartment units, indoor and covered parking, site offices, recreational facilities, a banquet house, a brew house, and common areas. The construction will happen in three phases, the first of which will accommodate all site improvements, the second of which will encompass rehabilitation of the existing structures, and the third of which will include the construction of two to three new buildings.

2. Previous Environmental Studies and Remedial Activities

2.1 Previous Environmental Assessment and Investigation Reports

Environmental information currently exists for the site from a Phase I Environmental Site Assessment (ESA) completed by LaBella in April 2020, a Phase II ESA completed by LaBella in May 2020, and a Supplemental Historic Fill Investigation completed by C & S in May 2021. The following summarizes those efforts. These reports are provided in **Appendix A**.

2.1.1 LaBella Phase I ESA Report –August 2020

The April 2020 Phase I ESA report prepared by LaBella identified the following RECs:

- "Historic Operations and Regulatory Listings at the Site: Based on historical records reviewed, it appears that the site has historically been used by the Will & Baumer Candle Co. as a bees wax and candle manufacturing facility since at least 1911 to approximately 2010. The site included offices, a candle factory, a laboratory, press and pan rooms, multiple sheds, a digester house, still house, a store room, a machine shop, a bleach house, a bleach yard, an oil house, and packaging and decorating areas. Multiple storage tanks including grease and oil as well as an acid tank and a fuel oil tank were identified on historic maps in the southeastern portions of the site. Railroad spurs run between the site buildings on the eastern portion of the site running north and south from at least 1911 until at least 1990. In addition, a refinery building was located adjacent south in at least 1911.

  Regulatory listings were identified for the site including former aboveground storage tanks (ASTs) containing fuel oil and gasoline, and a chemical AST of unknown nature. These tanks are listed as having been removed from the site. An inactive NYSDEC spill is associated with the site (Spill #9200872), indicates contamination of fuel oil was found while decommissioning old ASTs. No additional information was made available regarding this spill. In addition, hazardous waste generation was identified at the site from at least 1982 through at least 2010. Wastes generated include spent non halogenated solvents, ignitable wastes, corrosive wastes, chromium, methyl ethyl ketone, lead, benzene, chloroform, spent halogenated solvents, mercury, and cresol.

  A prior soil and groundwater investigation completed in 2010 included the installation of six soil borings which were converted to temporary groundwater monitoring wells at the site. Laboratory analytical results indicated the presence of several constituents in shallow fill and groundwater with concentrations generally low and below applicable standards, with the exception of toluene which was identified at concentrations above groundwater standards at three locations. These exceedances were attributed to residual impacts from the historic ASTs in the southeast portion of the site and prior Spill incidents closed by NYSDEC.

While no further work was recommended as a result of this 2010 investigation, the prior work was limited in scope and appears insufficient to assess potential environmental impacts based on the industrial history and nature of the Site.

- Drums of Unknown Nature located at the Site: Six 55-gallon drums of what appeared to be soil were identified to the north of Building #7. Three of these drums were tipped over spilling their contents to the ground surface. The origin and nature of this material is unknown."

2.1.2 LaBella Phase II ESA – May 2020

The Phase II ESA (i.e., Investigation) was completed to obtain an overview of the environmental and subsurface conditions and resolve possible issues identified in the Phase I ESA. The LaBella report indicates that the Investigation was performed consistent with *ASTM E1903-19 Standard Practice for Environmental Site Assessments: Phase II Environmental Site Assessment Process*. The investigation included the following:

- Completion of a geophysical survey;
- A subsurface investigation, which included the advancement of twenty-one (21) direct-push soil borings and installation of seven (7) temporary groundwater monitoring wells;
- The collection of subsurface soil and groundwater samples; and
- Laboratory analysis of the soil and groundwater samples.

The geophysical survey was limited to proposed boring locations and was intended only to confirm that subsurface utilities were not located in those areas.

The following table summarizes the areas investigated, as well as the number and types of samples collected during the LaBella Phase II ESA.

Area	Sampling Method(s)	No. of Samples	Analysis
Site Exterior Sub-Surface Soil	Geoprobe (direct-push) Borings (21)	7	VOC, SVOC, PCBs, Metals
Site Groundwater	Temporary Monitoring Wells (7)	7	VOC, SVOC

Field observations made during the investigation indicated the presence of petroleum odors in two of the soil borings. Elevated photoionization detector (PID) headspace screening results were also observed at these two locations, with headspace readings up to 161 parts-per-million (ppm) detected. Additionally, historic fill material (HFM) was encountered in the upper five feet of soil at the majority of the boring locations.

The principal contaminants detected at the site through the Phase II ESA are VOCs, SVOCs (polycyclic aromatic hydrocarbons or "PAHs"), and metals, as follows:

- Acetone (a VOC) was detected at concentrations greater than the Unrestricted Use SCO in four of the seven soil samples submitted for laboratory analysis. Other VOCs, including 2-butanone, benzene, carbon disulfide, ethylbenzene, n-butylbenzene, n-propylbenzene, naphthalene, o-xylene, p-isopropyltoluene, m & p-xylene, and toluene were detected in several of the soil samples at concentrations below the respective Unrestricted Use SCOs.
- SVOCs, including benzo(a)anthracene, benzo(b)fluoranthene, chrysene, fluoranthene, phenanthrene, and pyrene were detected at concentrations below the corresponding Unrestricted Use SCOs at three of the seven soil sampling locations.
- Lead was detected at concentrations greater than the Unrestricted Use SCO in two of the seven soil samples.
- Acetone was detected in six of the seven groundwater samples at concentrations below the groundwater standard of 50 ug/L. 2-butanone was detected in one groundwater sample at a concentration below the groundwater standard of 50 ug/L, and vinyl chloride was detected in one groundwater sample at a concentration below the groundwater standard of 2 ug/L.
- SVOCs, including benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene were detected in six of the seven groundwater samples at concentrations greater than the respective groundwater standards. Other SVOCs were also detected, but at concentrations less than the corresponding groundwater standards. The report qualified this finding by stating that but "these detections may not be representative of actual groundwater conditions but rather particulate matter within the sample".

2.1.3 C & S Supplemental Historic Fill Investigation – June 2021

The conditions encountered within the soil borings conducted during the LaBella Phase II ESA indicated that HFM containing black material, brick, ash, etc., was encountered in the upper five feet of soil in the majority of the soil borings. Only one of the soil samples collected during the Phase II ESA for laboratory analysis was obtained from the intervals containing HFM. As such, C & S conducted a supplemental investigation to further assess the nature of the fill and to determine if certain contaminants that are common to fill of similar nature were present above currently recognized SCOs established by NYSDEC. The supplemental investigation included the following:

- The advancement of sixteen (16) machine-excavated test pits across the eastern portion of the site where fill was most prominent;
- The collection of surface soil samples at two (2) locations adjacent to a former transformer house positioned at the western side of the former machine shop;
- The collection of surface soil samples at six (6) locations where former rail spurs traversed the east side of the site; and
- Laboratory analysis of the fill and surface soil samples.

The following table summarizes the areas investigated, as well as the number and types of samples collected during the C&S Investigation.

Area	Sampling Method(s)	No. of Samples	Analysis
Site Exterior Shallow Sub-Surface Soil (HFM)	Test Pits (16)	7	SVOC, PCB, Metals
Site Exterior Surface Soil	Manual	2	PCB
Site Exterior Surface Soil	Manual	6	SVOC, PCB, Metals

Field observations made during the investigation indicated the presence of HFM in all test pits. The historic fill material contained assorted materials, including concrete, brick, coal debris/dust, ash, slag, metal shavings, railroad ties, and plastic bottles. In most locations, the fill extended to depths of 4.5 To 5 feet below grade. Elevated PID headspace screening results were also observed at two locations, with headspace readings up to 36 parts-per-million (ppm) detected.

The principal contaminants detected within the surface soil and HFM at the site as a result of the test pit investigation are SVOCs (PAHs), PCBs, pesticides, and metals, as follows:

- Various SVOCs were detected at concentrations greater than the Industrial SCOs in two (2) of the seven (7) test pit soil samples, and in two (2) of the six (6) surface soil samples submitted for laboratory analysis. SVOCs were detected at concentrations greater than Restricted Residential SCOs in two (2) of seven (7) test pit/fill samples and in five (5) of six (6) surface soil samples collected.
- PCBs were detected at concentrations above Unrestricted Use SCOs in surface soil (0-2 inches in depth) at the two locations adjacent to the former transformer house, and at one (1) additional surface soil sample location.

- Two (2) pesticides (4,4'-DDE and 4,4'-DDT) were detected in two (2) surface soil samples at concentrations exceeding Unrestricted Use SCOs.
- Various metals, including zinc, arsenic, nickel, and lead were detected at concentrations exceeding Unrestricted Use SCOs in various surface soil samples. Arsenic was present at concentrations exceeding Industrial SCOs in four (4) of seven (7) test pit/HFM samples, zinc was detected at concentrations exceeding Industrial SCOs in two (2) of seven (7) test pit/HFM samples, and lead was detected at a concentration exceeding Industrial SCOs in one (1) of seven (7) test pit/HFM samples. Cadmium and copper were detected at concentrations exceeding Commercial SCOs in one (1) of seven (7) test pit/HFM samples. Other metals, including copper, arsenic, mercury, zinc, and lead were also detected in other test pit/HFM samples at concentrations exceeding Unrestricted Use SCOs.

2.1.4 Soil Vapor and Sub-Slab Vapor Data Summary

No soil vapor or sub-slab soil vapor investigation has been completed to date.

2.1.5 Prior Remedial Events

No prior remedial events are known to have been completed at the site.

2.2 Nature and Extent of Contamination

The upper approximately five feet of soil across much of the eastern and southeastern portion of the site consists of HFM. The HFM contains assorted materials, including concrete, brick, coal debris/dust, ash, slag, metal shavings, railroad ties, and plastic bottles. The underlying native soils consist of a mixture of silts and clays. Groundwater is present at depths ranging from approximately 0.4 to 7.2 feet below grade.

Various organic and inorganic contaminants are present in soil, including:

- VOCs (those commonly used in industrial operations and those that are commonly related to petroleum products);
- SVOCs, which are commonly associated with the burning of coal, fuel oil, and similar fossil fuels;
- PCBs, which were historically used in electrical transformers and other similar equipment, and as an additive to caulks and sealants;
- Various heavy metals, including arsenic, cadmium, copper, mercury, nickel, lead and zinc; and
- Pesticides.

The majority of these contaminants exist within the surface soil or within the HFM.

Various organic contaminants are present at low concentrations in groundwater, including VOCs (acetone, 2-butanone, and vinyl chloride, which are commonly used in industrial applications); and, potentially, SVOCs, but it was concluded that "these detections may not be representative of actual groundwater conditions but rather particulate matter within the sample". The area in which the site is located is served by municipal water service, and local groundwater is not used as a source of potable water. As such, ingestion of or direct contact with contaminated groundwater is not likely a significant concern.

Based on the nature of site contaminants, direct contact with contaminated soil or inhalation of airborne dust originating from contaminated areas of the site pose the primary exposure risk to site occupants and the local public. Potential for volatile organic compounds to migrate off-site through groundwater flow or through soil vapor also present potential concerns to on-site buildings and nearby properties.

3. Objectives, Scope and Rationale

The objectives of the RI are to evaluate contaminant impacts for the subsequent identification and evaluation of appropriate remedial actions necessary to redevelop the Site. The proposed sampling reflected herein is intended to:

1. Characterize the nature and extent of contamination on the site;
2. Identify / confirm contaminant sources;
3. Investigate site geologic and hydrogeologic conditions and their potential impacts to contaminant distribution and migration patterns;
4. Assess whether on-site contamination is migrating to and impacting off-site properties;
5. Assess contaminant migration and exposure pathways;
6. Qualitatively evaluate human health and ecological exposure risks, as applicable; and
7. Compile sufficient data to allow a complete analysis of potential and suitable remedial alternatives.

The RI proposed herein will include characterization of surface and subsurface soil (both HFM and native materials) and groundwater for contaminants of potential concern identified in 6 NYCRR Part 375. These target compounds include VOCs, SVOCs, metals (including hexavalent chromium), pesticides and herbicides, total cyanide, per- and polyfluoroalkyl substances (PFAS), and 1,4-dioxane. Additionally, the RI will assess whether soil vapor or sub-slab vapors present beneath the foundations of the existing buildings are impacted by VOCs.

The RI is based on information previously gathered regarding historical operations conducted at the Site, the results of the previous subsurface investigations, and the project objectives. The RI will include the following:

- **Soil Investigation** – This task will consist of the following elements: surface soil, historic fill, and underlying native soil characterization.
    - Surface soils will be further characterized to assess the nature and extent of contamination in areas that are proposed to be pervious (e.g. grass and landscaped areas, or other areas not covered by pavement).
    - HFM will be further characterized through the advancement of soil borings and test pits to identify the lateral and vertical distribution of HFM and to assess the nature and extent of contamination within the fill.
    - The underlying native soils will be characterized through the advancement of soil borings, to determine the depth of impacts from the overlying HFM and / or past Site operations.

For reference, existing surface and subsurface soil data are depicted on attached **Figures 4 and 5**, respectively. The locations of the surface soil samples and soil borings are shown on **Figures 4A and 5A,** respectively.

- **Groundwater Investigation** – Previous groundwater sampling activities completed during the 2021 Phase II Environmental Site Assessment utilized temporary monitoring wells. Existing groundwater data is depicted on attached **Figure 6**. Groundwater investigation activities to be performed in support of this RI will include the installation of 11 new permanent groundwater monitoring wells, the location of which are shown on **Figure 6A**.
- **Soil Vapor and Sub-Slab Vapor Assessment** – An assessment of site-wide soil vapor and sub-slab vapor beneath the existing buildings will be conducted during the RI, to assess potential vapor intrusion risk to existing and future site buildings and nearby buildings. The assessment will include the installation of seven soil vapor sampling points around the perimeter of the site, and 13 sub-slab vapor sampling points through the foundation slabs of the existing structures. The soil vapor and sub-slab vapor sampling points are depicted on attached **Figure 7**.

The RI activities will be completed in a manner consistent with NYSDEC Part 375-6 and the NYSDEC Division of Environmental Remediation's *Technical Guidance for Site Investigation and Remediation, dated May 2010 (DER-10)*. Soil vapor and sub-slab vapor sampling will be conducted in accordance with the New York State Department of Health's *Guidance for Evaluating Soil Vapor Intrusion in the State of New York (FINAL), dated October 2006*, and subsequent revisions. All investigation and sampling activities that will involve PFAS will be conducted in accordance with the NYSDEC's *Sampling, Analysis, and Assessment of Per- And Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs, dated June 2021.*

4. Remedial Investigation

This part of the RIWP describes the scope of investigative work necessary to collect sufficient data to determine the extent of contaminated fill material and other contaminated environmental media, which will support a subsequent AAR and RWP in achieving **Residential-Restricted Use SCOs under Track 4**. This section of the RIWP includes:

- Field Investigation
- Sampling Program
- Laboratory Analysis

The scope of the Remedial Investigation is described in the following sections. The various sampling locations reflected in the Plan are intended to provide representative data for each medium at the site, based on available information and site historical activities. The potential exists that site conditions, such as buried site utilities or access issues, may necessitate relocation of certain sampling points at the time of the investigation. In such event, the NYSDEC will be consulted to approve the relocation of any sampling location if the adjustment results in an off-set position that is greater than ten feet away from the proposed location.

All investigation findings will be recorded on sampling field sheets. Sample field sheets are provided as **Attachment D**. All work will be performed in conformance with this Plan, pertinent regulatory guidance documents cited herein, and the attached Quality Assurance Program Plan (QAPP) contained in **Attachment E**.

Standard Operating Procedures for field procedures including decontamination, procedures to prevent cross-contamination, sample collection protocol, sample handling protocol and investigation derived waste (IDW) management are provided as **Attachment F**. These include:

SOP Number	Title
CS001	Field Logging, Handling, and Documentation of Borehole Materials
CS002	Sample Collection and Field Documentation
CS003	Field Documentation of Drilling and Sampling Equipment
CS004	Well Construction
CS005	Water Level Measurement
CS006	Well Development
CS007	Purging and Sampling Methods for Monitoring Wells
CS008	Field Analytical Methods of Groundwater Samples
CS009	Handling, Packaging, and Transporting Field Samples
CS010	Air Sampling

4.1 Soil Investigation

The investigation of soil conditions across the site will include sampling of surface soil, HFM that have been deposited on the site, and underlying native soil. The soil investigation will be completed through the use of manual sampling methods (surface soil), test pits, and soil borings.

4.1.1 *Surface Soil Sampling*

Surface soil conditions will be investigated by collecting samples of surface soil from sixteen surface soil samples distributed across the site. The surface soil samples will be collected from areas that are not currently or proposed to be "capped" by asphalt or buildings. The samples will be collected from the surface to two inches below grade (beneath any existing vegetative cover) using a decontaminated, stainless steel spoon or spatula. Surface soil samples will be collected at the locations shown on **Figure 4A**.

The surface soil samples will be analyzed for the following list of target analytes:

- Part 375 VOCs
- Part 375 SVOCs
- Part 375 pesticides / herbicides
- PCBs
- Part 375 Metals (including total mercury)
- Hexavalent Chromium
- Total Cyanide
- PFAS and 1,4-dioxane

4.1.2 *Test Pit Investigation*

Prior investigation activities performed at the site encountered HFM on much of the eastern portion of the site. HFM was not encountered at all previous boring locations. The lateral distribution of HFM is not clearly defined. As such, test pits will be conducted during the RI, with the primary purpose of qualitatively defining the nature and lateral and vertical distribution of the existing HFM. **Figure 5A** identifies the location of the initial planned test pits. Twelve initial test pits are planned. Additional test pits will be performed, as needed, to identify the lateral extent of existing HFM.

As the test pits are excavated, the exposed soil / HFM will be:

- Classified with respect to predominant soil types, texture, and relative moisture content;
- Examined for non-soil components / artifacts indicative of fill material;
- Examined for visible staining or obvious odors suggestive of impact by petroleum products or other contaminants; and

- Field screened with a portable PID, to document whether VOC are released from the soil. The PID screening will be performed by headspace analysis methods, by placing a representative portion of the soil sample into a re-sealable plastic bag, and monitoring the airspace surrounding the soil within the bag as the soil is agitated to promote the release of VOC. The PID will be calibrated daily with a 100 ppm isobutylene/air calibration gas mixture.

The test pit locations and associated conditions will be photographed, and pertinent field observations will be recorded on test pit logs. Photographs will contain identifying information including site name, date, and test pit number. The test pit locations and the lateral extents of observed HFM will be documented using a hand-held GPS unit.

4.1.3 Soil Borings

Soil borings will be advanced to define vertical soil lithology across the site and to collect samples of the HFM and native soil for field screening and laboratory analysis. Seventeen soil borings are planned, as shown on **Figure 5A**. Eleven of the borings will be converted to monitoring wells after completion of the boring advancement. The well locations are depicted on **Figure 6A**.

In the event that the test pits reveal HFM conditions in a given area that vary significantly in nature and appearance from conditions observed elsewhere, or if obvious evidence of impacts (visible staining, characteristic petroleum or organic odors, free-phase product, visible sheens, or significantly elevated PID headspace screening results) is observed in the test pits, additional soil borings will be included in the RI scope to accurately assess such conditions. In such case, the proposed boring locations will be discussed with NYSDEC to obtain regulatory concurrence / approval prior to proceeding.

Fourteen of the proposed seventeen soil borings will be advanced to assess conditions in the shallow subsurface native soil. These borings will be advanced into native material, up to a depth of 16 feet (ft) bgs, or to the top of bedrock (if encountered at depths shallower than 16 feet). Three of the proposed soil borings will be advanced to assess conditions deeper in the native material. These borings will advance to a maximum depth of 40 feet bgs, or at the discretion of the project geologist and with consultation from NYSDEC. Boring locations will be located with a hand-held GPS.

Direct-push sampling methods will be used to advance the proposed shallow borings where wells will not be installed. Each of these borings will be continuously sampled in four- or five-foot intervals using a two-inch by four- or five-foot stainless steel sampling tube fitted with a disposable acetate liner. All non-disposable sampling equipment will be decontaminated between runs and between drill locations to avoid potential cross contamination of samples.

For the borings that will be converted into monitoring wells or will be advanced to deeper depths, these borings will be advanced using hollow-stem auger methods. The borings will be conducted with 4.25-inch I.D. hollow stem augers, and continuous soil sampling will be performed as the boring is advanced, using split-spoon samplers. The split spoon samplers will be driven at two-foot intervals ahead of the augers using a 140-pound hammer. The augers and drilling rods will be decontaminated prior to use via high pressure sprayer. The split-spoons will be decontaminated prior to use via an Alconox wash followed by a potable water rinse. Between each soil sample and soil boring, decontamination procedures will be repeated.

Soils from the split spoons and acetate liners will be:

- Classified with respect to predominant soil types, texture, and relative moisture content;
- Examined for non-soil components / artifacts indicative of fill material;
- Examined for visible staining or obvious odors suggestive of impact by petroleum products or other contaminants; and
- Field screened with a portable PID, to document whether VOC are released from the soil. The PID screening will be performed by headspace analysis methods, by placing a representative portion of the soil sample into a re-sealable plastic bag, and monitoring the airspace surrounding the soil within the bag as the soil is agitated to promote the release of VOC. The PID will be calibrated daily with a 100 ppm isobutylene/air calibration gas mixture.

Conditions encountered during the boring advancements will be documented on location-specific boring logs. The soil boring logs will include PID readings and soil description, including soil type, soil recovery, color, soil moisture levels, depth to groundwater, presence of visual and olfactory contamination. The boring logs will be completed by a qualified individual who reports directly to the Qualified Environmental Professional. Representative soil cores will be photographed upon retrieval and prior to disturbance. Photographs will contain identifying information including site name, date, boring number and depth interval. The boring logs will be included in the RI Report.

From the borings, fill and native soil samples will be collected for laboratory analysis to document Site conditions. C&S will collect two soil samples per boring for laboratory analysis. This will include a fill sample and native soil sample from each boring. The location / depth of sample collection will be determined as follows:

Fill Sampling

Where HFM is encountered in the borings, samples of the fill material will be collected for laboratory analysis. At least one sample will be collected from each fill type encountered. Based on previous boring data from the site, it is anticipated that the eastern ten to twelve borings may encounter HFM. The fill samples will be collected and analyzed for the following list of target analytes:

- Part 375 VOCs
- Part 375 SVOCs
- Part 375 pesticides / herbicides
- PCBs
- Part 375 Metals (including total mercury)
- Hexavalent Chromium
- Total Cyanide
- PFAS and 1,4-dioxane

Sampling depths / intervals will be biased to depths which exhibit the following (if present):

- visible staining;
- characteristic petroleum or organic odors;
- free-phase product;
- visible sheens; or
- significantly elevated PID headspace screening results.

In the absence of such condition, samples will be collected so as to be representative of the fill material profile.

Subsurface / Native Soil Sampling

For the proposed shallow borings, native soil will be visually assessed and field screened with a portable PID in each of the locations from its upper extent to at least 16 feet below ground surface (unless bedrock is encountered at a shallower depth). Sampling depths / intervals will be biased to depths which exhibit the following (if present):

- visible staining;
- characteristic petroleum or organic odors;
- free-phase product;
- visible sheens; or
- significantly elevated PID headspace screening results.

In the absence of such condition, samples will be collected as follows:

- In order to assess the impact of fill and / or Site operations on the underlying native soil, soil samples will be collected from the upper two to three feet of native material in the shallow borings.
- For the deep borings, samples will be collected from the 20 to 30 feet depth interval.

The soil samples will be collected and analyzed for the following:

- Part 375 VOCs
- Part 375 SVOCs
- Part 375 pesticides / herbicides
- PCBs
- Part 375 Metals (including total mercury)
- Total Cyanide
- Hexavalent Chromium
- PFAS and 1,4-dioxane

4.2 Groundwater Investigation

Site groundwater will be investigated through the installation, development, and sampling of eleven new groundwater monitoring wells. The well locations are depicted on attached **Figure 6A**. The installation, development, and sampling work is described below.

4.2.1 Monitoring Well Installation

Each monitoring well will be completed with ten feet of two-inch Schedule 40 PVC well screen with 0.010-inch slots, connected to an appropriate length of flush-thread, Schedule 40 PVC well riser to complete the well. The well screen will be placed to intercept the existing water table at each location. The well annulus surrounding the screened interval will be filled with uniformly-graded quartz sand to approximately one to two feet above the screened section. A seal comprised of two feet of hydrated bentonite chips or pellets will be placed immediately above the sand pack. The remaining annulus will be grouted to ground surface with bentonite-cement grout. Each well will be completed with a flush-mount or stick-up protective casing.

4.2.2 Monitoring Well Development

Following installation, the monitoring wells will be developed using a peristaltic or submersible pump. An in-line water quality measurement device (flow through cell) will be used during well development to monitor temperature, dissolved oxygen, conductivity, oxidation / reduction potential, and turbidity. Water levels will be measured periodically throughout well development to establish stabilization criteria for drawdown. Data on pumping rate, drawdown, and water volume required to meet parameter stability will be used during well purging and sampling activities. The well development will continue until:

- Field turbidity readings are below 50 nephelometric turbidity units (NTU), or until further improvement (decrease) in turbidity is not observed and a maximum of ten well volumes have been removed; and
- All other field parameters have stabilized. Conditions will be considered to be stabilized when water quality readings recorded from two consecutive well volumes are within the following variance tolerances:

Field Parameter	Unit of Measurement	Variance
pH	Standard units (su)	+/- 0.1
Conductivity	mS/cm	3%
Turbidity	(NTU)	10%
Dissolved Oxygen (D.O.)	mg/L	10%
Temperature	Degrees f	3%
Oxidation-reduction potential (ORP)	mV	+/- 10

Groundwater samples will not be collected within seven days of well development.

4.2.3 Monitoring Well Evacuation and Sampling

After a minimum of seven days following development, the wells will be evacuated until stabilized conditions are observed, and subsequently sampled. The evacuation and sampling will be performed as follows:

- Immediately upon well opening, the well headspace will be monitored with a PID. Wellhead PID measurements will be recorded on well sampling logs.
- Static water levels will be measured using an electronic water level indicator capable of measuring to 0.01-foot accuracy. The water levels will be measured relative to an established, repeatable point at the top of the PVC riser. The reference elevation for each well will be surveyed relative to an assigned site benchmark, and the reference point will be marked so that all future water level measurements are recorded to the same point.
- Prior to sampling, the monitoring wells will be evacuated of a minimum of three and up to ten well volumes using low-flow (typically < 0.5 L/min) purging techniques. The goal of low flow sampling technique is a maximum drawdown of less than 0.1 meters or a rate that does not cause excessive pressure changes, temperature changes, or physical impact on water quality. An electronic water level indicator will be used periodically during purging to monitor drawdown and determine an appropriate evacuation rate. Peristaltic or bladder pumps using

manufacturer-specified tubing will be used for purging and sampling groundwater.

- Additional well volumes will be evacuated, if necessary, to document stabilization of water quality. Using a flow through cell, the evacuated water will be monitored for temperature, dissolved oxygen, conductivity, oxidation / reduction potential, and turbidity. Water quality data will be recorded at least once per well volume extracted. Conditions will be considered to be stabilized when water quality readings recorded from two consecutive well volumes are within the following variance tolerances:

Field Parameter	Unit of Measurement	Variance
pH	Standard units (su)	+/- 0.1
Conductivity	mS/cm	3%
Turbidity	(NTU)	10%
Dissolved Oxygen (D.O.)	mg/L	10%
Temperature	Degrees f	3%
Oxidation-reduction potential (ORP)	mV	+/- 10

Groundwater sampling will follow well evacuation and be conducted using low-flow sampling techniques described above. The flow through cell will be removed and samples will be collected directly from the tubing. Sampling protocol and equipment will comply with the June 2021 NYSDEC PFAS guidance document "*Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS)*". Decontamination will be conducted after each well is sampled to reduce the likelihood of cross contamination. Calibration times, purging volumes, water levels and field measurements will be recorded in a field log and will be provided in the Remedial Investigation Report.

The groundwater samples will be analyzed for the following list of target analytes:

- TCL VOCs
- TCL SVOCs (both unfiltered and field-filtered)
- TCL pesticides / herbicides
- PCBs
- TAL Metals (including mercury; both unfiltered and field-filtered)
- Total Cyanide
- Hexavalent chromium (both unfiltered and field-filtered)
- PFAS and 1,4-dioxane

Prior groundwater sampling performed at the site in 2021 encountered detectable concentrations of SVOC in the collected groundwater samples. These data were qualified with a statement that "these detections may not be representative of actual groundwater conditions but rather particulate matter within the sample". Significant particulate matter in groundwater samples can also result in elevated concentrations of metals, which, in some cases, may not be representative of dissolved-phase groundwater conditions. Based on these factors, samples collected during the RI for SVOC and metals analyses (including mercury and hexavalent chromium) will be collected as both unfiltered and field-filtered samples. The unfiltered samples will be collected directly from the well (following appropriate evacuation and stabilization). Field-filtered samples will be passed through a five micron filter prior to being placed in the sample containers. A comparison of the unfiltered to the field-filtered concentrations of the target analytes will provide a better assessment of whether the observed compound concentrations are attributable to particulate matter or are representative of dissolved-phase conditions.

4.3 Soil Vapor Assessment

No assessment of soil vapor or soil vapor intrusion risk has been conducted to date at the site. A soil vapor assessment will be performed during the RI, to determine whether the soil vapor medium is contaminated with VOC, to evaluate the potential for vapor intrusion risk to the existing and future buildings on the Site, and to assess the potential for on-site or off-site migration of vapor-phase VOC in the unsaturated / vadose zone. The soil vapor assessment will utilize soil vapor implants positioned at targeted sampling locations positioned near the periphery of the property in each direction, as well as sub-slab vapor sampling points installed through the foundation slabs of the existing on-site buildings. The combination of these data points will provide information on soil vapor VOC concentrations at 20 locations, providing representative coverage of the entire property. The planned soil vapor and sub-slab vapor sampling locations are depicted on **Figure 7**.

The soil vapor assessment will be performed in accordance with the assessment methodologies recommended by the New York State Department of Health (NYSDOH) in its *Guidance for Evaluating Soil Vapor Intrusion in the State of New York (Final),* dated October 2006 (including subsequent updates).

4.3.1 Soil Vapor Implant Installation

Soil vapor sampling will be conducted near the property periphery in each direction to evaluate whether evidence of VOC migration via pore space in unsaturated soil is entering the property from off-site locations, or leaving the property and potentially impacting adjacent properties and structures. To accomplish this sampling, seven semi-permanent soil vapor implants will be installed.

The soil vapor implants will be installed using direct-push methods. Continuous soil sampling will be conducted at each location using Geoprobe® Systems' Macro-Core® soil samplers, to create a nominal 2.25-inch diameter borehole. The direct-push borings will be terminated at the target depth of the vapor implant placement. As consistent with NYSDOH guidance, the vapor implants will be positioned so as to allow collection of vapor samples at depths comparable to the depths of nearby foundation footings (normally +/- five feet in depth), or at least 12 inches above the water table, if groundwater is present at a depth less than six feet below grade. The groundwater depth will be determined based upon static water levels recorded in nearby wells.

Following creation of the borehole, the vapor implants will be placed at the target sampling depth (five feet below grade or 12-15 inches above the observed groundwater depth). Each implant will consist of a six-inch long vapor implant with stainless steel mesh / screen. Polyethylene tubing will be affixed to the top of the stainless steel screen, and will extend to the ground surface. The borehole annulus surrounding and to twelve inches above the top of the screen will be filled with clean glass beads to create an inert, porous vapor sampling zone. The remainder of the borehole annulus will be filled with a bentonite slurry to minimize outdoor air from entering the sampling zone.

4.3.2 Sub-Slab Vapor Sampling Point Construction

Sub-slab vapor samples will be collected from beneath the concrete foundation slab of each building. Thirteen sub-slab vapor samples will be collected. The vapor samples will be collected from temporary sub-slab vapor points. The sub-slab samples will be installed by drilling small diameter holes (1/2" to 5/8") through the concrete slab and approximately two inches into the underlying soil with a hammer drill. A polyethylene tube will be inserted through the hole into the sub-slab void at each location, and the tubes will be sealed to the concrete floor with modeling clay or beeswax.

4.3.3 Pre-Sampling Inspection & Product Inventory

Prior to the collection of the vapor samples, a pre-sampling inspection will be performed to: (1) evaluate the physical layout and conditions of each building, and (2) to identify and minimize conditions that may affect or interfere with the proposed vapor sampling. The data, along with information about potential sources of indoor air contamination, will be documented on a NYSDEC *Structure Sampling Questionnaire and Building Inventory* form. The information collected will include the following:

- Construction characteristics, including foundation cracks, utility penetrations, and/or other openings that may serve as preferential pathways for vapor intrusion or result in short-circuiting by allowing indoor air to communicate with the sub-slab sampling interval;
- Recent renovations or maintenance to the building, if applicable (e.g., fresh paint, new carpet, or furniture);
- Mechanical equipment that can affect pressure gradients (heating & air conditioning systems, exhaust fans, etc.);
- Use or storage of petroleum products (e.g., fuel containers, gasoline operated equipment, and unvented kerosene heaters), solvents, chemical products, cosmetics, and/or cleaning products, and;

- Recent use of petroleum-based finishes or products containing volatile chemicals, if applicable.

Since products stored inside within a building have the potential to affect the air quality of the rooms being tested, a product inventory survey will be completed for each building's interior. As identified and if readily available, chemical ingredients of interest will be recorded for each product. If the ingredients are not listed on the product's label, the product's full name and the manufacturer's name, address, and phone number will be recorded. Whenever practical, photographs of the products and their labeled ingredients will be used to supplement the inventory. Ambient air, within the building and near any locations where chemicals or products are stored, will be screened using a portable photo-ionization detector (PID) equipped with a 10.6 eV lamp. While a portable PID is not capable of detecting compounds to the level that is required for making decisions regarding exposure risks and appropriate response actions, this tool can help identify potential indoor sources of VOCs that may affect sample integrity and laboratory data usability. The presence and description of any odors (e.g., solvent, petroleum, etc.) and PID readings will be noted and utilized to help evaluate potential sources of volatile chemicals.

In the event that sources of volatile chemicals are encountered during the pre-sampling inspection, attempts will be made to control the potential source of the VOCs (by tightly sealing the container, placing them in a tightly sealed "Tupperware" type container or "Zip-lock" bag, and collecting them in an area of the building away from sample collection points), prior to the sampling event.

4.3.4 Vapor Sampling Event

The vapor sampling activities will include the collection of seven soil vapor samples, 13 sub-slab vapor samples, and one upwind outdoor air sample (to provide data on ambient concentrations of VOCs in the surrounding area). The samples will be collected simultaneously, over a 24-hour sampling period.

To avoid potential interferences and dilution effects, C & S will request of the Owner that the following activities not occur for the 24-hours prior to or during the sampling event:

- Painting;
- Using auxiliary heating devices, such as kerosene heaters;
- Cleaning, waxing, or polishing furniture, floors, or other woodwork with petroleum or oil-based products;
- Using air fresheners, scented candles, or odor eliminators;
- Engaging in hobbies that use materials containing VOCs;
- Using cosmetics while in the building, such as hairspray, nail polish, nail polish removers, or perfume / cologne;

- Applying pesticides;
- Using building repair or maintenance products, such as caulk; and
- Bringing freshly dry-cleaned clothing or furnishings into the building.

Additionally, the following provisions will be observed to minimize potential impacts to the air sample integrity and sufficiently document the sampling activities:

- Field sampling personnel will not pump gasoline en route to the sampling event to avoid the potential introduction of VOCs via clothing or contact from such activities;
- Field notes and sample canister labels will be prepared with ballpoint pens, and no use of "Sharpie" or similar type markers containing VOCs will occur during the sampling event;
- At the time of sampling, weather conditions (e.g., precipitation, indoor and outdoor temperatures, barometric pressure) and ventilation conditions (e.g., heating system active and windows closed) will be documented;
- Pertinent observations, such as odors, readings from field instrumentation, and significant activities in the vicinity (e.g., operation of heavy equipment) will be documented;
- Ambient air within the building and near any locations where chemicals or products that may impact indoor air sample results will be screened using a portable photo-ionization detector (PID) equipped with a 10.6 eV lamp, in a manner similar to the pre-sampling inspection;
- Photographs of each sample location and its surrounding area, the building and its foundation, observed foundation penetrations, and any other pertinent features will be collected;
- A sample log sheet summarizing the sample identification, date & times of sample collection, identity of samplers, sampling method & devices, volume of air sampled, vacuum of canisters before-and-after samples are collected, and chain-of-custody forms, will be maintained;
- Samples will be collected at a maximum flow rate of 0.2 liters per minute; and
- Sample locations, chemical storage areas, doorways, stairways, subsurface drains and utility perforations through building foundations, HVAC system supply and return registers, and any other pertinent information will be noted on a floor plan / site sketch of the building.

Prior to sampling, helium tracer gas will be utilized at each soil vapor and sub-slab vapor sampling location to ensure that an adequate seal is achieved between the surface (soil vapor samples) or concrete slab (sub-slab vapor samples) and the sampling tubes. The tracer gas will be introduced into a shroud that is installed over the tubes once they are installed and sealed. At the sub-slab vapor locations, the shroud will be sealed to the underlying concrete slab with modeling clay. Air will be drawn from the sampling tubes by a Restek Electronic Leak Detector that will provide real-time measurement of helium in the soil vapor or sub-slab air. An alarm will sound if helium in the extracted soil vapor or sub-slab air exceeds 10%, indicating a leak in the sample ports. If tracer gas in excess of 10% is detected, the port will be reconfigured until an adequate seal is achieved.

Prior to sampling from the soil vapor implants and the sub-slab sampling ports, one to three times the volume of the sampling tubing will be purged to remove air that is not representative of the sub-slab environment. The purging will occur at a flow rate below 0.2 liters per minute to minimize the potential for air from above the slab to be pulled into the sub-slab environment through excessive negative air pressure.

In addition to the soil vapor and sub-slab samples, a representative outdoor air sample will be collected from an upwind location of the Site. The sample location will be determined at the time of the sampling event, based upon the current wind direction and site features. The outdoor (upwind) sample location will be positioned away from trees and shrubbery, fences, and other site features that may affect air currents, and away from potential sources of airborne VOCs, such as vehicle parking areas, running gas-powered equipment, and building vents, that may result in elevated outdoor air sample results. The sample will be collected at a height of 3-to-5 feet above the ground to represent typical breathing zones.

Each soil vapor, sub-slab vapor, and outdoor air sample will be collected using a Summa™ canister (1-Liter capacity) equipped with a critical orifice flow regulation device calibrated to allow an air sample to be collected over a 24-hour sampling period. Sampling equipment will be provided by the project laboratory. Sampling will follow NYSDOH guidance. The sampling procedure is as follows:

- Air sample canisters will be labeled with a unique sample designation number. The sample number and location will be recorded on the field sampling form.
- The canister vacuum will be measured using an integrated vacuum gauge immediately prior to canister deployment and recorded on the field sampling form. The critical orifice flow controller will be installed, as supplied by the laboratory, on the canister; the canister will be opened fully at the beginning of sample collection period; and the start time will be recorded.
- The canister valve will be closed fully at the end of the sample period by disconnecting the regulator from the canister (after 24-hours). The end time will be recorded on the field sampling form. Any evidence of canister disturbance during the sample collection will be recorded.
- The canister vacuum will be measured and recorded immediately after canister retrieval at the end of the sample period. Once the vacuum is

measured, the canisters will be returned to their sampling boxes for safe storage and shipping. Field data will be verified as correctly entered on the field sampling forms prior to shipment and the canisters will be shipped to the laboratory under a chain-of-custody.

- Each sample will be analyzed for VOCs via United States Environmental Protection Agency (USEPA) Compendium Method TO-15.

The laboratory data will be presented in tabular form, compared to NYSDOH air guideline values, and submitted to the NYSDEC and NYSDOH for review.

Soil and sub-slab vapor sampling procedures are provided in **Appendix F**.

4.4 Sampling Plan and Laboratory Analysis

Table 1 summarizes the sampling program described in the sections above. Additionally, Quality Assurance / Quality Control (QA / QC) samples will be collected, and the following describes the minimum number of samples per media type.

- Soil samples
    - Matrix Spike / Matrix Spike Duplicate (MS / MSD), Each Matrix – 5% (8 total)
    - Blind Duplicate (DUP), Each Matrix – 5% (4 total)

- Groundwater samples
    - Field Blank – 1 per PFAS sampling event
    - Blind Duplicate – 5% (1 per round, 2 total)
    - Matrix Spike / Matrix Spike Duplicate (MS / MSD) – 5% (1 per round, 2 total)
    - Trip Blank – 1 per VOC sampling event

All samples collected during the RI will be analyzed by a laboratory maintain current accreditation for the target analyses under the NYSDOH Environmental Laboratory Approval Program (ELAP). All data will be reported as Analytical Services Protocol (ASP) Category B deliverables in Electronic Data Deliverable (EDD) format compatible with EQuIS.

A third party validator will review all laboratory data packages and prepare a Data Usability Summary Report (DUSR). The validator will evaluate the analytical results for the field samples and quality assurance / quality control samples and compare the findings to USEPA guidance to verify the accuracy and validity of the results. The EDD for all media will be uploaded to NYSDEC's EQuIS database.

4.5 Management of Investigation-Derived Wastes

Investigation-derived wastes (IDW) that are anticipated to be generated during the completion of the RI include:

- Drill cuttings / spoils (soil)
- Test pit spoils
- Equipment decontamination fluids
- Monitoring well development and evacuation water
- Personnel Protective Equipment (PPE)
- Disposable materials and supplies

All investigation-derived wastes will be collected and managed in accordance with the Section 3.3(e) of DER-10.

5. Quality Assurance and Quality Control Protocols

To ensure that suitable and verifiable data results are obtained from the information collected at the Site, quality assurance procedures are detailed in this section.

During the RI, the NYSDEC may split any soil or groundwater sample.

5.1 Sampling Methods, Analytical Procedures and Documentation

5.1.1 Sampling Methods

Sampling procedures will be conducted consistent with the NYSDEC *Sampling Guidelines and Protocols Manual*. Collection of representative samples will include the following procedures:

- Ensuring that the sample taken is representative of the material being sampled;
- Using proper sampling, handling and preservation techniques;
- Properly identifying the collected samples and documenting their collection in field records;
- Maintaining chain-of-custody; and
- Properly preserving samples after collection.

Soil Sampling

Soil sampling will be performed using two methods: (1) field screening using a PID; and (2) grab samples. Soil samples will be collected as grab samples that are split and placed into jars supplied by the laboratory as well as into individual zip-lock bags for screening. Screening soil samples will be allowed to sit in sealed zip-lock bag for a short period of time (minimum of five minutes). Headspace measurements will then be taken from each zip-lock bag. To prevent cross contamination, zip-lock bags will not be reused and will be properly disposed. Calibration of electronic field screening equipment will be completed daily and will be done to manufacturer's specifications.

As detailed in the *Sampling Guidelines and Protocols Manual*, grab samples will be placed in two to 16 ounce wide-mouth, plastic or glass jars, as provided by the lab. Sample jars will immediately be placed on ice in a cooler. The soil will be analyzed on a standard turnaround time.

Water Sampling

Groundwater sampling will be conducted consistent with NYSDEC and USEPA guidance for low-flow purging and sampling, as described in **Section 4**.

Water samples will be collected via pouring directly into pre-cleaned bottles provided by the laboratory and immediately placing the bottles on ice. The bottles and associated preservatives used, if any, will be based on the requirements of the analytical methods. The water will be analyzed for 1,4-dioxane, PFAS, pesticides / herbicides, hexavalent chromium, and total cyanide and metals on a standard turnaround time.

SVI Sampling

SVI sampling will be conducted consistent with the methods described in **Section 4**.

Samples will be collected in dedicated canisters provided by the laboratory. The canisters will be based on the requirements of the analytical methods. The samples will be analyzed for TO-15 List VOCs on a standard turnaround time.

5.1.2 Quality Assurance / Quality Control Samples

Matrix Spike / Matrix Spike Duplicates (MS / MSD) and duplicate samples will be collected for each medium, from a minimum of 5% of the locations. The locations of these QA/QC samples will be selected randomly.

Table 5-1: Summary of Estimated Sampling

Sample Type	Matrix	Est. #	Purpose
Surface Soil	Soil	16	Characterization
Historic Fill Material	Soil	12	Characterization
Native Soil Shallow	Soil	14	Characterization
Native Soil -Deep	Soil	3	Characterization
Groundwater (2 Rounds)	Water	22	Characterization
Soil Vapor	Soil Vapor	7	Characterization
Sub-Slab Vapor	Soil Vapor	13	Characterization
Duplicate – Surface Soil	Soil	1	QA/QC
Duplicate – Fill Material	Soil	1	QA/QC
Duplicate – Shallow Subsurface Soil	Soil	1	QA/QC
Duplicate – Deep Subsurface Soil	Soil	1	QA/QC

Sample Type	Matrix	Est. #	Purpose
Duplicate - Groundwater	Water	2	QA / QC
MS/MSD – Surface Soil	Soil	2	QA / QC
MS/MSD – Fill Material	Soil	2	QA / QC
MS/MSD – Shallow Subsurface Soil	Soil	2	QA / QC
MS/MSD – Deep Subsurface Soil	Soil	2	QA / QC
MS/MSD – Water	Water	4	QA / QC
Field Equipment Blank – Water	Water	2	QA / QC
Trip Blank	Water	2	QA / QC
Total		**109**	

5.1.3 Sample Custody

As outlined in NYSDEC *Sampling Guidelines and Protocols,* a sample is in custody under the following conditions:

- It is in your actual possession
- It is in your view after being in your physical possession
- It was in your possession and then you locked or sealed it up to prevent tampering
- It is in a secure area.

The environmental professional will maintain all chain-of-custody documents that will be completed for all samples that will leave the Site to be tested in the laboratory.

5.1.4 Analytical Procedures

All samples will be laboratory analyzed by a third-party laboratory that is accredited under the NYSDOH ELAP. Laboratory analytical methods will include the most current NYSDEC Analytical Services Protocol (ASP).

Soil and groundwater samples will be analyzed in accordance with EPA SW-846 methodology. A combination of the following contaminants will be analyzed:

- TCL VOCs (SW846 Method 8260)
- TCL SVOCs (SW846 Method 8270)
- TCL Pesticides (SW846 Method
- / herbicides (SW846 Method 8151A)
- PCBs (SW846 Method 8082A)
- TAL Metals (SW846 Method 6010D)
- Total Cyanide (SW846 Method 9010C/9012B)
- Hexavalent chromium (SW846 Method 7196A)
- PFAS (SW846 Method 537 or ISO 25101)
- 1,4-dioxane (SW846 Method 8270-SIM)

Category B deliverables will be requested to be used in a third-party data validation.

5.1.5 Data Usability

A data usability review will be completed for all analytical data generated as part of the investigation, and a DUSR will be prepared for all data sets, consistent with NYSDEC-DUSR Guidance contained in Appendix 2B of NYSDEC DER-10. The data review and DUSR preparation will be performed by an independent, third-party, qualified and experienced individual that has been approved by DER. The data review and DUSR preparation will serve to confirm and document that:

- The data package(s) is/are complete as defined under the requirements set forth in the most current DEC ASP Category B;
- All sample holding times have been met;
- All QC data (blanks, instrument tunings, calibration standards, calibration verifications, surrogate recoveries, spike recoveries, replicate analyses, laboratory controls, and sample data) fall within the protocol required limits and specifications;
- All data has been generated using established and agreed upon analytical protocols;
- An evaluation of the raw data confirms the results provided in the data summary sheets and quality control verification forms;
- The correct data qualifiers have been used and are consistent with the most current NYSDEC ASP; and
- Any QC exceedances are specifically noted in the DUSR and corresponding QC summary sheets from the data package have been attached to the DUSR.

6. Community Air Monitoring

Continuous air monitoring will be required during all active ground-intrusive activities, such as test boring advancement, test pitting, well installation, site excavation, trenching, handling and loading of contaminated soil and media, and other activities that disturb existing in-situ soil at the site. CAMP monitoring is not required for this project when using hand tools for shallow soil sampling, provided that sampling does not occur during extremely dry or windy conditions to minimize any off-site migration of contaminated soil particles.

The monitoring will include real-time sampling for respirable dust / particulates and airborne VOCs. The specifics of the air monitoring procedures and criteria are detailed in the Community Air Monitoring Plan (CAMP) in **Appendix C.**

The intent of the CAMP is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. Additionally, the CAMP helps to confirm that work activities did not spread contamination off-site through the air. The action levels specified within the Plan require increased monitoring, corrective actions to abate emissions, and / or work shutdown.

CAMP data summary tables will be provided to the NYSDEC and NYSDOH on a weekly basis (at a minimum), and any exceedances of CAMP action levels and corrective measure taken will be reported to the Departments immediately (within 24 hours).

7. Health and Safety

To verify the safety of the workers and the local community during the performance of the work, monitoring practices of the work environment will be in place during all phases of RI activities. A Health and Safety Plan (HASP) was prepared that details procedures for maintaining safe working conditions and minimizing the potential for exposure to hazardous material. The HASP is provided in **Appendix D**.

8. Fish and Wildlife Resources Impact Analysis

The NYSDEC Environmental Resource Mapper was utilized to determine if there are any known significant natural communities, endangered species, or threatened species on or in the vicinity of the site. According to the Resource Mapper:

- The site is located in the vicinity of a significant natural community. This significant natural community is identified as the Onondaga Salt Marsh, which is located northwest of the site, at the northern edge of Onondaga Lake.
- The site is located in the vicinity of rare animals (Lake Sturgeon) and rare plants.

Base on available information, a conclusive analysis of whether the site represents a threat to these species and communities is not possible at this time. Therefore, a more in depth analysis of the potential impacts to fish and wildlife will be conducted, in accordance with the procedures detailed in DER-10, as additional data becomes available through the RI activities.

9. Reporting

Based on the results of the work described above, a report will be prepared to describe the methodologies and results of the RI. The RI Report will:

- Be prepared in conformance with DER – 10;
- Be certified as required by DER – 10, section 1.5;
- Include a qualitative human exposure assessment;
- Include pertinent tables and figures;
- Include all field sampling forms/logs, including soil boring logs, monitoring well construction logs, groundwater sampling logs, soil vapor intrusion sampling logs, and questionnaire, etc.;
- Include all laboratory data reports (category B deliverables);
- Include data usability summary reports; and
- Include documentation regarding IDW management.

The RI Report will describe:

- Investigative methods;
- Observations and findings;
- Comparison of soil sample results to Residential Restricted Use SCOs;
- Results of the community air monitoring program; and
- Analytical results.

The document will be submitted to the NYSDEC for review and approval.

10. Schedule

Below is an anticipated schedule of milestones for the completion of the RI and the preparation of the AAR and RWP for the site. The schedule does not account for the possibility of Interim Remedial Measures (IRMs). If during the RI, impacts are identified that can readily be addressed by IRMs, the schedule will be updated accordingly.

Estimated Project Schedule:

Submission of Remedial Investigation Work Plan	April 2022
Submission of Interim Site Management Plan	April 2022
DEC Approval of Remedial Investigation Work Plan	June 2022
Begin Investigation Field Work	June/July 2022
Submit Draft Remedial Investigation Report	September 2022
Submit Final Remedial Investigation Report	October 2022
Significant Threat Determination / Fact Sheet	October 2022
DEC Approval of Remedial Investigation Report	October 2022
Submit Remedial Action Work Plan with Alternatives Analysis	November 2022

Figures

Legend

▭ Site

NAD 1983 CORS96 StatePlane New York Central FIPS 3102 Ft US
Projection: Transverse Mercator
Datum: NAD 1983 CORS96
False Easting: 820,208.3333
False Northing: 0.0000
Central Meridian: -76.5833
Scale Factor: 0.9999
Latitude Of Origin: 40.0000
Units: Foot US

USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, mation, U.S. Coastal Relief Model. Data refreshed August, 2021.

Document Path: F:\Project\X82 - Pascarella Development & Management LLC\GIS - DO NOT DELETE\Projects\RIWP\Figure 1 - Site Location.mxd

C&S COMPANIES®

C&S Engineers, Inc.
499 Col. Eileen Collins Blvd.
Syracuse, New York 13212
Phone: 315-455-2000
Fax: 315-455-9667
www.cscos.com

N

0 2,000
Feet
1 inch = 2,000 feet

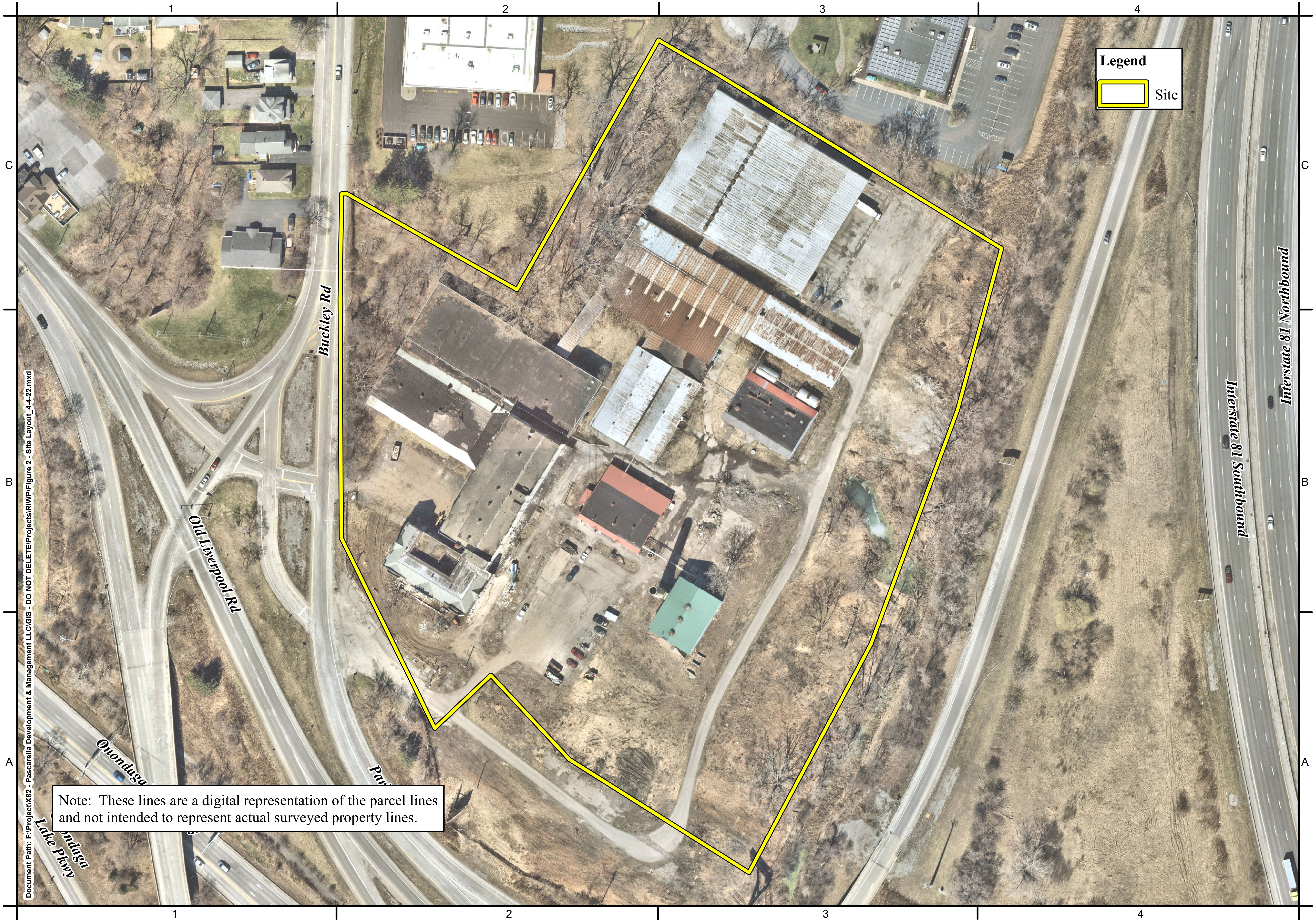
Remedial Investigation Work Plan
for
Former Will & Baumer Candle Co., Inc.
100 Buckley Road, Liverpool, New York

PROJECT NO: X82.001.002
DATE: April 2022
SCALE: AS SHOWN
DRAWN BY: JTB
DESIGNED BY: JTB
CHECKED BY: HNB

Modified: 4/4/2022 @ 8:12:03 AM

SITE LOCATION MAP

Figure 1



Note: These lines are a digital representation of the parcel lines and not intended to represent actual surveyed property lines.

Document Path: F:\Project\X82 - Pascarella Development & Management LLC\GIS - DO NOT DELETE\Projects\RIWP\Figure 2 - Site Layout_4-4-22.mxd

C&S COMPANIES®
C&S Engineers, Inc.
499 Col. Eileen Collins Blvd.
Syracuse, New York 13212
Phone: 315-455-2000
Fax: 315-455-9667
www.cscos.com

N

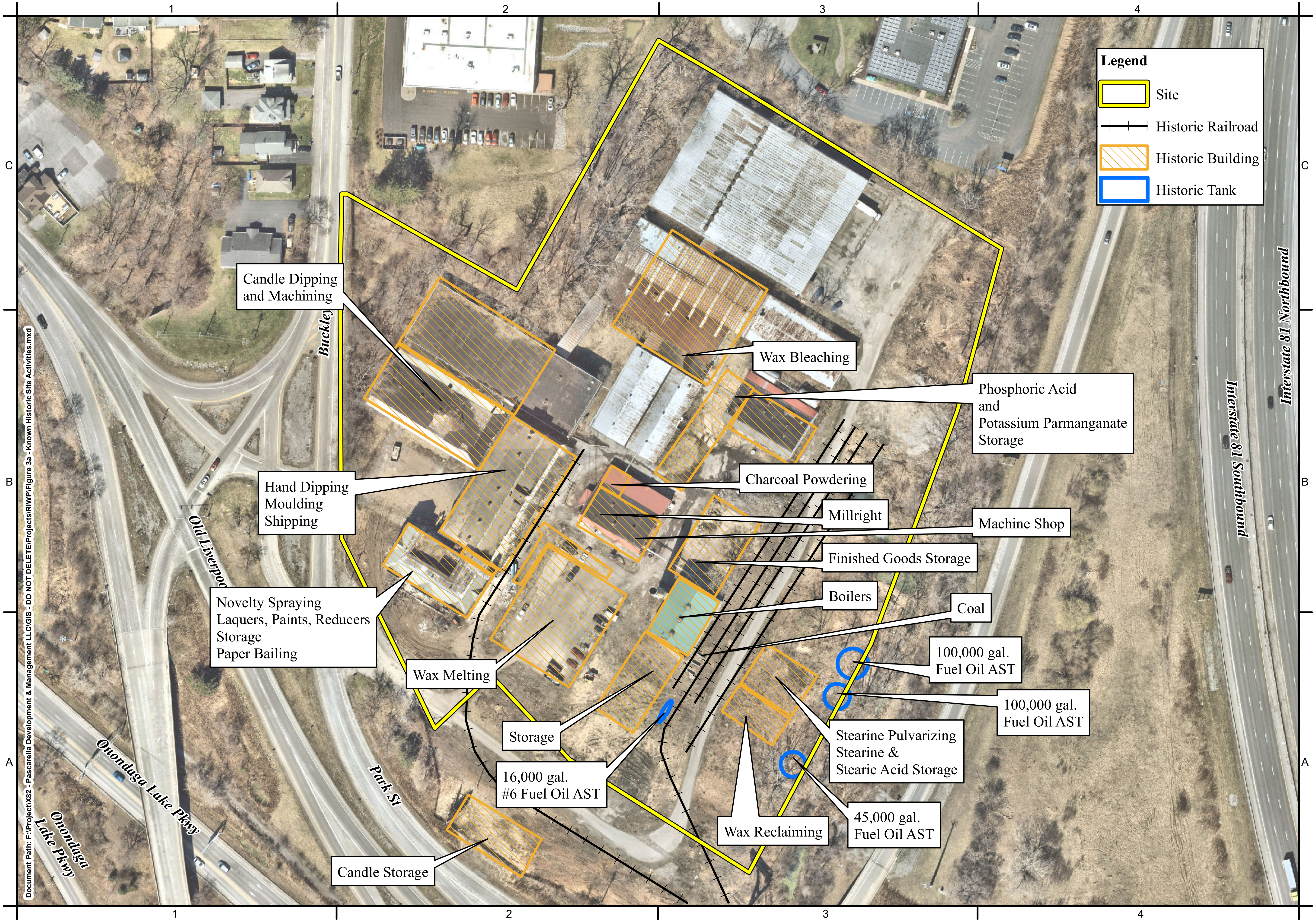
Remedial Investigation Work Plan
for
Former Will & Baumer Candle Co., Inc.
100 Buckley Road, Liverpool, New York

PROJECT NO: X55.001.002
DATE: April 2022
SCALE: AS SHOWN
DRAWN BY: JTB
DESIGNED BY: JTB
CHECKED BY: HNB

Modified: 4/4/2022 @ 8:27:23 AM

SITE LAYOUT MAP

Figure 2



Document Path: F:\Project\X82 - Pascarella Development & Management LLC\GIS - DO NOT DELETE\Projects\RIWP\Figure 3a - Known Historic Site Activities.mxd

C&S Engineers, Inc.
499 Col. Eileen Collins Blvd.
Syracuse, New York 13212
Phone: 315-455-2000
Fax: 315-455-9667
www.cscos.com

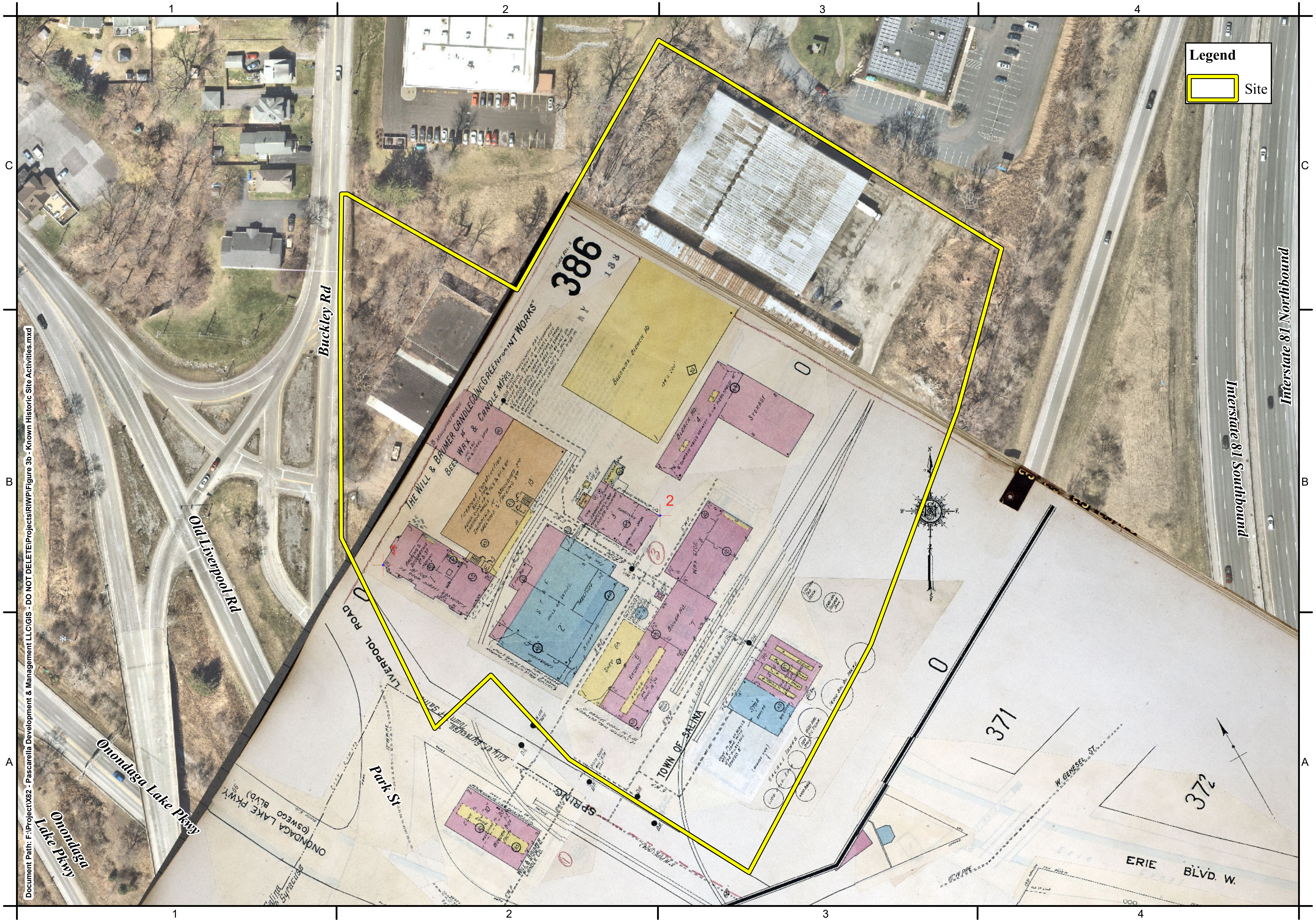
Remedial Investigation Work Plan
for
Former Will & Baumer Candle Co., Inc.
100 Buckley Road, Liverpool, New York

PROJECT NO: X55.001.002
DATE: April 2022
SCALE: AS SHOWN
DRAWN BY: JTB
DESIGNED BY: JTB
CHECKED BY: HNB

Modified: 4/26/2022 @ 1:18:26 PM

KNOWN HISTORIC SITE ACTIVITIES

Figure 3A



C&S Engineers, Inc.
499 Col. Eileen Collins Blvd.
Syracuse, New York 13212
Phone: 315-455-2000
Fax: 315-455-9667
www.cscos.com

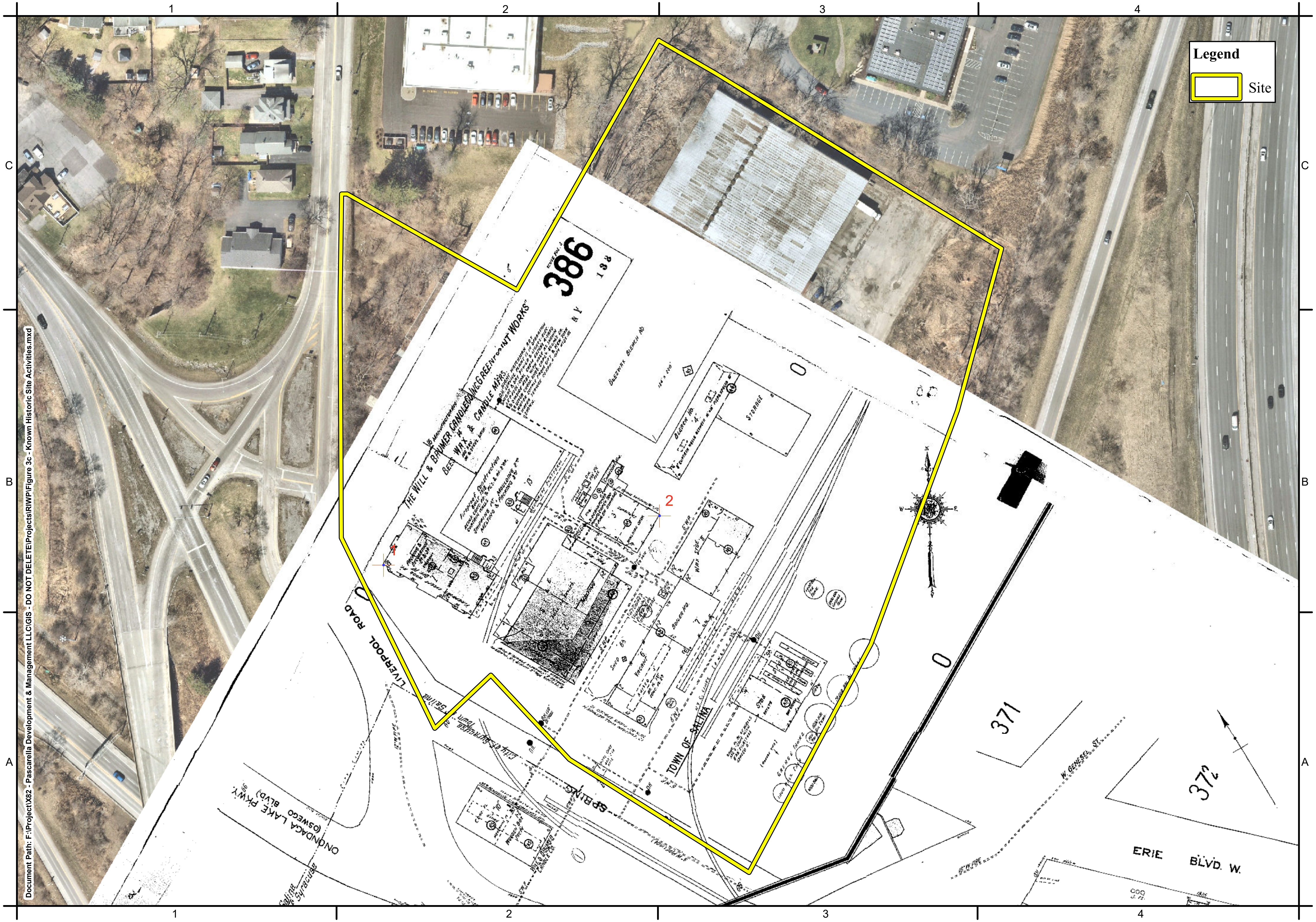
Remedial Investigation Work Plan
for
Former Will & Baumer Candle Co., Inc.
100 Buckley Road, Liverpool, New York

PROJECT NO: X55.001.002
DATE: April 2022
SCALE: AS SHOWN
DRAWN BY: JTB
DESIGNED BY: JTB
CHECKED BY: HNB

Modified: 4/26/2022 @ 1:18:46 PM

1911 SANBORN

Figure 3B



Document Path: F:\Project\X82 - Pascarella Development & Management LLC\GIS - DO NOT DELETE\Projects\RIWP\Figure 3c - Known Historic Site Activities.mxd

C&S Engineers, Inc.
499 Col. Eileen Collins Blvd.
Syracuse, New York 13212
Phone: 315-455-2000
Fax: 315-455-9667
www.cscos.com

N

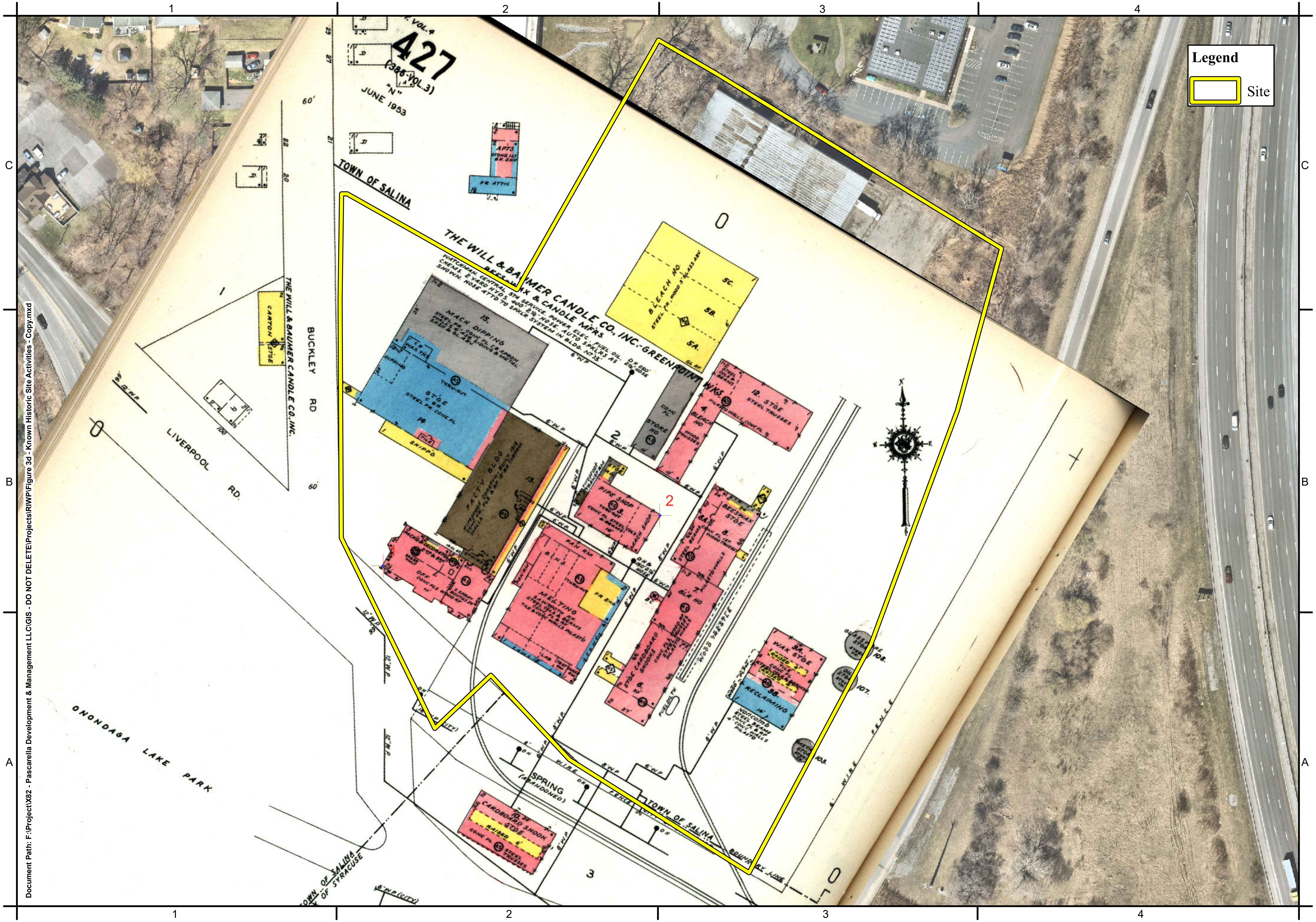
Remedial Investigation Work Plan
for
Former Will & Baumer Candle Co., Inc.
100 Buckley Road, Liverpool, New York

PROJECT NO:	X55.001.002
DATE:	April 2022
SCALE:	AS SHOWN
DRAWN BY:	JTB
DESIGNED BY:	JTB
CHECKED BY:	HNB

Modified: 4/26/2022 @ 1:19:17 PM

1942
SANBORN

Figure 3C



C&S COMPANIES®
C&S Engineers, Inc.
499 Col. Eileen Collins Blvd.
Syracuse, New York 13212
Phone: 315-455-2000
Fax: 315-455-9667
www.cscos.com

N

Remedial Investigation Work Plan
for
Former Will & Baumer Candle Co., Inc.
100 Buckley Road, Liverpool, New York

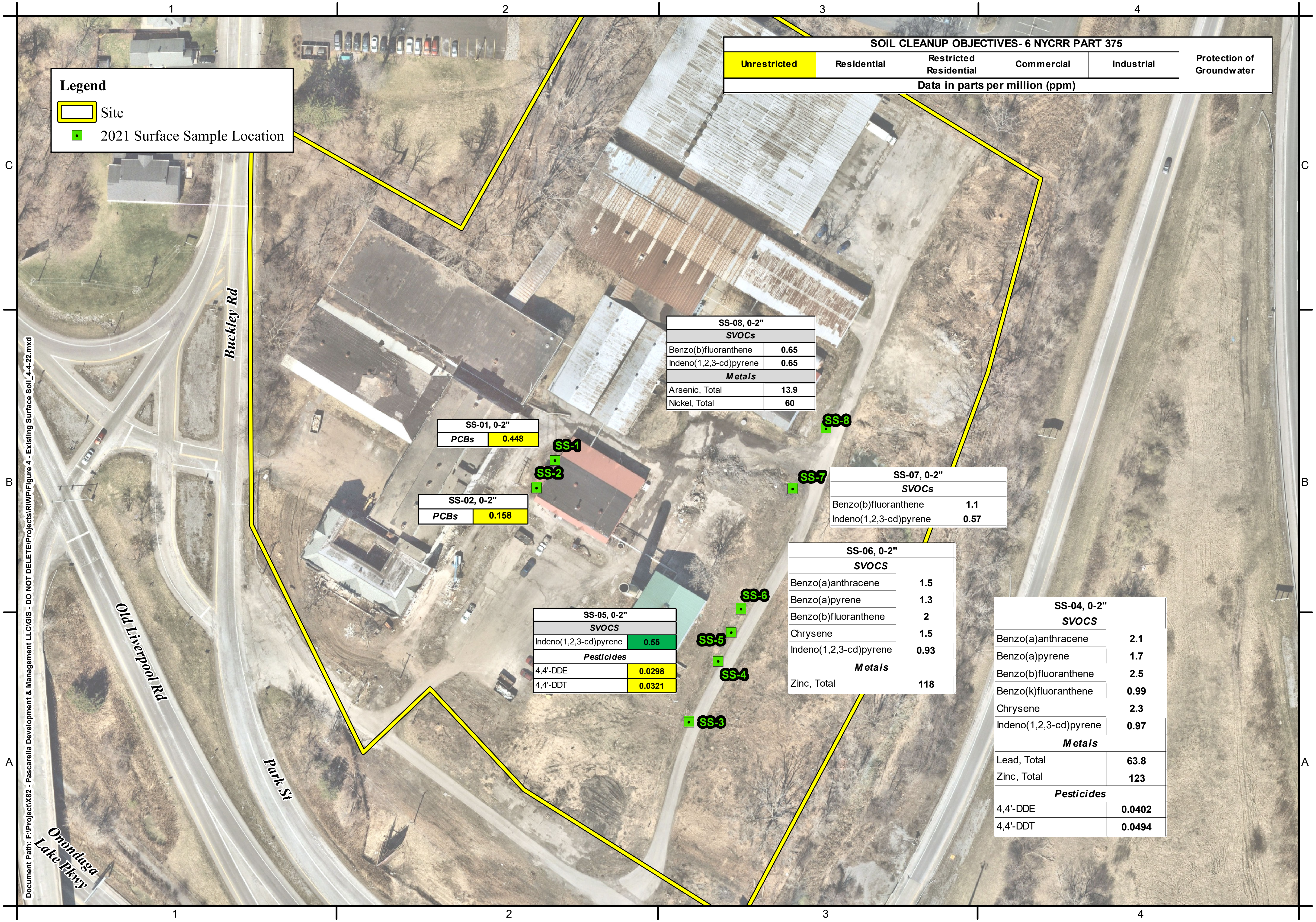
PROJECT NO:	X55.001.002
DATE:	April 2022
SCALE:	AS SHOWN
DRAWN BY:	JTB
DESIGNED BY:	JTB
CHECKED BY:	HNB

Modified: 4/26/2022 @ 1:19:41 PM

1953 SANBORN

Figure 3D

Document Path: F:\Project\X82 - Pascarella Development & Management LLC\GIS - DO NOT DELETE\Projects\RIWP\Figure 3d - Known Historic Site Activities - Copy.mxd



Document Path: F:\Project\X82 - Pascarella Development & Management LLC\GIS - DO NOT DELETE\Projects\RIWP\Figure 4 - Existing Surface Soil_4-4-22.mxd

SOIL CLEANUP OBJECTIVES- 6 NYCRR PART 375

Unrestricted	Residential	Restricted Residential	Commercial	Industrial	Protection of Groundwater
Data in parts per million (ppm)					

SS-01, 0-2"	
PCBs	0.448

SS-02, 0-2"	
PCBs	0.158

SS-08, 0-2"	
SVOCs	
Benzo(b)fluoranthene	0.65
Indeno(1,2,3-cd)pyrene	0.65
Metals	
Arsenic, Total	13.9
Nickel, Total	60

SS-07, 0-2"	
SVOCs	
Benzo(b)fluoranthene	1.1
Indeno(1,2,3-cd)pyrene	0.57

SS-06, 0-2"	
SVOCS	
Benzo(a)anthracene	1.5
Benzo(a)pyrene	1.3
Benzo(b)fluoranthene	2
Chrysene	1.5
Indeno(1,2,3-cd)pyrene	0.93
Metals	
Zinc, Total	118

SS-05, 0-2"	
SVOCS	
Indeno(1,2,3-cd)pyrene	0.55
Pesticides	
4,4'-DDE	0.0298
4,4'-DDT	0.0321

SS-04, 0-2"	
SVOCS	
Benzo(a)anthracene	2.1
Benzo(a)pyrene	1.7
Benzo(b)fluoranthene	2.5
Benzo(k)fluoranthene	0.99
Chrysene	2.3
Indeno(1,2,3-cd)pyrene	0.97
Metals	
Lead, Total	63.8
Zinc, Total	123
Pesticides	
4,4'-DDE	0.0402
4,4'-DDT	0.0494

C&S COMPANIES®
C&S Engineers, Inc.
499 Col. Eileen Collins Blvd.
Syracuse, New York 13212
Phone: 315-455-2000
Fax: 315-455-9667
www.cscos.com

N

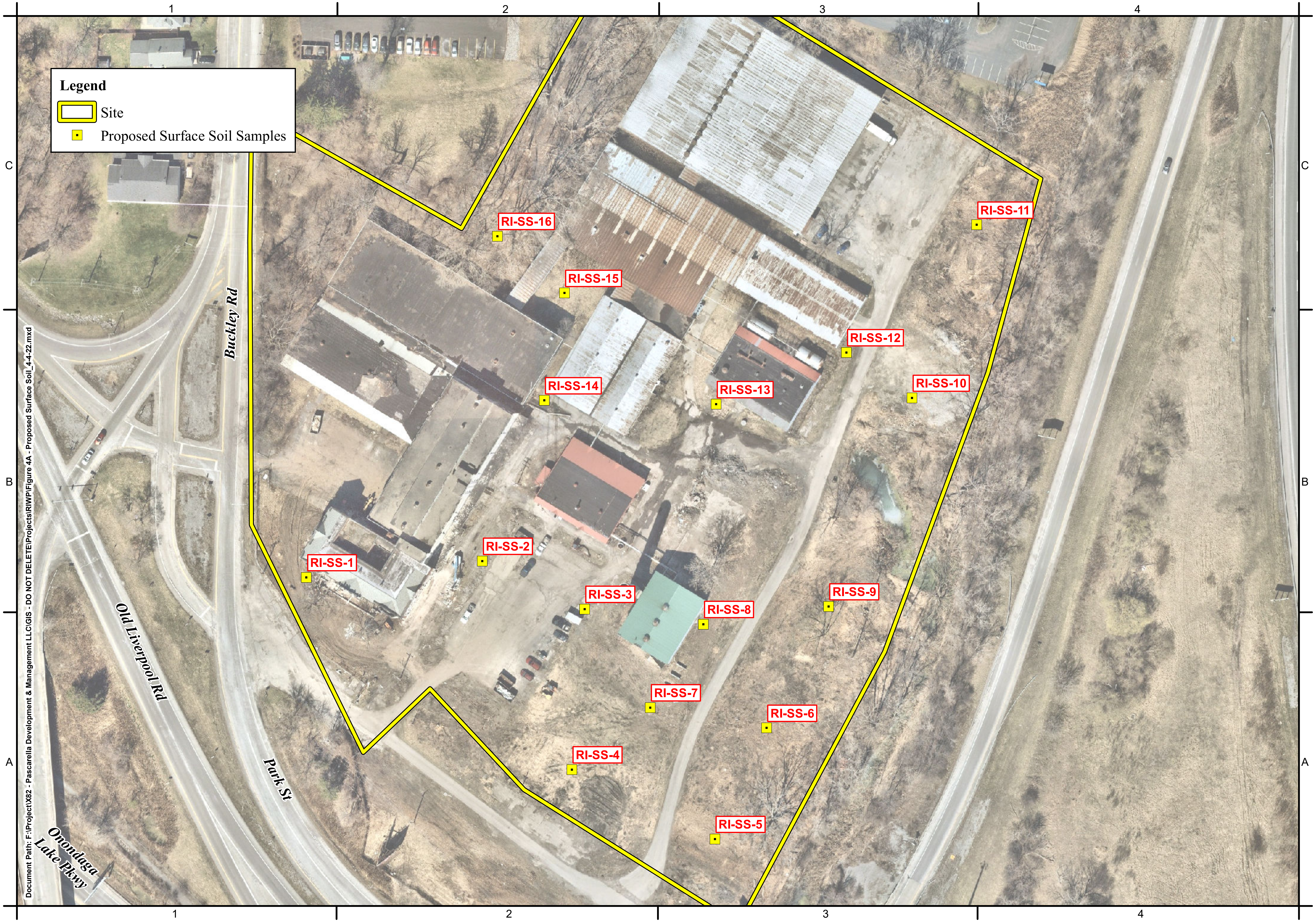
Remedial Investigation Work Plan
for
Former Will & Baumer Candle Co., Inc. Site
100 Buckley Road, Liverpool, New York

PROJECT NO:	X82.001.002
DATE:	April 2022
SCALE:	AS SHOWN
DRAWN BY:	JTB
DESIGNED BY:	JTB
CHECKED BY:	HNB

Modified: 4/8/2022 @ 2:51:50 PM

EXISTING SURFACE SOIL DATA

Figure 4



C&S COMPANIES®

C&S Engineers, Inc.
499 Col. Eileen Collins Blvd.
Syracuse, New York 13212
Phone: 315-455-2000
Fax: 315-455-9667
www.cscos.com

N

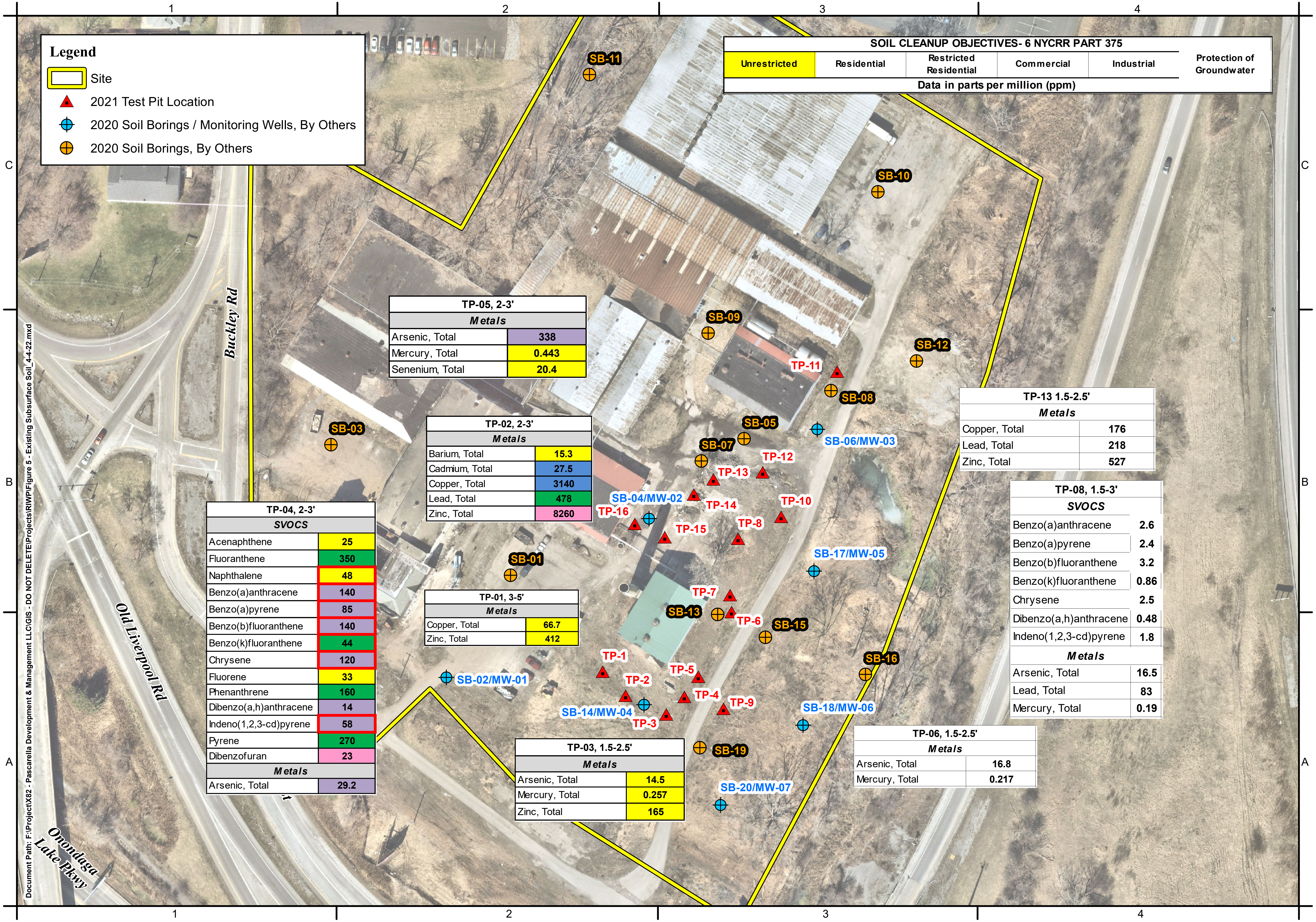
Remedial Investigation Work Plan
for
Former Will & Baumer Candle Co., Inc. Site
100 Buckley Road, Liverpool, New York

PROJECT NO:	X82.001.002
DATE:	April 2022
SCALE:	AS SHOWN
DRAWN BY:	JTB
DESIGNED BY:	JTB
CHECKED BY:	HNB

Modified: 4/28/2022 @ 3:34:28 PM

PROPOSED SURFACE SOIL SAMPLING

Figure 4A



Legend

- Site
- 2021 Test Pit Location
- 2020 Soil Borings / Monitoring Wells, By Others
- 2020 Soil Borings, By Others

SOIL CLEANUP OBJECTIVES- 6 NYCRR PART 375					
Unrestricted	Residential	Restricted Residential	Commercial	Industrial	Protection of Groundwater
Data in parts per million (ppm)					

TP-05, 2-3'	
Metals	
Arsenic, Total	338
Mercury, Total	0.443
Senenium, Total	20.4

TP-02, 2-3'	
Metals	
Barium, Total	15.3
Cadmium, Total	27.5
Copper, Total	3140
Lead, Total	478
Zinc, Total	8260

TP-04, 2-3'	
SVOCS	
Acenaphthene	25
Fluoranthene	350
Naphthalene	48
Benzo(a)anthracene	140
Benzo(a)pyrene	85
Benzo(b)fluoranthene	140
Benzo(k)fluoranthene	44
Chrysene	120
Fluorene	33
Phenanthrene	160
Dibenzo(a,h)anthracene	14
Indeno(1,2,3-cd)pyrene	58
Pyrene	270
Dibenzofuran	23
Metals	
Arsenic, Total	29.2

TP-01, 3-5'	
Metals	
Copper, Total	66.7
Zinc, Total	412

TP-03, 1.5-2.5'	
Metals	
Arsenic, Total	14.5
Mercury, Total	0.257
Zinc, Total	165

TP-13 1.5-2.5'	
Metals	
Copper, Total	176
Lead, Total	218
Zinc, Total	527

TP-08, 1.5-3'	
SVOCS	
Benzo(a)anthracene	2.6
Benzo(a)pyrene	2.4
Benzo(b)fluoranthene	3.2
Benzo(k)fluoranthene	0.86
Chrysene	2.5
Dibenzo(a,h)anthracene	0.48
Indeno(1,2,3-cd)pyrene	1.8
Metals	
Arsenic, Total	16.5
Lead, Total	83
Mercury, Total	0.19

TP-06, 1.5-2.5'	
Metals	
Arsenic, Total	16.8
Mercury, Total	0.217

Document Path: F:\Project\X82 - Pascarella Development & Management LLC\GIS - DO NOT DELETE\Projects\RIWP\Figure 5 - Existing Subsurface Soil_4-4-22.mxd

C&S COMPANIES®
C&S Engineers, Inc.
499 Col. Eileen Collins Blvd.
Syracuse, New York 13212
Phone: 315-455-2000
Fax: 315-455-9667
www.cscos.com

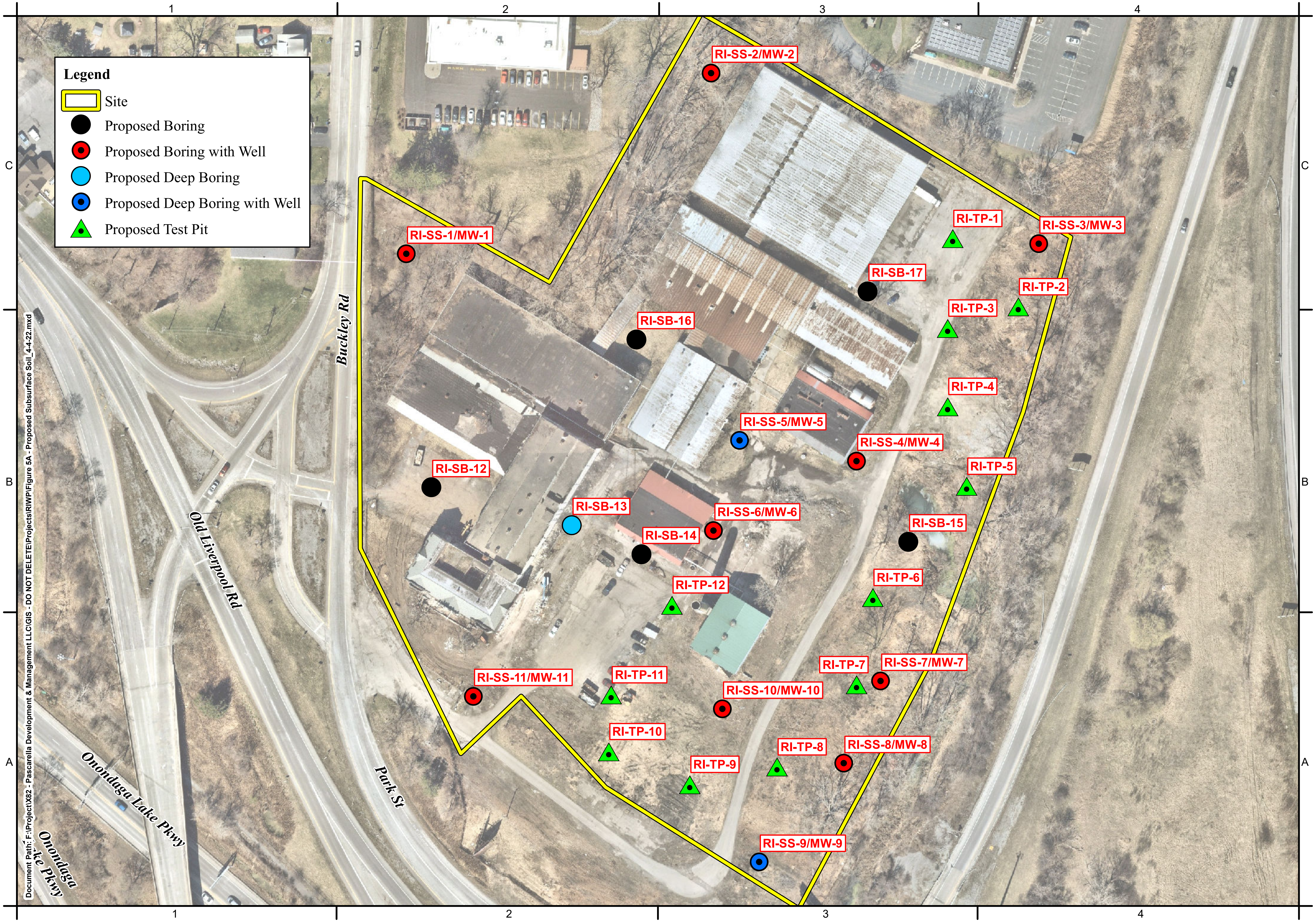
Remedial Investigation Work Plan
for
Former Will & Baumer Candle Co., Inc. Site
100 Buckley Road, Liverpool, New York

PROJECT NO:	X82.001.001
DATE:	April 2022
SCALE:	AS SHOWN
DRAWN BY:	
DESIGNED BY:	
CHECKED BY:	

Modified: 4/8/2022 @ 2:56:31 PM

EXISTING SUBSURFACE SOIL DATA

Figure 5



C&S COMPANIES®

C&S Engineers, Inc.
499 Col. Eileen Collins Blvd.
Syracuse, New York 13212
Phone: 315-455-2000
Fax: 315-455-9667
www.cscos.com

N

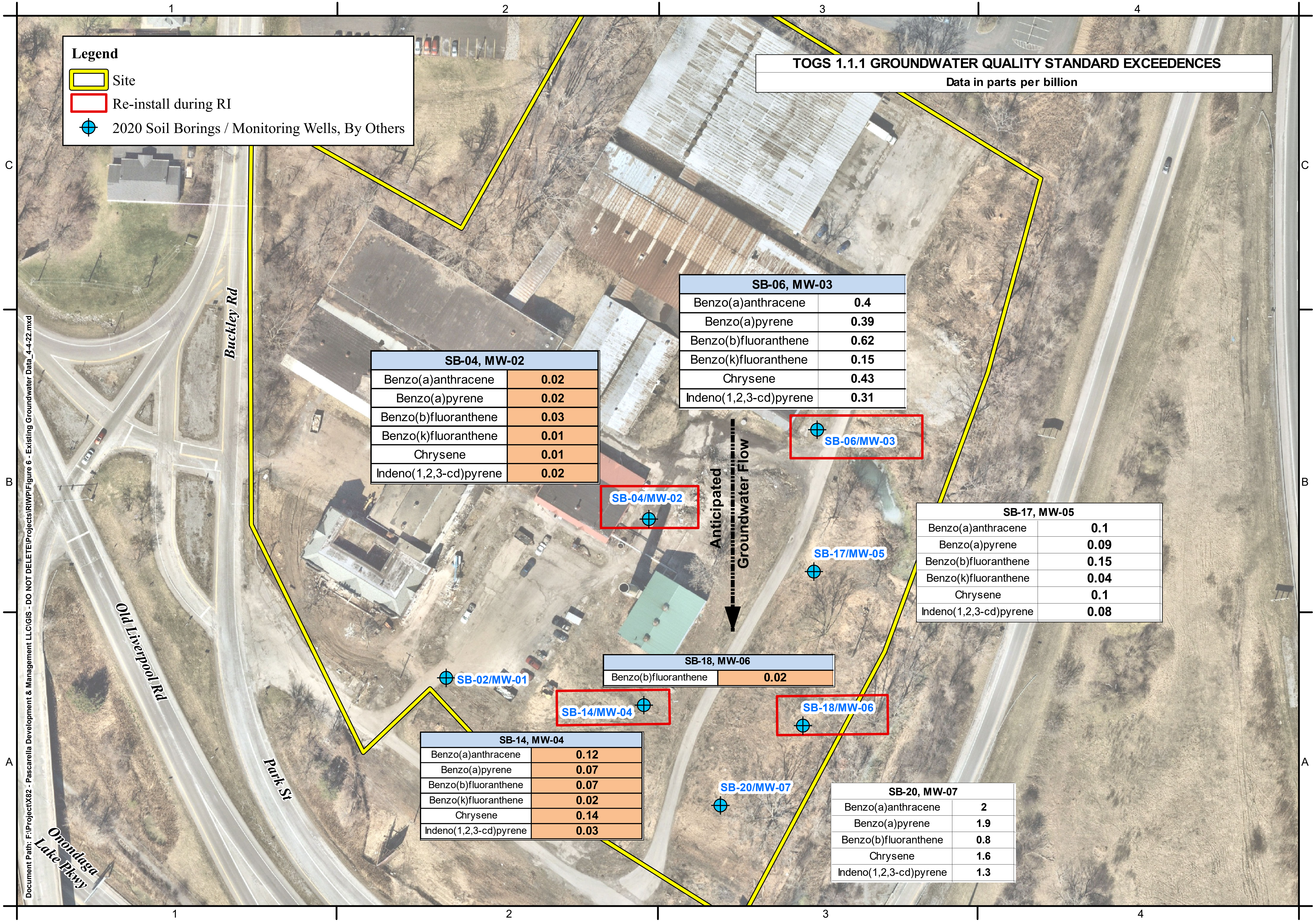
Remedial Investigation Work Plan
for
Former Will & Baumer Candle Co., Inc. Site
100 Buckley Road, Liverpool, New York

PROJECT NO:	X82.001.002
DATE:	April 2022
SCALE:	AS SHOWN
DRAWN BY:	JTB
DESIGNED BY:	JTB
CHECKED BY:	HNB

Modified: 4/28/2022 @ 3:18:14 PM

PROPOSED SUBSURFACE SAMPLING

Figure 5A



TOGS 1.1.1 GROUNDWATER QUALITY STANDARD EXCEEDENCES

Data in parts per billion

SB-04, MW-02	
Benzo(a)anthracene	0.02
Benzo(a)pyrene	0.02
Benzo(b)fluoranthene	0.03
Benzo(k)fluoranthene	0.01
Chrysene	0.01
Indeno(1,2,3-cd)pyrene	0.02

SB-06, MW-03	
Benzo(a)anthracene	0.4
Benzo(a)pyrene	0.39
Benzo(b)fluoranthene	0.62
Benzo(k)fluoranthene	0.15
Chrysene	0.43
Indeno(1,2,3-cd)pyrene	0.31

SB-17, MW-05	
Benzo(a)anthracene	0.1
Benzo(a)pyrene	0.09
Benzo(b)fluoranthene	0.15
Benzo(k)fluoranthene	0.04
Chrysene	0.1
Indeno(1,2,3-cd)pyrene	0.08

SB-18, MW-06	
Benzo(b)fluoranthene	0.02

SB-14, MW-04	
Benzo(a)anthracene	0.12
Benzo(a)pyrene	0.07
Benzo(b)fluoranthene	0.07
Benzo(k)fluoranthene	0.02
Chrysene	0.14
Indeno(1,2,3-cd)pyrene	0.03

SB-20, MW-07	
Benzo(a)anthracene	2
Benzo(a)pyrene	1.9
Benzo(b)fluoranthene	0.8
Chrysene	1.6
Indeno(1,2,3-cd)pyrene	1.3

Document Path: F:\ProjectX82 - Pascarella Development & Management LLC\GIS - DO NOT DELETE\Projects\RIWP\Figure 6 - Existing Groundwater Data_4-4-22.mxd

C&S Engineers, Inc.
499 Col. Eileen Collins Blvd.
Syracuse, New York 13212
Phone: 315-455-2000
Fax: 315-455-9667
www.cscos.com

N

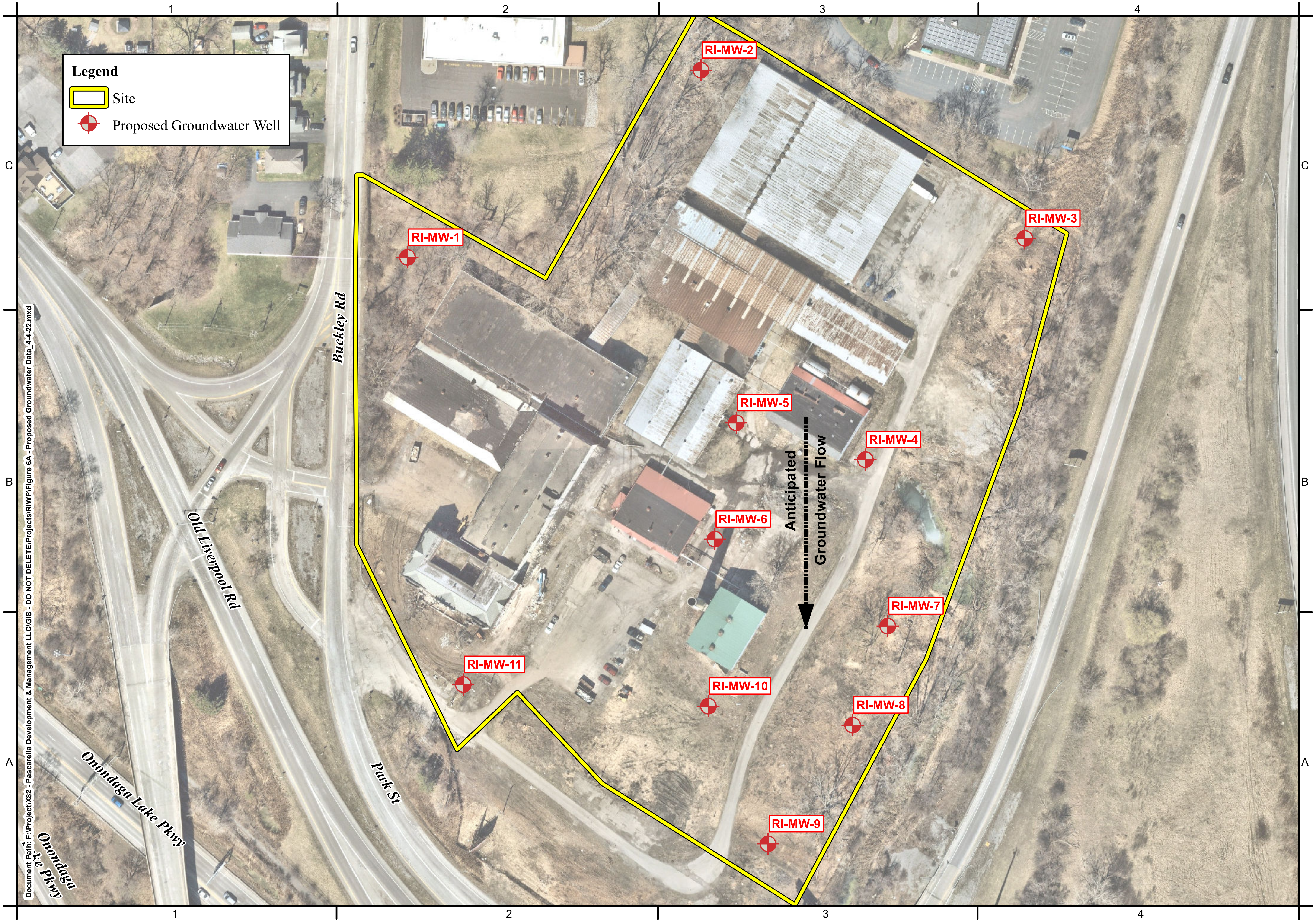
Remedial Investigation Work Plan
for
Former Will & Baumer Candle Co., Inc.
100 Buckley Road, Liverpool, New York

PROJECT NO:	X82.001.002
DATE:	April 2022
SCALE:	AS SHOWN
DRAWN BY:	JTB
DESIGNED BY:	JTB
CHECKED BY:	HNB

Modified: 4/8/2022 @ 3:21:31 PM

EXISTING GROUNDWATER DATA

Figure 6



C&S Engineers, Inc.
499 Col. Eileen Collins Blvd.
Syracuse, New York 13212
Phone: 315-455-2000
Fax: 315-455-9667
www.cscos.com

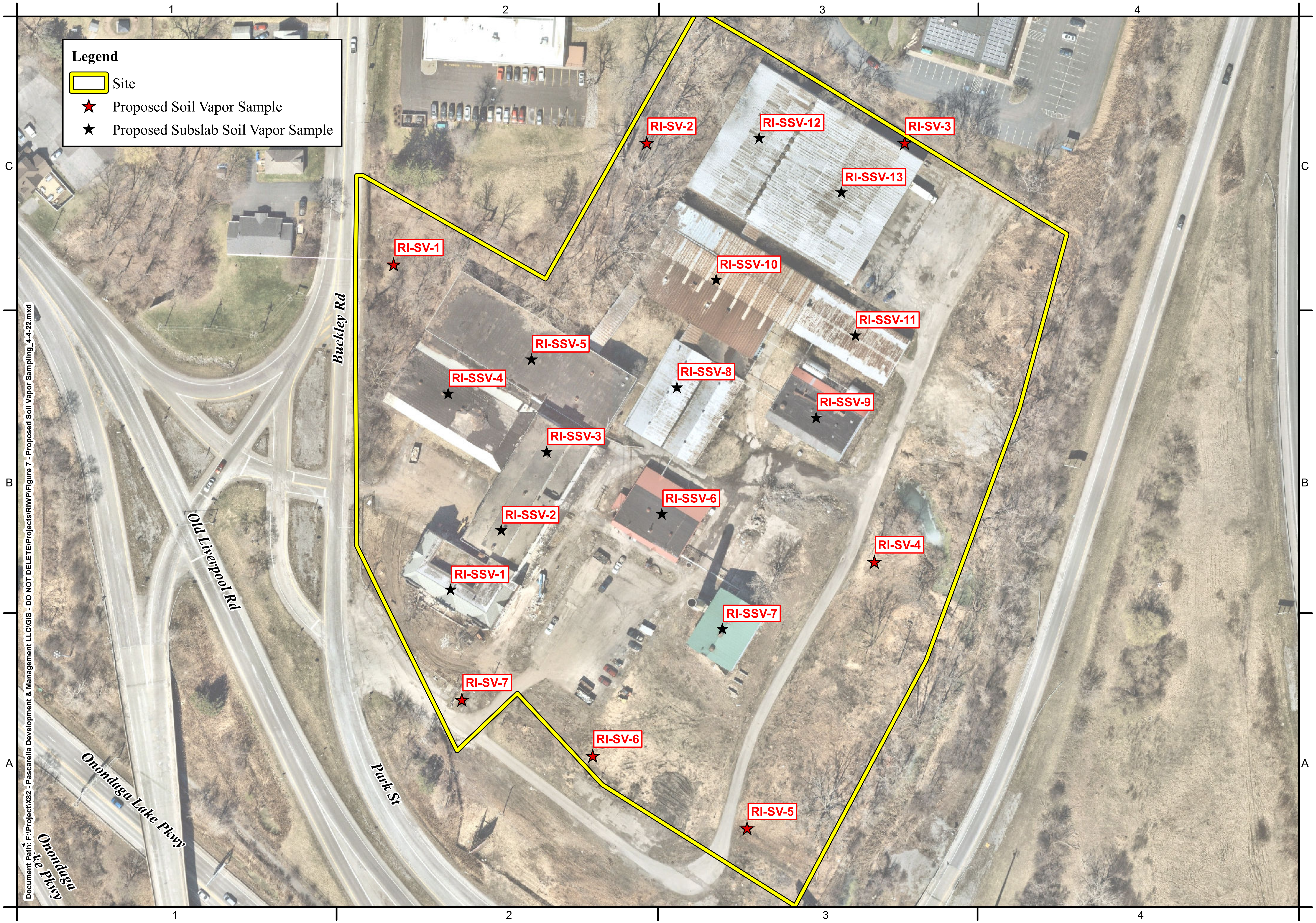
Remedial Investigation Work Plan
for
Former Will & Baumer Candle Co., Inc.
100 Buckley Road, Liverpool, New York

PROJECT NO:	X82.001.002
DATE:	April 2022
SCALE:	AS SHOWN
DRAWN BY:	JTB
DESIGNED BY:	JTB
CHECKED BY:	HNB

Modified: 4/28/2022 @ 3:41:38 PM

PROPOSED GROUNDWATER SAMPLING

Figure 6A



Document Path: F:\Project\X82 - Pascarella Development & Management LLC\GIS - DO NOT DELETE\Projects\RIWP\Figure 7 - Proposed Soil Vapor Sampling_4-4-22.mxd

C&S Engineers, Inc.
499 Col. Eileen Collins Blvd.
Syracuse, New York 13212
Phone: 315-455-2000
Fax: 315-455-9667
www.cscos.com

N

Remedial Investigation Work Plan
for
Former Will & Baumer Candle Co., Inc.
100 Buckley Road, Liverpool, New York

PROJECT NO:	X82.001.002
DATE:	April 2022
SCALE:	AS SHOWN
DRAWN BY:	JTB
DESIGNED BY:	JTB
CHECKED BY:	HNB

Modified: 4/28/2022 @ 3:25:52 PM

PROPOSED
SOIL
VAPOR
SAMPLING

Figure 7

Tables

Table 1: Sample and Analysis Summary

Sample Location	Media/ Type of Sample	Analyses											
		Hexavalent Cr	TCL Pesticides	TCL Herbicides	1,4-Dioxane	PFAS	Total Cyanide	PCB	VOC	SVOC	Total Metal	Filtered Metal	Filtered SVOC
RI-SS-01	Surface Soil	●	●	●	●	●	●	●	●	●	●		
RI-SS-02	Surface Soil	●	●	●	●	●	●	●	●	●	●		
RI-SS-03	Surface Soil	●	●	●	●	●	●	●	●	●	●		
RI-SS-04	Surface Soil	●	●	●	●	●	●	●	●	●	●		
RI-SS-05	Surface Soil	●	●	●	●	●	●	●	●	●	●		
RI-SS-06	Surface Soil	●	●	●	●	●	●	●	●	●	●		
RI-SS-07	Surface Soil	●	●	●	●	●	●	●	●	●	●		
RI-SS-08	Surface Soil	●	●	●	●	●	●	●	●	●	●		
RI-SS-09	Surface Soil	●	●	●	●	●	●	●	●	●	●		
RI-SS-10	Surface Soil	●	●	●	●	●	●	●	●	●	●		
RI-SS-11	Surface Soil	●	●	●	●	●	●	●	●	●	●		
RI-SS-12	Surface Soil	●	●	●	●	●	●	●	●	●	●		
RI-SS-13	Surface Soil	●	●	●	●	●	●	●	●	●	●		
RI-SS-14	Surface Soil	●	●	●	●	●	●	●	●	●	●		
RI-SS-14	Surface Soil	●	●	●	●	●	●	●	●	●	●		
RI-SS-15	Surface Soil	●	●	●	●	●	●	●	●	●	●		
RI-SS-16	Surface Soil	●	●	●	●	●	●	●	●	●	●		
RI-SS-__-MS	Surface Soil	●	●	●	●	●	●	●	●	●	●		
RI-SS-__-MSD	Surface Soil	●	●	●	●	●	●	●	●	●	●		

Sample Location	Media/ Type of Sample	Analyses											
		Hexavalent Cr	TCL Pesticides	TCL Herbicides	1,4- Dioxane	PFAS	Total Cyanide	PCB	VOC	SVOC	Total Metal	Filtered Metal	Filtered SVOC
RI-SS-__-DUP	Surface Soil	●	●	●	●	●	●	●	●	●	●		
RI-SB-01	SS Soil - HFM	●	●	●	●	●	●	●	●	●	●		
	SS Soil - Native	●	●	●	●	●	●	●	●	●	●		
RI-SB-02	SS Soil - HFM	●	●	●	●	●	●	●	●	●	●		
	SS Soil - Native	●	●	●	●	●	●	●	●	●	●		
RI-SB-03	SS Soil - HFM	●	●	●	●	●	●	●	●	●	●		
	SS Soil - Native	●	●	●	●	●	●	●	●	●	●		
RI-SB-04	SS Soil - HFM	●	●	●	●	●	●	●	●	●	●		
	SS Soil - Native	●	●	●	●	●	●	●	●	●	●		
RI-SB-05	SS Soil - HFM	●	●	●	●	●	●	●	●	●	●		
	SS Soil - Native	●	●	●	●	●	●	●	●	●	●		
RI-SB-06	SS Soil - HFM	●	●	●	●	●	●	●	●	●	●		
	SS Soil - Native	●	●	●	●	●	●	●	●	●	●		
RI-SB-07	SS Soil - HFM	●	●	●	●	●	●	●	●	●	●		
	SS Soil - Native	●	●	●	●	●	●	●	●	●	●		
RI-SB-08	SS Soil - HFM	●	●	●	●	●	●	●	●	●	●		
	SS Soil - Native	●	●	●	●	●	●	●	●	●	●		
RI-SB-09	SS Soil - HFM	●	●	●	●	●	●	●	●	●	●		
	SS Soil - Native	●	●	●	●	●	●	●	●	●	●		
RI-SB-10	SS Soil - HFM	●	●	●	●	●	●	●	●	●	●		
	SS Soil - Native	●	●	●	●	●	●	●	●	●	●		
RI-SB-11	SS Soil - HFM	●	●	●	●	●	●	●	●	●	●		
	SS Soil - Native	●	●	●	●	●	●	●	●	●	●		
RI-SB-12	SS Soil - HFM	●	●	●	●	●	●	●	●	●	●		
	SS Soil - Native	●	●	●	●	●	●	●	●	●	●		
RI-SB-13	SS Soil - HFM	●	●	●	●	●	●	●	●	●	●		
	SS Soil - Native	●	●	●	●	●	●	●	●	●	●		
RI-SB-14	SS Soil - HFM	●	●	●	●	●	●	●	●	●	●		

Sample Location	Media/ Type of Sample	Analyses											
		Hexavalent Cr	TCL Pesticides	TCL Herbicides	1,4-Dioxane	PFAS	Total Cyanide	PCB	VOC	SVOC	Total Metal	Filtered Metal	Filtered SVOC
	SS Soil - Native	●	●	●	●	●	●	●	●	●	●		
RI-SB-15	SS Soil - HFM	●	●	●	●	●	●	●	●	●	●		
	SS Soil - Native	●	●	●	●	●	●	●	●	●	●		
RI-SB-16	SS Soil - HFM	●	●	●	●	●	●	●	●	●	●		
	SS Soil - Native	●	●	●	●	●	●	●	●	●	●		
RI-SB-17	SS Soil - HFM	●	●	●	●	●	●	●	●	●	●		
	SS Soil - Native	●	●	●	●	●	●	●	●	●	●		
RI-SB-__-MS	SS Soil - HFM	●	●	●	●	●	●	●	●	●	●		
	SS Soil - Native	●	●	●	●	●	●	●	●	●	●		
RI-SB-__-MSD	SS Soil - HFM	●	●	●	●	●	●	●	●	●	●		
	SS Soil - Native	●	●	●	●	●	●	●	●	●	●		
RI-SB-__-DUP	SS Soil - HFM	●	●	●	●	●	●	●	●	●	●		
	SS Soil - Native	●	●	●	●	●	●	●	●	●	●		
RI-MW-01 Round 1	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●
RI-MW-02 Round 1	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●
RI-MW-03 Round 1	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●
RI-MW-04 Round 1	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●
RI-MW-05 Round 1	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●
RI-MW-06 Round 1	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●
RI-MW-07 Round 1	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●
RI-MW-08 Round 1	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●
RI-MW-09 Round 1	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●
RI-MW-10 Round 1	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●
RI-MW-11 Round 1	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●

Sample Location	Media/ Type of Sample	Analyses											
		Hexavalent Cr	TCL Pesticides	TCL Herbicides	1,4-Dioxane	PFAS	Total Cyanide	PCB	VOC	SVOC	Total Metal	Filtered Metal	Filtered SVOC
RI-MW-__-MS Round 1	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●
RI-MW-__-MSD Round 1	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●
RI-MW-__-DUP Round 1	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●
RI-MW-01 Round 2	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●
RI-MW-02 Round 2	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●
RI-MW-03 Round 2	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●
RI-MW-04 Round 2	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●
RI-MW-05 Round 2	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●
RI-MW-06 Round 2	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●
RI-MW-07 Round 2	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●
RI-MW-08 Round 2	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●
RI-MW-09 Round 2	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●
RI-MW-10 Round 2	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●
RI-MW-11 Round 2	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●
MW-__-MS Round 2	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●
MW-__-MSD Round 2	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●
MW-__-DUP Round 2	Groundwater	●	●	●	●	●	●	●	●	●	●	●	●
RI–SV-1									●				

Sample Location	Media/ Type of Sample	Analyses											
		Hexavalent Cr	TCL Pesticides	TCL Herbicides	1,4-Dioxane	PFAS	Total Cyanide	PCB	VOC	SVOC	Total Metal	Filtered Metal	Filtered SVOC
RI-SV-2									●				
RI-SV-3									●				
RI-SV-4									●				
RI-SV-5									●				
RI–SV-6									●				
RI-SV-7									●				
RI-SSV-1									●				
RI-SSV-2									●				
RI-SSV-3									●				
RI-SSV-4									●				
RI-SSV-5									●				
RI-SSV-6									●				
RI-SSV-7									●				
RI-SSV-8									●				
RI-SSV-9									●				
RI-SSV-10									●				
RI-SSV-11									●				
RI-SSV-12									●				
RI-SSV-13									●				
Subtotals:	**Surface Soil**	19	19	19	19	19	19	19	19	19	19		
	SS Soil - HFM	15	15	15	15	15	15	15	15	15	15		

Sample Location	Media/ Type of Sample	Analyses											
		Hexavalent Cr	TCL Pesticides	TCL Herbicides	1,4-Dioxane	PFAS	Total Cyanide	PCB	VOC	SVOC	Total Metal	Filtered Metal	Filtered SVOC
	SS Soil - Native	20	20	20	20	20	20	20	20	20	20		
	Groundwater	28	28	28	28	28	28	28	28	28	28	28	28
	Soil/Sub-Slab Vapor								20				
	Equipment Blank					2							
	Trip Blank								2				
TOTAL:		**82**	**82**	**82**	**82**	**84**	**82**	**82**	**104**	**82**	**82**	**28**	**28**

The above quantities include QA/QC (MS, MSD, Blank) samples. A blind duplicate (DUP), matrix spike (MS), and matrix spike duplicate (MSD) will be submitted for soil samples at a rate of 1 for every 20 samples collected, per matrix. In addition, one field duplicate and one equipment blank will be submitted for PFAS samples per sampling date.

Appendix A

Environmental Reports

Refer to Electronic Files

Appendix B

Community Air Monitoring Plan

Community Air Monitoring Plan

at

The Former Will & Baumer Candle Co., Inc. Site
100 Buckley Road
Town of Salina, Onondaga County,
New York

Site No. C734154

NYSDEC Site No. C734154

Prepared by:

C&S Engineers, Inc.
499 Col Eileen Collins Blvd.
Syracuse, New York 13212

April 2022

Overview

A Community Air Monitoring Plan (CAMP) requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work area when certain activities are in progress at contaminated sites. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities did not spread contamination off-site through the air.

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for VOCs and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary.

> **Continuous monitoring** will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil / waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.
>
> **Periodic monitoring** for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. “Periodic” monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

VOC Monitoring, Response Levels and Actions

Volatile organic compounds (VOCs) must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions, particularly if wind direction changes. The monitoring work should be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate, such as isobutylene. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

1. If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

2. If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.

3. If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.

4. All 15-minute readings must be recorded and be available for State (DEC and NYSDOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

<u>Particulate Monitoring, Response Levels, and Actions</u>

Particulate concentrations should be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment must be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

1. If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/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 must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m3 above the upwind level and provided that no visible dust is migrating from the work area.

2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m3 of the upwind level and in preventing visible dust migration.

3. All readings must be recorded and be available for State (DEC and NYSDOH) and County Health personnel to review.

Fugitive Dust and Particulate Monitoring

A program for suppressing fugitive dust and particulate matter monitoring at hazardous waste sites is a responsibility on the remedial party performing the work. These procedures must be incorporated into appropriate intrusive work plans. The following fugitive dust suppression and particulate monitoring program should be employed at sites during construction and other intrusive activities which warrant its use:

1. Reasonable fugitive dust suppression techniques must be employed during all site activities which may generate fugitive dust.

2. Particulate monitoring must be employed during the handling of waste or contaminated soil or when activities on site may generate fugitive dust from exposed waste or contaminated soil. Remedial activities may also include the excavation, grading, or placement of clean fill. These control measures should not be considered necessary for these activities.

3. Particulate monitoring must be performed using real-time particulate monitors and shall monitor particulate matter less than ten microns (PM10) with the following minimum performance standards:

(a) Objects to be measured: Dust, mists or aerosols;
(b) Measurement Ranges: 0.001 to 400 mg/m3 (1 to 400,000 :ug/m3);
(c) Precision (2-sigma) at constant temperature: +/- 10 :g/m3 for one second averaging; and +/- 1.5 g/m3 for sixty second averaging;
(d) Accuracy: +/- 5% of reading +/- precision (Referred to gravimetric calibration with SAE fine test dust (mmd= 2 to 3 :m, g= 2.5, as aerosolized);
(e) Resolution: 0.1% of reading or 1g/m3, whichever is larger;

(f) Particle Size Range of Maximum Response: 0.1-10;
(g) Total Number of Data Points in Memory: 10,000;
(h) Logged Data: Each data point with average concentration, time/date and data point number;
(i) Run Summary: overall average, maximum concentrations, time/date of maximum, total number of logged points, start time/date, total elapsed time (run duration), STEL concentration and time/date occurrence, averaging (logging) period, calibration factor, and tag number;
(j) Alarm Averaging Time (user selectable): real-time (1-60 seconds) or STEL (15 minutes), alarms required;
(k) Operating Time: 48 hours (fully charged NiCd battery); continuously with charger;
(l) Operating Temperature: -10 to 50o C (14 to 122o F); and
(m) Particulate levels will be monitored upwind and immediately downwind at the working site and integrated over a period not to exceed 15 minutes.

4. In order to ensure the validity of the fugitive dust measurements performed, there must be appropriate Quality Assurance/Quality Control (QA/QC). It is the responsibility of the remedial party to adequately supplement QA/QC Plans to include the following critical features: periodic instrument calibration, operator training, daily instrument performance (span) checks, and a record-keeping plan.

5. The action level will be established at 150 ug/m3 (15 minutes average). While conservative, this short-term interval will provide a real-time assessment of on-site air quality to assure both health and safety. If particulate levels are detected in excess of 150 ug/m3, the upwind background level must be confirmed immediately. If the working site particulate measurement is greater than 100 ug/m3 above the background level, additional dust suppression techniques must be implemented to reduce the generation of fugitive dust and corrective action taken to protect site personnel and reduce the potential for contaminant migration. Corrective measures may include increasing the level of personal protection for on-site personnel and implementing additional dust suppression techniques (see paragraph 7). Should the action level of 150 ug/m3 continue to be exceeded work must stop and DER must be notified as provided in the site design or remedial work plan. The notification shall include a description of the control measures implemented to prevent further exceedances.

6. It must be recognized that the generation of dust from waste or contaminated soil that migrates off-site, has the potential for transporting contaminants off-site. There may be situations when dust is being generated and leaving the site and the monitoring equipment does not measure PM-10 at or above the action level. Since this situation has the potential to allow for the migration of contaminants off-site, it is unacceptable. While it is not practical to

quantify total suspended particulates on a real-time basis, it is appropriate to rely on visual observation. If dust is observed leaving the working site, additional dust suppression techniques must be employed.

7. The following techniques have been shown to be effective for the controlling of the generation and migration of dust during construction activities:

(a) Applying water on haul roads;
(b) Wetting equipment and excavation faces;
(c) Spraying water on buckets during excavation and dumping;
(d) Hauling materials in properly tarped or watertight containers;
(e) Restricting vehicle speeds to 10 mph;
(f) Covering excavated areas and material after excavation activity ceases; and
(g) Reducing the excavation size and/or number of excavations.

Experience has shown that the chance of exceeding the 150ug/m3 action level is remote when the above-mentioned techniques are used. When techniques involving water application are used, care must be taken not to use excess water, which can result in unacceptably wet conditions. Using atomizing sprays will prevent overly wet conditions, conserve water, and provide an effective means of suppressing the fugitive dust.

8. The evaluation of weather conditions is necessary for proper fugitive dust control. When extreme wind conditions make dust control ineffective, as a last resort remedial actions may need to be suspended. There may be situations that require fugitive dust suppression and particulate monitoring requirements with action levels more stringent than those provided above. Under some circumstances, the contaminant concentration and/or toxicity may require additional monitoring to protect site personnel and the public. Additional integrated sampling and chemical analysis of the dust may also be in order. This must be evaluated when a health and safety plan is developed and when appropriate suppression and monitoring requirements are established for protection of health and the environment.

Appendix C

Site-Specific Health and Safety Plan

Health and Safety Plan for Remedial Investigation Activities

at

The Former Will & Baumer Candle Co., Inc. Site
100 Buckley Road
Town of Salina, Onondaga County,
New York

Site No. C734154

Prepared by:

C&S Engineers, Inc.
499 Col Eileen Collins Blvd.
Syracuse, New York 13212

April 2022

EMERGENCY PHONE NUMBERS

Emergency Medical Service	911
Police: City of Syracuse Police Department	911
Hospital: St. Joseph's Hospital	(315) 448-5111
Fire: Salina Consolidated Fire District	911
National Response Center	(800) 424-8802
Poison Control Center	(800) 222-1222
Center for Disease Control	(800) 311-3435
NYSDEC Region 7 (Syracuse, New York)	(315) 426-7551
C&S Engineers	(315) 455-2000
Nick Paro (Town of Salina)	(315) 457-6661
Yocasta DeJesus (USEPA Project Officer)	(212) 637-4340

TABLE OF CONTENTS

Page

FIGURES

APPENDICES

SECTION 1 – GENERAL INFORMATION

This Health and Safety Plan (HASP) addresses health and safety considerations for the activities that personnel employed by C&S Engineers, Inc., may be engaged in during site remedial investigation activities at the Former Will & Baumer Candle Co., Inc. site located in Salina, New York (Site). Figure 1 shows the approximate location of the Site. This HASP will be implemented by the Health and Safety Officer (HSO) during site work.

Compliance with this HASP is required of C&S personnel who enter this Site. The content of the HASP may change or undergo revision based upon additional information made available to the health, safety, and training (H&S) committee, monitoring results or changes in the technical scope of work. Any changes proposed must be reviewed by the H&S committee.

1.1 Responsibilities

Project Manager………………………………………………	Nevin Bradford Phone: (315) 703-4284 Cell: (315) 529-0482
Health and Safety Manager………………………………	Brent Testut Phone: (315) 703-4376 Cell: (707) 631-8846
Site Health and Safety Officer…………………………..	Hayden Haas Phone: (315) 703-4158 Cell: (315) 317-2446
Emergency Coordinator…………………………………	Hayden Haas Phone: (315) 703-4158 Cell: (315) 317-2446

SECTION 2 - HEALTH AND SAFETY PERSONNEL

The following information briefly describes the health and safety designations and general responsibilities for this Site.

2.1 Project Manager (PM)

The PM is responsible for the overall project including the implementation of the HASP. Specifically, this includes allocating adequate manpower, equipment, and time resources to conduct Site activities safely.

2.2 Health and Safety Manager

- Has the overall responsibility for coordinating and reporting health and safety activities and the health and safety of Site Workers.
- Must have completed, at a minimum, the OSHA 30-Hour Construction Safety Training, and either the 24-Hour training course for the Occasional Hazardous Waste Site Worker or the 40-Hour training course for the Hazardous Waste Operations Worker that meets OHSA 29 CFR 1910.
- Must have completed the 8-Hour Site supervisor/manager's course for supervisors and managers having responsibilities for hazardous waste Site operations and management.
- Directs and coordinates health and safety monitoring activities.
- Ensures that field teams utilize proper personal protective equipment (PPE).
- Conducts initial on-site specific training prior to Site Workers commencing work.
- Conducts and documents daily and periodic safety briefings.
- Ensures that field team members comply with this HASP.
- Immediately notifies the Project Manager of all accident/incidents.
- Determines upgrading or downgrading of PPE based on Site conditions and/or real time monitoring results.
- Ensures that monitoring instruments are calibrated daily or as the manufacturer's instructions determine.
- Provides daily summaries of field operations and progress to the Project Manager.
- Submits and maintains all documentation required in this HASP and any other pertinent health and safety documentation.

2.3 Health and Safety Officer (HSO)

- Must be designated by the Health and Safety Manager and at a minimum, have the OSHA 10-Hour Construction Safety Training.
- Must schedule and attend a Pre-Construction Safety Meeting with the Health and Safety Manager to discuss the Subcontractor Safety Requirements and must attend the Weekly Subcontractor Coordination Meeting.

- Responsible for ensuring subcontractors and their lower tier contractors comply with project safety requirements.
- Must make frequent and regular inspections of their work areas and activities and ensure hazards that are under their control are corrected immediately and all other hazards are reported to the Project Manager and Health and Safety Manager.
- Must report all work related injuries, regardless of severity, to the Project Manager and the Health and Safety Manager within 24 hours after they occur.

2.4 Emergency Coordinator

- The Emergency Coordinator or his on-site designee will, in coordination with The Town of Salina, implement the emergency response procedures outlined in Section 12 whenever conditions at the Site warrant such action.
- The Emergency Coordinator or his on-site designee will be responsible for assuring the evacuation, emergency treatment, emergency transport of C&S personnel as necessary, and notification of emergency response units (refer to phone listing in the beginning of this HASP) and the appropriate management staff.

2.5 Site Workers

- Report any unsafe or potentially hazardous conditions to the Health and Safety Manager.
- Maintain knowledge of the information, instructions, and emergency response actions contained in the HASP.
- Comply with rules, regulations, and procedures as set forth in this HASP, including any revisions that are instituted.
- Prevent unauthorized personnel from entering work Site.

SECTION 3 - PERTINENT SITE INFORMATION

3.1 Site Location and General History

The Site is comprised of a single tax parcel of 11.68 acres in total area. The property is located at 100 Buckley Road, in the southeastern portion of the Town of Salina, immediately north of its border with the City of Syracuse, in central Onondaga County, New York. Interstate Route 81 is located immediately east of the Site, and Onondaga Lake is located approximately 750 feet southwest of the Site. The site is bounded to the north by medical offices, to the south by the convergence of several roadways (Buckley Road, Park Street, Old Liverpool Road, and Onondaga Lake Parkway), followed by Onondaga Lake, east by Interstate Route 81 and its Exit 22/23A/23B interchange, and northwest by Buckley Road, followed by single-family residential parcels. Properties surrounding the Site are a mix of residential and commercial in nature.

Eleven buildings that were formerly associated with the Will & Baumer operations remain on the site. Except for one building that is leased by a local furniture retailer and used for temporary storage of office furniture inventory, the buildings are currently vacant and unused.

Site History and Suspect Recognized Environmental Conditions

Available historic information indicates that the Site was used for industrial purposes by the Will & Baumer Candle Co., Inc. (Will & Baumer), and/or its predecessors and successors, from at least 1911 (and possibly as early as 1904) until 2010. Will & Baumer manufactured beeswax candles at the Site.

On-site historic operations included offices, manufacturing spaces, a laboratory, press and pan rooms, multiple sheds, a digester house, a still house, a store room, a machine shop and maintenance building, a bleach house, a bleach yard, an oil / boiler house, and packaging and decorating areas. Multiple storage tanks containing fuel oil, gasoline, grease and oil, and acid were used on the Site throughout its period of operation. The majority of the tanks were present on the southeastern portion of the Site. Railroad sidings and spurs were also present on the eastern and southern portions of the site. In addition, a refinery building was located adjacent to the south in at least 1911. Known historic operations are depicted on attached Figure 3.

Facility operations involved the generation of regulated hazardous wastes, with documented generation from at least 1982 through at least 2010. As the nature of operations remained generally consistent throughout Will & Baumer's presence at the site (dating to the early 1900s), it is suspected that similar wastes were also generated prior to 1982. Wastes generated include spent industrial solvents (such as those used in cleaning metal components), ignitable wastes, corrosive wastes, and heavy metal-containing wastes.

Past investigations indicate that the upper approximately five feet of soil across much of the eastern and southeastern portion of the site consists of historic fill material. The historic fill material contains assorted materials, including concrete, brick, coal debris/dust, ash, slag, metal shavings, railroad ties, and plastic bottles. The underlying native soils consist of a mixture of silts and clays. Groundwater is present at depths ranging from approximately 0.4 to 7.2 feet below grade.

Various organic and inorganic contaminants are present in soil, including volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), various heavy metals, and pesticides. The majority of these contaminants exist within the historic fill material or where it has been deposited.

Various organic contaminants are present at low concentrations in groundwater, including VOCs, and, potentially SVOCs, but it was concluded that "these detections may not be representative of actual groundwater conditions but rather particulate matter within the sample".

The specific contaminants currently known to exist in each media are as follows:

Media	Contaminant Class	Identified Compounds
Surface Soil	PCBs	Aroclor 1254 Aroclor 1260 Aroclor 1268
	SVOCs	Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Chrysene Indeno(1,2,3-c,d)pyrene
	Metals	Arsenic Nickel Lead Zinc
	Pesticides	4,4'-DDE 4,4'-DDT
Fill/Soil	SVOCs	Acenaphthene Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Chrysene Dibenzo(a,h)anthracene Dibenzofuran Fluoranthene Fluorene Indeno(1,2,3-c,d)pyrene Naphthalene Phenanthrene Pyrene

Media	Contaminant Class	Identified Compounds
Fill/Soil	Metals	Arsenic Barium Cadmium Copper Lead Nickel Mercury Selenium Zinc
Groundwater	VOCs	Acetone 2-Butanone Vinyl Chloride
	SVOCs*	Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Chrysene Indeno(1,2,3-c,d)pyrene

*Presence of these compounds in groundwater may have been associated with high particulate content (i.e., turbidity) in groundwater samples at time of sampling.

Based on the nature of site contaminants, direct contact with contaminated soil or inhalation of airborne dust originating from contaminated areas of the site pose the primary exposure risk. Potential for inhalation of volatile organic compounds also presents a potential exposure concern.

SECTION 4 – TRAINING

4.1 Site-Specific Training

Training will be provided that specifically addresses the activities, procedures, monitoring, and equipment for the Site operations prior to going on site. Training will include familiarization with Site and facility layout, known and potential hazards, and emergency services at the Site, and details all provisions contained within this HASP. This training will also allow Site Workers to clarify anything they do not understand and to reinforce their responsibilities regarding safety and operations for their particular activity.

4.2 Safety Briefings

C&S project personnel will be given briefings by the HSO on a daily or as needed basis to further assist Site workers in conducting their activities safely. Pertinent information will be provided when new operations are to be conducted. Changes in work practices must be implemented due to new information made available, or if Site or environmental conditions change. Briefings will also be given to facilitate conformance with prescribed safety practices. When conformance with these practices is not occurring or if deficiencies are identified during safety audits, the project manager will be notified.

SECTION 5 - PERSONAL PROTECTIVE EQUIPMENT

5.1 General

The level of protection to be worn by field personnel will be defined and controlled by the HSO. Depending upon the type and levels of material present or anticipated at the site, varying degrees of protective equipment will be needed. If the possible hazards are unknown, a reasonable level of protection will be taken until sampling and monitoring results can ascertain potential risks. The levels of protection listed below are based on USEPA Guidelines. A list of the appropriate clothing for each level is also provided.

Level A protection must be worn when a reasonable determination has been made that the highest available level of respiratory, skin, eye, and mucous membrane protection is needed. It should be noted that while Level A provides maximum available protection, it does not protect against all possible hazards. Consideration of the heat stress that can arise from wearing Level A protection should also enter into the decision making process. Level A protection includes:

- Open circuit, pressure-demand self-contained breathing apparatus (SCBA)
- Totally encapsulated chemical resistant suit
- Gloves, inner (surgical type)
- Gloves, outer, chemical protective
- Boots, chemical protective

Level B protection must be used when the highest level of respiratory protection is needed, but hazardous material exposure to the few unprotected areas of the body (e.g., the back of the neck) is unlikely. Level B protection includes:

- Open circuit, pressure-demand SCBA or pressure airline with escape air bottle
- Chemical protective clothing: Overalls and long sleeved jacket; disposal chemical resistant coveralls; coveralls; one or two piece chemical splash suit with hood
- Gloves, inner (surgical type)
- Gloves, outer, chemical protective
- Boots, chemical protective

Level C must be used when the required level of respiratory protection is known, or reasonably assumed to be, not greater than the level of protection afforded by air purifying respirators; and hazardous materials exposure to the few unprotected areas of the body (e.g. the back of the neck) is unlikely. Level C protection includes:

- Full or half face air-purifying respirator
- Chemical protective clothing: Overalls and long-sleeve jacket; disposable chemical resistant coveralls; coveralls; one or two piece chemical splash suit
- Gloves, inner (surgical type)
- Gloves, outer, chemical protective
- Boots, chemical protective

Level D is the basic work uniform. It cannot be worn on any site where respiratory or skin hazards exist. Level D protection includes:

- Safety boots/shoes
- Safety glasses
- Hard hat with optional face shield

Note that the use of SCBA and airline equipment is contingent upon the user receiving special training in the proper use and maintenance of such equipment.

5.2 Personal Protective Equipment – Site Specific

Level D with some modification will be required when working in the work zone on this Site. In addition to the basic work uniform specified by Level D protection, Nitrile gloves will be required when contact with soil or ground water is likely. Hearing protection will be worn when power equipment is used to perform subsurface investigation work. An upgrade to a higher level (Level C) of protection may occur if determined necessary by the HSO.

SECTION 6 - MONITORING PROCEDURES

6.1 Monitoring During Site Operations

All Site environmental monitoring should be accompanied by periodic meteorological monitoring of appropriate climatic conditions.

6.1.1 Drilling / Test Pit Operations (Monitoring Well Installation and Subsurface Borings)

Monitoring will be performed by the HSO or drilling observer during the conduct of work. A photoionization detector (PID) equipped with a 10.6 eV lamp will be utilized to monitor for the presence of volatile organic vapors within the breathing zone, the borehole, and subsurface samples upon their retrieval. Drill cuttings and excavation spoils will also be monitored by use of the PID. The PID will be field checked for calibration accuracy three times per day (morning, lunch, and end of day. If subsurface conditions warrant, a combustible gas indicator (CGI) with oxygen alarm may also be used to monitor the borehole for the presence of combustible gases. Similar monitoring of fluids produced during well development will also be conducted.

6.2 Action Levels

If readings on the PID exceed 10 ppm for more than fifteen minutes consecutively, then personal protective equipment should be upgraded to Level C. The air purifying respirator used with Level C protective equipment must be equipped with organic vapor cartridges. If readings on the explosive gas meter are within a range of 10%-25% of the LEL then continuous monitoring will be implemented. Readings above 25% of the LEL indicate the potential for an explosive condition. Sources of ignition should be removed and the Site should be evacuated.

6.3 Personal Monitoring Procedures

Personal monitoring shall be performed as a contingency measure in the event that VOC concentrations are consistently above the 10 ppm action level as detected by the PID. If the concentration of VOCs is above this action level, then amendments to the HASP must be made before work can continue at the Site.

SECTION 7 – COMMUNICATIONS

A phone will be located on Site to be utilized by personnel conducting investigation. Cell phones will be the primary means of communicating with emergency support services/facilities.

SECTION 8 - SAFETY CONSIDERATIONS FOR SITE OPERATIONS

8.1 General

Standard safe work practices that will be followed include:

- Do not climb over/under drums, or other obstacles.
- Do not enter the work zone alone.
- Practice contamination avoidance, on and off-site.
- Plan activities ahead of time, use caution when conducting concurrently running activities.
- No eating, drinking, chewing or smoking is permitted in work zones.
- Due to the unknown nature of waste placement at the Site, extreme caution should be practiced during excavation activities.
- Apply immediate first aid to any and all cuts, scratches, abrasions, etc.
- Be alert to your own physical condition. Watch your buddy for signs of fatigue, exposure, etc.
- A work/rest regimen will be initiated when ambient temperatures and protective clothing create a potential heat or cold stress situation.
- No work will be conducted without adequate natural light or without appropriate supervision.
- Task safety briefings will be held prior to onset of task work.
- Ignition of flammable liquids within or through improvised heating devices (barrels, etc.) or space heaters is forbidden.
- Entry into areas of spaces where toxic or explosive concentrations of gases or dust may exist without proper equipment is prohibited.
- Any injury or unusual health effect must be reported to the Site health and safety officer.
- Prevent splashing or spilling of potentially contaminated materials.
- Use of contact lenses is prohibited while on site.
- Beards and other facial hair that would impair the effectiveness of respiratory protection are prohibited if respiratory protection is necessary.
- Field crew members should be familiar with the physical characteristics of investigations, including:

    - Wind direction in relation to potential sources
    - Accessibility to co-workers, equipment, and vehicles
    - Communication
    - Hot zones (areas of known or suspected contamination)
    - Site access
    - Nearest water sources

- The number of personnel and equipment in potentially contaminated areas should be minimized consistent with site operations.

8.2 Field Operations

8.2.1 Intrusive Operations

The HSO or designee will be present on-site during all intrusive work, e.g., drilling operations, excavations, trenching, and will provide monitoring to oversee that appropriate levels of protection and safety procedures are utilized by C&S Engineers, Inc., personnel. The use of salamanders or other equipment with an open flame is prohibited and the use of protective clothing, especially hard hats and boots, will be required during drilling or other heavy equipment operations.

SECTION 9 - DECONTAMINATION PROCEDURES

Decontamination involves physically removing contaminants and/or converting them chemically into innocuous substances. Only general guidance can be given on methods and techniques for decontamination. Decontamination procedures are designed to:

- Remove contaminant(s).
- Avoid spreading the contamination from the work zone.
- Avoid exposing unprotected personnel outside of the work zone to contaminants.

Contamination avoidance is the first and best method for preventing spread of contamination from a hazardous site. Each person involved in site operations must practice the basic methods of contamination avoidance listed below. Additional precautions may be required in the HASP.

- Know the limitations of all protective equipment being used.
- Do not enter a contaminated area unless it is necessary to carry out a specific objective.
- When in a contaminated area, avoid touching anything unnecessarily.
- Walk around pools of liquids, discolored areas, or any area that shows evidence of possible contamination.
- Walk upwind of contamination, if possible.
- Do not sit or lean against anything in a contaminated area. If you must kneel (e.g., to take samples), use a plastic ground sheet.
- If at all possible, do not set sampling equipment directly on contaminated areas. Place equipment on a protective cover such as a ground cloth.
- Use the proper tools necessary to safely conduct the work.

Specific methods that may reduce the chance of contamination are:

- Use of remote sampling techniques.
- Opening containers by non-manual means.
- Bagging monitoring instruments.
- Use of drum grapplers.
- Watering down dusty areas.

Equipment which will need to be decontaminated includes tools, monitoring equipment, and personal protective equipment. Items to be decontaminated will be brushed off, rinsed, and dropped into a plastic container supplied for that purpose. They will then be washed with a detergent solution and rinsed with clean water. Monitoring instruments may be wrapped in plastic bags prior to entering the field in order to reduce the potential for contamination. Instrumentation that is contaminated during field operations will be carefully wiped down. Heavy equipment, if utilized for operations where it may be contaminated, will have prescribed decontamination procedures to prevent contaminant materials from potentially leaving the Site. On-site contractors, such as drillers or backhoe operators, will be responsible for decontaminating all construction equipment prior to demobilization.

SECTION 10 – DISPOSAL PROCEDURES

All discarded materials, waste materials, or other objects shall be handled in such a way as to reduce or eliminate the potential for spreading contamination, creating a sanitary hazard, or causing litter to be left on-site. All potentially contaminated materials, e.g., clothing, gloves, etc., will be bagged or drummed as necessary and segregated for proper disposal. All contaminated waste materials shall be disposed of as required by the provisions included in the contract and consistent with regulatory provisions. All non-contaminated materials shall be collected and bagged for appropriate disposal. Investigation Derived Waste (IDW) will be managed and characterized. Characterization of IDW may require TCLP sampling and analysis consistent with the work plan for the Site and DER-10 Technical Guidance for Site Investigation and Remediation dated May 2010.

SECTION 11 - EMERGENCY RESPONSE PROCEDURES

As a result of the hazards at the Site, and the conditions under which operations are conducted, there is the possibility of emergency situations. This section establishes procedures for the implementation of an emergency plan.

11.1 Emergency Coordinator

Emergency Coordinator: .... Hayden Haas .... Work Phone: (315) 703-4158

The Emergency Coordinator or his on-site designee will, in concert with the City of Cortland, implement the emergency response procedures whenever conditions at the Site warrant such action. The Emergency Coordinator or his on-site designee will be responsible for assuring the evacuation, emergency treatment, emergency transport of C&S personnel as necessary, and notification of emergency response units (**refer to phone listing** in the beginning of this HASP) and the appropriate management staff.

11.2 Evacuation

In the event of an emergency situation, such as fire, explosion, significant release of toxic gases, etc., all personnel will evacuate and assemble in a designated assembly area. The Emergency Coordinator or his on-site designee will have authority to contact outside services as required. Under no circumstances will incoming personnel or visitors be allowed to proceed into the area once the emergency signal has been given. The Emergency Coordinator or his on-site designee must see that access for emergency equipment is provided and that all ignition sources have been shut down once the emergency situation is established. Once the safety of all personnel is established, the Fire Department and other emergency response groups will be notified by telephone of the emergency.

11.3 Potential or Actual Fire or Explosion

Immediately evacuate the Site and notify local fire and police departments, and other appropriate emergency response groups, if LEL values are above 25% in the work zone or if an actual fire or explosion has taken place.

11.4 Environmental Incident (spread or release of contamination)

Control or stop the spread of contamination if possible. Notify the Emergency Coordinator and the Project Manager. Other appropriate response groups will be notified as appropriate.

11.5 Personnel Injury

Emergency first aid shall be applied on-site as necessary. Then, decontaminate (en route if necessary) and transport the individual to nearest medical facility if needed. The ambulance/rescue squad shall be contacted for transport as necessary in an emergency. A map of directions to the nearest hospital is shown in Attachment A.

11.6 Personnel Exposure

- *Skin Contact*: Use copious amounts of soap and water. Wash/rinse affected area thoroughly, and then provide appropriate medical attention. Eyes should be thoroughly rinsed with water for at least 15 minutes.
- *Inhalation*: Move to fresh air and/or, if necessary, decontaminate and transport to emergency medical facility.
- *Ingestion*: Decontaminate and transport to emergency medical facility.
- *Puncture Wound/Laceration*: Decontaminate, if possible, and transport to emergency medical facility.

11.7 Adverse Weather Conditions

In the event of adverse weather conditions, the HSO will determine if work can continue without sacrificing the health and safety of field workers.

11.8 Incident Investigation and Reporting

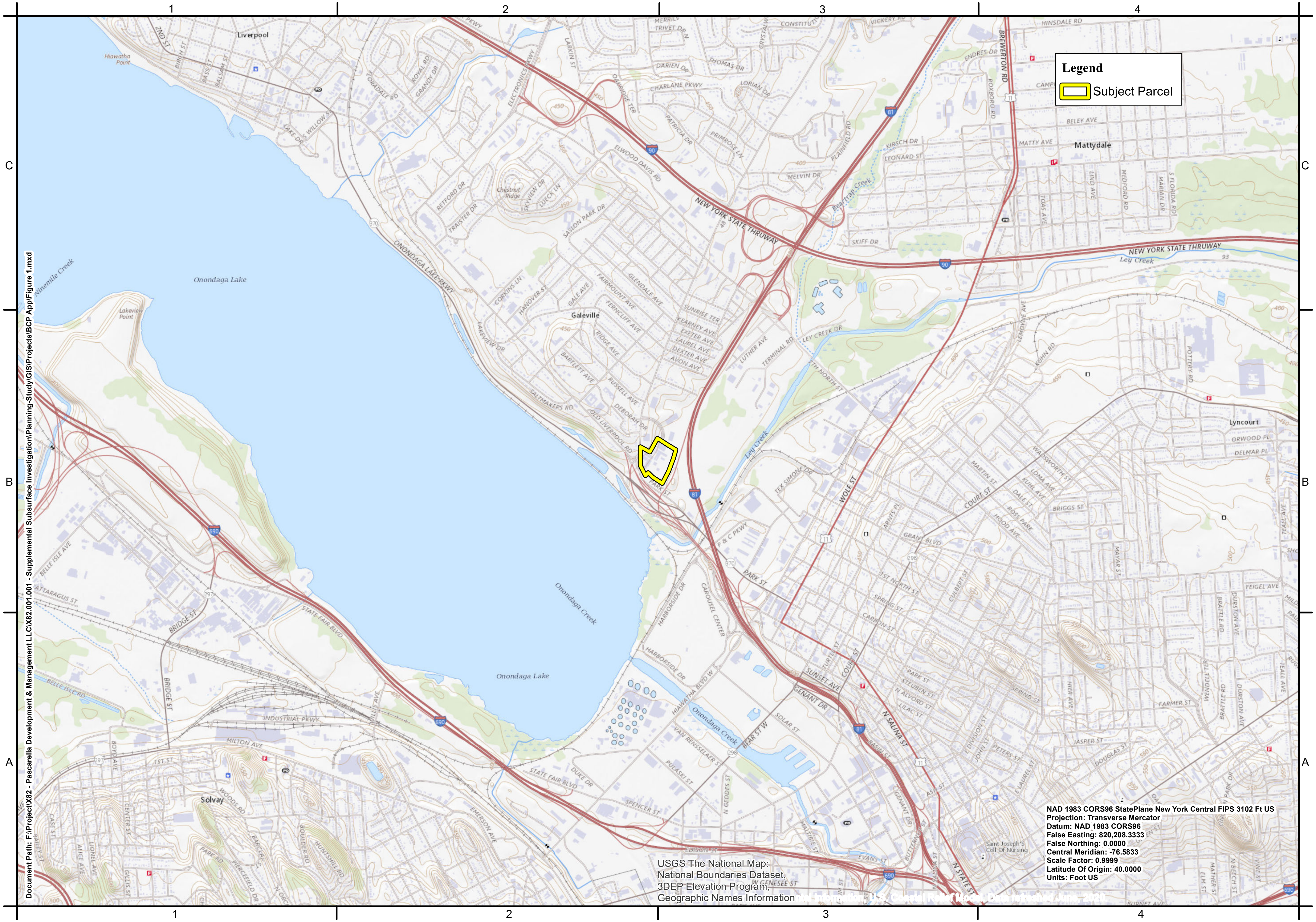
In the event of an incident, procedures discussed in the Medical Emergency/Incident Response Protocol, presented in Appendix A of this HASP, shall be followed.

SECTION 12 - AUTHORIZATIONS

Personnel authorized to enter the Site while operations are being conducted must be approved by the HSO. Authorization will involve completion of appropriate training courses, medical examination requirements, and review and sign-off of this HASP. No C&S personnel should enter the work zone alone. Each site visitor should check in with the HSO or Project Manager prior to entering the work zones.

FIGURE 1

SITE LOCATION MAP



USGS The National Map:
National Boundaries Dataset,
3DEP Elevation Program,
Geographic Names Information

NAD 1983 CORS96 StatePlane New York Central FIPS 3102 Ft US
Projection: Transverse Mercator
Datum: NAD 1983 CORS96
False Easting: 820,208.3333
False Northing: 0.0000
Central Meridian: -76.5833
Scale Factor: 0.9999
Latitude Of Origin: 40.0000
Units: Foot US

Document Path: F:\Project\X82 - Pascarella Development & Management LLC\X82.001.001 - Supplemental Subsurface Investigation\Planning-Study\GIS\Projects\BCP App\Figure 1.mxd

C&S Engineers, Inc.
499 Col. Eileen Collins Blvd.
Syracuse, New York 13212
Phone: 315-455-2000
Fax: 315-455-9667
www.cscos.com

N

0 2,000 Feet

1 inch = 2,000 feet

Brownfield Cleanup Program Application
for
Former Will & Baumer Candle Co., Inc. Site
100 Buckley Road, Liverpool, New York

PROJECT NO:	X82.001.001
DATE:	October 2021
SCALE:	AS SHOWN
DRAWN BY:	
DESIGNED BY:	
CHECKED BY:	

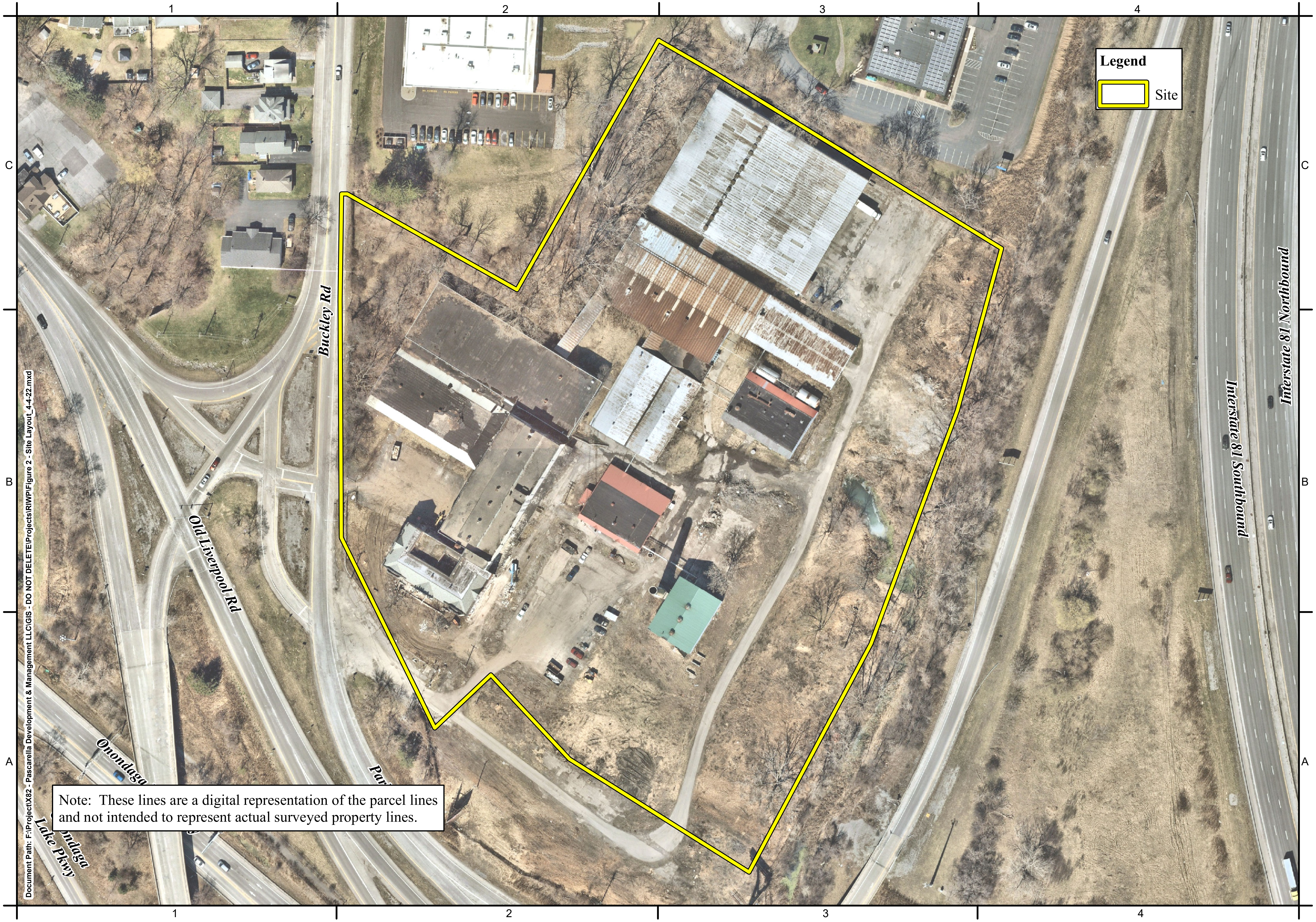
Modified: 10/8/2021 @ 9:45:16 AM

USGS Topographic Map

Figure 1

FIGURE 2

SITE LAYOUT



Note: These lines are a digital representation of the parcel lines and not intended to represent actual surveyed property lines.

Document Path: F:\Project\X82 - Pascarella Development & Management LLC\GIS - DO NOT DELETE\Projects\RIWP\Figure 2 - Site Layout_4-4-22.mxd

C&S COMPANIES®

C&S Engineers, Inc.
499 Col. Eileen Collins Blvd.
Syracuse, New York 13212
Phone: 315-455-2000
Fax: 315-455-9667
www.cscos.com

Remedial Investigation Work Plan
for
Former Will & Baumer Candle Co., Inc.
100 Buckley Road, Liverpool, New York

PROJECT NO:	X55.001.002
DATE:	April 2022
SCALE:	AS SHOWN
DRAWN BY:	JTB
DESIGNED BY:	JTB
CHECKED BY:	HNB

Modified: 4/4/2022 @ 8:27:23 AM

SITE LAYOUT MAP

Figure 2

Attachment A

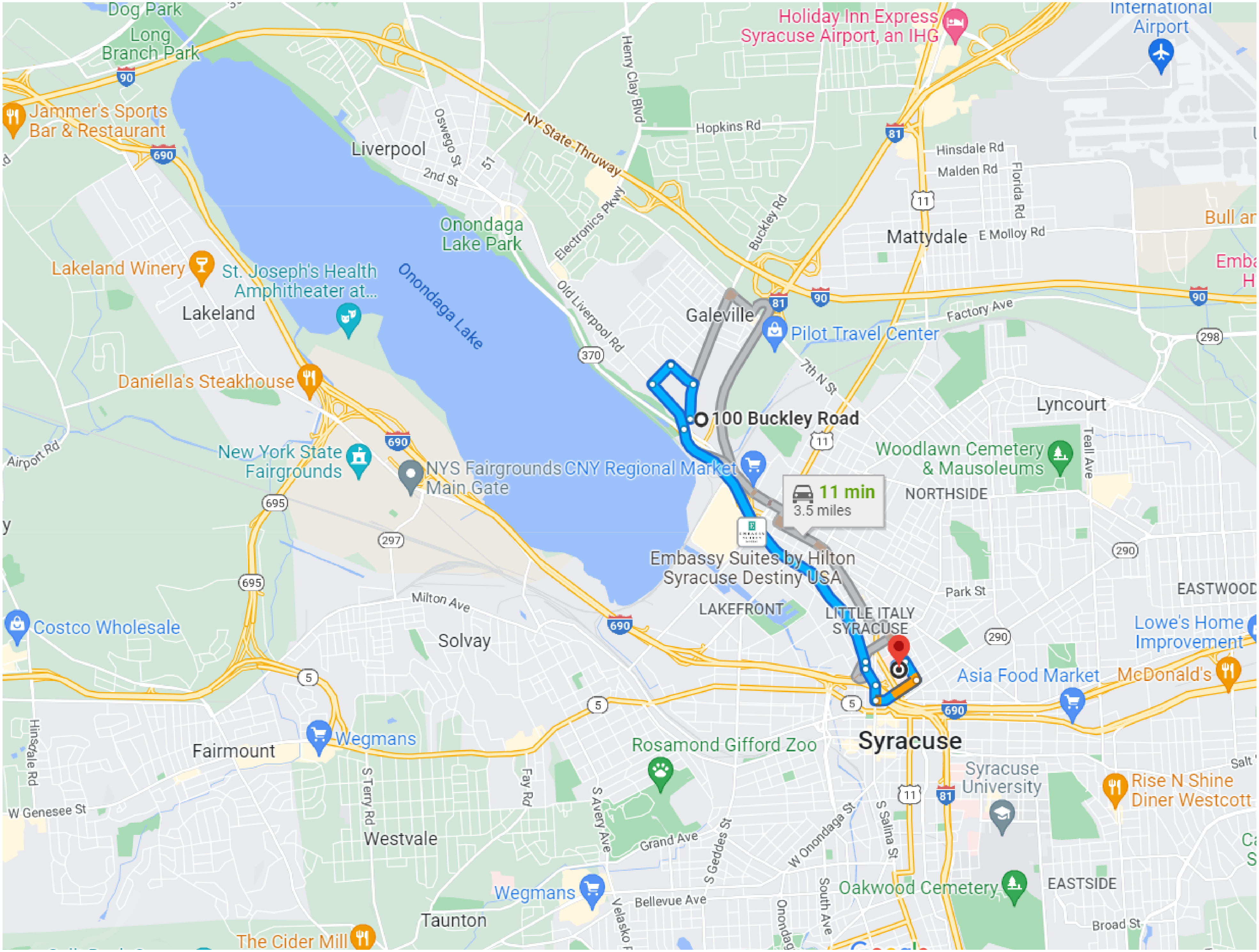
MAP AND DIRECTIONS TO HOSPITAL

Google Maps

100 Buckley Road, Liverpool, NY to St. Joseph's Health Hospital

Drive 3.9 miles, 8 min

Address: 301 Prospect Street, Syracuse, New York 13203 | Hospital Telephone Number: (315)448-5111


100 Buckley Road
11 min
3.5 miles
Liverpool
Galeville
Onondaga Lake
Onondaga Lake Park
St. Joseph's Health Amphitheater at...
Lakeland
Lakeland Winery
Daniella's Steakhouse
New York State Fairgrounds
NYS Fairgrounds Main Gate
CNY Regional Market
Embassy Suites by Hilton Syracuse Destiny USA
LAKEFRONT
LITTLE ITALY SYRACUSE
Syracuse
Syracuse University
Mattydale
Lyncourt
NORTHSIDE
EASTWOOD
EASTSIDE
Solvay
Fairmount
Westvale
Taunton
Pilot Travel Center
Woodlawn Cemetery & Mausoleums
Oakwood Cemetery
Rosamond Gifford Zoo
Wegmans
Wegmans
Costco Wholesale
Asia Food Market
McDonald's
Lowe's Home Improvement
Rise N Shine Diner Westcott
The Cider Mill
Jammer's Sports Bar & Restaurant
Holiday Inn Express Syracuse Airport, an IHG
International Airport
Dog Park
Long Branch Park
NY State Thruway
Hopkins Rd
Henry Clay Blvd
Buckley Rd
Electronics Pkwy
Old Liverpool Rd
7th N St
Hinsdale Rd
Malden Rd
Florida Rd
E Molloy Rd
Factory Ave
Teall Ave
Park St
Milton Ave
Airport Rd
Oswego St
2nd St
W Genesee St
Hinsdale Rd
S Terry Rd
Fay Rd
S Avery Ave
Grand Ave
S Geddes St
W Onondaga St
S Salina St
South Ave
Bellevue Ave
Broad St
90
690
81
11
370
695
297
5
290
298
51

Map data ©2022 Google 1 mi

100 Buckley Rd
Liverpool, NY 13088

1. Head north on Buckley Rd toward Deborah Dr

24 s (0.2 mi)

Continue on Russell Ave to Old Liverpool Rd

1 min (0.4 mi)

2. Turn left onto Russell Ave

0.2 mi

3. Turn left onto Greenpoint Ave

0.2 mi

Take I-81 S to E Willow St in Syracuse

4 min (2.7 mi)

4. Turn left onto Old Liverpool Rd

0.4 mi

5. Use any lane to merge onto I-81 S via the ramp to Syracuse

2.1 mi

6. Take exit 19 for Salina St

262 ft

7. Slight left

0.1 mi

8. Slight right onto N Salina St

0.1 mi

Continue on E Willow St to your destination

2 min (0.5 mi)

9. Turn left onto E Willow St

0.3 mi

↰ 10. Turn left onto N Townsend St

0.1 mi

↰ 11. Turn left onto Union Ave

299 ft

↗ 12. Slight right at Prospect Ave

79 ft

St. Joseph's Health Hospital

301 Prospect Ave, Syracuse, NY 13203

Appendix B

GUIDANCE ON INCIDENT INVESTIGATION AND REPORTING

MEDICAL EMERGENCY / INCIDENT RESPONSE PROTOCOL

1.0 PURPOSE

From time to time employees of C&S Engineers, Inc. will sustain an injury while working on the job. While every effort is being made to prevent this, in the event of an injury or illness on the job, the following procedures will be implemented. This format may also be utilized in the event of a property damage incident.

2.0 SCOPE

This guideline applies to all C&S Engineers, Inc. job sites and employees.

3.0 GUIDELINES

Upon notification or awareness of an incident/accident with injuries or illness the Emergency Coordinator or his On-Site Designee will:

1. Ensure that the injured employee is receiving immediate first aid and medical care.
2. Notify Emergency Services (911) if injuries are severe.
3. Stabilize the work area; ensure that no one else can be injured.
4. Notify the Project Manager at the earliest possible convenience.
5. Notify the Owner/Client at the earliest possible convenience.

To assist the Health and Safety Manager in the root cause analysis, the Emergency Coordinator or his On-Site Designee will also make an attempt to:

1. Obtain the names and phone numbers of witnesses.
2. Preserve the accident scene if possible for analysis.

3.1 Injury Management

1. If the patient is stable with non-life threatening injuries, the foreman will ensure the employee is transported to the emergency medical facility listed in Section 1 of the HASP. Directions to the nearest emergency medical facility are located in **Attachment A** of the HASP.

At no time will an injured employee drive themselves to medical care.

2. If the patient has serious or life threatening injuries, the emergency coordinator or his on- site designee will notify the emergency services for the area for treatment and transport to a hospital or emergency room. Serious injuries can be considered but not limited to head injuries, loss of consciousness, severe laceration or amputation, fractured bones, burns and eye injuries.

3. Following the treatment and care of the injured employee, the emergency coordinator or his on-site designee and the project manager will initiate the completion of the first injury report. The Health & Safety Manager will assist.

3.2 Project Manager

1. Upon notification of a personal injury or illness on the job site, will notify C&S Engineers, Inc, President and Corporate Legal and C&S Companies Health and Safety Manager.
2. Will report to the worksite to initiate the first injury report.
3. Will report to the treatment facility to check on the well being of the injured employee.
4. The project manager will ensure that the treatment facility is aware that this is a workers compensation case.
5. Will assist the Health and Safety Manager in the analysis of the incident.

3.3 Health & Safety Manager

1. Upon notification of the personal injury will determined if it is necessary to report to the treatment facility or the accident site, depending on the nature of the injuries and the circumstances of the accident.
2. Will report to the worksite to begin a root cause analysis investigation of the accident.
3. The investigation may include interview of witnesses, field crew , and project manager, the photographing of the scene, reconstruction of the accident scene, using test instruments and taking measurements. The Health and Safety Manager may draw diagrams from the information learned.
4. The Health and Safety Manager will work with the owner/client as necessary to investigate the accident.
5. The Health & Safety manager will ensure that the site is safe to resume work.
6. The Health & Safety Manager shall initiate the New York State Compensation form requirements (C-2) and forward a copy of the C-2 to the C & S Engineers, Inc. controller for transmittal to the Compensation Carrier within 8 hrs of notification of the incident or by the end of the next business day.
7. The Health and Safety manager, upon completion of the investigation, will provide the
8. Project Manager with a written investigative report (copy to the President)
9. The accident will be reviewed at the next Project Managers meeting with the intent to prevent further or similar events on other projects.
10. The Health & Safety Manager will assess the incident to determine OSHA record ability and make record if necessary on the OSHA 300 form, within five working days.

4.0 INCIDENT RESPONSE

4.1 Purpose

To prevent the occurrence of accidents on C&S Engineers, Inc., work sites and to establish a procedure for investigation and reporting of incidents occurring in, or related to C&S work activities.

4.2 Scope

Applies to all incidents related to C&S Engineers, Inc. work activities.

4.3 Definitions

Accident - An undesired event resulting in personal injury and/or property damage, and/or equipment failure.

Fatality - An injury or illness resulting in death of the individual.

Incident - Any occurrence which results in, or could potentially result in, the need for medical care or property damage. Such incidents shall include lost time accidents or illness, medical treatment cases, unplanned exposure to toxic materials or any other significant occurrence resulting in property damage or in "near misses."

Incidence Rate - the number of injuries, illnesses, or lost workdays related to a common exposure base of 100 full-time workers. The rate is calculated as:

N/EH x 200,000

N = number of injuries and illnesses or lost workday cases; EH = total hours worked by all associates during calendar year. 200,000 = base for 100 full-time equivalent workers (working 40 hours per week, 50 weeks per year).

Injury - An injury such as a cut, fracture, sprain, amputation, etc. which results from a work accident or from a single instantaneous event in the work environment.

Lost Workday Case - A lost workday case occurs when an injured or ill employee experiences days away from work beginning with the next scheduled work day. Lost workday cases do not occur unless the employee is effected beyond the day of injury or onset of illness.

Recordable Illness - An illness that results from the course of employment and must be entered on the OSHA 300 Log and Summary of Occupational Injuries and Illnesses. These illnesses require medical treatment and evaluation of work related injury. For example, dermatitis, bronchitis, irritation of eyes, nose, and throat can result from work and non-work related incidents.

Recordable Injury - An injury that results from the course of employment and must be entered on the OSHA 300 Log and Summary of Occupational Injuries and Illnesses. These injuries require medical treatment; may involve loss of consciousness; may result in restriction of work or motion or transfer to another job; or result in a fatality.

Near Miss - An incident which, if occurring at a different time or in a different personnel or equipment configuration, would have resulted in an incident.

4.4 Responsibilities

Employees - It shall be the responsibility of all C&S Engineers, Inc. employees to report all incidents as soon as possible to the HSC, regardless of the severity.

Human Resources - has overall responsibility for maintaining accident/ incident reporting and investigations according to current regulations and recording injuries/ illness on the OSHA 300 log, and posting the OSHA 300 log.

Emergency Coordinator - It is the responsibility of the Emergency Coordinator to investigate and prepare an appropriate report of all accidents, illnesses, and incidents occurring on or related to C&S Engineers, Inc. work. The Emergency Coordinator shall complete Attachment A within 24 hours of the incident occurrence.

Health and Safety Manager (HSM) - It is the responsibility of the HSM to investigate and prepare an appropriate report of all lost time injuries and illnesses and significant incidents occurring on or related to C&S Companies. The HSM shall maintain the OSHA 300 form.

Project Managers (PM) - It shall be the PM's responsibility to promptly correct any deficiencies in personnel, training, actions, or any site or equipment deficiencies that were determined to cause or contribute to the incident investigated.

5.0 GUIDELINES

5.1 Incident Investigation

The Project Manager will immediately investigate the circumstances surrounding the incident and will make recommendations to prevent recurrence. The HSM shall be immediately notified by telephone if a serious accident/ incident occurs. The incident shall be evaluated to determine whether it is OSHA recordable. If the incident is determined to be OSHA 300 recordable, it shall be entered on the OSHA 300 form.

The Project Manager with assistance from the HSM must submit to the office an incident report form pertaining to any incident resulting in injury or property damage.

5.2 Incident Report

The completed incident report must be completed by the Project Manager within 12 hours of the incident and distributed to the HSM, and Human Resources. This form shall be maintained by Human Resources for at least five years for all OSHA recordable cases. This form serves as an equivalent to the OSHA 101 form.

5.3 Incident Follow-up Report

The Incident Follow-Up Report (Attachment B) shall be distributed with the Incident Report within one week of the incident. Delay in filing this report shall be explained in a brief memorandum.

5.4 Reporting of Fatalities or Multiple Hospitalization Accidents

Fatalities or accidents resulting in the hospitalization of three or more employees must be reported to OSHA verbally or in writing within 8 hours. The report must contain 1) circumstances surrounding the accident(s), 2) the number of fatalities, and 3) the extent of any injuries.

5.5 OSHA 300A Summary Form

Recordable cases must be entered on the log within six workdays of receipt of the information that a recordable case has occurred. The OSHA log must be kept updated to within 45 calendar days.

OSHA 300 forms must be updated during the 5 year retention period, if there is a change in the extent or outcome of an injury or illness which affects an entry on a log. If a change is necessary, the original entry should be lined out and a corrected entry made on that log. New entries should be made for previously unrecorded cases that are discovered or for cases that initially weren't recorded but were found to be recordable after the end of the year. Log totals should also be modified to reflect these changes.

5.6 Posting

The log must be summarized at the end of the calendar year and the summary must be posted from February 1 through May 31.

5.7 OSHA 300A

Facilities selected by the Bureau of Labor Statistics (BLS) to participate in surveys of occupational injuries and illnesses will receive the OSHA 300A. The data from the annual summary on the OSHA 300 log should be transferred to the OSHA 300A, other requested information provided and the form returned as instructed by the BLS.

5.8 Access to OSHA Records

All OSHA records (accident reporting forms and OSHA 300 logs) should be available for inspection and copying by authorized Federal and State government officials.

Employees, former employees, and their representatives must be given access for inspection and copying to only the log, OSHA No. 300, for the establishment in which the employee currently works or formerly worked.

6.0 REFERENCES

29 CFR Part 1904

7.0 ATTACHMENTS

Attachment A - Incident Investigation Form
Attachment B - Incident Follow-Up Report
Attachment C - Establishing Recordability

ATTACHMENT A

INCIDENT INVESTIGATION FORM

Accident investigation should include:

Location: ____

Time of Day: ____

Accident Type: ____

Victim:____

Nature of Injury:____

Released Injury:____

Hazardous Material:____

Unsafe Acts:____

Unsafe Conditions:____

Policies, Decisions:____

____

Personal Factors:____

____

Environmental Factors:____

____

____

ATTACHMENT B

INCIDENT FOLLOW-UP REPORT

Date ____

Foreman: ____

Date of Incident: ____

Site:____

Brief description of incident: ______________________________________

____

____

____

____

Outcome of incident: ____

____

____

____

Physician's recommendations: _______________________________________

____

____

____

Date the injured returned to work:___________________________________

Project Manager Signature: ____

Date: ____

ATTACH ANY ADDITIONAL INFORMATION TO THIS FORM

ATTACHMENT B

ATTACHMENT ESTABLISHING RECORDABILITY

1. Deciding whether to record a case and how to classify the case.

Determine whether a fatality, injury or illness is recordable.

A fatality is recordable if:

- Results from employment

An injury is recordable if:

- Results from employment and
- It requires medical treatment beyond first aid or
- Results in restricted work activity or job transfer, or
- Results in lost work day or
- Results in loss of consciousness

An illness is recordable if:

- It results from employment

2. Definition of "Resulting from Employment"

Resulting from employment is when the injury or illness results from an event or exposure in the work environment. The work environment is primarily composed of: 1) The employer's premises, and 2) other locations where associates are engaged in work-related activities or are present as a condition of their employment.

The employer's premises include company rest rooms, hallways, cafeterias, sidewalks and parking lots. Injuries occurring in these places are generally considered work related.

The employer's premises EXCLUDES employer controlled ball fields, tennis courts, golf courses, parks, swimming pools, gyms, and other similar recreational facilities, used by associates on a voluntary basis for their own benefit, primarily during off work hours.

Ordinary and customary commute, is not generally considered work related.

Employees injured or taken ill while engaged in consuming food, as part of a normal break or activity is not considered work related. Employees injured or taken ill as the result of smoking, consuming illegal drugs, alcohol or applying make up are generally not considered work related. Employee injured by un authorized horseplay is generally not considered work related, however, an employee injured as a result of a fight or other workplace violence act, may be considered work related.

Associates who travel on company business are considered to be engaged in work related activities all the time they spend in the interest of the company. This includes travel to and from customer contacts, and entertaining or being entertained for purpose of promoting or discussing business. Incidents occurring during normal living activities (eating, sleeping, recreation) or if the associate deviates from a reasonably direct route of travel are not considered OSHA recordable.

3. Distinction between Medical Treatment and First Aid.

First aid:

Any one-time treatment, and any follow up visit for the purpose of observation, of minor scratches, cuts, burns, splinters, etc., which do not ordinarily require medical care. Such one time treatment, and follow up visit for the purpose of observation, is considered first aid even though provided by a physician or registered professional personnel.

Medical Treatment (recordable):

a) Must be treated only by a physician or licensed medical personnel.
b) Impairs bodily function (i.e. normal use of senses, limbs, etc.).
c) Results in damage to physical structure of a non-superficial nature (fractures).
d) Involves complications requiring follow up medical treatment.

Appendix D

Field Sampling Forms

C&S Engineers, Inc.
499 Col Eileen Collins Blvd
Syracuse, NY 13212
Phone: 315-455-2000
Fax: 315-455-9667
www.cscos.com

Well Sampling Field Data Sheet

Well Casing Unit Volume

(gal/l.f.)

1¼" = 0.08 2" = 0.17 3" = 0.38
4" = 0.66 6" = 1.5 8" = 2.6

Client Name: ____________________
Site Name: ____________________
Project No.: ____________________
Field Staff: ____________________

WELL DATA

Date									
Water meter utilized and date last calibrated									
Reference Measuring Point									
Well Number									
PID Reading at Well Head (ppm)									
Diameter (inches)									
Reference Point Elevation (feet)									
Total Sounded Depth (feet)									
Static Water Level (feet)									
Groundwater Elevation									
H_2O Column (feet)									
Pump Intake (feet)									
Well Volume (gallons)									
Amount to Evacuate (gallons)									
Amount Evacuated (gallons)									

FIELD READINGS

Date	Stabilization Criteria								
Time									
Volume Extracted	gallons								
Static Water Level (feet)	NA								
pH (Std. Units)	+/-0.1								
Conductivity (mS/cm)	3%								
Turbidity (NTU)	10%								
D.O. (mg/L)	10%								
Temperature (ºC) (ºF)	3%								
ORP^3(mV)	+/-10 mv								
Appearance									
Free Product (Yes/No)									
Odor									
Comments									

C = Clear T = Turbid ST = Semi Turbid VT = Very Turbid

C&S Engineers, Inc.
499 Col Eileen Collins Blvd
Syracuse, New York 13212
Phone: 315-455-2000
Fax: 315-455-9667

BORING LOG

Boring No.	
Sheet 1 of:	
Project No.:	
Surface Elev.:	
Datum:	
Start Date:	
Finish Date:	
Inspector:	

Project Name:

Location:

Client:

Drilling Firm:

Groundwater	**Depth**	**Date & Time**
While Drilling:		
Before Casing Removal:		
After Casing Removal:		

Drill Rig:

Casing:

Sampler:

Hammer:

Rock Core:

Undist:

Other:

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine **MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					

C&S Engineers, Inc.
499 Col. Eileen Collins Blvd.
Syracuse, New York 13212
Phone: 315-455-2000
Fax: 315-455-9667

BORING LOG
GENERAL INFORMATION & KEY

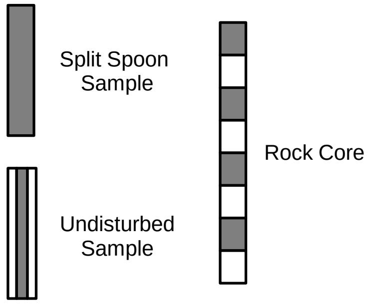
Casing, Sampling and Other Equipment

H.S.A: Hollow Stem Auger (record I.D.)
S.S.A: Solid Stem Auger (record O.D.)
Steel: Hollow Steel Flush Joint Casing (recorded I.D.)
Open: Open Hole / No Casing (record I.D.)
S.S.: Split Spoon (record I.D.)
Hammer: Auto - Automatic, Manual - Manual (rope & cat-head)
Undist: Tube - Shelby, Oste - Osteberg (record I.D. & length)

<u>Rock Cores</u>

Standard	I.D.	Wire Line	I.D.
EW / EX	1-13/32"	--	--
AW / AX	1-25/32"	AQ	1-1/8"
BW / BX	2-7/32"	BQ	1-1/2"
NW / NX	2-27/32"	NQ	1-31/32"
HW / HX	2-25/32"	HQ	2-5/8"

Symbol Legend & Abbreviations



<u>Abbreviations</u>

W.O.R. - Weight of Rods
W.O.H. - Weight of Rods & Hammer
N - Standard Penetration Test N-value
N.W.E. - No Water Encountered
do - ditto (same as above)
Rec - Recovery
RQD - Rock Quality Designation
PP - Pocket Penetrometer
Tor - Torvane

<u>Color</u>

br - brown
rd - red
gr - gray
grn - green
blk - black
wht - white

Description of Soil Density

Relative Soil Density determined while advancing the soil boring by using ASTM Method D-1586, *Standard Penetration Test N-Value*. The N-Value is calculated by adding the hammer blow counts of the 2nd and 3rd sampling intervals together for driving a 2" O.D. sampler with a 140 lb. hammer falling 30" --OR-- by obtaining Pocket Penetrometer or Torvane Readings.

<u>Course Grained Soils</u>

Greater than half the material larger than No. 200 Sieve (sand and gravel)

N-Value	Relative Density
< 4	Very Loose
4 to 10	Loose
11 to 30	Medium Dense
31 to 50	Dense
> 50	Very Dense

<u>Fine Grained Soils</u>

N-Value	Undrained Shear Strength (q_u)				Relative Density
	psi	psf	tsf or kg/cm^2	kN/m^2	
< 2	< 2.5	< 375	< 0.2	< 20	Very Soft
2 to 4	2.5 - 5	375 - 750	0.20 - 0.40	20 - 40	Soft
5 to 8	5 -10	750 - 1,500	0.40 - 0.75	40 - 75	Firm -or- Medium Stiff
9 to 15	10 - 20	1,500 - 3,000	0.75 - 1.50	75 - 150	Stiff
16 to 30	20 - 40	3,000 - 6,000	1.50 - 3.00	150 - 300	Very Stiff
> 30	> 40	> 6,000	> 3	> 3,000	Hard

Description of Soil Type

Material	Grain Size	Material	Grain Size	Material	Grain Size	Material	Grain Size
Boulder	> 8"	**Gravel**		**Sand**		**Silt & Clay**	< #200
Cobble	8" - 3"	Course	3" - 1-1/2"	Course	#4 - #10		
		Medium	1-1/2" - 3/4"	Medium	#10 - #40		
		Fine	3/4" - #4	Fine	#40 - #200		

Note: # indicates U.S. Standard Sieve with size shown.

Bed Rock Classification Terms & Field Test / Field Observation

Term	Field Test / Field Observation
Hardness	
Soft	Can be Scratched by Fingernail
Medium Hard	Easily Scratched by Pen Knife or Nail
Hard	Difficultly Scratched by Pen Knife or Nail
Very Hard	Cannot be Scratched by Pen Knife or Nail
Weathering	
Very Weathered	Based on observations (e.g., amount of disintegration, iron staining, core recovery, clay seams, amount of material within joints, etc.)
Weathered	
Sound	
Bedding (Natural Breaks in Rock Layers)	
Laminated	< 1 inch
Thinly Bedded	1 inch to 4 inches
Bedded	4 inches to 12 inches
Thickly Bedded	12 inches to 36 inches
Massive	> 36 inches

<u>Rock Mass Classification based on RQD</u>

RQD	Rock Mass Quality
< 25%	very poor
25% - 50%	poor
50% - 75%	fair
75% - 90%	good
90% - 100%	excellent

$$RQD = \frac{\Sigma \text{ of pieces} \geq 4"}{\text{total length of run}}$$

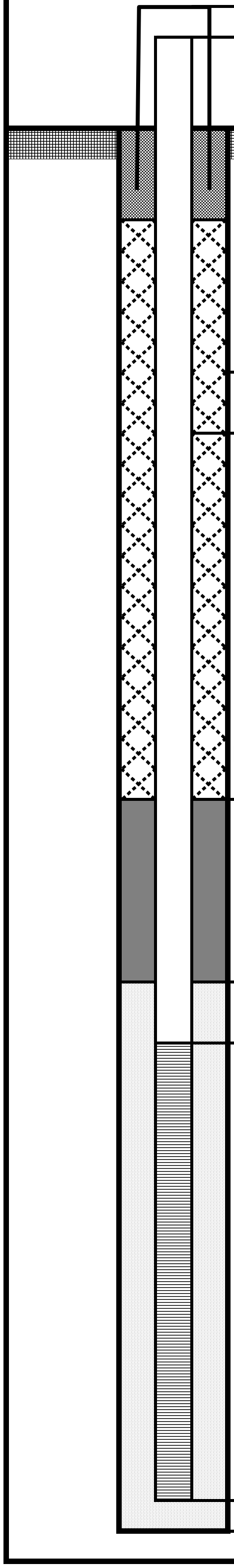
ASTM Method D-6032, *Standard Test Method for Determining Rock Quality Designation (RQD) of Rock Cores*

C&S Engineers, Inc.
499 Col Eileen Collins Blvd
Syracuse, NY 13212
Phone: 315-455-2000
Fax: 315-455-9667

GROUNDWATER OBSERVATION WELL CONSTRUCTION LOG

		Well No.	
		Project No.:	
		Surface Elev.:	
Project Name:		***Datum:***	
Location:		***Start Date:***	
Client:		***Finish Date:***	
Drilling Firm:		***Inspector:***	
Drill Rig:		***Casing:***	

Notes: (provide description of observation well location, method of construction, development method and any other information)



Top Protective Casing
Top of Riser

0'-0" Ground Surface

Surface Backfill Material
☐ Soil Cuttings
☐ Bentonite Slurry
☐ Cement/Bentonite Grout
☐ Concrete

Bore Hole Diameter

Well Diameter

Well Material
☒ PVC
☐ Stainless Steel

Backfill Material
☐ Soil Cuttings
☐ Bentonite Slurry
☐ Cement/Bentonite Grout
☐ Concrete

Depth To:

Top of Seal

Seal Material
☐ Bentonite Chips/Pellets
☐ Bentonite Slurry
☐ Cement/Bentonite Grout

Top of Filter Pack

Top of Screen

Screen Slot Size
☐ 010 in
☐ 015 in
☐ 020 in
☐ 025 in

Filter Material
☐ 00 Sand Pack
☐ 0 Sand Pack
☐ 1 Sand Pack
☐ 2 Sand Pack
☐ 3 Sand Pack
☐ 4 Sand Pack

Bottom of Screen
Bottom of Bore Hole

Groundwater Measurement Data

Date	Time	Depth to Water	Water Elevation	Tide Status

Air Sampling Field Sheet

Site Name: ______________________________

Site Address: ______________________________

C&S Project #: ______________________________

C&S Staff:

Location ID	Canister ID	Regulator ID	Date / Time Deployed	Pressure at Deployment	PID at Deployment	Date / Time Retrieved	Pressure at Retrieval	PID at Retrieval

Location	Date / Time	Air Pressure	Wind Direction	Wind Speed	Temperature	Precipitation	Cloud Cover	Dew Point

Comments on building layout, construction, HVAC, or other features that may affect intrusion or air flow:

Comments on building functions or material storage that could affect sample results:

Sample Location Sketch:

Appendix E

Quality Assurance Project Plan

QUALITY ASSURANCE PROJECT PLAN

FOR

The Former Will & Baumer Candle Co., Inc. Site

100 Buckley Road

Town of Salina, Onondaga County, New York

Site No. C734154

Prepared by:

C&S Engineers, Inc.

499 Colonel Eileen Collins Blvd

Syracuse, New York 13212

Prepared on Behalf of:

UR-ban Villages PFA, LLC

925 Seventh North Street

Liverpool, New York 13088

April 2022

Table of Contents

1 Introduction

C&S' Quality Control (QC) Program is a vital part of its approach to remedial investigations. Through our thorough QC program, our firm is able to provide accurate and dependable data. QC also provides safe working conditions for field staff.

The QC program contains procedures, which provide for collected data to be properly evaluated, and which document that quality control procedures have been followed in the collection of samples. The QC program represents the methodology and measurement procedures used in collecting quality field data. This methodology includes the proper use of equipment, documentation of sample collection, and sample handling practices.

Procedures used in the firm's QC program are consistent with federal, state, and local regulations, as well as, appropriate professional and technical standards.

This QC program has been organized into the following areas:

- QC Objectives
- Field Sampling Techniques
    - Procedures
    - Preparation
    - Measurement
    - Decontamination
- Sample Management

2 Quality Control Objectives

2.1 Data Quality Objectives

Data Quality Objectives (DQOs) are statements which describe the desired quality of data necessary to meet the objectives of the sampling program. The DQOs for the site sampling program were formulated during the scoping effort and developed as part of this Plan. The general steps followed in preparation of the DQOs were as follows:

- *Identification of the media to be sampled* - Identifies the media being investigated (e.g., ground water, surface soil).
- *Identification of the data uses* - Identifies the intended use of the data according to the following:
    - Site Characterization - Data are used to determine the composition, nature, and extent of contamination.
    - Risk Assessment - Data are used to evaluate the actual or potential risks posed by contaminants determined to be present on-site. Particular attention is given to sampling at locations where human exposure is possible.
    - Health and Safety Plan (HASP) - Data are used to establish the level of protection needed for on-site workers during site characterization activities.
    - Monitoring - Data are used during the monitoring of the remedial action to access the effectiveness of such action.
    - PRP Enforcement - Data are used to help establish potentially responsible parties (PRP's).
    - Evaluation of Alternatives - Data are used to evaluate various proposed remedial technologies and assist in proper design of alternatives.
- *Identification of the data types* - Identifies what types of analyses are to be performed.
- *Sample Collected* - Describes the sample types to be collected.
    - Environmental - Refers to a specific media sampled such as water, soil, air, or biological.
    - Source - Refers to sampling an actual contamination source.
    - Grab - A discrete sample representative of a specific location.
    - Composite - A sample that represents a mixture of a number of grab samples that represents the average properties over the extent of areas sampled.
    - Biased -Sampling that focuses on a specific area of expected contamination or uncontaminated area (background).
- *Identification of the data quality needs* - Identifies the analytical options available to support data collection activities and are identified as follows:
    - Level I: *Field Screening* - portable type instruments which provide real-time data.

  - Level II: *Field Analysis* - portable analytical instruments in an on-site lab or transported to the site.
  - Level III: *Standard Analytical Protocols* - standard analytical protocols or without the NYSDEC Analytical Services Protocol (ASP) (2000) reportables/ deliverables documentation.
  - Level IV: *NYSDEC ASP Reportables/Deliverables* - rigorous QA / QC protocols and reportables/deliverables documentation; NYSDEC ASP (2000) Category B deliverables.
  - Level V: *Non-Standard* - methods which have been modified to meet specific site study or remediation needs or by use of some other specialized analytical methods that cannot be obtained through standard or typical avenues of analytical support.

- *Identification of Data Quality Factors* - Describes factors which influence the quality or quantity of data to be collected. Primary contaminants and associated levels of concern are identified concerning ARARs or potential risks. The required detection limit are also given or referenced.

- *Identification of QA / QC Samples* - Specifies additional samples to be collected to support Quality Assurance / Quality Control (QA / QC) procedures. Additional samples to be collected could include:
  - *Matrix Spike/Matrix Spike Duplicates* - Matrix spike and matrix spike duplicate samples are collected as a duplicate sample to which the analytical laboratory will add known amounts of target analytes. These QA / QC samples are intended to assess the extraction procedure used by the laboratory.
  - *Blind Duplicates* – Blind duplicates are a duplicate of another sample submitted for analysis. The location of the sample is recorded in the field book and not disclosed on the chain of custody. These QA / QC samples are intended to assess the repeatability of analysis by the laboratory.
  - *Field Blanks* - Field (equipment) blanks are samples which are obtained by running analyte-free water through the sample collection equipment in a way that is identical to the sample collection procedures. Field blanks may be used during QA / QC procedures to evaluate if sampling equipment has contributed contaminants to the samples.
  - *Trip Blanks* - Trip blanks are samples which are prepared prior to the sampling event in the same type of sample container and are kept with the collected samples throughout the sampling event unit analysis. Trip blank vials are not opened in the field and are analyzed for volatile organics only.

2.2 Sampling Procedures

All sampling objectives, locations, and procedures have been included as the Remedial Investigation Work Plan (RIWP) and are further described in Section 3. Items including Field Measurement Techniques, General Field Decontamination, and Sample Management have also been included in Sections 3 and 4.

2.3 Laboratory Certification and Coordination

The Environmental Laboratory Approval Program (ELAP) certification is an accreditation issued by the New York State Department of Health (NYSDOH). Such laboratories have demonstrated that they consistently ensure the accuracy and reliability of samples analyzed. All chemical analyses for samples from the site will be completed by an ELAP laboratory capable of performing project specific analyses as indicated in this QA / QC plan. The project QA / QC Officer will also be responsible for all project related laboratory coordination.

Supporting documentation related to per- and polyfluoroalkyl substances (PFAS) analysis, such as standard operating procedures (SOPs), analyte lists, and method detection limits (MDLs) are provided in **Attachment A**.

2.4 Analytical Methodologies

Sampling and analysis will be performed for the Target Compound List (TCL) parameters including volatiles. The specific analyses will be conducted according to the following NYSDEC ASP 2000 methodologies:

Parameter Group	**Analysis Method**
Volatile Organic Compounds	8260C or TO-15 for air
Semi-volatile Organic Compounds	8270D
Polychlorinated Biphenyls	8082A
Pesticides	8081B
Herbicides	8151A
Metals / Inorganics	6010D, 7471B, 9010C/9012B, 7196A
PFOA/PFOS	LC-MS/MS using 537.1 methodologies

Samples will be analyzed by Alpha Analytical Inc. (Alpha) and the data will be presented in Category B reportables / deliverables format. Alpha maintains accreditation for the project-related analyses under NYSDOH ELAP Number 11148.

2.5 Analytical Quality Control

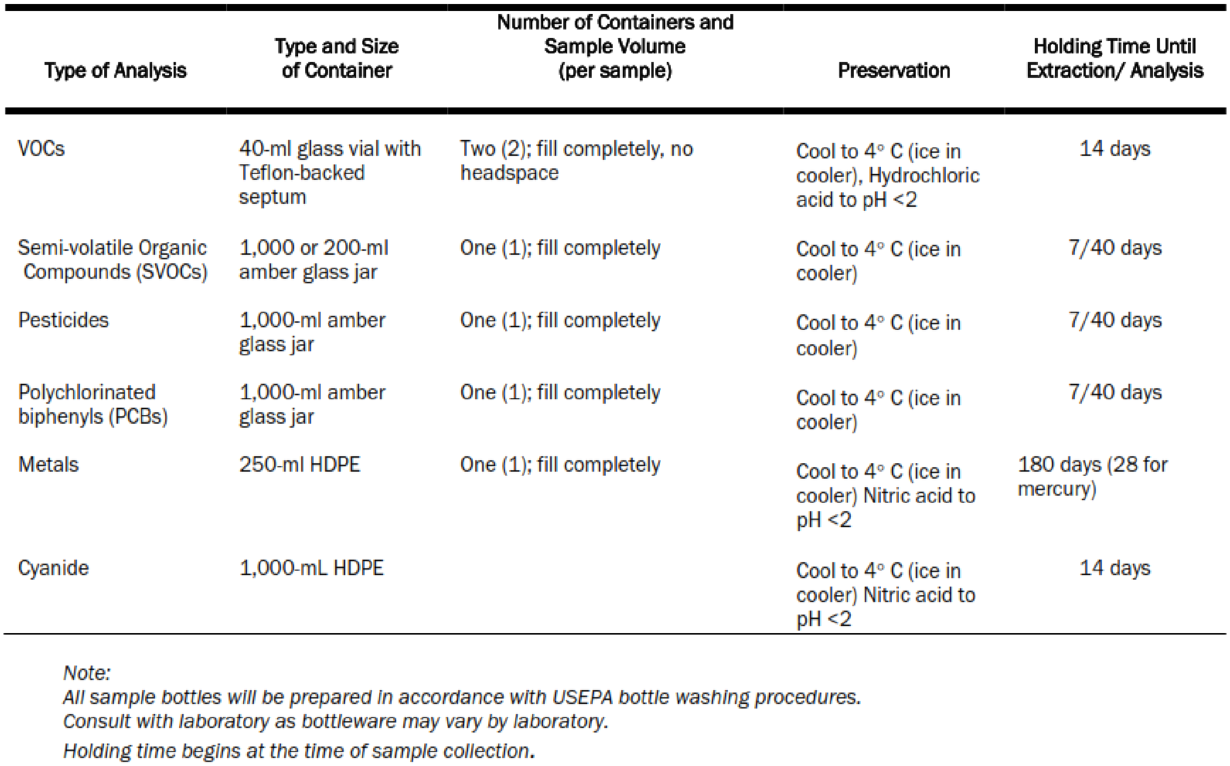
Analytical quality control for this Project will be consistent with the methodology and quality assurance/quality control requirements in the NYSDEC ASP 2000.

The tables on the following page detail sample volumes, containers, preservation, and holding time for typical analytes.

2.6 Data Usability Summary Report

A Data Usability Summary Report (DUSR) will be prepared by Data Validation Services consistent with NYSDECs Guidance for the Development of Quality Assurance Plans and Data Usability Summary Reports as given in DER-10. The main objective of the DUSR is to determine whether the data presented meets the project specific needs for data quality and data use.

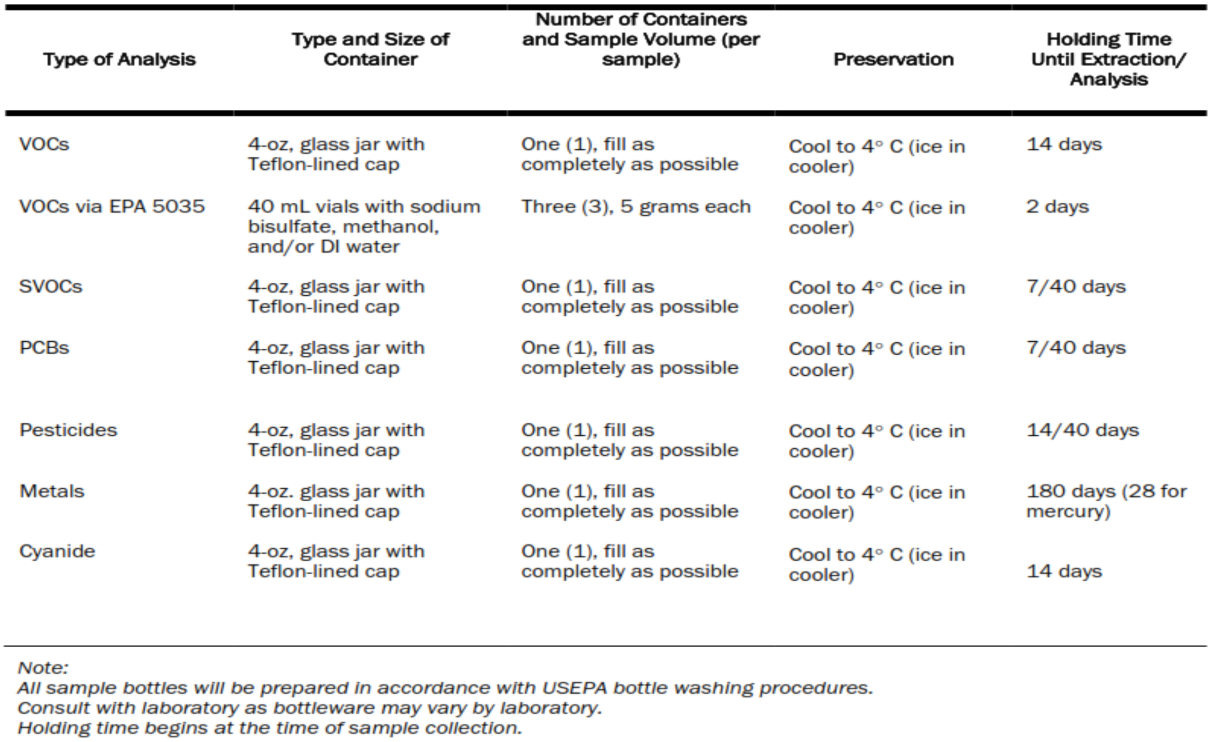
Table 2.5a
Water Samples



Type of Analysis	Type and Size of Container	Number of Containers and Sample Volume (per sample)	Preservation	Holding Time Until Extraction/ Analysis
VOCs	40-ml glass vial with Teflon-backed septum	Two (2); fill completely, no headspace	Cool to 4° C (ice in cooler), Hydrochloric acid to pH <2	14 days
Semi-volatile Organic Compounds (SVOCs)	1,000 or 200-ml amber glass jar	One (1); fill completely	Cool to 4° C (ice in cooler)	7/40 days
Pesticides	1,000-ml amber glass jar	One (1); fill completely	Cool to 4° C (ice in cooler)	7/40 days
Polychlorinated biphenyls (PCBs)	1,000-ml amber glass jar	One (1); fill completely	Cool to 4° C (ice in cooler)	7/40 days
Metals	250-ml HDPE	One (1); fill completely	Cool to 4° C (ice in cooler) Nitric acid to pH <2	180 days (28 for mercury)
Cyanide	1,000-mL HDPE		Cool to 4° C (ice in cooler) Nitric acid to pH <2	14 days

Note:
All sample bottles will be prepared in accordance with USEPA bottle washing procedures.
Consult with laboratory as bottleware may vary by laboratory.
Holding time begins at the time of sample collection.

Table 2.5b
Soil Samples



Type of Analysis	Type and Size of Container	Number of Containers and Sample Volume (per sample)	Preservation	Holding Time Until Extraction/ Analysis
VOCs	4-oz, glass jar with Teflon-lined cap	One (1), fill as completely as possible	Cool to 4° C (ice in cooler)	14 days
VOCs via EPA 5035	40 mL vials with sodium bisulfate, methanol, and/or DI water	Three (3), 5 grams each	Cool to 4° C (ice in cooler)	2 days
SVOCs	4-oz, glass jar with Teflon-lined cap	One (1), fill as completely as possible	Cool to 4° C (ice in cooler)	7/40 days
PCBs	4-oz, glass jar with Teflon-lined cap	One (1), fill as completely as possible	Cool to 4° C (ice in cooler)	7/40 days
Pesticides	4-oz, glass jar with Teflon-lined cap	One (1), fill as completely as possible	Cool to 4° C (ice in cooler)	14/40 days
Metals	4-oz. glass jar with Teflon-lined cap	One (1), fill as completely as possible	Cool to 4° C (ice in cooler)	180 days (28 for mercury)
Cyanide	4-oz, glass jar with Teflon-lined cap	One (1), fill as completely as possible	Cool to 4° C (ice in cooler)	14 days

Note:
All sample bottles will be prepared in accordance with USEPA bottle washing procedures.
Consult with laboratory as bottleware may vary by laboratory.
Holding time begins at the time of sample collection.

Applicable information for PFAS samples is as follows:

Table 2.5c
PFAS Samples

Matrix	Type and Size of Container	Number of Containers and Sample Volume (per sample)	Preservation	Holding Time Until Extraction / Analysis
Water	2 – 250 ml polypropylene	Two (2) fill as completely as possible	Cool to 4°C (ice in cooler) 1.25 grams Trizma	14 days to extraction 28 days after extraction
Soil	1 – 250 ml HDPE or polypropylene	One (1) fill as completely as possible	Cool to 4°C (ice in cooler)	28 days

3 Field Sampling Plan

3.1 Sampling Procedures

The following sections provide procedures for collecting a variety of samples, not all of which will be needed at this site.

3.1.1 Preparation for Sampling

The sample collection technique is of prime importance to assure the integrity of the collected sample. The following techniques include provisions so that:

- A representative sample is obtained;
- Contamination of the sample is minimized;
- The sample is properly preserved; and
- An acceptable Chain-of-Custody record is maintained.

The QA / QC Sampling Component of the Plan includes:

- Incorporation of accepted sampling techniques referenced in the sampling plan;
- Procedures for documenting any field actions contrary to the QA / QC Plan;
- Documentation of all preliminary activities such as equipment check-out, calibrations, and container storage and preparation;
- Documentation of field measurement quality control data (quality control procedures for such measurements shall be equivalent to corresponding QC procedures);
- Documentation of field activities;
- Documentation of post-field activities including sample shipment and receipt, field team debriefing, and equipment check-in;
- Generation of quality control samples including duplicate samples, field blanks, equipment blanks, and trip blanks;
- The use of these samples in the context of data evaluation with details of the methods employed (including statistical methods) and of the criteria upon which the information generated will be judged; and
- The number of QA / QC samples generally required are shown in the following table. When there is a disagreement with QA / QC sample numbers and types, between this document and a Work Plan, the Work Plan shall prevail.

Table 3-1
QA / QC Samples

Sample Type	Analysis	Number	Note
MS / MSD	Full Suite	Every sample batch, or minimum of 5% (1 per 20)	Two additional samples at a given location
Trip Blank	VOC	One per day or 5% (1 per 20), whichever is more frequent	Vials of clean water provided by laboratory. Packed with collected samples.

Field Blank	PFAS	One per day or 5% (1 per 20), or whichever is more frequent	Clean water passed through / over decontaminated sample collection equipment / tubing
Blind Duplicate	Same as field sample	Every sample batch, or minimum of 5% (1 per 20)	An additional sample at a given location

The personnel responsible for collection of groundwater, soil, air, miscellaneous media, and petroleum spill remediation / verification samples will be familiar with standard sampling procedures and follow the appropriate protocol. Field records will be maintained in bound notebooks with numbered pages to document daily instrument calibration, locations sampled, field observations, and weather conditions. Each page will be dated and signed by the sampler. Each notebook will be numbered and a log of notebooks will be maintained by the project manager.

Prior to sampling, all equipment must be procured and accommodations for sample container delivery, and sample shipment must be made. The following is a list of general equipment that would be on hand for sampling events. Special equipment for each sampling event is presented in the section describing that specific sampling event.

General Field Sampling Equipment

- Field Data Sheets
- Chain-of-Custody forms
- Engineers tape and folding ruler with 0.01 foot intervals
- Field Record Sheets
- Latex gloves
- Face-safety shield
- Tyvek coveralls
- Respirators
- Photoionization detector
- Bio-degradable phosphate free detergent
- Coolers and ice (no blue ice)
- Drums
- Sample bottles
- Aluminum foil
- Duct and filament tape
- Tap water
- Distilled water
- Laboratory grade methanol and hexane
- Wash buckets
- Decontamination towels / cloths
- Large disposal containers
- Large plastic sheets

3.2 Sample Collection Techniques

3.2.1 Surface Soil Sampling

Surface soil samples will be collected at the locations and depths indicated in the Work Plan. When sampling is conducted in areas where a vegetative turf has been established, a pre-cleaned trowel or shovel will be used to remove the turf so that it may be replaced at the conclusion of sampling. Samples will then be collected using a pre-cleaned, stainless steel spoon. When the sample is obtained, it will be deposited into a pre-cleaned stainless steel bowl or plastic pail for mixing prior to filling the sample containers. The soil will be mixed thoroughly until the material is homogenized. At that point, the soil will be placed into the laboratory provided containers.

Once removed from the ground the soil will immediately be observed for soil characteristics, including general soil type (sand, silt, clay), moisture, and evidence of impairment ((e.g. petroleum or chemical odors, staining, volatile organic vapors as measured by a photoionization detector (PID)). The PID will be calibrated daily (and more often as required by the manufacturer's data) prior to use in the field, using calibration test gases.

When PFAS sampling / testing is required, no sampling equipment components or sample containers should come into contact with aluminum foil, LDPE, glass, or Teflon tape. Acceptable equipment includes stainless steel spoons and bowl, HDPE containers, and steel shovels or augers that are not coated.

3.2.2 Subsurface Soil Sampling – Direct Push Drilling

3.2.2.1 Boring Advancement

Generally, soil borings will be advanced with a Geoprobe direct push sampling system. The use of direct push technology allows for rapid sampling, observation, and characterization of relatively shallow overburden soils. The Geoprobe utilizes a four to five-foot Macrocore barrel / sampler, with disposable acetate sleeves. Soil cores will be retrieved in four or five-foot sections, and can be easily cut from the acetate sleeves for observation and sampling. The Macrocore barrels will be decontaminated between boring locations using an alconox and water solution.

Prior to initiating drilling activities, the Macrocore barrels, drive rods, and pertinent equipment, will be steam cleaned or washed with an alconox and water solution. This cleaning procedure will also be used between each boring. Throughout and after the cleaning processes, direct contact between the equipment and the ground surface will be avoided. Plastic sheeting and/or clean support structures (e.g., pallets, sawhorses) will be used.

Test borings will be advanced with 2-inch (or larger) inside diameter (ID) direct push Macrocore through overburden soils. Drilling fluids, other than potable water will not be allowed without special consideration and agreement from NYSDEC. The use of lubricants is also not allowed unless approved by the NYSDEC representative.

Investigation derived soils will be returned to the hole in which they originate after samples have been taken. If excess soils remain, the soils will be placed in a designated spoils pile. The spoils pile will be placed on clean plastic and covered with clean plastic. The plastic will be secured to prevent soil erosion. The spoils pile will remain onsite until remedial efforts commence. At that time, the soils will be either disposed of in accordance with NYSDEC DER-10 guidelines or used as fill onsite underneath the clean cover system.

3.2.3 Subsurface Soil Sampling – Hollow Stem Auger

The drilling and installation of monitoring wells will be performed using a rotary drill rig which will have sufficient capacity to perform 4 1/4-inch ID hollow-stem auger drilling in the overburden, retrieve Macrocore or split-spoon samples. Equipment sizes and diameters may vary based on project-specific criteria. Any investigative derived waste generated during the advancement of soil borings and monitoring well installations will be containerized and characterized for proper disposal.

Prior to initiating drilling activities, the augers, sampler drive rods, split spoons, and other pertinent equipment will be steam cleaned or washed with an alconox and water solution. This cleaning procedure will also be used between each boring. Steam cleaning activities will be performed in a designated on-site decontamination area. During and after the cleaning processes, direct contact between the equipment and the ground surface will be avoided. Plastic sheeting and/or clean support structures (e.g., pallets, sawhorses) will be used.

Test borings will be advanced with 4 1/4-inch ID hollow stem augers through overburden, driven by truck-, track-, or trailer-mounted drilling equipment. Alternative methods of drilling or equipment may be allowed or requested for project specific criteria, but must be approved by the NYSDEC. Drilling fluids, other than water from a NYSDEC-approved source, will not be allowed without special consideration and agreement from NYSDEC. The use of lubricants is also not allowed unless approved by the NYSDEC representative.

Hollow stem auger advanced groundwater-monitoring wells typically utilize minimum 2-inch threaded flush joint PVC pipe with 0.010-in. slotted screen or pre-packed well screens. PVC piping used for risers and screens will conform to the requirements of ASTM-D 1785 Schedule 40 pipe. All materials used to construct the wells will be NSF / ASTM approved. Solvent PVC glue shall not be used at any time in the construction of the wells. The bottom of the screen shall be sealed with a treated wood cap or plastic plug. No lead shot or lead wool is to be employed in sealing the bottom of the well or for sealant at any point in the well.

Investigation derived soils will be returned to the hole from which they originated, after samples have been taken. If excess soils remain, the soils will be placed in a designated spoils pile. The spoils pile will be placed on clean plastic and covered with clean plastic. The plastic will be secured to prevent soil erosion. The spoils pile will remain onsite until remedial efforts commence. At that time, the soils will be either disposed of consistent with NYSDEC DER-10 guidelines or used as fill onsite underneath the clean cover system (if permitted by the Remedial Action Work Plan).

3.2.3.1 Subsurface Soil Sample Screening and Collection

When acetate sleeves or split spoons are removed from borings, the soil will immediately be observed for soil characteristics, including general soil type (sand, silt, clay), moisture, confining layers, and evidence of impairment (e.g. petroleum or chemical odors, staining, volatile organic vapors as measured by a PID – ex-situ and headspace). Generally, sample selection is based on evidence of impairment, depth, spatial distribution, or for delineation purposes. Normally, sample locations will not be known until the end of each day in the field. Therefore, samples for potential analysis will be placed in new Ziploc bags and placed on ice until they are placed into laboratory provided glassware.

When PFAS sampling / testing is required, no sampling equipment components or sample containers should come into contact with aluminum foil, LDPE, glass, or Teflon tape. Acceptable equipment includes stainless steel spoons and bowl, HDPE containers, and steel tools that are not coated.

3.2.4 Groundwater Monitoring Well Construction / Completion

Artificial Sand Pack

When utilized, granular backfill will be chemically and texturally clean, inert, siliceous, and of appropriate grain size for the screen slot size and the host environment. The sand pack will be installed using a tremie pipe, when possible (i.e., a tremie pipe may not fit into smaller, 2-inch diameter boreholes). When utilized, the well screen and casing will be installed, and the sand pack placed around the screen and casing to a depth extending at least 2 feet above the top of the screen. A pre-packed well screen may be used if pre-approved by the NYSDEC.

Bentonite Seal

A minimum 2-foot thick seal will be placed directly on top of the sand pack, and care will be taken to avoid bridging. In the event that Site geology does not allow for a 2-foot seal (e.g., only 1-foot of space remains between the top of the sand pack and ground surface), the remaining space in the annulus will be filled with bentonite.

Grout Mixture

Upon completion of the bentonite seal, the well may be grouted with a 30% solids pure bentonite grout, a non-shrinking cement grout, a cement / bentonite grout mix, or a bentonite / soil mix as indicated in the Work Plan. The grout will be placed from the top of the bentonite seal to the ground surface.

Surface Protection

At all times during the progress of the work, precautions shall be used to prevent tampering with or the entrance of foreign material into the well. Upon completion of the well, a suitable cap shall be installed to prevent material from entering the well. Where permanent wells are to be installed, the well riser shall be protected by a flush mounted road box set into a concrete pad or locking well cap for stick-up wells. A concrete pad, sloped away from the well, shall be constructed around the flush mount road box or stick-up casing at ground level.

Any well that is to be temporarily removed from service or left incomplete due to delay in construction shall be capped with a watertight cap.

Surveying

Coordinates and elevations will be established for each monitoring well and sampling location. Elevations to the closest 0.01 foot shall be used for the survey. Well elevations will be measured from the top of well riser. These elevations shall be referenced to a regional, local, or project-specific datum. The location, identification, coordinates, and elevations of the wells will be plotted on maps with a scale large enough to show their location with reference to other structures at each site.

Well Development

After completion of the well, but not sooner than 48 hours after grouting is completed, development will be accomplished using pumping, bailing, and / or surge blocking. No dispersing agents, acids, disinfectants, or other additives will be used during development or introduced into the well at any other time. During development, water will be removed throughout the entire water column by periodically lowering and raising the pump intake (or bailer stopping point).

Water elevations will be taken on all wells prior to development, purging, and sampling. All measurements will be taken within a 24-hour period to obtain consistent elevations and recorded on well data sheets. The procedure for measuring water levels in the monitoring wells is:

- Unlock and remove well cap;
- Test the atmosphere of the well with the calibrated PID. If the gases from the well have caused the air in the breathing zone to read greater than 5 ppm, stop work and refer to the HASP
- Measure water level to nearest 0.01 foot with a water level indicator (electronic).

- Water level indicators will be decontaminated before moving to next well. The tape and cable are decontaminated by washing in a bucket of distilled water-biodegradable phosphate free-detergent solution, followed by a rinse with distilled water.

Investigation derived liquids (e.g. well and decon water) will be drummed and treated as non-hazardous waste pending the results of chemical analysis. Investigation derived liquid waste including well development, well purging water, and decontamination liquids will be containerized and staged onsite in a designated secure area. The containers will be affixed with appropriate labels and remain onsite until remedial work begins. The materials will be treated / disposed consistent with applicable regulations.

The development process will continue until removal of a minimum of 110% of the water lost during drilling, three well volumes; whichever is greater (or as specified in the Work Plan), and when water quality monitoring demonstrates stabilization of the effluent. The water quality meter will be calibrated prior to each sampling event (and more often as required by the manufacturer's data), using calibration fluids. Stabilization criteria is shown in the table below. In the event that limited recharge does not allow for the recovery of all drilling water lost in the well or three well volumes, the well will be allowed to stabilize to conditions deemed representative of groundwater conditions. Stabilization periods will vary by project but will be confirmed with the NYSDEC prior to sampling.

A flow-through cell will be utilized to facilitate the recording of real-time effluent water quality data. Water quality values will be recorded numerous times throughout well development and purging, at a frequency of no more than one well volume between recordings.

Table 3-2
Well Development Stabilization Criteria

Parameter	**Stabilization Criteria**
pH	Difference of ±0.2
specific electric conductance	Difference of ± 3%
temperature	Difference of ± 0.5 °C
turbidity	±10% (when turbidity is greater than 10 NTUs)
oxidation -reduction potential (ORP)	± 20 millivolts
dissolved oxygen (DO)	10% or ±0.2 mg/L, whichever is greater

3.2.5 Groundwater Sample Collection

Groundwater samples will be collected using a dedicated low flow pump. When analysis is limited to VOCs, samples may be collected with disposable or stainless steel bailers. When PFAS sampling / testing is required, only the following equipment will be permitted:

- Stainless steel inertia pump with HDPE tubing
- Peristaltic pump with HDPE and silicone tubing
- Stainless steel bailer with stainless steel ball
- Bladder pump (identified as PFAS-free) with HDPE tubing

All sampling equipment will be properly decontaminated in the field (see Section 3.4). The following equipment will be available for sampling of monitoring wells in addition to the general sampling equipment list:

- Well Data Sheets
- Pump
- Electronic water level indicator
- Water Quality Meter
- Acid resistant gloves

The following activities will be completed before going into the field every day before the start of sampling:

1. Fill out appropriate section on Well Data Sheet for the wells to be sampled;
2. Obtain the sampling schedule for each well to be sampled;
3. Calibrate the PID with the calibration gas;
4. Determine the amount of sampling to be done for the day and prepare the necessary number of coolers;
5. Each well to be sampled will have designated coolers containing the pre-labeled, certified clean, sample bottles. The groundwater samples will be placed in the cooler labeled for the well from which they were taken. The bottle shall be labeled with large distinguishable letters, so that the groundwater samples will be placed in the proper cooler; and
6. Select the appropriate sample bottles for the day's sampling. The bottles shall be pre-marked with a sample parameter and preservatives. Reusable glass bottles will have been cleaned and prepared at the laboratory. The bottles for the various parameters to be analyzed from each well location will then be placed in a cooler.

The following steps describe the sample collection of groundwater:

1. Unlock and remove the well cap;
2. When VOCs are a contaminant of concern, test the air at the wellhead with the calibrated PID. If the gases from the well have caused the air in the breathing zone to read greater than 5 ppm, stop work and refer to the HASP. Record the reading on the Well Data Sheet;
3. In order to obtain a representative sample of the formation water, the well must be purged of the static water within the well. Prior to purging, the static water level within the well must be measured and the measurement recorded on the Well Data Sheet. To determine the amount of water necessary to purge, find the liquid column height in the well to determine the total volume (three liquid column borehole volumes) of liquid to be purged;
4. Purge the well; lower pump slowly into the well until it is below the water surface. In accordance with the Work Plan, purge waters will be containerized for disposal during remedial activities.
5. Record the amount of water purged in the field logbook and on the Well Data Sheet.
6. If the static water level drops below 25 percent of the initial static water level, allow for full recovery (measure the water level) and then sample. If recovery takes more than twenty minutes, proceed to next well but return to sample within 24 hours.
7. Fill the appropriate sample bottles according to the sampling schedule for each well. While filling the sample bottles, record the well number, type, volume of container, and the preservatives used on the Ground Water Sampling Analyses form.

8. The preservatives for the various sampling parameters were previously added to the clean sample bottles by the laboratory. Some parameters may require additional special handling.
9. Volatile organics analyses sample vials must be free of air bubbles. When a bubble-free sample has been obtained, it must be immediately chilled.
10. Collect the matrix spike duplicates, duplicates, field blanks, and trip blanks, as applicable. Take samples according to sampling schedule presented in the Work Plan.
11. Record all pertinent information in field logbook and on the Well Data Sheet (include color, odor, sediment content of sample, etc.). Any situations at the site that have the potential to interfere with the analytical results should also be recorded here.
12. Lock well, inspect well site, and note any maintenance required.
13. Dispose of potentially contaminated materials in designated container.

3.2.6 Soil and Sub-Slab Vapor Sample Collection

Soil Vapor / Sub-Slab Soil Gas Sampling

Soil vapor implants and sub-slab sampling points are installed to collect soil gas immediately from exterior locations around the site periphery and from below the existing slabs, respectively. Soil vapor and sub-slab gas samples are collected using a 1-Liter Summa™ canister fitted with a flow orifice pre-calibrated to collect a 1-Liter sample over a 24-hour period. Once the 24-hour sampling period has been completed, the canister is boxed and shipped to the laboratory for analysis. A brief summary of the sampling protocol is provided below. The sub-slab vapor points are installed by first advancing a small diameter hole (approximately 3/8-inches in diameter) through the floor slab to determine thickness. The holes are drilled via a hammer drill or concrete core. The hole extends through the slab and terminates at the interface with underlying material (i.e. gravel base or soil). A sample point consisting of a length of tubing is placed into the boring. The cored slab annulus is filled with clay placed around the sub-slab vapor point. The bottom of the sub-slab vapor point extends to the bottom of slab. Prior to sub-slab soil gas sample collection, the monitoring point and above grade tubing is purged at a rate not exceeding 200 ml/min. The total volume purged prior to sample collection equals three volumes of air in the open space of tubing and the sample point. At the end of the sampling event, a pressure gauge reading is recorded. The 1-Liter canister with a calibrated 24-hour orifice is connected to the tubing. The following summarizes the above:

- The sub-slab sampling point construction is temporary, with the sampling points securely mounted through the concrete slab and grouted in place using pottery clay.
- Prior to sub-slab soil gas sample collection, the monitoring point and above grade tubing is purged at a rate not exceeding 200 ml/min.
- Samples are collected over a 24-hour period at a flow rate not greater than 200 mL/min.
- Helium is used as a field tracer during sampling. The Helium is introduced into a dome next to the above grade sampling train and Summa™ canister to a minimum concentration of 50% helium. Many PIDs and helium gauges draw air at a greater rate than 100 ml/min and as such, shall not be connected directly to the sub slab vapor sampling point or tubing. The tubing will be purged at a rate not exceeding 200 ml/min. The purged air will be inserted directly into an empty tedlar bag. The helium is read from the tedlar bag using a

helium meter that is capable to read down to 1-2%. Sub-slab vapor must be confirmed to contain less than 10% of the shroud concentration prior to proceeding with sampling.

- Field documentation is maintained in a field notebook and on field data forms.

Ambient Air Sampling

Ambient air samples are collected in the same manner as the indoor air samples.

3.3 General Decontamination

The following procedures will be performed for the decontamination of exploration equipment, sampling equipment, and personnel after each drilling/sampling event:

Drill rig, backhoe, and excavator - The drill rig, direct-push rig, backhoe, and/or excavator will be cleaned prior to their entrance and exit of the site. Greases and oils will not be used on any down hole equipment during drilling or exploration activities.

Exploration equipment - To avoid cross contamination, use of a PID meter and cleaning between each sampling site will be employed on backhoe arms, buckets, hollow stem augers, casing drill rods, down-hole tools, and appurtenant equipment.

Split spoon sampler - The split spoon sampler will be scrubbed, cleaned, and put through a series of rinses between each sampling event. A number of split spoon samplers will be used so that one can be utilized for sampling while the others are being cleaned.

Reusable equipment - The following steps will be employed to decontaminate reusable equipment:

- Rinse equipment of soil or foreign material with potable water;
- Immerse and scrub equipment with bio-degradable phosphate-free detergent and potable water;
- Immerse and scrub in a potable water rinse without detergent;
- Immerse and scrub in deionized/distilled water;
- Saturate by spraying or immersion in laboratory-grade hexane;
- Air dry and wrap cleaned equipment in foil to carry to next monitoring site to prevent contamination of equipment during transfer; and
- The decontamination wash and rinse water will not be considered hazardous unless visual inspection or monitoring by the PID and other equipment indicate that contaminants may be present. The rinse waters can be discharged on-site if they are not contaminated. If contaminants are expected to be present, the rinsate waters should be placed in 55 gallon drums and stored on-site.

Disposable equipment - The following steps will be employed to decontaminate disposable equipment:

- Rinse with potable water;
- Remove all standing liquid from the piece of equipment;
- Dispose of the equipment in a dedicated container for contaminated solids; and
- Dispose of rinse water in 55 gallon drums if contaminants are found to be present.

Sample containers - upon filling and capping sample bottles, the outside of the bottle will be wiped off with a clean paper towel. These towels will be disposed of in a dedicated container for contaminated solids.

Personnel decontamination - The following procedures will be used to decontaminate sampling personnel.

- After each sampling event chemical resistant gloves will be disposed of in a dedicated container for contaminated solids;
- At the end of each sampling day, Tyvek™ coveralls will be disposed of in a dedicated container for contaminated solids;
- Boots will be rinsed off with water to remove mud, clay, or any other contaminants; and
- Personnel will be required to follow procedures outlined in the HASP.

Special Considerations When Sampling for PFAS

- Clothing that contains PTFE material, including Gore-Tex or that have been water-proofed with PFAS materials should be avoided. All clothing worn by sampling personnel should first be laundered multiple times. Acceptable rain gear includes PVC, polyurethane, or rubber. If such materials are required because site conditions warrant additional protection for samplers, their use will be documented in the field notes.
- Decontamination water shall be verified in advance to be PFAS-free through laboratory analysis or certification. Previous results of non-detect for PFAS are acceptable.

All decontamination waters will be containerized and staged onsite in a designated secure area. The containers will be affixed with appropriate labels and remain onsite until remedial work begins.

4 Sample Management Plan

4.1 Sample Management

This Sample Management Plan provides procedures to document and track samples and results obtained during this work effort. A series of pre-printed forms with the appropriate information serves as a vehicle for documentation and tracking.

In order to accomplish this task, the documentation materials will include sample labels, sample characterization and Chain-of-Custody sheets, daily field reports, and a sample log.

Sample Label - A sample label will be completed for each sample obtained and will be affixed to the sample container. The label is configured in a way to address various types of mediums. Information on the label includes, at a minimum, client name, location, sample description, sample number, date, time, grab sample, composite sample, notes, and sampler's name.

Sample Characterization & Chain-of-Custody Sheet - All pertinent field information will be entered onto the sample characterization and chain-of-custody sheets including client name, sample ID, sample description, location of sample, sampling method, number of containers, container type, analysis required, and preservation. The monitoring well form has space allotted for entering information regarding the well including depth to water, well volume, sample pH, temperature, color, etc. The Chain-of-Custody section of the form will document the sample's pathway of sample shipment which will include names of persons delivering/receiving, dates, and times. The reverse side of this form will be used by the laboratory to document analysis performed on the sample. Copies of the completed forms will be retained by the Engineer and the analytical laboratory. The original sample characterization and Chain-of-Custody sheets will be submitted in the Remedial Investigation report along with the laboratory results.

Daily Field Reports - Daily activities will be recorded on the Inspection Report form. The purpose of this form will be to summarize the work performed on the site each day. The completed forms will be submitted to the Project Manager on a daily basis for short term site activity and on a weekly basis for site activities of a longer duration.

Sample Log - The sample log will be utilized to track each individual sample obtained at the site. The upper portion, "Field Identification" will be completed the day the sample is taken. The form will accompany the sample characterization and Chain-of-Custody form to the laboratory. Personnel at the laboratory will complete the middle section of this form and return it to the Engineer, who will use the document to track incoming results. The bottom of the sheet has space allocated to enter "Recommended Actions" based on laboratory results.

4.2 Sample Handling

Each collected sample will be dispensed into the appropriate sample containers for the type of analysis to be performed. Sampling staff will wear nitrile gloves at all times when handling samples. Appropriate sample preservatives will be added to the sample containers by the contracted analytical laboratory prior to the delivery into the field, except in cases where the sample preservative must be added after sample collection. All samples that require cool storage will be immediately placed in coolers with appropriate packaging materials so as to protect the breakage of sample containers during shipment. The sample coolers will be filled with cubed ice (no "Blue Ice") prior to leaving the sample collection location. In the instance that a local analytical laboratory is contracted, the samples will be hand delivered to the laboratory each sampling day. The chain-of-custody forms will be signed by the laboratory personnel picking up the samples and placed within the coolers. In the instance that an analytical laboratory is contracted which is not based locally and a common carrier is used for sample shipment, the chain-of-custody forms will be signed by the sampler and the carrier personnel and placed inside of the coolers. Careful packaging techniques will be used to prevent sample containers from breakage during shipment. Materials such as cardboard, foam wrap, or Styrofoam may be used as packaging materials. All samples will be delivered to the contracted analytical laboratory on the day they were collected and will be received by the laboratory within 24 hours of sample collection. The samples will be collected with sufficient time allowed at the end of the day for the analytical laboratory to properly process the sample chain-of-custody form.

Attachment A

Supporting Document for PFAS Sampling

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

SAMPLING, ANALYSIS, AND ASSESSMENT OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS)

Under NYSDEC's Part 375 Remedial Programs

June 2021

www.dec.ny.gov

Table of Contents

June 2021

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

ERRATA SHEET for

SAMPLING, ANALYSIS, AND ASSESSMENT OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) Under NYSDEC's Part 375 Remedial Programs Issued January 17, 2020

Citation and Page Number	Current Text	Corrected Text	Date
Title of Appendix I, page 32	Appendix H	Appendix I	2/25/2020
Document Cover, page 1	Guidelines for Sampling and Analysis of PFAS	Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs	9/15/2020
Routine Analysis, page 9	"However, laboratories analyzing environmental samples…PFOA and PFOS in drinking water by EPA Method 537, 537.1 or ISO 25101."	"However, laboratories analyzing environmental samples…PFOA and PFOS in drinking water by EPA Method 537, 537.1, ISO 25101, or Method 533."	9/15/2020
Additional Analysis, page 9, new paragraph regarding soil parameters	None	"In cases where site-specific cleanup objectives for PFOA and PFOS are to be assessed, soil parameters, such as Total Organic Carbon (EPA Method 9060), soil pH (EPA Method 9045), clay content (percent), and cation exchange capacity (EPA Method 9081), should be included in the analysis to help evaluate factors affecting the leachability of PFAS in site soils."	9/15/2020
Data Assessment and Application to Site Cleanup Page 10	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFAS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Target levels for cleanup of PFAS in other media, including biota and sediment, have not yet been established by the DEC.	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Preliminary target levels for cleanup of PFOA and PFOS in other media, including biota and sediment, have not yet been established by the DEC.	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Water Sample Results Page 10	PFAS should be further assessed and considered as a potential contaminant of concern in groundwater or surface water (…) If PFAS are identified as a contaminant of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.	PFOA and PFOS should be further assessed and considered as potential contaminants of concern in groundwater or surface water (…) If PFOA and/or PFOS are identified as contaminants of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.	9/15/2020
Soil Sample Results, page 10	“The extent of soil contamination for purposes of delineation and remedy selection should be determined by having certain soil samples tested by Synthetic Precipitation Leaching Procedure (SPLP) and the leachate analyzed for PFAS. Soil exhibiting SPLP results above 70 ppt for either PFOA or PFOS (individually or combined) are to be evaluated during the cleanup phase.”	“Soil cleanup objectives for PFOA and PFOS will be proposed in an upcoming revision to 6 NYCRR Part 375-6. Until SCOs are in effect, the following are to be used as guidance values. “ [Interim SCO Table] “PFOA and PFOS results for soil are to be compared against the guidance values listed above. These guidance values are to be used in determining whether PFOA and PFOS are contaminants of concern for the site and for determining remedial action objectives and cleanup requirements. Site-specific remedial objectives for protection of groundwater can also be presented for evaluation by DEC. Development of site-specific remedial objectives for protection of groundwater will require analysis of additional soil parameters relating to leachability. These additional analyses can include any or all the parameters listed above (soil pH, cation exchange capacity, etc.) and/or use of SPLP. As the understanding of PFAS transport improves, DEC welcomes proposals for site-specific remedial objectives for protection of groundwater. DEC will expect that those may be dependent on additional factors including soil pH, aqueous pH, % organic carbon, % Sand/Silt/Clay, soil cations: K, Ca, Mg, Na, Fe, Al, cation exchange capacity, and anion exchange capacity. Site-specific remedial objectives should also consider the dilution attenuation factor (DAF). The NJDEP publication on DAF can be used as a reference: https://www.nj.gov/dep/srp/guidance/rs/daf.pdf. ”	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Testing for Imported Soil Page 11	Soil imported to a site for use in a soil cap, soil cover, or as backfill is to be tested for PFAS in general conformance with DER-10, Section 5.4(e) for the PFAS Analyte List (Appendix F) using the analytical procedures discussed below and the criteria in DER-10 associated with SVOCs. If PFOA or PFOS is detected in any sample at or above 1 µg/kg, then soil should be tested by SPLP and the leachate analyzed for PFAS. If the SPLP results exceed 10 ppt for either PFOA or PFOS (individually) then the source of backfill should be rejected, unless a site-specific exemption is provided by DER. SPLP leachate criteria is based on the Maximum Contaminant Levels proposed for drinking water by New York State's Department of Health, this value may be updated based on future Federal or State promulgated regulatory standards. Remedial parties have the option of analyzing samples concurrently for both PFAS in soil and in the SPLP leachate to minimize project delays. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.	Testing for PFAS should be included any time a full TAL/TCL analyte list is required. Results for PFOA and PFOS should be compared to the applicable guidance values. If PFOA or PFOS is detected in any sample at or above the guidance values then the source of backfill should be rejected, unless a site-specific exemption is provided by DER based on SPLP testing, for example. If the concentrations of PFOA and PFOS in leachate are at or above 10 ppt (the Maximum Contaminant Levels established for drinking water by the New York State Department of Health), then the soil is not acceptable. PFOA, PFOS and 1,4-dioxane are all considered semi-volatile compounds, so composite samples are appropriate for these compounds when sampling in accordance with DER-10, Table 5.4(e)10. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Footnotes	None	[1] TOP Assay analysis of highly contaminated samples, such as those from an AFFF (aqueous film-forming foam) site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances. [2] The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the soil cleanup objective for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).	9/15/2020
Additional Analysis, page 9	In cases… soil parameters, such as Total Organic Carbon (EPA Method 9060), soil…	In cases… soil parameters, such as Total Organic Carbon (Lloyd Kahn), soil…	1/8/2021
Appendix A, General Guidelines, fourth bullet	List the ELAP-approved lab(s) to be used for analysis of samples	List the ELAP- certified lab(s) to be used for analysis of samples	1/8/2021
Appendix E, Laboratory Analysis and Containers	Drinking water samples collected using this protocol are intended to be analyzed for PFAS by ISO Method 25101.	Drinking water samples collected using this protocol are intended to be analyzed for PFAS by EPA Method 537, 537.1, 533, or ISO Method 25101	1/8/2021
Water Sample Results Page 9	"In addition, further assessment of water may be warranted if either of the following screening levels are met: a. any other individual PFAS (not PFOA or PFOS) is detected in water at or above 100 ng/L; or b. total concentration of PFAS (including PFOA and PFOS) is detected in water at or above 500 ng/L"	Deleted	6/15/2021

June 2021

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs

---

Objective

New York State Department of Environmental Conservation's Division of Environmental Remediation (DER) performs or oversees sampling of environmental media and subsequent analysis of PFAS as part of remedial programs implemented under 6 NYCRR Part 375. To ensure consistency in sampling, analysis, reporting, and assessment of PFAS, DER has developed this document which summarizes currently accepted procedures and updates previous DER technical guidance pertaining to PFAS.

Applicability

All work plans submitted to DEC pursuant to one of the remedial programs under Part 375 shall include PFAS sampling and analysis procedures that conform to the guidelines provided herein.

As part of a site investigation or remedial action compliance program, whenever samples of potentially affected media are collected and analyzed for the standard Target Analyte List/Target Compound List (TAL/TCL), PFAS analysis should also be performed. Potentially affected media can include soil, groundwater, surface water, and sediment. Based upon the potential for biota to be affected, biota sampling and analysis for PFAS may also be warranted as determined pursuant to a Fish and Wildlife Impact Analysis. Soil vapor sampling for PFAS is not required.

Field Sampling Procedures

DER-10 specifies technical guidance applicable to DER's remedial programs. Given the prevalence and use of PFAS, DER has developed "best management practices" specific to sampling for PFAS. As specified in DER-10 Chapter 2, quality assurance procedures are to be submitted with investigation work plans. Typically, these procedures are incorporated into a work plan, or submitted as a stand-alone document (e.g., a Quality Assurance Project Plan). Quality assurance guidelines for PFAS are listed in Appendix A - Quality Assurance Project Plan (QAPP) Guidelines for PFAS.

Field sampling for PFAS performed under DER remedial programs should follow the appropriate procedures outlined for soils, sediments or other solids (Appendix B), non-potable groundwater (Appendix C), surface water (Appendix D), public or private water supply wells (Appendix E), and fish tissue (Appendix F).

QA/QC samples (e.g. duplicates, MS/MSD) should be collected as specified in DER-10, Section 2.3(c). For sampling equipment coming in contact with aqueous samples only, rinsate or equipment blanks should be collected. Equipment blanks should be collected at a minimum frequency of one per day per site or one per twenty samples, whichever is more frequent.

Analysis and Reporting

As of October 2020, the United States Environmental Protection Agency (EPA) does not have a validated method for analysis of PFAS for media commonly analyzed under DER remedial programs (non-potable waters, solids). DER has developed the following guidelines to ensure consistency in analysis and reporting of PFAS.

The investigation work plan should describe analysis and reporting procedures, including laboratory analytical procedures for the methods discussed below. As specified in DER-10 Section 2.2, laboratories should provide a full Category B deliverable. In addition, a Data Usability Summary Report (DUSR) should be prepared by an independent, third party data validator. Electronic data submissions should meet the requirements provided at: https://www.dec.ny.gov/chemical/62440.html.

DER has developed a *PFAS Analyte List* (Appendix F) for remedial programs to understand the nature of contamination at sites. It is expected that reported results for PFAS will include, at a minimum, all the compounds listed. If lab and/or matrix specific issues are encountered for any analytes, the DER project manager, in consultation with the DER chemist, will make case-by-case decisions as to whether certain analytes may be temporarily or permanently discontinued from analysis at each site. As with other contaminants that are analyzed for at a site, the *PFAS Analyte List* may be refined for future sampling events based on investigative findings.

Routine Analysis

Currently, New York State Department of Health's Environmental Laboratory Approval Program (ELAP) does not offer certification for PFAS in matrices other than finished drinking water. However, laboratories analyzing environmental samples for PFAS (e.g., soil, sediments, and groundwater) under DER's Part 375 remedial programs need to hold ELAP certification for PFOA and PFOS in drinking water by EPA Method 537, 537.1, ISO 25101, or Method 533. Laboratories should adhere to the guidelines and criteria set forth in the DER's laboratory guidelines for PFAS in non-potable water and solids (Appendix H - Laboratory Guidelines for Analysis of PFAS in Non-Potable Water and Solids). Data review guidelines were developed by DER to ensure data comparability and usability (Appendix H - Data Review Guidelines for Analysis of PFAS in Non-Potable Water and Solids).

LC-MS/MS analysis for PFAS using methodologies based on EPA Method 537.1 is the procedure to use for environmental samples. Isotope dilution techniques should be utilized for the analysis of PFAS in all media. Reporting limits for PFOA and PFOS in aqueous samples should not exceed 2 ng/L. Reporting limits for PFOA and PFOS in solid samples should not exceed 0.5 µg/kg. Reporting limits for all other PFAS in aqueous and solid media should be as close to these limits as possible. If laboratories indicate that they are not able to achieve these reporting limits for the entire *PFAS Analyte List*, site-specific decisions regarding acceptance of elevated reporting limits for specific PFAS can be made by the DER project manager in consultation with the DER chemist.

Additional Analysis

Additional laboratory methods for analysis of PFAS may be warranted at a site, such as the Synthetic Precipitation Leaching Procedure (SPLP) and Total Oxidizable Precursor Assay (TOP Assay).

In cases where site-specific cleanup objectives for PFOA and PFOS are to be assessed, soil parameters, such as Total Organic Carbon (Lloyd Kahn), soil pH (EPA Method 9045), clay content (percent), and cation exchange capacity (EPA Method 9081), should be included in the analysis to help evaluate factors affecting the leachability of PFAS in site soils.

SPLP is a technique used to determine the mobility of chemicals in liquids, soils and wastes, and may be useful in determining the need for addressing PFAS-containing material as part of the remedy. SPLP by EPA Method 1312 should be used unless otherwise specified by the DER project manager in consultation with the DER chemist.

Impacted materials can be made up of PFAS that are not analyzable by routine analytical methodology. A TOP Assay can be utilized to conceptualize the amount and type of oxidizable PFAS which could be liberated in the environment, which approximates the maximum concentration of perfluoroalkyl substances that could be generated if all polyfluoroalkyl substances were oxidized. For example, some polyfluoroalkyl substances may degrade or transform to form perfluoroalkyl substances (such as PFOA or PFOS), resulting in an increase in perfluoroalkyl substance concentrations as contaminated groundwater moves away from a source. The TOP Assay converts, through oxidation, polyfluoroalkyl substances (precursors) into perfluoroalkyl substances that can be detected by routine analytical methodology.[1]

Commercial laboratories have adopted methods which allow for the quantification of targeted PFAS in air and biota. The EPA's Office of Research and Development (ORD) is currently developing methods which allow for air emissions characterization of PFAS, including both targeted and non-targeted analysis of PFAS. Consult with the DER project manager and the DER chemist for assistance on analyzing biota/tissue and air samples.

Data Assessment and Application to Site Cleanup

Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Preliminary target levels for cleanup of PFOA and PFOS in other media, including biota and sediment, have not yet been established by the DEC.

Water Sample Results

PFOA and PFOS should be further assessed and considered as potential contaminants of concern in groundwater or surface water if PFOA or PFOS is detected in any water sample at or above 10 ng/L (ppt) and is determined to be attributable to the site, either by a comparison of upgradient and downgradient levels, or the presence of soil source areas, as defined below.

If PFOA and/or PFOS are identified as contaminants of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.

Soil Sample Results

Soil cleanup objectives for PFOA and PFOS will be proposed in an upcoming revision to 6 NYCRR Part 375-6. Until SCOs are in effect, the following are to be used as guidance values.

Guidance Values for Anticipated Site Use	PFOA (ppb)	PFOS (ppb)
Unrestricted	0.66	0.88
Residential	6.6	8.8
Restricted Residential	33	44
Commercial	500	440
Industrial	600	440
Protection of Groundwater[2]	1.1	3.7

---

[1] TOP Assay analysis of highly contaminated samples, such as those from an AFFF (aqueous film-forming foam) site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances.

[2] The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the guidance value for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).

PFOA and PFOS results for soil are to be compared against the guidance values listed above. These guidance values are to be used in determining whether PFOA and PFOS are contaminants of concern for the site and for determining remedial action objectives and cleanup requirements. Site-specific remedial objectives for protection of groundwater can also be presented for evaluation by DEC. Development of site-specific remedial objectives for protection of groundwater will require analysis of additional soil parameters relating to leachability. These additional analyses can include any or all the parameters listed above (soil pH, cation exchange capacity, etc.) and/or use of SPLP.

As the understanding of PFAS transport improves, DEC welcomes proposals for site-specific remedial objectives for protection of groundwater. DEC will expect that those may be dependent on additional factors including soil pH, aqueous pH, % organic carbon, % Sand/Silt/Clay, soil cations: K, Ca, Mg, Na, Fe, Al, cation exchange capacity, and anion exchange capacity. Site-specific remedial objectives should also consider the dilution attenuation factor (DAF). The NJDEP publication on DAF can be used as a reference: https://www.nj.gov/dep/srp/guidance/rs/daf.pdf.

Testing for Imported Soil

Testing for PFAS should be included any time a full TAL/TCL analyte list is required. Results for PFOA and PFOS should be compared to the applicable guidance values. If PFOA or PFOS is detected in any sample at or above the guidance values then the source of backfill should be rejected, unless a site-specific exemption is provided by DER based on SPLP testing, for example. If the concentrations of PFOA and PFOS in leachate are at or above 10 ppt (the Maximum Contaminant Levels established for drinking water by the New York State Department of Health), then the soil is not acceptable.

PFOA, PFOS and 1,4-dioxane are all considered semi-volatile compounds, so composite samples are appropriate for these compounds when sampling in accordance with DER-10, Table 5.4(e)10. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.

Appendix A - Quality Assurance Project Plan (QAPP) Guidelines for PFAS

The following guidelines (general and PFAS-specific) can be used to assist with the development of a QAPP for projects within DER involving sampling and analysis of PFAS.

General Guidelines in Accordance with DER-10

- Document/work plan section title – Quality Assurance Project Plan
- Summarize project scope, goals, and objectives
- Provide project organization including names and resumes of the project manager, Quality Assurance Officer (QAO), field staff, and Data Validator
    - The QAO should not have another position on the project, such as project or task manager, that involves project productivity or profitability as a job performance criterion
- List the ELAP certified lab(s) to be used for analysis of samples
- Include a site map showing sample locations
- Provide detailed sampling procedures for each matrix
- Include Data Quality Usability Objectives
- List equipment decontamination procedures
- Include an "Analytical Methods/Quality Assurance Summary Table" specifying:
    - Matrix type
    - Number or frequency of samples to be collected per matrix
    - Number of field and trip blanks per matrix
    - Analytical parameters to be measured per matrix
    - Analytical methods to be used per matrix with minimum reporting limits
    - Number and type of matrix spike and matrix spike duplicate samples to be collected
    - Number and type of duplicate samples to be collected
    - Sample preservation to be used per analytical method and sample matrix
    - Sample container volume and type to be used per analytical method and sample matrix
    - Sample holding time to be used per analytical method and sample matrix
- Specify Category B laboratory data deliverables and preparation of a DUSR

Specific Guidelines for PFAS

- Include in the text that sampling for PFAS will take place
- Include in the text that PFAS will be analyzed by LC-MS/MS for PFAS using methodologies based on EPA Method 537.1
- Include the list of PFAS compounds to be analyzed (*PFAS Analyte List*)
- Include the laboratory SOP for PFAS analysis
- List the minimum method-achievable Reporting Limits for PFAS
    - Reporting Limits should be less than or equal to:
        - Aqueous – 2 ng/L (ppt)
        - Solids – 0.5 µg/kg (ppb)
- Include the laboratory Method Detection Limits for the PFAS compounds to be analyzed
- Laboratory should have ELAP certification for PFOA and PFOS in drinking water by EPA Method 537, 537.1, EPA Method 533, or ISO 25101
- Include detailed sampling procedures
    - Precautions to be taken
    - Pump and equipment types
    - Decontamination procedures
    - Approved materials only to be used
- Specify that regular ice only will be used for sample shipment
- Specify that equipment blanks should be collected at a minimum frequency of 1 per day per site for each matrix

Appendix B - Sampling Protocols for PFAS in Soils, Sediments and Solids

General

The objective of this protocol is to give general guidelines for the collection of soil, sediment and other solid samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Containers

Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation’s Division of Environmental Remediation.

No sampling equipment components or sample containers should come in to contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel spoon
- stainless steel bowl
- steel hand auger or shovel without any coatings

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Sampling is often conducted in areas where a vegetative turf has been established. In these cases, a pre-cleaned trowel or shovel should be used to carefully remove the turf so that it may be replaced at the conclusion of sampling. Surface soil samples (e.g. 0 to 6 inches below surface) should then be collected using a pre-cleaned, stainless steel spoon. Shallow subsurface soil samples (e.g. 6 to ~36 inches below surface) may be collected by digging a hole using a pre-cleaned hand auger or shovel. When the desired subsurface depth is reached, a pre-cleaned hand auger or spoon shall be used to obtain the sample.

When the sample is obtained, it should be deposited into a stainless steel bowl for mixing prior to filling the sample containers. The soil should be placed directly into the bowl and mixed thoroughly by rolling the material into the middle until the material is homogenized. At this point the material within the bowl can be placed into the laboratory provided container.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2° Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A soil log or sample log shall document the location of the sample/borehole, depth of the sample, sampling equipment, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix C - Sampling Protocols for PFAS in Monitoring Wells

General

The objective of this protocol is to give general guidelines for the collection of groundwater samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include: stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including plumbers tape and sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel inertia pump with HDPE tubing
- peristaltic pump equipped with HDPE tubing and silicone tubing
- stainless steel bailer with stainless steel ball
- bladder pump (identified as PFAS-free) with HDPE tubing

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Monitoring wells should be purged in accordance with the sampling procedure (standard/volume purge or low flow purge) identified in the site work plan, which will determine the appropriate time to collect the sample. If sampling using standard purge techniques, additional purging may be needed to reduce turbidity levels, so samples contain a limited amount of sediment within the sample containers. Sample containers that contain sediment may cause issues at the laboratory, which may result in elevated reporting limits and other issues during the sample preparation that can compromise data usability. Sampling personnel should don new nitrile gloves prior to sample collection due to the potential to contact PFAS containing items (not related to the sampling equipment) during the purging activities.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Collect one equipment blank per day per site and minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers
- Additional equipment blank samples may be collected to assess other equipment that is utilized at the monitoring well
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A purge log shall document the location of the sample, sampling equipment, groundwater parameters, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix D - Sampling Protocols for PFAS in Surface Water

General

The objective of this protocol is to give general guidelines for the collection of surface water samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include: stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation’s Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel cup

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Where conditions permit, (e.g. creek or pond) sampling devices (e.g. stainless steel cup) should be rinsed with site medium to be sampled prior to collection of the sample. At this point the sample can be collected and poured into the sample container.

If site conditions permit, samples can be collected directly into the laboratory container.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification.   Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Collect one equipment blank per day per site and minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A sample log shall document the location of the sample, sampling equipment, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix E - Sampling Protocols for PFAS in Private Water Supply Wells

General

The objective of this protocol is to give general guidelines for the collection of water samples from private water supply wells (with a functioning pump) for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Drinking water samples collected using this protocol are intended to be analyzed for PFAS by EPA Method 537, 537.1, 533, or ISO Method 25101. The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation’s Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials (e.g. plumbers tape), including sample bottle cap liners with a PTFE layer.

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Locate and assess the pressure tank and determine if any filter units are present within the building. Establish the sample location as close to the well pump as possible, which is typically the spigot at the pressure tank. Ensure sampling equipment is kept clean during sampling as access to the pressure tank spigot, which is likely located close to the ground, may be obstructed and may hinder sample collection.

Prior to sampling, a faucet downstream of the pressure tank (e.g., washroom sink) should be run until the well pump comes on and a decrease in water temperature is noted which indicates that the water is coming from the well. If the homeowner is amenable, staff should run the water longer to purge the well (15+ minutes) to provide a sample representative of the water in the formation rather than standing water in the well and piping system including the pressure tank. At this point a new pair of nitrile gloves should be donned and the sample can be collected from the sample point at the pressure tank.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- If equipment was used, collect one equipment blank per day per site and a minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers.
- A field reagent blank (FRB) should be collected at a rate of one per 20 samples. The lab will provide a FRB bottle containing PFAS free water and one empty FRB bottle. In the field, pour the water from the one bottle into the empty FRB bottle and label appropriately.
- Request appropriate data deliverable (Category B) and an electronic data deliverable
- For sampling events where multiple private wells (homes or sites) are to be sampled per day, it is acceptable to collect QC samples at a rate of one per 20 across multiple sites or days.

Documentation

A sample log shall document the location of the private well, sample point location, owner contact information, sampling equipment, purge duration, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate and available (e.g. well construction, pump type and location, yield, installation date). Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appendix F - Sampling Protocols for PFAS in Fish

This appendix contains a copy of the latest guidelines developed by the Division of Fish and Wildlife (DFW) entitled "General Fish Handling Procedures for Contaminant Analysis" (Ver. 8).

Procedure Name: General Fish Handling Procedures for Contaminant Analysis

Number: FW-005

Purpose: This procedure describes data collection, fish processing and delivery of fish collected for contaminant monitoring. It contains the chain of custody and collection record forms that should be used for the collections.

Organization: Environmental Monitoring Section
Bureau of Ecosystem Health
Division of Fish and Wildlife (DFW)
New York State Department of Environmental Conservation (NYSDEC)
625 Broadway
Albany, New York 12233-4756

Version: 8

Previous Version Date: 21 March 2018

Summary of Changes to this Version: Updated bureau name to Bureau of Ecosystem Health. Added direction to list the names of all field crew on the collection record. Minor formatting changes on chain of custody and collection records.

Originator or Revised by: Wayne Richter, Jesse Becker

Date: 26 April 2019

Quality Assurance Officer and Approval Date: Jesse Becker, 26 April 2019

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

GENERAL FISH HANDLING PROCEDURES FOR CONTAMINANT ANALYSES

A. Original copies of all continuity of evidence (i.e., Chain of Custody) and collection record forms must accompany delivery of fish to the lab. A copy shall be directed to the Project Leader or as appropriate, Wayne Richter. All necessary forms will be supplied by the Bureau of Ecosystem Health. Because some samples may be used in legal cases, it is critical that each section is filled out completely. Each Chain of Custody form has three main sections:

1. The top box is to be filled out **and signed** by the person responsible for the fish collection (e.g., crew leader, field biologist, researcher). This person is responsible for delivery of the samples to DEC facilities or personnel (e.g., regional office or biologist).

2. The second section is to be filled out **and signed** by the person responsible for the collections while being stored at DEC, before delivery to the analytical lab. This may be the same person as in (1), but it is still required that they complete the section. Also important is the **range of identification numbers** (i.e., tag numbers) included in the sample batch.

3. Finally, the bottom box is to record any transfers between DEC personnel and facilities. Each subsequent transfer should be **identified, signed, and dated**, until laboratory personnel take possession of the fish.

B. The following data are required on each **Fish Collection Record** form:

1. Project and Site Name.

2. DEC Region.

3. All personnel (and affiliation) involved in the collection.

4. Method of collection (gill net, hook and line, etc.)

5. Preservation Method.

C. The following data are to be taken on each fish collected and recorded on the **Fish Collection Record** form:

1. Tag number - Each specimen is to be individually jaw tagged at time of collection with a unique number. Make sure the tag is turned out so that the number can be read without opening the bag. Use tags in sequential order. For small fish or composite samples place the tag inside the bag with the samples. The Bureau of Ecosystem Health can supply the tags.

2. Species identification (please be explicit enough to enable assigning genus and species). Group fish by species when processing.

3. Date collected.

4. Sample location (waterway and nearest prominent identifiable landmark).

5. Total length (nearest mm or smallest sub-unit on measuring instrument) and weight (nearest g or

smallest sub-unit of weight on weighing instrument). Take all measures as soon as possible with calibrated, protected instruments (e.g. from wind and upsets) and prior to freezing.

6. Sex - fish may be cut enough to allow sexing or other internal investigation, but do not eviscerate. Make any incision on the right side of the belly flap or exactly down the midline so that a left-side fillet can be removed.

D. General data collection recommendations:

1. It is helpful to use an ID or tag number that will be unique. It is best to use metal striped bass or other uniquely numbered metal tags. If uniquely numbered tags are unavailable, values based on the region, water body and year are likely to be unique: for example, R7CAY11001 for Region 7, Cayuga Lake, 2011, fish 1. If the fish are just numbered 1 through 20, we have to give them new numbers for our database, making it more difficult to trace your fish to their analytical results and creating an additional possibility for errors.

2. Process and record fish of the same species sequentially. Recording mistakes are less likely when all fish from a species are processed together. Starting with the bigger fish species helps avoid missing an individual.

3. If using Bureau of Ecosystem Health supplied tags or other numbered tags, use tags in sequence so that fish are recorded with sequential Tag Numbers. This makes data entry and login at the lab and use of the data in the future easier and reduces keypunch errors.

4. Record length and weight as soon as possible after collection and before freezing. Other data are recorded in the field upon collection. An age determination of each fish is optional, but if done, it is recorded in the appropriate “Age” column.

5. For composite samples of small fish, record the number of fish in the composite in the Remarks column. Record the length and weight of each individual in a composite. All fish in a composite sample should be of the same species and members of a composite should be visually matched for size.

6. Please submit photocopies of topographic maps or good quality navigation charts indicating sampling locations. GPS coordinates can be entered in the Location column of the collection record form in addition to or instead for providing a map. These records are of immense help to us (and hopefully you) in providing documented location records which are not dependent on memory and/or the same collection crew. In addition, they may be helpful for contaminant source trackdown and remediation/control efforts of the Department.

7. When recording data on fish measurements, it will help to ensure correct data recording for the data recorder to call back the numbers to the person making the measurements.

E. Each fish is to be placed in its own individual plastic bag. For small fish to be analyzed as a composite, put all of the fish for one composite in the same bag but use a separate bag for each composite. It is important to individually bag the fish to avoid difficulties or cross contamination when processing the fish for chemical analysis. Be sure to include the fish’s tag number inside the bag, preferably attached to the fish with the tag number turned out so it can be read. Tie or otherwise secure the bag closed. **The Bureau of Ecosystem Health will supply the bags.** If necessary, food grade bags may be procured from a suitable vendor (e.g., grocery store). It is preferable to redundantly label each bag with a manila tag tied between the knot and the body of the bag. This tag should be labeled with the project name, collection location, tag number, collection date, and fish species. If scales are collected, the scale envelope should be labeled with the same information.

F. Groups of fish, by species, are to be placed in one large plastic bag per sampling location. **The Bureau of Ecosystem Health will supply the larger bags.** Tie or otherwise secure the bag closed. Label the site bag with a manila tag tied between the knot and the body of the bag. The tag should contain: project, collection location, collection date, species and **tag number ranges**. Having this information on the manila tag enables lab staff to know what is in the bag without opening it.

G. Do not eviscerate, fillet or otherwise dissect the fish unless specifically asked to. If evisceration or dissection is specified, the fish must be cut along the exact midline or on the right side so that the left side fillet can be removed intact at the laboratory. If filleting is specified, the procedure for taking a standard fillet (SOP PREPLAB 4) must be followed, including removing scales.

H. Special procedures for PFAS: Unlike legacy contaminants such as PCBs, which are rarely found in day to day life, PFAS are widely used and frequently encountered. Practices that avoid sample contamination are therefore necessary. While no standard practices have been established for fish, procedures for water quality sampling can provide guidance. The following practices should be used for collections when fish are to be analyzed for PFAS:

    No materials containing Teflon.
    No Post-it notes.
    No ice packs; only water ice or dry ice.
    Any gloves worn must be powder free nitrile.
    No Gore-Tex or similar materials (Gore-Tex is a PFC with PFOA used in its manufacture).
    No stain repellent or waterproof treated clothing; these are likely to contain PFCs.
    Avoid plastic materials, other than HDPE, including clipboards and waterproof notebooks.
    Wash hands after handling any food containers or packages as these may contain PFCs. Keep pre-wrapped food containers and wrappers isolated from fish handling.
    Wear clothing washed at least six times since purchase.
    Wear clothing washed without fabric softener.
    Staff should avoid cosmetics, moisturizers, hand creams and similar products on the day of sampling as many of these products contain PFCs (Fujii et al. 2013). Sunscreen or insect repellent should not contain ingredients with “fluor” in their name. Apply any sunscreen or insect repellent well downwind from all materials. Hands must be washed after touching any of these products.

I. All fish must be kept at a temperature <45° F (<8° C) immediately following data processing. As soon as possible, freeze at -20° C ± 5° C. Due to occasional freezer failures, daily freezer temperature logs are required. The freezer should be locked or otherwise secured to maintain chain of custody.

J. In most cases, samples should be delivered to the Analytical Services Unit at the Hale Creek field station. Coordinate delivery with field station staff and send copies of the collection records, continuity of evidence forms and freezer temperature logs to the field station. For samples to be analyzed elsewhere, non-routine collections or other questions, contact Wayne Richter, Bureau of Ecosystem Health, NYSDEC, 625 Broadway, Albany, New York 12233-4756, 518-402-8974, or the project leader about sample transfer. Samples will then be directed to the analytical facility and personnel noted on specific project descriptions.

K. A recommended equipment list is at the end of this document.

page ______ of ______

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF FISH AND WILDLIFE
FISH COLLECTION RECORD

Project and Site Name ____ DEC Region __________

Collections made by (include all crew) ____

Sampling Method: ☐Electrofishing ☐Gill netting ☐Trap netting ☐Trawling ☐Seining ☐Angling ☐Other ____________________

Preservation Method: ☐Freezing ☐Other ________________ Notes (SWFDB survey number): ____________________

FOR LAB USE ONLY- LAB ENTRY NO.	COLLECTION OR TAG NO.	SPECIES	DATE TAKEN	LOCATION	AGE	SEX &/OR REPROD. CONDIT	LENGTH ( )	WEIGHT ( )	REMARKS

richter: revised 2011, 5/7/15, 10/4/16, 3/20/17; becker: 3/23/17, 4/26/19

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
CHAIN OF CUSTODY

I, ______________________________, of ____ collected the
(Print Name) (Print Business Address)

following on ____________________, 20____ from ____
(Date) (Water Body)

in the vicinity of ____
(Landmark, Village, Road, etc.)

Town of ____, in __________________________________ County.

Item(s) ____

____

Said sample(s) were in my possession and handled according to standard procedures provided to me prior to collection. The sample(s) were placed in the custody of a representative of the New York State Department of Environmental Conservation on ____________________________________, 20______.

____ ____________________________
Signature Date

I, ___________________________________, received the above mentioned sample(s) on the date specified and assigned identification number(s) ____ to the sample(s). I have recorded pertinent data for the sample(s) on the attached collection records. The sample(s) remained in my custody until subsequently transferred, prepared or shipped at times and on dates as attested to below.

____ ____________________
Signature Date

SECOND RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
THIRD RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
FOURTH RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
RECEIVED IN LABORATORY BY (Print Name)	TIME & DATE	REMARKS
SIGNATURE	UNIT	
LOGGED IN BY (Print Name)	TIME & DATE	ACCESSION NUMBERS
SIGNATURE	UNIT	

richter: revised 21 April 2014; becker: 23 March 2017, 26 April, 2019

NOTICE OF WARRANTY

By signature to the chain of custody (reverse), the signatory warrants that the information provided is truthful and accurate to the best of his/her ability. The signatory affirms that he/she is willing to testify to those facts provided and the circumstances surrounding the same. Nothing in this warranty or chain of custody negates responsibility nor liability of the signatories for the truthfulness and accuracy of the statements provided.

HANDLING INSTRUCTIONS

On day of collection, collector(s) name(s), address(es), date, geographic location of capture (attach a copy of topographic map or navigation chart), species, number kept of each species, and description of capture vicinity (proper noun, if possible) along with name of Town and County must be indicated on reverse.

Retain organisms in manila tagged plastic bags to avoid mixing capture locations. Note appropriate information on each bag tag.

Keep samples as cool as possible. Put on ice if fish cannot be frozen within 12 hours. If fish are held more than 24 hours without freezing, they will not be retained or analyzed.

Initial recipient (either DEC or designated agent) of samples from collector(s) is responsible for obtaining and recording information on the collection record forms which will accompany the chain of custody. This person will seal the container using packing tape and writing his signature, the time and the date across the tape onto the container with indelible marker. Any time a seal is broken, for whatever purpose, the incident must be recorded on the Chain of Custody (reason, time, and date) in the purpose of transfer block. Container then is resealed using new tape and rewriting signature, with time and date.

EQUIPMENT LIST

Scale or balance of appropriate capacity for the fish to be collected.

Fish measuring board.

Plastic bags of an appropriate size for the fish to be collected and for site bags.

Individually numbered metal tags for fish.

Manila tags to label bags.

Small envelops, approximately 2” x 3.5”, if fish scales are to be collected.

Knife for removing scales.

Chain of custody and fish collection forms.

Clipboard.

Pens or markers.

Paper towels.

Dish soap and brush.

Bucket.

Cooler.

Ice.

Duct tape.

Appendix G – PFAS Analyte List

Group	Chemical Name	Abbreviation	CAS Number
Perfluoroalkyl sulfonates	Perfluorobutanesulfonic acid	PFBS	375-73-5
	Perfluorohexanesulfonic acid	PFHxS	355-46-4
	Perfluoroheptanesulfonic acid	PFHpS	375-92-8
	Perfluorooctanesulfonic acid	PFOS	1763-23-1
	Perfluorodecanesulfonic acid	PFDS	335-77-3
Perfluoroalkyl carboxylates	Perfluorobutanoic acid	PFBA	375-22-4
	Perfluoropentanoic acid	PFPeA	2706-90-3
	Perfluorohexanoic acid	PFHxA	307-24-4
	Perfluoroheptanoic acid	PFHpA	375-85-9
	Perfluorooctanoic acid	PFOA	335-67-1
	Perfluorononanoic acid	PFNA	375-95-1
	Perfluorodecanoic acid	PFDA	335-76-2
	Perfluoroundecanoic acid	PFUA/PFUdA	2058-94-8
	Perfluorododecanoic acid	PFDoA	307-55-1
	Perfluorotridecanoic acid	PFTriA/PFTrDA	72629-94-8
	Perfluorotetradecanoic acid	PFTA/PFTeDA	376-06-7
Fluorinated Telomer Sulfonates	6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2
	8:2 Fluorotelomer sulfonate	8:2 FTS	39108-34-4
Perfluorooctane-sulfonamides	Perfluroroctanesulfonamide	FOSA	754-91-6
Perfluorooctane-sulfonamidoacetic acids	N-methyl perfluorooctanesulfonamidoacetic acid	N-MeFOSAA	2355-31-9
	N-ethyl perfluorooctanesulfonamidoacetic acid	N-EtFOSAA	2991-50-6

Appendix H - Laboratory Guidelines for Analysis of PFAS in Non-Potable Water and Solids

General

New York State Department of Environmental Conservation's Division of Environmental Remediation (DER) developed the following guidelines for laboratories analyzing environmental samples for PFAS under DER programs. If laboratories cannot adhere to the following guidelines, they should contact DER's Quality Assurance Officer, Dana Barbarossa, at dana.barbarossa@dec.ny.gov prior to analysis of samples.

Isotope Dilution

Isotope dilution techniques should be utilized for the analysis of PFAS in all media.

Extraction

For water samples, the entire sample bottle should be extracted, and the sample bottle rinsed with appropriate solvent to remove any residual PFAS.

For samples with high particulates, the samples should be handled in one of the following ways:

1. Spike the entire sample bottle with isotope dilution analytes (IDAs) prior to any sample manipulation. The sample can be passed through the SPE and if it clogs, record the volume that passed through.
2. If the sample contains too much sediment to attempt passing it through the SPE cartridge, the sample should be spiked with isotope dilution analytes, centrifuged and decanted.
3. If higher reporting limits are acceptable for the project, the sample can be diluted by taking a representative aliquot of the sample. If isotope dilution analytes will be diluted out of the sample, they can be added after the dilution. The sample should be homogenized prior to taking an aliquot.

If alternate sample extraction procedures are used, please contact the DER remedial program chemist prior to employing. Any deviations in sample preparation procedures should be clearly noted in the case narrative.

Signal to Noise Ratio

For all target analyte ions used for quantification, signal to noise ratio should be 3:1 or greater.

Blanks

There should be no detections in the method blanks above the reporting limits.

Ion Transitions

The ion transitions listed below should be used for the following PFAS:

PFOA	413 > 369
PFOS	499 > 80
PFHxS	399 > 80
PFBS	299 > 80
6:2 FTS	427 > 407
8:2 FTS	527 > 507
N-EtFOSAA	584 > 419
N-MeFOSAA	570 > 419

Branched and Linear Isomers

Standards containing both branched and linear isomers should be used when standards are commercially available. Currently, quantitative standards are available for PFHxS, PFOS, NMeFOSAA, and NEtFOSAA. As more standards become available, they should be incorporated in to the method. All isomer peaks present in the standard should be integrated and the areas summed. Samples should be integrated in the same manner as the standards.

Since a quantitative standard does not exist for branched isomers of PFOA, the instrument should be calibrated using just the linear isomer and a technical (qualitative) PFOA standard should be used to identify the retention time of the branched PFOA isomers in the sample. The total response of PFOA branched and linear isomers should be integrated in the samples and quantitated using the calibration curve of the linear standard.

Secondary Ion Transition Monitoring

Quantifier and qualifier ions should be monitored for all target analytes (PFBA and PFPeA are exceptions). The ratio of quantifier ion response to qualifier ion response should be calculated for each target analyte and the ratio compared to standards. Lab derived criteria should be used to determine if the ratios are acceptable.

Reporting

Detections below the reporting limit should be reported and qualified with a J qualifier.

The acid form of PFAS analytes should be reported. If the salt form of the PFAS was used as a stock standard, the measured mass should be corrected to report the acid form of the analyte.

Appendix I - Data Review Guidelines for Analysis of PFAS in Non-Potable Water and Solids

General

These guidelines are intended to be used for the validation of PFAS analytical results for projects within the Division of Environmental Remediation (DER) as well as aid in the preparation of a data usability summary report. Data reviewers should understand the methodology and techniques utilized in the analysis. Consultation with the end user of the data may be necessary to assist in determining data usability based on the data quality objectives in the Quality Assurance Project Plan. A familiarity with the laboratory's Standard Operating Procedure may also be needed to fully evaluate the data. If you have any questions, please contact DER's Quality Assurance Officer, Dana Barbarossa, at dana.barbarossa@dec.ny.gov.

Preservation and Holding Time

Samples should be preserved with ice to a temperature of less than 6°C upon arrival at the lab. The holding time is 14 days to extraction for aqueous and solid samples. The time from extraction to analysis for aqueous samples is 28 days and 40 days for solids.

Temperature greatly exceeds 6ºC upon arrival at the lab*	Use professional judgement to qualify detects and non-detects as estimated or rejected
Holding time exceeding 28 days to extraction	Use professional judgement to qualify detects and non-detects as estimated or rejected if holding time is grossly exceeded

*Samples that are delivered to the lab immediately after sampling may not meet the thermal preservation guidelines. Samples are considered acceptable if they arrive on ice or an attempt to chill the samples is observed.

Initial Calibration

The initial calibration should contain a minimum of five standards for linear fit and six standards for a quadratic fit. The relative standard deviation (RSD) for a quadratic fit calibration should be less than 20%. Linear fit calibration curves should have an R^2 value greater than 0.990.

The low-level calibration standard should be within 50% - 150% of the true value, and the mid-level calibration standard within 70% - 130% of the true value.

%RSD >20%	J flag detects and UJ non detects
R^2 >0.990	J flag detects and UJ non detects
Low-level calibration check <50% or >150%	J flag detects and UJ non detects
Mid-level calibration check <70% or >130%	J flag detects and UJ non detects

Initial Calibration Verification

An initial calibration verification (ICV) standard should be from a second source (if available). The ICV should be at the same concentration as the mid-level standard of the calibration curve.

ICV recovery <70% or >130%	J flag detects and non-detects

Continuing Calibration Verification

Continuing calibration verification (CCV) checks should be analyzed at a frequency of one per ten field samples. If CCV recovery is very low, where detection of the analyte could be in question, ensure a low level CCV was analyzed and use to determine data quality.

CCV recovery <70 or >130%	J flag results

Blanks

There should be no detections in the method blanks above the reporting limits. Equipment blanks, field blanks, rinse blanks etc. should be evaluated in the same manner as method blanks. Use the most contaminated blank to evaluate the sample results.

Blank Result	Sample Result	Qualification
Any detection	<Reporting limit	Qualify as ND at reporting limit
Any detection	>Reporting Limit and >10x the blank result	No qualification
>Reporting limit	>Reporting limit and <10x blank result	J+ biased high

Field Duplicates

A blind field duplicate should be collected at rate of one per twenty samples. The relative percent difference (RPD) should be less than 30% for analyte concentrations greater than two times the reporting limit. Use the higher result for final reporting.

RPD >30%	Apply J qualifier to parent sample

Lab Control Spike

Lab control spikes should be analyzed with each extraction batch or one for every twenty samples. In the absence of lab derived criteria, use 70% - 130% recovery criteria to evaluate the data.

Recovery <70% or >130% (lab derived criteria can also be used)	Apply J qualifier to detects and UJ qualifier to non detects

Matrix Spike/Matrix Spike Duplicate

One matrix spike and matrix spike duplicate should be collected at a rate of one per twenty samples. Use professional judgement to reject results based on out of control MS/MSD recoveries.

Recovery <70% or >130% (lab derived criteria can also be used)	Apply J qualifier to detects and UJ qualifier to non detects of parent sample only
RPD >30%	Apply J qualifier to detects and UJ qualifier to non detects of parent sample only

Extracted Internal Standards (Isotope Dilution Analytes)

Problematic analytes (e.g. PFBA, PFPeA, fluorotelomer sulfonates) can have wider recoveries without qualification. Qualify corresponding native compounds with a J flag if outside of the range.

Recovery <50% or >150%	Apply J qualifier
Recovery <25% or >150% for poor responding analytes	Apply J qualifier
Isotope Dilution Analyte (IDA) Recovery <10%	Reject results

Secondary Ion Transition Monitoring

Quantifier and qualifier ions should be monitored for all target analytes (PFBA and PFPeA are exceptions). The ratio of quantifier ion response to qualifier ion response should be calculated from the standards for each target analyte. Lab derived criteria should be used to determine if the ratios are acceptable. If the ratios fall outside of the laboratory criteria, qualify results as an estimated maximum concentration.

Signal to Noise Ratio

The signal to noise ratio for the quantifier ion should be at least 3:1. If the ratio is less than 3:1, the peak is discernable from the baseline noise and symmetrical, the result can be reported. If the peak appears to be baseline noise and/or the shape is irregular, qualify the result as tentatively identified.

Branched and Linear Isomers

Observed branched isomers in the sample that do not have a qualitative or quantitative standard should be noted and the analyte should be qualified as biased low in the final data review summary report. Note: The branched isomer peak should also be present in the secondary ion transition.

Reporting Limits

If project-specific reporting limits were not met, please indicate that in the report along with the reason (e.g. over dilution, dilution for non-target analytes, high sediment in aqueous samples).

Peak Integrations

Target analyte peaks should be integrated properly and consistently when compared to standards. Ensure branched isomer peaks are included for PFAS where standards are available. Inconsistencies should be brought to the attention of the laboratory or identified in the data review summary report.

Appendix F

Standard Operating Procedures

Field Logging, Handling and Documentation of Borehole Materials

Standard Operating Procedure

CS001

C&S Engineers, Inc.

141 Elm Street

Buffalo, New York 14203

January 2013

Revision Log

Revision	***Effective Date***	**Prepared By**	***Description of Changes***	***Affected Pages***
0	1/4/13	Daniel Riker, P.G.	New Procedure	All

Field Logging, Handling and Documentation of Borehole Materials

Table of Contents

Field Logging, Handling and Documentation of Borehole Materials

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the process for field logging, handling and documentation of borehole materials on C&S Engineers, Inc. (C&S) environmental assessment and investigation projects.

2.0 SCOPE

This SOP is a mandatory document and will be implemented by all C&S Project participants when field logging, handling and documenting borehole materials for all C&S projects.

3.0 TRAINING

3.1 All users of this SOP are trained by reading the procedure.

3.2 The Field Team Leader (FTL) will monitor the proper implementation of this procedure and ensures that relevant team members have completed all applicable training assignments.

4.0 DEFINITIONS

4.1 Borehole Materials– are anything that may emanate from the subsurface during a drilling project, and typically consist of soil, core, cuttings, rubble, rock chips, groundwater and drilling fluids (gas, vapor, and liquid).

4.2 Borehole Material Management — the collection, documentation, storage and control of borehole materials and records. The Drilling and Field Support Teams are responsible for implementing borehole material management activities at the drill site under the oversight and support of the Subsurface Technologies Team. All borehole materials are managed as waste materials.

4.3 Core — is a cylindrical section of rock, or fragment thereof, that is taken as a sample of the interval penetrated by a core bit and that is brought to the surface for examination and/or analysis.

4.4 Core Run—is the process of drilling and recovering a length of core; also the piece of core recovered from a core barrel during the core run.

4.5 Curation/Disposal Strategy — A strategy summarizing a specific project's plans for borehole material handling, curation and disposal. Includes planned depth of boreholes, number of samples to be removed and a schedule for these activities. The curation strategy also allows the Field Team a place to describe options in borehole material curation.

4.6 Cuttings—are materials produced during drilling that are removed from the borehole.

4.7 Drilling Documents— consist of the following: Equipment and Supplies Checklist, Photographic Log (when necessary), Field Borehole Analytical Sample Removal Checklist, Field Screening Log, Borehole Log, Curation/Disposal Strategy and drilling guidance documents.

4.8 Drilling Guidance Document — a document summarizing the location, objectives and operation guidelines for a specific borehole. Included are details and exceptions relevant to the logging, handling, documentation and curation/disposal strategy of borehole materials for the borehole (i.e. Field Implementation Plan (FIP) or Scope of Work (SOW)).

4.9 Rubble—are pieces of core with diameters smaller than half the diameter of whole core, such that reconstruction between individual pieces is not possible.

4.10 Sample—a physical entity, collected in the field that is the original source material for all-subsequent analyses and testing activities.

4.11 Site-Specific Health and Safety Plan (SSHASP)—A health and safety plan that is specific to a site or C&S-related field activity that has been approved by a C&S health and safety representative. This document contains information specific to the project including scope of work, relevant history, descriptions of hazards by activity associated with the project site(s), and techniques for exposure mitigation (e.g., personal protective equipment [PPE]) and hazard mitigation.

4.12 Subsample—a selection or aliquot from a sample that may or may not be representative of the sample.

5.0 BACKGROUND AND PRECAUTIONS

5.1 This procedure prescribes the specific borehole material management methods to be followed and documentation to be prepared during handling and field logging of selected borehole materials identified in the site guidance documents. This SOP will be used in conjunction with an approved SSHASP. Also, consult the SSHASP for information on and use of all PPE.

5.2 This procedure is limited to the activities necessary to take custody of core and cuttings from drill rig personnel, conduct field screening, remove time sensitive analytical samples and subsamples for preliminary characterization, complete photo documentation when necessary and perform field structural, and lithologic description.

5.3 The requirements of this procedure are subject to modification depending on the exact nature of the borehole being drilled, as delineated in a drilling project guidance document (e.g. a FIP or SOW).

6.0 RESPONSIBLE PERSONNEL

The following participants are responsible for activities identified in this procedure.

6.1 Field Team Leader
6.2 Quality Program Project Leader
6.3 C&S Staff

7.0 EQUIPMENT

Borehole material management field equipment will be assembled before initiation of field activities.

8.0 PROCEDURE

Note: Subcontractors performing work under C&S's Project's quality program may follow this standard operating procedure (SOP) for borehole material logging, handling and documentation or may use their own procedure(s) as long as the substitute meets the requirements prescribed by the C&S Project Quality Management Plan, and is approved by C&S's Project's Quality Program Project Leader (QPPL) before the commencement of the designated activities.

This procedure describes the handling of the subset of borehole materials to be curated from the time they are withdrawn from the borehole to the time they are ready to be transported. For the purposes of this SOP, borehole material may also refer to other solid materials, such as drive samples or augured materials. These activities will be performed under the direction of the FTL.

In rare drilling situations, core and cuttings handling procedures will be performed in sequential order. However, drilling often occurs at a rate that requires prioritization of those handling procedures. In addition, samples collected for time sensitive analyses require prioritization of those handling procedures. A drilling project typically has periods of high production interspersed with slow periods. It is critical to perform field screening, determine recovery, and collect accurate depths, photographs (when necessary), and samples during periods of high production. Less critical handling functions (e.g., logging, boxing, labeling, washing, screening, geologic study, and stratigraphic interpretation) may be accomplished during slow periods. The FPL, FTL, and technical team leadership should evaluate the borehole handling procedures on a case-by-case basis to maintain quality yet allow efficient drilling production. If possible, modification to handling methods should be described in the guidance documents and documented on-site in the FTL notebook.

8.1 Borehole Material Staging

The driller or helper will collect the core or cuttings according to drilling methods outlined in the project guidance documents. Borehole materials will be field screened in the exclusion zone (HAZWOPER site) or access control zone (other sites) prior to subsequent handling.

At sites where collection of hazardous samples is not a concern, section 8.1.1 can be dispensed with and material staging may proceed directly to section 8.1.2. Such a determination will be made in preparation of the project guidance documents. However, a Field Screening Log will be completed by a qualified individual noting that the material does not exhibit hazardous properties.

8.1.1 Field Screening

Drilling technique and site-specific conditions will dictate how borehole materials will be field screened to ensure participant health and safety (H&S). Specific field screening procedures will be outlined in the SSHASP and guidance documents. Field screening should ensure participant H&S and not delay drilling production.

A comparison of field screening results also will be made with the action levels for radiation and organic vapors established in the SSHASP. If readings indicate activity or concentrations above action levels, then drilling activities will immediately be suspended, all participants will be removed to the field support area and will remain at the site (in case of potential radiological contamination).

8.2 Temporary Packaging of Time Sensitive Analytical Samples

Many time-sensitive analyses require that analytical samples be collected, containerized, and preserved immediately after the borehole materials are brought to the surface. The requirement for the removal of analytical samples directly from the drill site will be delineated in the site-specific guidance documents.

8.3 Measurement and Determination of Material Loss

8.3.1 Measurement of Run Interval for Core Samples

8.3.1.1 Starting at the top of the core run, pieces of core will be fitted together to reconstruct larger sections of core. If possible, rubble will be reconstructed to accurately represent the interval from which it was recovered.

8.3.1.2 The core will be measured with a steel engineering tape to the nearest 0.1 ft. Record the amount of core drilled and recovered on the Run Marker (pink index card), the Core Log, and as required by project specific guidance. Total core loss cannot be determined until the next run is recovered.

8.3.2 Determination of Core Loss

Note: If a core loss is indicated after measuring the core, field support participants and the driller will determine the interval(s) at which the loss(es) occurred. This SOP suggests the following guidelines:

8.3.2.1 Assign the core loss to obvious loss zones.

8.3.2.2 If there are no obvious loss zones, assign the core loss to the lowermost rubble zone in that run.

8.3.2.3 If there are no rubble zones, place the loss at the bottom of the run.

8.3.3 Enter the borehole ID, the core loss interval, and the total amount of true core loss on a "Lost Core Marker" (white index card) and place in the proper location.

8.4 Marking Core (Depth Notation and Stripes)

8.4.1 Measure the core to the nearest 0.1 foot with a steel engineering measuring tape. The top of the run will be the starting point for measurement. If the top of the run is angled (e.g., a fracture) and does not match with the previous run, the starting point will be the axis of the core. Indicate footage on the cores at 1-foot intervals. Do not mark footages on the inside of the core boxes because the core may be repackaged and footages invalidated.

8.4.2 Orientation stripes need to be marked on the core to show top vs. bottom of run. Use red and blue permanent markers to place parallel orientation stripes on core (see Attachment E). An alternative method for marking depths and orientation stripes may be used depending on the condition of the borehole material. Orientation stripes on bagged or packaged cuttings, rubble, and disaggregated core are not required, unless a reasonable attempt has been made to preserve the uphole/downhole respective position of the material.

8.5 Core Photography

Field photography of the core prior to excessive handling is a reliable method to document the approximate in-situ condition of the core and provides a visual record in the event of core destruction. Depending upon the requirements of the site-specific guidance documents, core may be photographed with either a still or video camera or both, while core is in the inner tube and after the core has been logged and boxed.

8.6 Core Logging

8.6.1 Borehole materials logging will be performed by a qualified field team member (preferably a geologist) pursuant to currently endorsed C&S Project guidance for stratigraphic nomenclature and lithologic description.

8.6.2 Complete the Borehole Log.

8.7 Removal of Analytical Samples (Core)

8.7.1 Sampling of Borehole materials will be completed and documented by a qualified field team member.

8.7.2 Remove the analytical sample from the core or cuttings and place a marker (blue index card), at the location the sample portion was removed. Log the sample as removed from the core or cuttings.

8.8 Core Box Loading and Storing

8.8.1 Box the core/cuttings/rubble with the top or lowest depth of the run at the lower left corner and with core orientation maintained. Rule of thumb is “going downhole, load core/cuttings left to right, front to back in core box”.

8.8.2 Transfer all markers (Run-pink, Lost Core-white and Analytical Sample Removed-blue) from their position in the core rack to their corresponding position in the core box during the loading process.

8.8.3 Core boxes can be stored on site.

9.0 RECORDS

The FTL is responsible for submitting the following records:

- Borehole Log

Sample Control and Field Documentation

Standard Operating Procedure

CS002

C&S Engineers, Inc.

141 Elm Street

Buffalo, New York
14203

January 2013

Revision Log

Revision	***Effective Date***	**Prepared By**	***Description of Changes***	***Affected Pages***
0	1/4/13	Daniel Riker, P.G.	New Procedure	All

Sample Control and Field Documentation

Table of Contents

Sample Control and Field Documentation

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the process for documenting the traceability of samples collected for C&S Engineers, Inc. (C&S) assessment and environmental investigation projects using sample control and field documentation, specifically, container labels, Sample Collection Logs, Chain of Custody (COC)/Request for Analysis forms, and Daily Activity Log forms or field notebooks.

2.0 SCOPE

2.1 All C&S Personnel shall implement this mandatory SOP when documenting the traceability of samples collected for C&S projects.

2.2 Subcontractors performing work under the C&S Project's quality program shall follow this SOP for documenting the traceability of samples collected for C&S projects.

3.0 TRAINING

3.1 C&S Personnel shall train to and use the current version of this SOP.

3.2 The FTL or designee shall monitor the proper implementation of this procedure and shall ensure that relevant team members complete all applicable training assignments.

4.0 DEFINITIONS

4.1 Chain of custody (COC)—The procedural steps to assure traceability of a sample from initial collection to final disposition. A sample is in one's custody when one or more of the criteria listed below are satisfied:

- The sample is in one or more of the field team members' physical possession.

- The sample is in one's view after being in one's physical possession.

- The sample is in a locked or secured area (accessible only to authorized personnel) and maintained in a manner that would make any tampering evident.

Documentation of these criteria provides evidence that the chain of custody was maintained. The Field COC form documents the traceability of the sample and the sample location.

4.2 Technical team members—The individuals working on the project.

4.3 Field team members—Those authorized individuals present at a sampling site during sample collection.

5.0 BACKGROUND AND PRECAUTIONS

All work performed for a C&S project must be thoroughly and accurately documented. Sample control and field documentation are necessary to document the work performed in the field, to ensure traceability and defensibility of resulting data, and to be legally defensible. Lack of complete documentation may render the fieldwork invalid.

6.0 RESPONSIBLE PERSONNEL

The following personnel are responsible for activities identified in this procedure.

6.1 C&S Personnel
6.2 Field Team Leader or designee
6.3 Courier
6.4 Sample Management Office Staff
6.5 Technical and Field Team Member

7.0 EQUIPMENT

The list below represents the equipment necessary to complete the tasks defined in this procedure.

- Computer
- Compatible printer

8.0 PROCEDURE

8.1 Generate Sample Control and Field Documentation

8.1.1 While collecting samples, the Field Team Leader (FTL) or designee shall complete all the blank fields in the Sample Control and Field Documentation.

8.1.2 The FTL or designee shall correct the planned values by filling in the "as collected" spaces, based on field observations. If the planned values are accurate, the FTL or designee shall write in "OK" in the "as collected" spaces.

8.1.3 The FTL or designee shall ensure that sample labels that provide information regarding the samples are affixed to the sample containers prior to or immediately following the sampling activity.

8.1.4 The FTL or designee shall ensure that the blank fields are completed; these include Date and Time of sample collection and the Field Point of Contact.

Note: Each label includes the following information:

- Container Code: The type of container assigned to this sample.
- Special Instructions: Special instructions requested of the laboratory.
- Date, Time: Date and time of sample collection.
- Sample ID: Sample identification number and container number for each sample in shipment.
- Analysis: Analytical method requested for type of contaminant for which sample is analyzed.
- Preservative: Type of preservative needed for a particular analysis (e.g., ice, HN03, none).
- Field POC, Initials: Printed name and initials of point of contact.

8.2 Complete Sample Collection Logs

8.2.1 The FTL or designee shall ensure the completion of the Sample Collection Log.

8.2.2 The FTL or designee shall ensure that all fields on the SCL are complete (i.e., information supplied for all fields provided). Note: Write "N/A" (for "not applicable") in the field as appropriate.

8.2.3 The FTL or designee shall record additional information, as necessary, on either an attachment to the SCL, the Daily Activity Log, or the Field Notebook, as appropriate.

8.2.4 The FTL or designee shall complete the SCL by signing it; this documents the collection of the sample.

8.2.5 An independent field team member shall review the SCL to ensure its completeness and accuracy, indicating review with an approval signature.

8.3 Use Field Chain of Custody Forms

8.3.1 The FTL or designee shall ensure the use of the Field Chain of Custody (COC) forms to document the integrity of all samples and to maintain a record of sample collection and transfer between personnel.

Note: A unique control number must appear on each Field COC. Complete a Field COC for each sample collected.

8.3.2 The FTL or designee shall ensure that information is supplied in all blank spaces on the Field COC form; if the space is not applicable, enter “N/A.”

Note: The Field COC form contains the following information:

- Event Name: The name assigned to the sampling event during generation of the field sampling paperwork.

- COC ID: A unique number assigned to the individual form.

- Sample ID: A unique identification number assigned to each sample. Do not fill in by hand or modify the Sample IDs. The sample IDs are unique and not field assigned.

- Sample Order Matrix: Sample matrix description provided to analytical laboratory.

- C&S Team Leader: Project Team Leader, Team Leader, or designee, as appropriate.

- FTL: The FTL responsible for collection of the sample.

- Destination: The SMO or analytical laboratory(s) within the Laboratory where samples are sent.

- Destination POC: The SMO or analytical laboratory contact.

- Container ID: The container number for each container that makes up the sample.

- Order: Analytical method requested for type of contaminant for which sample is analyzed.

- Container Description: Volume and type of container used.

- Preservative: Type of preservation needed for the particular analysis (e.g., ice, HN03, none).

- Collected Y/N: Indicate whether the container was collected by filling in “Y” or “N.”

- Reason: Fill in the reason for not collecting a container. This is required if a container is not collected.

- Special Instructions: Additional relevant information pertaining to the samples (e.g., condition on receipt).

- Relinquished By and Date/Time: Printed name and signature of field team member transferring possession of samples to the mobile analytical laboratory(s) or SMO, or to any other authorized person and the date and time the samples are relinquished.

- Received By and Date/Time: Printed name and signature of the individual receiving the samples and the date and time the samples are received.

Note: The individual accepting custody of a sample or set of samples must verify that all containers identified on the Field COC Form are contained in the package(s) requiring acceptance. The signature on the form acknowledges receipt of all the sample containers.

8.3.3 The FTL or designee shall ensure delivery of the samples to the SMO and/or other analytical laboratory(s) with completed Field COC form (i.e., inspect the forms for completeness and accuracy).

8.4 If Delivering Samples to Another Analytical Laboratory

8.4.1 The FTL or designee shall sign the Field COC form in the "Relinquished By" field, and an individual at the mobile analytical laboratory signs the form in the "Received By" field; both note the date and time of the transfer.

8.4.2 After an individual at the mobile analytical laboratory acknowledges receipt of samples by signing the form, the FTL or designee may keep a photocopy of the Field COC.

Note: The COC/Request for Analysis form signed off by the mobile analytical laboratory(s) is not a completed record because, after screening is completed, the form is used again to transfer the samples back to the field team for disposal. The FTL or designee may retain a photocopy from the initial interaction with the mobile analytical laboratory(s) for his/her use only.

8.5 Use Custody Seals

8.5.1 The FTL or designee shall ensure the use of Custody seals in order to guarantee that samples are not tampered with during shipment to the analytical laboratories.

Note: The lid of every sample container is sealed with a custody seal. Ensure that the seal securely contacts both the bottle and the lid. The sample collector initials and dates each seal.

8.5.2 The FTL or designee shall ensure delivery of the sealed sample containers to the analytical laboratory(s).

8.6 Collect the Samples Field team members shall follow applicable SOPs for media-specific sample collection; these SOPs may require adherence to special instructions or completing additional forms.

8.7 Complete Sample Control and Field Documentation

The FTL or designee shall ensure the collection of all required field data and completeness of the sample control and field documentation. (If the information is "not applicable" to the project, put "N/A" as appropriate.)

Note: Do not destroy or discard documents even if they are illegible or contain inaccuracies that require replacement documents. Resolve any inaccuracies upon discovery by crossing through the error with a single line, correcting it on the original document, and initialing and dating the correction. If the correction is not self-explanatory, the individual must assign a number to the correction and attach to the original a sheet that fully describes the correction.

8.8 Complete Field Investigation Summaries

8.8.1 The FTL shall keep field notes that briefly summarize each day's progress.

8.8.2 Field personnel shall use bound field notebooks or Daily Activity Log forms (for use in loose-leaf notebooks), in addition to the sample control and field documentation, to record all pertinent field data; this includes detailed summaries of information pertaining to the field investigation and additional field data (e.g., unusual events such as storms).

Note: If Daily Activity Log Forms are used, paginate each sheet of the Daily Activity Log for each day (e.g., 1 of 4, 2 of 4, etc.). Entries in the Field Notebooks or Daily Activity Log forms include the following:

- Date: Month, day, and year at the start of each day and at the top of each page.
- Time: The time of each activity.
- Technical Area: Two-digit number indicating the TA in which the sampling activities are executed.
- Operable Unit: Four-digit number indicating the OU in which the sampling activities are executed.
- Site Work Plan: If applicable, include the Site Work Plan number.
- Signature: Preparer must sign the entries at the end of each day.
- Comments: Comments may include, but are not limited to a general description of work performed; deviations from approved plans or procedures; names and affiliations of all C&S Personnel on site (field team members and/or visitors); a description of general field conditions (weather…) encountered; problems encountered/ resolutions implemented; sketches and calculations pertaining to the job; supplies and equipment used; when photographs are taken in the field, the time, date, location, roll identification number, frame number, general compass direction, a description of the subject matter, and the photographer's name must be recorded; decontamination practices, such as the time at which decontamination is performed; a description of waste generated as a result of the field investigation; and/or any additional field observations pertinent to the investigation.

9.0 RECORDS

9.1 The FTL shall submit the following records:

- Field Notebooks
- Daily Activity Logs (if used)
- Chain of Custody/Request for Analysis Forms for containers delivered to laboratories

Field Decontamination of Drilling and Sampling Equipment

Standard Operating Procedure

CS003

C&S Engineers, Inc.

141 Elm Street

Buffalo, New York 14203

January 2013

Revision Log

Revision	***Effective Date***	**Prepared By**	***Description of Changes***	***Affected Pages***
0	1/4/13	Daniel Riker, P.G.	New Procedure	All

Field Decontamination of Drilling and Sampling Equipment

Table of Contents

Field Decontamination of Drilling and Sampling Equipment

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the process for the general field decontamination of drilling and sampling equipment on C&S Engineers, Inc. (C&S) environmental assessment and investigation projects. It is intended to help ensure the integrity of soil, sediment, rock, water, and other samples collected from potentially contaminated sites and to minimize the potential for cross contamination between sampling locations. Implementation of this procedure will help protect site and community personnel by requiring that equipment not be removed from a controlled area without proper decontamination.

2.0 SCOPE

This SOP will be implemented by all C&S Project personnel when performing decontamination of drilling and sampling equipment.

Note: Subcontractors performing work for C&S shall follow this SOP for decontaminating drilling and sampling equipment or may use their own procedure(s) as long as the substitute meets C&S's requirements and has been approved by the C&S's Project's Quality Program Project Leader (QPPL) before the commencement of the designated activities.

3.0 TRAINING

3.1 The Field Team Leader (FTL) will ensure that field team members who are engaged in the collection of characterization samples for the Project are familiar with sampling equipment field decontamination objectives and procedures. This would include personnel who are collecting environmental media samples using hand tools, mechanical drilling and sampling equipment, or excavation equipment.

3.2 The FTL shall monitor the proper implementation of this procedure and ensure that relevant team members have completed all applicable training assignments.

4.0 DEFINITIONS

4.1 Container — A portable device in which a material is stored, transported, treated, disposed of, or otherwise handled.

4.2 Cross contamination — The inadvertent introduction of contaminated materials from one location to another.

4.3 Site-Specific Health and Safety Plan (SSHASP)—A health and safety plan that is specific to a site or C&S-related field activity that has been approved by a C&S health and safety representative. This document contains information specific to the project including scope of work, relevant history, descriptions of hazards by activity associated with the project site(s), and techniques for exposure mitigation (e.g., personal protective equipment [PPE]) and hazard mitigation.

5.0 BACKGROUND AND PRECAUTIONS

Note: This SOP is to be used in conjunction with an approved SSHASP. Also, consult the SSHASP for information on and use of all PPE.

5.1 To help ensure that samples collected for the purpose of characterizing a potentially contaminated site are representative of the point place where they are collected, the equipment used to collect those samples should be decontaminated between each sampling event. Decontamination helps minimize the potential for cross contamination between sampling locations and helps protect site and community personnel by requiring that equipment not be removed from the site without proper decontamination. The decontamination process should be tailored to the types of contaminants anticipated. The volume of decontamination wastes generated should be kept at a minimum.

5.2 This procedure addresses decontamination for hazardous chemical constituents. A dry decontamination process is used first for the primary purpose of removing soil that may be contaminated by hazardous constituents, followed by a wet decontamination process intended to remove the remaining constituents. Dry decontamination is essentially the mechanical and/or chemical cleaning of the equipment without the excessive use of liquids. Dry decontamination is used first to minimize liquid waste production, especially the production of liquid mixed wastes. Wet decontamination is essentially a washing process to remove constituents that are not removed by the dry decontamination process.

5.3 In the interest of waste minimization, in some cases, extraneous soils removed by mechanical means may be returned to the site of origin (e.g., using a wire brush to remove and return soil directly to the borehole from an auger flight) if evidence of contamination (viz., staining, odors, and/or elevated organic vapor measurements) is not present.

5.4 Decontamination procedures shall be conducted in accordance with the applicable Site-Specific Health and Safety Plan to help ensure that personnel performing the decontamination are protected from equipment-related accidents and from exposures to hazardous wastes. Implementation of these procedures may involve steam cleaning of drilling, excavation, and sampling equipment. The water from a steam cleaner is under high pressure and temperature, and is capable of causing burns and scalding.

6.0 RESPONSIBLE PERSONNEL

The following personnel are responsible for activities identified in this procedure.

6.1 Project Personnel
6.2 Field Team Leader
6.3 Quality Program Project Leader
6.4 Site Safety Officer
6.5 Radiological Control Technician

7.0 EQUIPMENT

C&S field staff will provide the equipment and supplies needed to implement this procedure.

8.0 PROCEDURE

Optional approaches for decontamination are presented below to provide flexibility in addressing site-specific situations. Deviations from SOPs made during performance of fieldwork, if any, will be recorded in the project notebook.

8.1 Decontamination Areas

8.1.1 Decontamination areas shall be established to provide “dry” and/or “wet” decontamination, depending on the decontamination needs at the site.

8.1.2 The dry decontamination area is used to remove loose, contaminated soil adhering to the equipment. This area may be located where the drilling or excavation is taking place, to minimize the potential for spreading contaminants from the site. If contamination is potentially extensive or if environmental factors such as wind may cause uncontrolled dispersal of potentially contaminated soil or other substances, decontamination may, at the discretion of the FTL, be conducted within an open-top solids containment vessel. Before decontamination, clean plastic sheeting should be placed on the ground or inside the solids containment vessel to collect material removed from the equipment. Waste material removed from the equipment should be managed appropriately. For example, when steel brushes are used to clean soil particles off auger flights, at the location of the open borehole, this material may be returned to the hole. An equipment table, covered with clean plastic sheeting, may be placed near the dry decontamination area to facilitate disassembly of the contaminated sampling equipment. Drums may be placed nearby to contain waste material.

8.1.3 The wet decontamination area is used to remove contaminants that were not removed during dry decontamination. The wet decontamination area equipment varies depending upon the nature, size and complexity of the sampling operation and of the equipment to be decontaminated. For sampling tasks involving drilling or excavating equipment, the wet decontamination area must have a liquid containment vessel, and may involve a high-pressure steam cleaner, a pump to transfer liquid wastes, and drums or other containers with liners for storing liquid wastes. The drums or containers should have secondary containment. An equipment table, covered with clean plastic sheeting, may be placed next to the wet decontamination area to facilitate re-assembly and wrapping of the decontaminated equipment pending further use. For sampling tasks using hand augers or other small equipment, the wet decontamination area may consist of tubs, buckets, brushes and spray bottles. Separate buckets or tubs shall be used for washing and rinsing this equipment. The use of spray bottles for rinsing minimizes the generation of water that must be collected for disposal.

8.1.4 Whenever possible, the decontamination area should be placed downwind of site personnel; giving consideration to the anticipated contaminants, detection of airborne contaminants above background, wind and weather conditions, and other site considerations such as site layout, access, and other site activities. Where possible, the decontamination area should not be located downwind of dust-producing site operations that could contaminate the equipment. The decontamination area may be located adjacent to the designated and secured drum storage area to reduce the need to move drums around the site.

8.1.5 The decontamination of equipment that is to be removed from a contaminated area to a controlled or uncontrolled area shall be performed with the approval and oversight of the Site Safety Officer.

8.2 Drilling/Excavation Equipment Decontamination

In general, this section applies to drilling equipment and other hardware that goes down a borehole. It includes: drill pipe, well casing, well development pumps, bailers, geophysical tools, rods, augers and drill bits. Decontamination pads for these items need to be sufficiently large to do the job. Such items should be placed on a sawhorse or rack for inspection and decontamination.

Note: Steam cleaning should not take place directly behind a drill rig when operational; this might create a slip/trip hazard.

8.2.1 Before commencing sampling operations for a project, those parts of the drilling or excavation equipment that will come in contact with the sampled media shall be screened for volatile organics. If soil adhering to the equipment is found to be contaminated during the field screening, dry decontamination procedures shall be applied as described in Section 8.2.2 below. If hazardous chemicals are potentially present, any dry decontamination shall be followed by the wet decontamination procedures described in Section 8.2.3 below. In addition, a visual inspection should be performed of the entire piece of equipment; and gross residuals such as dirt from previous operations may be removed at the discretion of the FTL if it could affect the objectives of the sampling operation or has the potential of falling from the equipment and contaminating the site.

8.2.2 If contamination is found or suspected on the surface of the equipment, or in the soil on the equipment, that piece of equipment shall be decontaminated in the dry decontamination area. The coarse contaminated material may be gently removed using a steel brush, and the more cohesive material may be removed with a flat scraper such as a wooden spatula or paint stirring stick. A water spray bottle may be used to lightly moisten dry soil being removed from the equipment, if needed to control dust. Only the minimum amount of water spray should be used to keep the waste moisture content low.

8.2.3 If hazardous and/or residual radioactive contamination is still present after dry decontamination, a wet decontamination process shall be used. The liquid containment vessel should be empty at the start of each wet decontamination campaign, especially if the previous wet decontamination did not require a methanol rinse, so that the volume of wastes generated by the decontamination process can be minimized.

8.2.3.1 In general, a non-phosphate detergent and water wash with a water rinse is adequate for most decontamination requirements. Alternatively, the contaminants may be removed by steam cleaning, by washing with Alconox™ detergent, or by another appropriate method, followed by a water wash using a standard scrub brush. The equipment shall then be rinsed with clean water. A second rinse should be performed using distilled or deionized water, particularly in cases where the chemistry of the water supply is not monitored on a regular basis. Where trace metals are anticipated, an acidic rinse may follow the detergent wash and rinse in the decontamination process to remove the trace metals, followed by a distilled or deionized water rinse.

8.2.3.2 If organic contaminants are expected, a rinse with a solvent such as methanol may follow the detergent wash and rinse to remove the organics. If used, the solvent shall either be wiped off or allowed to evaporate completely, and shall be followed by a water rinse. Methanol, solvent and acid contaminated waste shall be segregated and managed appropriately. Before using an acid or solvent, confirmation is required that the particular acid or solvent used is not a contaminant of concern at the site. These waste streams must be approved in a waste characterization strategy form prior to generation. Decontamination rinsate containing solvents or acids may need to be analyzed for pH and/or ignitability tests prior to disposal.

8.2.3.3 The equipment is then allowed to air dry or is dried with clean rags, towelettes, paper towels, or by other appropriate methods. Only those parts of the equipment that come into direct contact with the potentially contaminated media need to be decontaminated in this manner. If an equipment (rinsate) blank is required by the governing sampling and analysis plan or quality assurance project plan, a deionized water rinsate should be collected following completion of the decontamination process.

8.2.4 Decontaminated drilling and excavating equipment not in active use, such as hollow-stem auger sections, drill rods, down-hole hammers, and bits, may at the discretion of the FTL be wrapped in plastic or otherwise protected from dirt and dust until needed.

8.2.5 Following the initial decontamination, the drilling or excavation equipment is typically not decontaminated again until completion of the specific borehole or excavation, unless cross contamination within a single borehole or excavation is of concern. The need to decontaminate during drilling or excavation may be determined by the FTL from field screening or may be indicated in drilling plans, excavation plans, or other work plans. The internal surfaces of augers have the potential to come in contact with contaminated soil and should be screened periodically before demobilization.

8.2.6 Decontamination of drilling equipment upon demobilization at a specific borehole or excavation, those parts of the drilling or excavation equipment that came in contact with the sampled media shall be decontaminated before mobilizing at another site, using methods appropriate for the type of contamination potentially present. Decontamination shall be conducted as described in Sections 8.2.2 and 8.2.3 above. In addition, a visual inspection should be performed on each piece of entire equipment, as described in Section 8.2.1.

8.2.9 Contaminated soil shall be removed from the dry decontamination area following each decontamination campaign and appropriately disposed.

8.2.10 Water in the liquid containment vessel shall be removed from the vessel following each decontamination campaign and appropriately disposed.

8.2.11 Equipment decontamination personnel shall follow the requirements of the Site-Specific Health and Safety Plan when removing personal protective equipment (PPE). Rags, plastic, PPE, etc. shall be appropriately disposed.

8.2.12 Upon completion of site sampling and decontamination activities, the decontamination area shall be secured.

8.3 Sampling Equipment Decontamination

8.3.1 Both sample collection and sample preparation equipment are decontaminated according to the procedure described in this section.

8.3.2 After sampling equipment has been used to collect each sample, sample shall be removed (except in the case of Shelby tubes) and processed according to the appropriate SOP. If Shelby tubes are used to collect samples, the sample is generally left inside the tube during shipment; in such cases the outside of the tube should be screened before shipment and decontaminated as required.

8.3.4 If hazardous contamination is potentially present, the equipment shall be decontaminated as described in Section 8.2.2 and 8.2.3. If an equipment (rinsate) blank is required, it should be collected in accordance with the instructions in Section 8.2.3.

8.3.5 Decontaminated sampling equipment not in active use should be protected from dirt and dust (e.g. wrap in foil or plastic) and segregated from contaminated equipment until needed.

8.3.6 Minimizing the amount of sampling equipment used during sampling activities will minimize the time required for decontamination as well as the generation of wastes. Segregation of solid and liquid decontamination wastes is emphasized in this procedure to minimize the volume of liquid wastes generated.

8.3.7 Sample preparation equipment used to collect sub-samples that will constitute a single composite sample does not need to be decontaminated between each sub-sample collection.

8.3.8 If the rinsate in the liquid containment vessel includes methanol, it should be transferred to a separate lined drum before additional methanol-free decontamination to minimize cross contamination and potentially mixed waste generation. Drums should not be overfilled to allow for expansion. Methanol-soaked rags or towelettes should be bagged and placed into a separate lined drum. Methanol contaminated waste shall be segregated and managed. Methanol decontamination wastes must be approved in a waste characterization strategy form prior to generation. Waste containers shall be appropriately labeled and handled.

8.3.9 Equipment decontamination personnel shall follow the requirements of the SSHASP when removing PPE. Rags, plastic, PPE, etc. shall be properly bagged, drummed, labeled and handled.

Well Construction

Standard Operating Procedure

CS004

C&S Engineers, Inc.

141 Elm Street

Buffalo, New York
14203

January 2013

Revision Log

Revision	***Effective Date***	**Prepared By**	***Description of Changes***	***Affected Pages***
0	1/4/13	Daniel Riker, P.G.	New Procedure	All

Well Construction

Table of Contents

Well
Construction

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the process of well construction for C&S Engineers, Inc. (C&S) assessment and environmental investigation projects.

2.0 SCOPE

This SOP is a mandatory document and shall be implemented by all C&S Project participants when constructing wells for C&S projects.

Note: Subcontractors performing work under the C&S Project's quality program shall follow this SOP for constructing wells or may use their own procedure(s) as long as the substitute meets the requirements prescribed by the C&S Project Quality Management Plan, and is approved by the C&S Project's Quality Program Project Leader (QPPL) before the commencement of the designated activities.

3.0 TRAINING

3.1 All users of this SOP are trained by reading the procedure.

3.2 The Field Team Leader (FTL) shall monitor the proper implementation of this procedure and ensure that relevant team members have completed all applicable training assignments.

4.0 DEFINITIONS

4.1 Annular space or annulus — The space between the borehole wall and the well casing, or the space between a casing pipe and a liner pipe.

4.2 Annular seal — The material, usually cement grout or bentonite, placed in the space between the borehole wall and the well casing for zone isolation, especially used to prevent surface contamination from entering the borehole.

4.3 Bentonite/Bentonite annular seal — A hydrous aluminum silicate (clay) in slurry, powder, granular, or pellet form that, when hydrated, provides an impervious seal between the well casing and the borehole wall. Bentonite may also be used in a 2% to 5% mixture with Portland Type I, Type II, or Type I/II cement to form a pumpable grout seal that expands as the material hardens.

4.4 Filter pack — Sand, gravel, or glass beads that are uniform, clean, and well rounded and generally siliceous that are placed in the annulus of the well, between the borehole wall and the well intake in order to prevent formation material from entering through the well.

4.5 Grout — Cement or bentonite mixtures used in sealing boreholes and wells and for zone isolation. Only Portland Type I, Type II, and Type I/II cement is approved for use at investigative sites.

4.6 Monitoring well — Any well or borehole constructed for the purpose of monitoring fluctuations in groundwater levels, quality of groundwater, or the concentration of contaminants in the vadose zone or groundwater.

4.7 Silica Sand — Washed and sieved sand of a specified size distribution or gradation composed primarily of silica (e.g., quartz).

4.8 Site-Specific Health and Safety Plan (SSHASP)—A health and safety plan that is specific to a site or C&S-related field activity that has been approved by a C&S health and safety representative. This document contains information specific to the project including scope of work, relevant history, descriptions of hazards by activity associated with the project site(s), and techniques for exposure mitigation (e.g., personal protective equipment [PPE]) and hazard mitigation.

4.9 Tremie pipe — A small-diameter pipe used to carry sand pack, bentonite, or grouting materials to the bottom of the borehole. Materials are pumped under pressure or poured to the hole bottom through the pipe. The pipe is retracted as the annulus is filled.

4.10 Turbidity (nephelometric) — A measure of the intensity of light scattered by sample particulates relative to a standard reference suspension. The range of water turbidity is measured in nephelometric turbidity units (NTU).

4.11 Vadose zone — A zone between the ground surface and the water table that contains water below atmospheric pressure and air or gasses at atmospheric pressure. Also known as the zone of aeration or unsaturated zone.

4.12 Well casing — A solid piece of pipe, typically steel, stainless steel or polyvinyl chloride (PVC), used to keep a well open in either unconsolidated materials or unstable rock and as a means to contain zone-isolation materials such as cement grout or bentonite.

4.13 Well screen — Perforated casing that allows fluids, while minimizing or eliminating sediment into the well.

5.0 BACKGROUND AND PRECAUTIONS

Note: This SOP is to be used in conjunction with an approved SSHASP. Also, consult the SSHASP for information on and use of all PPE.

5.1 A properly constructed well allows access to formation fluids or gases for the collection of samples and for determining in situ characteristics. Ideally, the well should not alter the medium that is being sampled.

5.2 The following is a partial list of critical issues involved in well planning, design, and construction:

- preventing the spread of possible contamination;
- selecting soil-boring or rock-coring technique and hole sizes;
- selecting casing and screen materials, including composition and dimensions;
- determining screen-slot size, screen type, and screen interval;
- determining filter pack composition, gradation, and dimensions; and
- choosing a grouting plan.

Refer to the site-specific documents for the location and specifications of the wells to be installed. Wells are generally installed as components of monitoring systems in accordance with Environmental Protection Agency (EPA) guidance. Well construction, development of the wells, collection and measurement of samples, and the documentation of data must be performed as described in this SOP.

The following steps are primarily directed at deep and intermediate depth wells (generally greater than 300’ in depth) and are not necessarily requirements for hand borings or shallow boreholes.

5.2.1 Perform a site hydrogeologic examination to estimate key parameters (for example, anticipated aquifer depth and thickness, types of contaminants, geology and grain-size distribution).

5.2.2 Coordinate schedules/actions with the Project Leader and appropriate technical team.

5.2.3 The source(s) of any water used on site must be pre-approved by the Project Leader before field operations begin. A potable, nonchlorinated source is preferred, and the source is to be documented in the daily logs. At their discretion, the Project Leader may require analytical samples be collected of the water source.

5.2.4 Any use of solvents, glues, or cleaners is prohibited unless approved in writing by the Project Leader. If official permission is granted for their use, describe the material and include the manufacturer and type (specification) (MSDS sheet must also be included). The on-site use of nonenvironmentally safe and/or unapproved pipe-dope, grease, soap, or oil is also prohibited for any purpose with the exception of machinery fuel and lubricants

5.2.5 Monitor the borehole opening and the breathing zone as necessary according to the appropriate C&S SOPs and SSHASP. Perform readings as often as necessary to ensure the safety of workers, and record all measurements on the appropriate data-collection forms.

6.0 RESPONSIBLE PERSONNEL

The following personnel are responsible for activities identified in this procedure.

6.1 C&S Project Personnel
6.2 Driller
6.3 Field Team Leader
6.4 Site Geologist

7.0 EQUIPMENT

Descriptions of commonly used pieces of equipment are listed below.

7.1 Well-Construction Supplies (Some of these items are suggestions only, and the list is not all-inclusive.). Silica sand (i.e. 30/70, 20/40, and 8/12 grain size); Cement—Portland Type I, Type II or Type I/II only; Approved water supply, preferably untreated; Well casing, screen, cap, and bottom plug for each well, as required; Mechanical casing centralizers, if required; Bentonite pellets, crushed bentonite, or bentonite grout; A 5-ft length of protective steel casing—black iron or galvanized— 6-, 8-, or 10-in. in diameter, according to needs; Guard posts; Locking cap; Padlocks

7.2 Well-Construction Equipment

- Drill rig and accompanying equipment (augers, drill rods, casing, samplers, etc.)

- Tremie pipe

- Grout-mixing and pressure-pumping unit

- Support equipment for maintaining 24 hr/day operation

8.0 PROCEDURE

8.1 General Well Installation Record Keeping

8.1.1 Record all field measurements and comments on the Borehole/Well Completion Information form or the Borehole/Well Construction Field Data Log form. Fill out the forms as described in the completion instructions included with each form.

8.1.1.1 The FTL shall consult with the Project Leader before modifying an existing well design. Any modification must be recorded in the Borehole/Well Construction Field Data Log form and the Daily Activity Log form or a field notebook.

8.1.2 Record pertinent information on the Borehole/Well Completion Information form. At a minimum, record boring/well identification number, location of boring (coordinates if available), nominal hole diameter and depth at which diameter changes, screen location, backfill, seals, grout, cave-in, centralizers, and the height of the riser above the ground surface. Record the actual composition of the grout, seals, and backfill on each Borehole/Well Construction Field Data Log form. Include the screen slot size (in inches), slot configuration, and screen manufacturer. Include the protective casing detail on all well sketches.

After well development is complete, indicate the static water level on the well-construction diagram.

8.2 Sand Pack

A sand pack helps ensure continuous flow capability from the natural formation to the well bore. The following is a list of instructions for using a sand pack, if required.

8.2.1 The minimum annular distance between well screen and the borehole wall is 1 inch.

8.2.2 The specifications of the proposed sand-pack material should be approved by the FTL before use. Use well-sorted (poorly graded) and rounded sand that is clean, inert, and siliceous and compatible with the screen slot size in-use.

8.2.3 The average grain size of the sand is based on the grain-size distribution of the medium being monitored in the screened formation. Use sand that has a gradation that will allow less than 10% of filter-pack material to pass through the screen slots.

8.2.4 Record the filter-pack size, the company from which it was purchased, and the lot number (if available) for each installation. Be prepared to take an airtight pint size sample of filter pack material and furnished to the Project Leader upon request for each well to serve as a quality control.

8.2.5 Fill the annulus between the well screen and borehole wall with silica sand to a height 5 ft above the screened interval and 5 ft below the screen if above a bentonite seal or as specified in applicable Title I or II drawings if required. For wells greater than 30 ft in depth, a tremie pipe will be used to place the materials.

Note: For intermediate and deep wells, go to Sections 7.6 - 7.9 for the complete procedure to place the dry product backfill materials.

8.2.6 Ascertain the depth of the top of the sand with a measuring device with an accuracy within 0.5’ and verify the thickness of the sand pack. Measurements must be repeatable. If necessary, add more sand to bring the top of the sand pack to the proper elevation.

8.2.7 Under no circumstances should the sand pack extend into any aquifer other than the one to be monitored. In most cases, the well design can be modified to allow for a sufficient sand pack without the threat of cross flow between producing zones.

8.2.8 If specified in the project documents, partial development of the sand pack may be required (to help settle sand pack) before installation of bentonite seal and grout.

8.2.9 In the event that a predominantly fine-grained, water-bearing unit is encountered, it may be desirable to construct a monitor well that uses a factory-manufactured screen and filter pre-pack assembly. Various sand-pack gradations are available. The pre-packed screen subassembly is attached to the solid well casing (riser) in the same manner as a conventional screen. The fine-grained formation materials are allowed to collapse against the pre-packed well screen. Pre-packed well screens have larger OD's which must be considered when calculating backfill.

8.2.10 Centralizers will be placed above and below each screen or as specified in Title I design documents. Generally, no less than one every 50 ft for the uniform and complete annular filling by granular backfill, seal, and grout materials. Centralizers may be required at 10-ft intervals or less when installing angle holes. In some cases, such as very shallow wells and where tremie-pipe placement of materials is done through pipes or augers, the spacing of centralizers can be expanded or eliminated entirely. Fasten centralizers to the well casing and radially space them at 120° or 90° intervals.

8.3 Intermediate Bentonite Seal

The following steps outline the use of an intermediate bentonite seal from the top of the sand pack to 2 ft above.

8.3.1 Before placing the bentonite seal, be sure the filter pack has settled by measuring the depth of the top of the sand with the tremie pipe or a measuring device with an accuracy within 0.5'. The sand pack should rise to a depth of 5 ft above the top of the screen.

Note: For intermediate and deep wells, go to Section 7.9 for procedures on sounding backfill depths.

8.3.2 In media that will not maintain an open hole, leave the casing or the hollow-stem augers in the hole during filter-pack placement and bentonite-seal placement to the extent practical. Maintain the bentonite in the casing/auger a small distance (1 to 2 ft) above the bottom of the casing/auger for even placement, as the casing/augers are removed. Special attention should be given to the amount of fill material if this procedure is followed due to the risk of bridging in saturated conditions.

Note: For intermediate and deep wells, go to Section 7.7 for the procedure on drill casing retraction during backfill placement.

8.3.3 Visually check the condition of the bentonite backfill material before pumping it into the hole by pumping a sample into a bucket. Retract the tremie pipe 3 ft from the top of the sand pack and begin pumping.

8.3.4 Place a bentonite-chip or -pellet seal above the sand pack and below the annular well seal to prevent infiltration of cement into the filter pack and the well. Hydrate the bentonite seal and wait a minimum of 4 hrs before adding a slurry grout.

Note: Use bentonite chips, bentonite pellets, or crushed, granular bentonite. The pellets should have a minimum purity of 90% montmorilonite clay and a minimum dry bulk density of 75 lb/ft3. No bentonite will be placed into the well bore—place a cap over the top of the well casing before pouring the bentonite pellets.

8.3.5 In special circumstances, an open borehole may be drilled to a depth below where the screen is set. If grout is used to seal off a lower aquifer or as backfill up to the proper level, place a bentonite seal above the grout and hydrate for 4 hrs before the casing, screen, and sand pack are introduced. Allow the grout to set up for a minimum of 24 hrs before placing the bentonite seal. Place 5 ft of sand pack between this grout and the well screen. Place the bentonite seal in the borehole as described below.
The minimum width for the annular well seal (between casing and borehole) is 2 in. for C&S Project wells.

8.3.6 For wells that are 30 ft or less in depth:

8.3.6.1 Pour the bentonite directly down the annulus. Pour the pellets from different points around the casing to ensure even an application. A tremie pipe may be used to redistribute and level the top of the seal.

8.3.6.2 Fill the annulus between the well casing and borehole above the filter pack with a bentonite seal at least 2 ft thick (vertically); hydrate and wait 12 hrs.

8.3.7 For wells deeper than 30 ft:

The bentonite backfill material can be pumped or poured through a tremie pipe. The FTL shall determine the method after evaluating the condition of the borehole walls. If there are no centralizers in the upper portions of the casing, manipulate the casing to prevent pellets from hanging up in the narrow annulus and to allow them to settle to the bottom as rapidly as possible.

Note: For intermediate and deep wells, go to Sections 8.6 - 8.9 for the complete procedure to place the dry product backfill materials.

8.3.8 Measure the distance to the top of the seal with an acceptable measuring device to verify that the proper thickness of seal has been placed in the annulus.

Note: For intermediate and deep wells, go to Section 8.9 for the complete procedure on sounding the depth of backfill materials.

8.3.9 Until the proper thickness of bentonite has been placed in the well annulus, repeat the application and verification.

8.4 Annular Well Seal

8.4.1 For placement of dry product annular backfill materials in intermediate and deep wells, go to Sections 8.6 - 8.9 for complete backfilling procedures.

8.4.2 If a cement-grout annular seal is to be installed, use only Portland Type I, Type II or Type I/II cement. The grout must be mixed thoroughly with 2% to 5% bentonite powder to produce a nonshrinking seal. The cement must be mechanically mixed thoroughly before it is pumped into the borehole.

8.4.3 If a slurry of bentonite is used as an annular seal, prepare the slurry by mixing powdered or granular bentonite with pre-approved potable water according to manufacturer specifications. The slurry should be of sufficiently high specific gravity and viscosity to prevent movement of the overlying grout into the saturated zone. Pellets may be added to solidify the surface of the bentonite slurry in order to prevent cement intrusion.

8.4.4 In some cases a dry mixture of fine sand, silica flour, and bentonite powder or a mixture of cuttings, sandy clay, or tight soil may be used where the fill material will have less permeability than the formation. In general the cuttings cannot be easily emplaced because of screening and/or compacting problems. Cuttings mixed with dry bentonite can be used for abandonment purposes.

8.5 Surface Well Seal Minimum Depth and Width

The minimum depth of an annular well seal above the fill is 10 ft. The minimum width of the annular seal is one inch. Use grouts as specified in project documents. Place grout in the annulus of the wells as described below.

8.5.1 Fill the annulus between the well casing and borehole wall with cement grout.

8.5.2 On all wells 30 ft deep or deeper, pump the cement grout through the tremie pipe to the bottom of the open annulus until undiluted grout flows from the annulus at the ground surface.

Note: The cement grout should consist of a mix of cement (Portland Type I, Type II, or Type I/II) and 2% to 5% bentonite mix. Use only grout mixed with pre-approved water.

8.5.3 When drilling in materials that will not maintain an open hole, leave the hollow-stem auger or temporary casing in the hole during grouting to the extent practical. Remove them as the level of the grout rises above the bottom of the auger.

8.5.4 If necessary, add more grout to compensate for the removed casing or auger and tremie pipe and to ensure that the top of the grout is at or above the ground surface.

8.5.5 The protective casing should now be placed over the well casing.

8.6 Placement of Dry Product Annular Backfill Materials (Intermediate and Deep Wells)

8.6.1 The driller shall place all annular fill materials (dry products only) through a tremie pipe maintaining a 10-ft minimum buffer between the targeted backfill depth and the bottom of the tremie pipe.

8.6.2 Both the driller and the site geologist shall maintain accurate tallies of tremie pipe and drill casing to ensure that the exact depths are known at all times.

8.6.3 Both the driller and the site geologist shall, on a scheduled basis, compare their tremie pipe and drill casing tallies to ensure they are in agreement. In the event they are not in agreement, backfilling activities will be suspended until an acceptable resolution is attained and the depths can be verified to the satisfaction of both parties.

8.6.4 The driller shall use potable water (municipal supply) as a transport fluid to carry dry materials such as bentonite pellets and silica sand down the tremie to the desired depth.

8.6.5 The driller shall record in a field notebook the quantities of water and additives used during the placement of annular backfill material.

8.6.6 The driller shall use silica sand that meets the specifications in the Title II design drawing (typically fine-grained 30/70 and 20/40 grade) for filter packs and transition zones between filter packs and bentonite seals.

8.7 Drill Casing Retraction During Backfill Operations (For Intermediate and Deep Wells)

8.7.1 The driller shall retract the drill casing in stages as backfill materials are emplaced to avoid borehole collapse in potentially unstable formations.

8.7.2 The driller shall maintain a 10-ft minimum buffer between the targeted backfill depth and the bottom of the drill casing to prevent backfill from getting between well casing and drill casing. This may result in sand locking the casings or smearing bentonite across well screens

8.7.3 The driller shall determine the length of drill casing to be retracted between pours based on borehole stability, the size of the batch to be poured, and casing stickup in the rig table. The site geologist shall provide borehole stability information to the driller based on site stratigraphic, geophysical logging data, and video logs if available. For large intervals of backfill in stable formations, it may be acceptable to pull 100 or more feet of casing followed by one large or several small batches of backfill. In unstable formations, casing should be retracted at shorter intervals of 20 to 40 ft, followed by small batches of backfill, to minimize borehole caving into the annular space. Cave-ins may result in damage to the well casing and screens, displacement of annular fill materials, and may compromise the integrity of annular seals.

8.8 Volume Calculations

8.8.1 Both the driller and the site geologist shall make volume calculations of all materials introduced into the borehole prior to emplacement. Backfilling should not proceed until the calculated volumes are in agreement.

8.8.2 Both the driller and the site geologist shall ensure that the calculated volume for the interval to be filled is not exceeded regardless of the character of the formation.

8.8.3 The driller shall take extreme care when backfilling with bentonite below a screened section of the well casing to prevent impact to the screen.

8.8.4 The driller shall ensure the target depth for standard batches of bentonite are at a minimum 20 ft below the bottom of the screen. The driller shall ensure that the remainder of the bentonite interval below the screen is poured in small batches calculated to raise the level in the annulus by 2 to 3 ft per batch.

8.8.5 The driller shall sound (measure) the bentonite after each batch until the desired depth is reached. The bentonite shall be allowed to hydrate for a minimum of 30 minutes before installing silica sand.

Note: The volume of the annular space can be determined by subtracting the volume displaced by the well casing (outside diameter) from the total borehole volume. The borehole volume and casing displacement is determined using drilling reference tables or the formula for the volume of a cylinder (V=pr2h). Annular space volume (Va) is determined using Va=Vt-Vc; where a=annulus, t=total, and c=casing.

8.8.6 The driller or the site geologist shall perform calculations for each batch. All calculations shall be recorded in the field logbook.

8.9 Sounding Backfill Depths (For Intermediate and Deep Wells)

8.9.1 The driller shall sound the depth to the top of the fill material using a mechanical (weighted tape/wire line) or electronic sounding device. The site geologist shall oversee and concur with each measurement before recording the depth in the logbook and Title II drawing. The sounding line shall be run through a sheave suspended over the borehole and lowered through the tremie pipe. Care should be taken to avoid entanglement of the sounding line in the well casing centralizers. The driller and site geologist shall maintain cognizance of centralizer locations relative to the tremie pipe at all times.

8.9.2 If a mechanical sounding line is used (weighted tape or wire line), the driller will carefully monitor the tension on the wire or tape as the weight nears the depth where the fill is calculated to be. When an electronic sounder is used, the driller shall carefully monitor the cable-counter and slow the sounder winch as it approaches the calculated depth of the fill.

8.9.3 Once the sounding device tags bottom, the driller will verify the measurement by repeating the measurement process two times with the same result, or within five tenths of a foot (+/-0.5 ft). The site geologist shall then record the confirmed measurement in the field logbook to the nearest tenth of a foot (0.1-ft).

Note: Measurements read from a cable counter or graduated tape must be adjusted to account for the length of the weight on the end of the wire or tape. The height of the tremie pipe stickup (above ground level) must be subtracted from the each measurement when referencing depths below ground level.

8.10 Installing Protective Casing Around All Monitor Wells. The minimum elements in the protection design include the following:

8.10.1 The protective steel casing and locking cap should be weatherproof. The locking cap should be secured to the casing by padlocks.

8.10.2 Set the protective casing (5-ft minimum length) so that the top of the pipe is about 1.5 to 3 ft above the ground surface and grout it in place.

8.10.3 Use 8-in.-diameter pipe for 4-in. wells, 6-in.-diameter pipe for2-in. wells and 10-in diameter pipe for 5-in. wells (depending on approved borehole size). A drain hole near ground level that is 0.5 in. in diameter is permitted.

8.10.4 Mark the location ID on the inside and outside of the cover with indelible ink, metal punch lettering kit or by writing with an arc welding machine/rod.

8.10.5 Form and pour the concrete protective pad around the protective steel casing. Pad dimensions will not be less than 2 ft ×2 ft ×0.5 ft. The concrete pad should be sloped away from the casing for positive drainage.

8.10.6 In addition to the protective casing, the installation of guard posts is recommended in areas where vehicle traffic might pose a hazard.

8.11 Recording Well Construction Details

8.11.1 The driller and site geologist shall keep an accurate record of all well construction materials in the site logbook. The records shall include at minimum the following:

- type of material,
- manufacturer name and address,
- batch or control number,
- calculations showing estimated volume of material placed during each lift,
- number of packages of each product used in each interval/lift,
- size of individual packages,
- volume and composition of transport fluids,
- condition of materials and packaging; and
- any other potentially valuable information.

8.11.2 After completing a unit of backfill (i.e. filterpack interval), the site geologist shall make and record a comparison between the calculated and actual volumes of material required in the field logbook. Methods of installation shall also be described and recorded in the field logbook.

8.12 Documenting the Final Well Configuration

8.12.1 The site geologist shall record the final measured depth of each complete unit of annular fill on the most recently approved Title II well design drawing and in the field logbook.

8.12.2 The site geologist shall record all observations made during backfilling and depth sounding in the field logbook.

8.12.3 Observations should include at a minimum the following:

- differences in the design-specified and as-built fill levels of each unit of annular fill,
- anomalous depth measurements,
- an evaluation of any problems encountered and the final resolutions, and
- any other information or observations that may be useful in assessing the quality of the installation.

8.13 Post-Operation Activities

8.13.1 Ensure all equipment is accounted for and decontaminate equipment where necessary. Return equipment to the equipment manager and report incidents of malfunction or damage.

9.0 RECORDS

The FTL is responsible for submitting the following records:

9.1 Daily Activity Log forms or a field notebook

9.2 Completed Borehole/Well Completion Information form

9.3 Completed Borehole/Well Construction Field Data Log form

9.4 Well construction calculations

Water-Level Measurement

Standard Operating Procedure

CS005

C&S Engineers, Inc.

141 Elm Street

Buffalo, New York
14203

January 2013

Revision Log

Revision	*Effective Date*	**Prepared By**	*Description of Changes*	*Affected Pages*
0	1/4/13	Daniel Riker, P.G.	New Procedure	All

Water-Level Measurement

Table of Contents

Water-Level Measurement

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the method for determining the depth to groundwater in an open borehole, cased monitor well, or piezometer for Engineers, Inc. (C&S) assessment and environmental investigation projects.

2.0 SCOPE

This SOP is a mandatory document and shall be implemented by all C&S Project participants when water-level measurements are obtained for a C&S project.

3.0 TRAINING

3.1 All users of this SOP are trained by reading the procedure.

3.2 The Field Team Leader (FTL) shall monitor the proper implementation of this procedure and ensures that relevant team members have completed all applicable training assignments.

4.0 DEFINITIONS

4.1 Piezometer— An observation well with a short screen at the bottom used to access groundwater; usually used to measure head at a point in a saturated zone. If the screen straddles the top of an unconfined saturated zone, the position of the water table is obtained.

4.2 Potentiometric surface— Level at which water stands in wells; also water table or piezometric surface. Water level depends on the depth of the screen in the saturated zone.

4.3 Site-Specific Health and Safety Plan (SSHASP)—A health and safety plan that is specific to a site or C&S-related field activity that has been approved by a C&S health and safety representative. This document contains information specific to the project including scope of work, relevant history, descriptions of hazards by activity associated with the project site(s), and techniques for exposure mitigation (e.g., personal protective equipment [PPE]) and hazard mitigation.

5.0 BACKGROUND AND PRECAUTIONS

5.1 This SOP shall be used in conjunction with an approved SSHASP. Also, consult the SSHASP for information on and use of all PPE.

5.2 Water-level measurements are generally used to construct potentiometric-surface maps. Water-level data are also used to determine groundwater flow direction, hydraulic gradients, impacts due to pumping or other aquifer stresses as well as hydraulic conductivity and flow velocity.

5.3 The documentation of water-level measurements, air quality for the health and safety of field personnel, and equipment calibration will be performed as described in the associated SOPs. Refer to the site-specific work plan for more information on the scope of work activities, equipment, and frequency of measurements.

5.4 Water-level measurements from boreholes, piezometers, or monitor wells across an area should be obtained in less than a 24-hour period or within as short a period of time as possible. Under some conditions all measurements must be taken within a shorter time interval or simultaneously. The following conditions require measurements to be taken within a shorter time period:

- If the difference in water levels between adjacent wells is too large to be due to the natural hydraulic gradient or well-depth differences,
- If drastic atmospheric pressure changes occur within the monitoring period,
- If the saturated zone is affected by water levels in a nearby river, impoundment or unlined ditch,
- If the saturated zone is stressed by intermittent pumping of production wells, or,
- If the saturated zone is being actively recharged because of a precipitation event.

5.5 Allow water levels in piezometers and monitor wells to stabilize for a minimum of 24 hours after well construction and development before measurements are taken. Repeat measurements periodically to determine if a static water level has been achieved. Recovery may take longer in wells completed in tight formations.

6.0 RESPONSIBLE PERSONNEL

The following personnel are responsible for activities identified in this SOP:

6.1 Focus Area Leader
6.2 Team Leader
6.3 Quality Program Project Leader
6.4 C&S Project personnel

7.0 EQUIPMENT

The device used to measure water levels should be adequate to attain an accuracy of 0.01 ft. Generally acceptable devices are listed below.

7.1 Electric water-level meter — A flat graduated tape attached to a stainless steel probe containing an electrode, which emits an audible and visible signal when contact with water is made. This is the most common and preferred manual device.

7.2 Flame ionization detector (FID) — A portable air-monitoring instrument that functions as a non-specific total hydrocarbon analyzer. In the gas chromatograph mode, an FID provides tentative qualitative/quantitative vapor identification.

7.3 Photoionization detector (PID) — A portable monitoring instrument used to detect the concentrations of organic and some inorganic gases in air. The vapor concentrations detected are non-specific as to compound species. A PID is used (1) to protect the health and safety of field personnel and (2) for field screening to select which samples will be sent for laboratory analysis.

7.4 Popper — A popper is a metal cylinder with a concave undersurface that is attached to the end of a steel tape. The cylinder makes an audible “pop” when it hits the water allowing the distance to the water surface to be determined on the tape.

7.5 Pressure Transducer — An electronic probe connected to a wire cable that is lowered into the water column of a well to measure pressure. The pressure measured is the total pressure, which includes both the hydrostatic pressure of the fluid column above the transducer and the atmospheric pressure at the fluid surface. Changes in head are proportional to changes in the height of the water column or water-level. Pressure transducers are designed to be used with electronic data-logging instruments and send a current to the data logger. The current is proportional to the pressure and can be converted to meaningful units by the data logger.

7.6 Steel tape and chalk — This equipment includes a graduated steel tape with a weight attached to its end used to measure depth to water (DTW). The graduations on the end of the tape are coated with chalk and the tape is lowered into the well until the lower part of the tape is submerged in water. The total tape in the well is noted and the tape is withdrawn. The change in color of the chalk coating indicates the position of the water surface. The length of wet tape is subtracted from total tape length to determine depth to water.

8.0 PROCEDURE

Note: Subcontractors performing work under C&S’s Project’s quality program may follow this SOP for water-level measurement. Subcontractors may use their own procedure(s) as long as the substitute procedures meet requirements prescribed by C&S’s Project Quality Management Plan, and have been approved by C&S’s Project’s Quality Program Project Leader (QPPL) before starting the activity(s).

8.1 Pre-operation Activities

8.1.1 When planning to collect water-level measurements from a number of wells, it is prudent to start with those wells that are the least contaminated and proceed toward wells having increasing levels of contamination. A review of the most current water quality data for the wells of interest should be conducted in order to plan the water-level measuring event.

8.1.2 Calibrate and check equipment before leaving for the field. Use the same measuring device each time to ensure accuracy.

8.1.3 In general, keep measuring equipment clean so that it cannot be the means of introducing dirt or contaminants into a well or piezometer. Decontaminate all equipment that will be used inside the first well. Throughout the event, systematically continue to decontaminate equipment prior to entering any new well.

8.1.4 Preplan the event using existing maps to locate the monitor wells to be measured on maps. Ensure that access is cleared to all well sites. Acquire keys to locked gates as needed.

8.2 Manual Water-level Measurement Procedures

8.2.1 Upon approaching the first well, unlock the protective steel well-head cover and remove the well cap. Note the well ID, date and time of day in the field notebook. Allow the well to equilibrate to atmospheric pressure. If required by site-specific conditions, monitor the headspace of the well with a photoionization detector (PID) or a flame ionization detector (FID) to determine the presence of volatile organic compounds and record the measurements in the field notebook.

8.2.2 Lower an electric water-level meter or equivalent (for instance, permanently installed transducers or popper) into the well until the water surface is encountered.

8.2.3 Measure the DTW, defined as the distance from the water surface to the measuring point. Commonly, a surveyed measuring point is prominently marked at the top of the well casing. If a surveyed measuring point does not exist, place a mark on the casing as a reference measuring point. The mark should be permanent; a groove cut with a file is recommended. If the measuring point is missing or unknown, record the reference point from which the measurement was made. Repeat the DTW readings until results are reproduced at least three times. Record the final measurement, well number, and measuring date and time Water-level Elevation (WLE). Record water-level elevation in feet above mean sea level.

8.2.4 Reel in the water-level meter tape and remove it from the well. Replace the well cap and secure the locking protective well-head cover.

8.2.5 Decontaminate the down-hole equipment and store it appropriately for transport to the next well site.

8.2.6 Note and record in the field notebook any physical changes (like erosion or cracks) in the protective concrete pad or variation in the total depth of the well.

8.3 Post-operation Activities

8.3.1 Complete all data collection forms and sign all pages.

9.0 RECORDS

The FTL is responsible for submitting the following records:

9.1 Completed Water-Level Elevation Data Sheet

9.2 Daily Activity Log form or field notebook

Well Development

Standard Operating Procedure

CS006

C&S Engineers, Inc.

141 Elm Street

Buffalo, New York
14203

January 2013

Revision Log

Revision	***Effective Date***	**Prepared By**	***Description of Changes***	***Affected Pages***
0	1/4/13	Daniel Riker, P.G.	New Procedure	All

Well Development

Table of Contents

Well Development

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes procedures for the development of monitor wells subsequent to drilling and installation on C&S Engineers, Inc. (C&S) environmental assessment and investigation projects.

2.0 SCOPE

This SOP is a mandatory document and shall be implemented by all C&S Project participants when performing well development procedures for C&S Projects.

3.0 TRAINING

3.1 All users of this SOP are trained by reading the procedure.

3.2 The Field Team Leader (FTL) shall ensure the proper implementation of this procedure and that relevant team members have completed all applicable training assignments.

4.0 DEFINITIONS

4.1 Development — Procedures performed to (1) repair damage to the formation caused by drilling activities and (2) increase the porosity permeability of the materials surrounding the well screen. Development procedures serve to remove foreign materials from the groundwater, well annulus, or well screen during and/or after well installation, and to facilitate hydraulic communication between the formation and the well screen.

4.2 Filter pack — Sand or gravel that is emplaced in the well annulus surrounding a screen to prevent formational material from entering the well.

4.3 pH — The hydrogen ion concentration in water. A measure of the acidity or alkalinity of a solution, numerically equal to 7 for neutral solutions, increasing with alkalinity and decreasing with acidity.

4.4 Regional water table monitor well — A monitor well that is screened below the water table in the regional aquifer.

4.5 Site-Specific Health and Safety Plan (SSHASP)—A health and safety plan that is specific to a site or C&S-related field activity that has been approved by a C&S health and safety representative. This document contains information specific to the project including scope of work, relevant history, descriptions of hazards by activity associated with the project site(s), and techniques for exposure mitigation (e.g., personal protective equipment [PPE]) and hazard mitigation.

4.6 Specific (electrical) conductance — A measure of the ease with which a conduction current flows through a substance under the influence of an applied electric field. It is dependent upon the presence of ions (total and relative concentrations, valence, and mobility) and temperature. It is the reciprocal of resistivity and is measured in either Siemens(S) or micro-ohms per centimeter (mohm/cm) at 25.C.

4.7 Turbidity — Refers to inorganic solids and organic matter suspended in water. Turbity, in nephelometric turbidity units (NTU), is measured as the intensity of light scattered by the suspended particulates in a water sample relative to a standard reference suspension. The goal of well development is to improve water quality until turbidity readings have stabilized at levels of less than 5 NTU.

4.8 Well casing volume — volume of water standing in a well. One casing volume, in gallons, is computed as the measured length of the water column (ft) times the cross-sectional area of the well casing (ft^2) times 7.48 gal/ft^3.

5.0 BACKGROUND AND PRECAUTIONS

This SOP shall be used in conjunction with an approved SSHASP. Also, consult the SSHASP for information on and use of all PPE.

5.1 All well drilling and installation procedures create a skin, or filter cake, on the borehole wall. During well development, the fine particulate matter is removed from the well or saturated formation near the screen. A secondary function of development is to settle the annular fill to a stable position.

5.2 The following factors influence the success of well development:

- the drilling method employed in the well construction,
- the design and completion of the well, and;
- the type and gradation of geologic material surrounding the screen.

5.3 Well Development Methods

There are various techniques that may be effective in developing wells depending on the hydrogeologic conditions encountered in the aquifer, drilling method used, and well design. Since hydrogeologic conditions may be complex and unpredictable, a single SOP cannot be developed that will apply to all possible situations. Rather, the methods discussed briefly below are intended to be used as alternatives or as a series of steps to achieve acceptable well development results. Refer to the site-specific work plan for more information on the scope of work activities for determining the most appropriate method to be used for existing conditions.

5.3.1 Wire-brush method — Running a tight-fitting wire brush up and down the interior of the well casing, screen, and sump serves to remove sediment and debris particles and clears the screen openings. Use of the wire-brush method followed by bailing is an effective primary development scheme preliminary to surging or pumping.

5.3.2 Bailing method — Bailing involves inserting and withdrawing of a bailer or length of pipe with an end cap on the bottom. Bailing serves to remove turbid water and exerts a surging action as the bailer passes the screen. After wire brushing of the well interior has been performed, the well is bailed to remove sediment and debris. The bailing method is also used as an alternative when the formation or water-producing zone fails to supply water at sufficient rates to sustain development by pumping.

5.3.3 Mechanical surging — Surging involves raising and lowering a surge block inside the well to force water to flow into and out of a screen and through the filter pack. The seals on the surge block are the same diameter as the inside of the well casing or ‰in. smaller if surging is conducted inside the screened interval. Turbid water must frequently be bailed from the well so that fines are not forced into the formatting and to prevent sand from locking up the surge block.

5.3.4 Swabbing method — A swab is a mechanical surging device that is pulled upward through the water column in a well. Swabbing may be done with single- or double-swab flanges and with or without water-bypass vents. Water may be injected into the well to the formation through the swabbing tool. In this method, water flows into one part of the screen, through the filter pack and adjacent formation, and out in another part of the screen. Swabbing is an aggressive development method that may be suitable if the introduction of water is acceptable. Swabbing is not recommended for wells with plastic casing or screens.

5.3.5 High-velocity jetting — Jetting, or forcing water through the screen from nozzles on a pipe assembly, can clear screen openings. The jetting method is not always advisable as it forces the fines back into the filter pack and formation, and adds large volumes of water to the system.

5.3.6 Overpumping — A simple method of removing fines from a water-bearing formation is by overpumping. This method involves alternately pumping the well at a rate that will force it to become dry and allowing it to recover. The overpumping method is not always effective, particularly in unconsolidated formations, and may result in a formation that is partially developed.

5.3.7 Pump development — Pump development is commonly used as the final phase of well development for C&S Project monitor wells after wire brushing and bailing methods have been performed. A submersible pump and packer assembly, if applicable, is installed and pumping at a sustainable rate is conducted until the water attains acceptable criteria to complete well development.

6.0 RESPONSIBLE PERSONNEL

The following personnel are responsible for activities identified in this procedure:

6.1 Focus Area Leader
6.2 Team Leader
6.3 Quality Program Project Leader
6.4 C&S Project personnel

7.0 EQUIPMENT

The equipment used will depend on the development method selected.

8.0 PROCEDURE

The following sections describe the various techniques that may be used to develop the monitoring wells. It should be noted that not all of these techniques must be employed at every site.

Note: Subcontractors performing work under the C&S Project's quality program may follow this standard operating procedure (SOP) for well development. Subcontractors may substitute their own procedure(s) provided the substitute meets the requirements prescribed by the C&S Project Quality Management Plan, and have been approved by the C&S Project's Quality Program Project Leader (QPPL) before starting designated activities.

8.1 Pre-operation Activities

8.1.1 Coordinate efforts for on-site staging of water that is produced during development. Assemble containers for temporary water storage. The containers must be structurally sound, decontaminated, compatible with anticipated contaminants, and field manageable. All development water must be containerized until water can be discharged or other appropriate disposal method. Clearly label each container with the location ID, date, and time. Labels should be placed on the side of the containers and covered with clear tape to ensure their permanence.

8.1.2 Decontaminate all equipment that will enter the well or come into contact with the development water before developing each well.

8.1.3 Assemble equipment on a plastic sheet in an area that is beyond the range of splashing development water activities.

8.1.4 Well development may begin as soon as is practical after the well is installed, but no sooner than 24 hrs after grouting is completed. Do not use any dispersing agents, acids, or disinfectants to enhance the development of the well unless specifically instructed in writing by the Focus Area Leader. If problems or unusual conditions arise that require the addition of water to aide development, the site geologist should coordinate with the Focus Area Leader as soon as possible.

8.2 Well Development Activities

8.2.1 Open the surface protective casing and remove the well cap (if applicable). Monitor air quality at the top of the casing and in the breathing zone using a PID or other suitable monitoring instrument.

8.2.2 Measure and record depth to water and the total depth of the well.

8.2.3 Perform wire-brush procedures throughout the interior length of the well casing, screen(s), and sump.

8.2.4 Begin bailing to remove turbid water from the well and sediment from the sump. Measure and record initial field chemical parameters (pH, electrical conductivity, and temperature) and turbidity. Periodically measure field parameters, as appropriate. Note and record volumes of water produced as bailing proceeds.

8.2.5 Begin pump-development procedures. For wells with multiple completions, each water-bearing zone is isolated using inflatable packers above and below the screen. The following general steps are taken to develop each screen individually and in succession:

8.2.5.1 The drilling contractor installs a submersible pump-and-packer assembly across the first screen to be developed. Pumping is initiated at a sustainable rate that will not induce excessive drawdown.

8.2.5.2 A transducer and/or a bubble piezometer may be installed in the well to measure water levels during the pump-development phase.

8.2.5.3 When the pump has been turned on, collect a sample of the development water to measure and record initial field chemical parameters and turbidity. Note the initial color, clarity, and any obvious odor of the water. Periodically monitor water quality parameters throughout the pump-development phase. Likewise, note and record flow measurements (flow rate and volume produced) as indicated by an in-line flow meter. Continue to record measurements until the screen interval has been fully developed.

8.2.6 In general, well development procedures will continue for each screen interval until (1) the development water becomes free of suspended sediment, (2) an appropriate volume of water has been purged, and (3) field parameters have stabilized. Criteria for completing well development are described as follows:

8.2.6.1 Turbidity criteria — Well development shall continue until the turbidity readings stabilize or cannot be improved.

8.2.6.2 Purge volume criteria — For wells where borehole drilling was conducted without the use of drilling fluid (water, mud, or additives); purge a minimum of five casing volumes of water before stopping well development. In situations where the groundwater flow from the screen interval is exceeded by the development pumping rate, the well may temporarily dry up.

8.2.6.3 Field parameter criteria — This criterion for well development has been met when field chemical parameters have stabilized over a series of monitoring measurements.

8.2.6.4 Development criteria deviations — If it is determined that one or more of the above criteria for well development cannot be met regardless of the amount of pumping, an alternate procedure for verifying that the well is adequately developed will be utilized.

8.3 Documentation

8.3.1 All manually measured data and procedural descriptions should be recorded in a field notebook.

8.3.2 Complete the appropriate data entry requirements on a Borehole/Well Completion Information form to document well development.

8.3.3 All deviations from the SOP should be documented.

8.4 Post-operation Activities

8.4.1 Groundwater samples may be collected from the well the same day that well development is complete or as otherwise specified in project documents.

8.4.2 Insure that all equipment is accounted for and decontaminated.

9.0 RECORDS

The FTL is responsible for submitting the following records.

9.1 Completed Borehole/Well Construction forms

9.2 Completed Well Development forms

Purging and Sampling Methods for Monitoring Wells

Standard Operating Procedure

CS007

C&S Engineers, Inc.

141 Elm Street

Buffalo, New York
14203

January 2013

Revision Log

Revision	***Effective Date***	**Prepared By**	***Description of Changes***	***Affected Pages***
0	1/4/13	Daniel Riker, P.G.	New Procedure	All

Purging and Sampling Methods for Monitoring Wells

Table of Contents

Purging and Sampling Methods for Single Completion Wells

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes methods used on C&S Engineers, Inc. (C&S) environmental assessment and investigation projects for evacuating stagnant water from a monitoring well in sufficient quantities so that the water samples that are collected afterwards are representative of the formation interval open to the monitoring well.

2.0 SCOPE

2.1 This SOP is a mandatory document and shall be implemented by all C&S Project participants when performing purging and sampling of monitoring wells for C&S projects.

2.2 Subcontractors performing work under the C&S Project's quality program may follow this SOP for purging and sampling of monitoring wells. Subcontractors may use their own procedures provided the substitute meets the requirements prescribed by the C&S Project Quality Management Plan, and has been approved by the C&S Project's Quality Program Project Leader (QPPL) before beginning the activities.

3.0 TRAINING

3.1 C&S Project personnel using this SOP are trained by reading the procedure.

3.2 The Field Team Leader (FTL) shall monitor the proper implementation of this procedure and ensures that relevant team members have completed all applicable training assignments.

4.0 DEFINITIONS

4.1 Hydrogen-ion activity (pH) — The effective negative log base 10 of hydrogen ion [H+] activity. A measure of how acidic or a basic solution is (numerically equal to 7 for neutral solutions and increasingly basic above and acidic below that value).

4.2 Redox potential (Eh in mV) — Chemical reactions whereby a participating element changes its oxidation state by losing or gaining valence electrons.

4.3 Monitoring well — A well constructed with a single well screen across a zone of groundwater saturation.

4.4 Site-Specific Health and Safety Plan (SSHASP) — A health and safety plan that is specific to a site or C&S-related field activity that has been approved by a C&S health and safety representative.

This document contains information specific to the project including scope of work, relevant history, descriptions of hazards by activity associated with the project site(s), and techniques for exposure mitigation (e.g., personal protective equipment [PPE]) and hazard mitigation.

4.5 Conductance, or conductivity — A measure of the ease with which an electrical current flows through a substance under the influence of an applied electrical field. It is dependent upon the presence of dissolved ions (total and relative concentrations, valence, and mobility) and temperature. It is the reciprocal (inverse) of resistivity.

4.6 Specific conductance — Defined as the electrical conductance that would occur between the faces of a 1-cm cube of water. It is generally measured in microSiemens per centimeter (mS/cm), which was previously called micromhos per centimeter (mmhos/cm), or milliSiemens per centimeter (mS/cm). Since specific conductance is temperature sensitive, it is commonly corrected to its equivalent value at 25.C for data comparison. Some equipment makes this conversion automatically, in which case these readings should be noted as "at 25.C." Otherwise, the water temperature at the time of the conductance reading should be recorded along with the conductance measurement so that the reading can later be corrected to 25.C.

4.7 Turbidity — Refers to inorganic solids, gas bubbles and organic matter suspended in water. Turbidity, in nephelometric turbidity units (NTU), is measured as the intensity of light scattered by the suspended particulates in a water sample relative to a standard reference suspension. The goal of well purging for water sampling is to minimize turbidity to a level as low as reasonably achievable.

4.8 Volatile Organic Compounds (VOCs) — A class of chemical compounds, predominantly hydrocarbons and halogenated hydrocarbons, with low molecular weights and low boiling points that are insoluble or slightly soluble in water.

4.9 Well casing volume (bore volume) — The volume of water standing in a well. One casing volume, in gallons, is computed as the measured length (ft) of the water column times the cross-sectional area (ft^2) of the well casing times the constant 7.48 gal/ft^3.

5.0 BACKGROUND AND PRECAUTIONS

5.1 This SOP shall be used in conjunction with an approved SSHASP. Also, consult the SSHASP for information on and use of all PPE.

5.2 Background

5.2.1 Groundwater that is stagnant in the monitoring well is subject to chemical reactions that may significantly alter the composition of the formation water. This stagnant water may no longer be representative of the groundwater surrounding the well.

5.2.2 Prior to collecting a representative ground water sample for laboratory analysis, ground water must be purged from the well according to the following guidelines:

- Under optimum conditions, a minimum of three well casing volumes should be removed from the well (see section 8.2.6 for method of calculation) before sampling.

- Preferably, turbidity values prior to sampling should be less than 5 NTU. A value of less than 5 NTU is not always obtainable under some circumstances such as excess biogenic CO_2, poorly developed wells and invasive sampling techniques that agitate the water in the well casing (variable pumping rates and bailing). Under these circumstances a sample may still be collected.

- Specific conductance and pH readings should stabilize to within 10% variance of two or more consecutive readings.

- Occasionally select wells are developed in aquifers that have poor recharge characteristics due to low hydraulic conductivity, shallow hydraulic gradients or a combination of both. Removal of three well casing volumes under these conditions may not be possible due to time constraints, site accessibility, sample volume requirements and prohibitive costs. When these circumstances are encountered, purge a minimum of one well casing volume and sample after specific conductance and pH have stabilized to within 10% variance of two or more consecutive readings.

- The choice of equipment for well purging depends on the well yield, depth to groundwater, casing diameter, the required analysis, and the requirements in the appropriate work plan. The decision to use any well-purging system should be based solely on what is appropriate for that particular situation.

6.0 RESPONSIBLE PERSONNEL

The following personnel are responsible for activities identified in this procedure.

6.1 C&S Project Personnel
6.2 Field Team Leader
6.3 Quality Program Project Leader
6.4 Subcontractors

7.0 EQUIPMENT

Alphabetized descriptions of commonly used pieces of equipment, their advantages, and their limitations are listed below.

7.1 Bailer — A hollow tube or pipe fitted with a valve that is lowered into a well and retrieved to purge groundwater from a well.

7.1.1 Bailers may be constructed of stainless steel, polyethylene, or Teflon. When lowered into well, water enters the tube, the valve closes, and the filled bailer is retrieved with a rope or cable. Bailing purges the well casing and screen of standing water. Between bailing cycles, groundwater recovers in the well from the screen interval.

7.1.2 For shallow, small-diameter wells with low yields, well purging by the bailer method is feasible in the absence of a dedicated low-flow pump. Bailers are mechanically simple, lightweight and highly portable, constructed in many sizes, and require no external power source. Bailers are easily operated and cleaned and are inexpensive. In addition, considerable time and cost savings are possible by using dedicated bailers to reduce the decontamination task and to limit the possibility of cross-contamination.

7.1.3 The primary limitation of bailers is their limited-volume purging capability; especially in deep wells where purging is labor intensive and time consuming.

7.1.4 Bailers may disturb the water by the pressure changes created by purging.

7.1.5 Sampling personnel are directly exposed to any contaminants present.

7.1.6 Care must taken to prevent dropping or catching the bailer in the well, and care must be taken not to let the bailer line or bailer come in contact with the ground.

7.2 Bladder pump — A gas-driven submersible pump with an internal bladder that alternately inflates and collapses while forcing water through a plastic tube from the well to the surface.

7.2.1 The bladder pump assembly is suspended by the discharge tubing and submerged in the well near the lower part of the screen. Groundwater is transported through the discharge tube to the surface by positive gas displacement. A portable air compressor or bottled nitrogen is used to drive the pump.

7.2.2 Dedicated Teflon bladder pumps are recommended to minimize the introduction of contamination into the well. The maximum sample depth for a bladder pump is 400 ft. A bladder pump has an adjustable flow rate to allow purging at high rates and sampling at a low rate and causes very little agitation of the water.

7.3 Reciprocating-piston submersible pump — a gas-driven submersible pump that uses mechanical piston action to purge groundwater from a well.

7.3.1 The pump assembly is suspended by the discharge tubing and submerged in the well. Water is transported through the discharge tube to the surface by piston action. A portable air compressor is used to drive the pump.

7.3.2 The reciprocating piston submersible pump is a portable system that can purge wells where the depth to the water's surface is up to 500 ft. These pumps develop high pumping rates and can be operated in 2-inch-diameter wells. The pump is self-priming, and the compressed gas (air or nitrogen) that drives the pump does not contact the purged water. The pump is constructed from stainless steel or Teflon and can be decontaminated easily.

7.4 Electric submersible pump — An electric-motor-operated submersible pump that uses an internal rotating turbine to intake well water and force it to the surface.

7.4.1 The pump assembly is suspended by the discharge tubing and submerged in the well. The turbine in the pump bowl creates sufficient pressure to force water up the discharge pipe. Usually, a portable generator is required to power the electric pump (unless electricity is available) and a truck-mounted winch may be required to move and lower the pump into the well.

7.4.2 The submersible pump may be used for purging both shallow, small-diameter wells and deep, large-diameter wells that require large rates of discharge. Manufacturers offer small-diameter pumps constructed of stainless steel and Teflon that are capable of efficient purging at significant depths. The pump may be portable and self-contained.

7.4.3 Disadvantages of the submersible pump are that:

- the pump can be difficult to decontaminate and transport along with auxiliary equipment

- the pump motor may be damaged by dry pumping

- the gears may be damaged by water that contains high levels of suspended sediment

- large-capacity pumps are expensive

- with negative displacement, pumps can significantly aerate the sample, thus changing the in-situ chemistry and stripping dissolved Volatile Organic Compounds (VOCs).

- Careful monitoring during operation is needed to obtain optimum pump performance and to preclude the possibility of equipment damage.

8.0 PROCEDURE

8.1 Use Current Procedure

It is each person’s responsibility to ensure that they trained to and utilize the current version of this procedure.

8.2 Preliminary Activities

8.2.1 The sampler or field team leader shall obtain appropriate sampling paperwork and request for analysis.

8.2.2 The sampler or field team leader shall obtain appropriate sample containers, sample documentation (i.e., collection log and chain-of-custody forms, container labels, etc.) and sampling equipment.

8.2.3 The sampler or field team leader shall make provisions for proper storage and disposal of purged well water.

8.3 Pre-operation Field Activities – To be completed by Sampler or Field Team Leader.

8.3.1 Assemble the equipment and supplies.

8.3.2 Verify that the equipment and meters are in good working order.

8.3.3 Calibrate the meters with the appropriate calibration standards or follow equipment operator's instruction manual.

8.3.4 In the field, locate the wells to be sampled.

8.3.5 Select appropriate staging and decontamination areas.

8.3.6 Prior to entering the first well to be sampled, decontaminate all equipment that will come into contact with the groundwater. Routinely decontaminate all down-the-well equipment before entering any additional well. Use new rope for bailers, as necessary, for each well sampled.

8.3.7 Measure and record the depth to water in the well from a designated measuring point. Also, measure the total depth (TD) of the well.

8.3.8 Determine the well casing volume.

Determine the height of the water column standing in the well by subtracting depth to water, in feet, from the total well depth. Measure the well diameter, in feet. Calculate the volume in gallons.

8.4.9 A minimum of three casing volumes should be purged before collecting a sample. If a sample must be collected before three casing volumes have been purged due to poor recharge, this activity will be documented in the field notebook and/or on the sample collection log.

8.5 Well Purging Operations- To be completed by Sampler or Field Team Leader.

8.5.1 If using a submersible pump, set the pump intake in the well at the approximate midpoint of the screened interval. Pump intake placement may differ according to site-specific goals.

8.5.2 Begin pumping water at a sustainable rate that will not induce drawdown in the well to an extent that air is drawn in at the intake.

8.5.3 Likewise, if a dedicated pump is being used, note the depth of the intake and ensure that the water level is not drawn below that level.

8.5.2 If using a bailer, lower the bailer to the bottom of the well, allow it to fill, and withdraw it. Discharge the water into a bucket, drum, or other appropriate container for temporary storage.

8.5.3 If possible, the water level should be monitored during purging to ensure that the water does not fall below the level of the pump intake.

8.5.4 Periodically record the discharge rate (usually by a bucket of known volume and stopwatch) and the time of day. Also, calculate and tabulate the gallons discharged since the start of purging.

8.5.5 Periodically measure and record the water-quality parameters of the well fluid. Consult the appropriate work plan to determine which parameters to measure and the proper frequency of measurements. Field parameters should be measured at the start of purging and at least once per casing volume.

8.5.6 The well is ready to be sampled when (1) a minimum of three casing volumes of water has been purged (see 8.2.7) (2) field chemical parameters (e.g., pH and specific conductance) have stabilized, and (3) turbidity is stable or less than 5 NTU. Field parameters are considered stabilized when pH varies by less than 0.2 units or the variation in the other parameters over a series of four readings is within ten percent. If these parameters do not stabilize, a sample may still be collected and the records of the various parameters recorded so that analytical data may be placed in the proper context.

8.5.7 Record the final set of field parameters.

8.6 Water Sampling Operations- To be completed by Sampler or Field Team Leader.

8.6.1 Prepare to sample the well by organizing sample bottles, paperwork, and filtering apparatus, if appropriate.

8.6.2 Collect water samples in the order of priority as stated in the appropriate work plan or as otherwise directed. In general, collect the non-filtered samples in the order of most volatile to least volatile compounds.

8.6.3 Special precaution must be taken when collecting samples to be analyzed for VOCs. Volatile compounds will escape from the water to the air if any air is entrapped in the container. A VOC sample should be collected in a glass vial with a Teflonﬁ -coated septum seal so that there are no bubbles in the container after the screw cap and septum seal are applied. Pre-preserve the vial with hydrochloric acid before collecting the sample. To ensure that air bubbles are not trapped in the vial, reduce the flow rate, fill the vial until a reverse meniscus forms above the top of the vial, and screw on the cap. Invert and tap the bottle to check for the presence of air bubbles. If air bubbles are present, the sample should be collected again.

8.6.4 Collect filtered samples using a 0.45 mm pore size filter. The filter may be a flat membrane supported by a filter-holder assembly or may be an in-line cartridge filter. If the filter-holder assembly and tubing is used, field personal must insure that it has been thoroughly cleaned and decontaminated. Filters coarser than 0.45 mm may be used to pre-filter however, the final filter size must be < 0.45 mm. Flow a minimum of 100 ml of the sample through the filter and discard the filtered water before collecting a filtered sample for analysis.

8.6.1 Occasionally it may be necessary to collect a sample in the field and filter at another location. Reasons include it may not be practical to use filtration apparatus at a remote site or the water sample is too turbid to filter at the time of collection. If the latter is the case, allow the suspension in the water sample to settle before filtering and preserving. An appropriate container must be used when collecting water to be filtered off-site. For example, water destined for metals and anions analysis should be collected in a polyethylene bottle or carboy; organics must be transported in a glass container. Do not use the same container that is used to transport the unfiltered water from the field as the final container that is shipped to the analytical laboratory.

8.6.6 Fill out the sample collection logs, chain of custody, and label the sample containers.

8.6.7 Preserve the samples with the appropriate preservatives. Check the pH of each sample that is preserved with pH paper.

8.6.8 After shutting down the pump, or bailing and sampling has been completed, measure and record the water-level drawdown in the well. The data will provide information about water recovery in the well for future sampling events.

8.7 Post-operation Activities - To be completed by Sampler or Field Team Leader.

8.7.1 After sampling, secure the well and well vault.

8.7.2 When sampling is completed, or at the end of the day, carefully clean the outside of the meters with a damp disposable towel to remove any visible dirt.

8.7.3 Decontaminate the pump assembly and other pieces of equipment that contacted the groundwater.

8.7.4 Restore the well site to its original presampling condition. Secure the site when leaving.

8.7.5 Store the purged groundwater until proper disposal can be accomplished.

9.0 RECORDS

The FTL is responsible for submitting the following records:

9.1 Daily Activity Log forms

9.2 Water Quality Sampling Record

Field Analytical Measurements of Groundwater Samples

Standard Operating Procedure

CS008

C&S Engineers, Inc.

141 Elm Street

Buffalo, New York
14203

January 2013

Revision Log

Revision	*Effective Date*	**Prepared By**	*Description of Changes*	*Affected Pages*
0	1/4/13	Daniel Riker, P.G.	New Procedure	All

Field Analytical Measurements of Groundwater Samples

Table of Contents

Field Analytical Measurements of Groundwater Samples

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes procedures for measuring field water quality parameters of groundwater samples on C&S Engineer, Inc. (C&S) environmental assessment and investigation projects. Measurement procedures include those for temperature, specific conductance, alkalinity, pH, dissolved oxygen, and turbidity that closely represent water quality conditions in the aquifers.

2.0 SCOPE

This SOP is a mandatory document and shall be implemented by all C&S Project personnel when performing field parameter measurements of groundwater samples for C&S Projects.

Note: Subcontractors performing work under the C&S Project's quality program may follow this SOP for measuring field water quality parameters of groundwater samples. Subcontractor's own procedures may be used provided that the substitute procedures meet the requirements prescribed by the C&S Project Quality Management Plan, and have been approved by C&S's Project's Quality Program Project Leader (QPPL) before starting the activities.

3.0 TRAINING

3.1 C&S Project personnel using this SOP are self-trained by reading the procedure.

3.2 The Field Team Leader (FTL) shall monitor the proper implementation of this procedure and ensure that relevant team members have completed all applicable training assignments.

4.0 DEFINITIONS

4.1 Alkalinity — Various soluble mineral salts are found in natural water and arid soils. In water analysis, alkalinity indicates the presence of dissolved constituents that include carbonates, bicarbonates, and/or hydroxides, and occasionally borates, chlorates, silicates, or phosphates, which have the capacity to neutralize acids.

4.2 Dissolved oxygen — The amount of oxygen dissolved in water, in parts per million (ppm) by weight or in milligrams per liter (mg/L).

4.3 Hydrogen-ion activity (pH) — The negative log base 10 of the activity of dissociated hydrogen ions [H+]. A measure of the acidity or basicity of a solution, numerically equal to 7 for neutral solutions, increasing with alkalinity and decreasing as acidity increases.

4.4 Site-Specific Health and Safety Plan (SSHASP)—A health and safety plan that is specific to a site or C&S Project-related field activity that has been approved by a C&S Project health and safety representative. This document contains information specific to the project including scope of work, relevant history, descriptions of hazards by activity associated with the project site(s), and techniques for exposure mitigation (e.g., personal protective equipment [PPE]) and hazard mitigation.

4.5 Specific conductance (electrical conductivity) — A measure of the ease with which an applied electric field can flow through a material. It is dependent upon the presence of ions (total and relative concentrations, valence, and mobility) and temperature. It is the reciprocal of resistivity and is measured in either siemens (S) or micro-mhos per centimeter (mmho/cm) at 25.C.

4.6 Turbidity (nephelometric) — Refers to inorganic solids and organic matter suspended in water. Turbidity is measured in nephelometric turbidity units (NTU) as the intensity of light scattered by the sample particulates relative to a standard reference solution. A turbidity value of 50 NTU or below is generally the sample acceptance criteria for non-filtered samples.

5.0 BACKGROUND AND PRECAUTIONS

5.1 This SOP shall be used in conjunction with an approved SSHASP. Also, consult the SSHASP for information on and use of all PPE.

5.2 Field water quality parameters are normally measured at the time of well-purging and groundwater-sampling activities. Because the value of these parameters begins to change with prolonged exposure to atmospheric conditions, wellhead measurements generally yield the most accurate representation of in-situ values. Measurements of temperature, turbidity, specific conductance, and pH made prior to sampling for laboratory analysis are also used as the final indication that a well is purged of stagnant water. Groundwater alkalinity and dissolved oxygen are highly dependent on the availability and partial pressures of carbon dioxide and oxygen in the subsurface environment. Preservation of samples selected for turbidity analyses is not practical.

6.0 RESPONSIBLE PERSONNEL

The following personnel are responsible for activities identified in this SOP.

6.1 C&S Project Personnel
6.2 Quality Program Project Leader
6.3 Team Leader

7.0 EQUIPMENT

Descriptions of commonly used equipment items and their capabilities are listed below.

7.1 Hach 2100 Portable Turbidimeter — A collected water sample contained in a vial is inserted into the instrument to optically measure and digitally display turbidity with a measurement range of 0 to 1000 NTU.

7.2 Horiba U-10 Water Quality Checker — The instrument sensor is inserted into a sample container of collected water to directly measure six parameters: pH, temperature, dissolved oxygen, electrical conductivity, turbidity, and salinity.

8.0 PROCEDURE

Note: For quality control, field measurements should be repeated, from the beginning, on the same samples that are selected for lab replicates. Follow instructions in the site-specific Sampling and Analysis Plan (SAP) for types and numbers of samples to be taken for quality control.

8.1 Pre-operation Activities

8.1.1 Assemble the equipment, manufacturer's operator's manuals, and supplies necessary.

8.1.2 Verify that the equipment and meters are in good working order. The meters should not be dirty or have crusted material on the probes, and the batteries should be charged.

8.2 Use of Meters to Measure Field Parameters

This section contains general instructions on the use of meters that measure water temperature, conductivity, pH, alkalinity, dissolved-oxygen, and turbidity. Because there are several types of meters, refer to the operator's manual for specific instructions on the particular instrument being used.

8.2.1 Temperature

8.2.1.1 Calibrate an immersion thermometer or thermocouple by comparing its readings with those of the reference thermometer at two different temperatures that bracket the temperature range normally measured in the field. Calibration must be done at least annually and whenever the instrument is suspected of having been misused, damaged, or producing erratic or erroneous readings. The instrument should be within 1" Celsius compared with a thermometer calibrated to the National Institute of Standards and Technology standards.

8.2.1.2 Obtain a representative groundwater sample.

8.2.1.3 Place the temperature probe into the groundwater sample, read the temperature upon stabilization, and record the value in the field notebook and/or Water Quality Stabilization Record (see Section 8.3).

8.2.1.4 Some pH and electrical conductivity meters are equipped with a temperature probe, which can be used to simultaneously measure sample temperature.

8.2.2 Specific Conductance (electrical conductivity)

8.2.2.1 Use a battery operated electrical conductivity meter that is equipped with a temperature compensator and reads directly in mmho/cm at 25.C.

8.2.2.2 Use certified calibration standards to calibrate the conductivity meter. Commercially available standards come in 100, 500, 1,000, 10,000, 50,000, and 100,000 mmho/cm solutions. Use two standard solutions that are within an order of magnitude of the expected sample value.

8.2.2.3 Turn on the meter and adjust the conductivity range selector to the appropriate setting. Rinse the conductivity probe with deionized water and then measure the conductivity of the standard solution.

8.2.2.4 If the meter auto-calibrates, read and record (see Sect 8.3) the conductivity value immediately upon stabilization. If the meter requires manual calibration, digitally enter the appropriate solution value. Remeasure the solution in measure mode and record the value.

8.2.2.5 Obtain a representative groundwater sample.

8.2.2.6 Rinse the probe with deionized water. With the meter in measure mode, immerse the probe in the groundwater sample and record the reading (see Section 8.3).

8.2.3 Hydrogen-Ion Activity (pH)

8.2.3.1 Refer to the operations manual for calibration instructions specific to the pH meter in use. A general calibration procedure is given below.

8.2.3.2 Commercially prepared buffered calibration solutions are available for pH values of 4.01, 7.0, and 10.01 standard units. At least two standard solutions are required. Check the expiration dates on the buffer solutions to verify that the solutions are still valid for equipment calibration.

8.2.3.3 Choose two buffer solutions that bracket the expected sample pH. Attempt auto-calibration mode by immersing the pH electrode in the first solution and pressing the calibrate button. After the reading has stabilized, record the value (see Section 8.3). Rinse electrode with deionized water and repeat using the second solution. If manual calibration is required, digitally enter the appropriate pH values after reading each buffer solution. With the meter in measure mode, remeasure and record the values for each solution.

8.2.3.4 Obtain a representative groundwater sample.

8.2.3.5 With the meter in measure mode, rinse the electrode with deionized water and place it into the groundwater sample. Wait for the pH to stabilize and then record the reading (see Section 8.3).

8.2.4 Dissolved Oxygen

8.2.4.1 Most dissolved-oxygen meters may be auto-calibrated on site by simply exposing the probe to saturated air and pressing the calibration button.

8.2.4.2 Obtain a representative groundwater sample.

8.2.4.3 Place the dissolved-oxygen probe into the groundwater sample and record the final value of dissolved-oxygen concentration to the nearest 0.1 mg/l (see Section 8.3).

8.2.5 Turbidity

8.2.5.1 Use Hach Model 2100 or 2100A or an acceptable equivalent that is capable of turbidity measurements (nephelometric) in conformance with EPA's Method 180.1 (EPA, 1983).

8.2.5.2 Most turbidimeters are precalibrated and need a zero adjustment before being used for testing. To zero a turbidimeter, place a vial with a standard solution of 0 NTU into the sample chamber and press the zero button. The solution can be either purchased or produced with deionized water and a filter system.

8.2.5.3 Obtain a representative groundwater sample.

8.2.5.4 Fill a vial with the recommended amount of groundwater sample. To get accurate results, the vial must be clean and free of defects. Discard any vials with scratches. Wipe the vial clean with lint-free tissues before inserting it into the chamber (it is important to keep the vials clean). To avoid smudges, handle each vial by its top rim only. Record turbidity readings (see Section 8.3).

8.3 Documentation

Document all information. Information should be recorded in either field notebooks or Daily Activity Log forms and on the Water Quality Sampling Record and also, if needed, on the Water Quality Stabilization Record (Attachment B—form and completion instructions). Information that should be recorded includes

- equipment model and serial number,
- expiration date of calibration solution,
- lot number of calibration solution,
- manufacturer of calibration solution,
- date and time of calibration,
- calibration measurements,
- water sample field parameter measurements, and
- date and time of each set of measurements.

8.4 Postoperation Activities

8.4.1 When the sampling is completed, or at the end of the field day, carefully clean the outside of the sampling instruments with a damp disposable towel to remove any visible dirt. Clean and decontaminate the equipment and replenish supplies.

8.4.2 Return the equipment to the equipment manager. Report any malfunctions, performance deviations, or damage.

8.4.3 Restore the site to the presampling conditions as described in the site-specific documents.

9.0 RECORDS

The FTL is responsible for submitting the following records:

10.1 Water Quality Sampling Record form

10.2 Water Quality Stabilization Record form

10.3 Daily Activity Log form and field notebook

Handling, Packaging and Transporting Field Samples

Standard Operating Procedure

CS009

C&S Engineers, Inc.

141 Elm Street

Buffalo, New York
14203

January 2013

Revision Log

Revision	***Effective Date***	**Prepared By**	***Description of Changes***	***Affected Pages***
0	1/4/13	Daniel Riker, P.G.	New Procedure	All

Handling, Packaging and Transporting Field Samples

Table of Contents

Handling, Packaging and Transporting Field Samples

1.0 PURPOSE

This SOP directs field team members in the preparation of environmental and waste characterization samples for transportation to a laboratory for C&S Engineers, Inc. (C&S) environmental assessment and investigation projects.

2.0 TRAINING

2.1 The Field Team Leader (FTL) is responsible for ensuring that field team members who handle, package and transport field samples for C&S projects are familiar with the objectives of and are properly trained in the procedures controlling these activities.

2.2 All users of this SOP are trained by through the review of this SOP. The Field Team Leader (FTL) will monitor the proper implementation of this procedure and ensure that relevant team members have completed and documented all applicable training.

3.0 DEFINITIONS

3.1 Environmental samples — Air, soil, water, or other media samples that are collected from surface waters, wells, soils or other locations and are not expected to exhibit properties classified by DOT as hazardous.

3.2 DOT-Regulated samples — Samples of on-site air particulates, soil, or water and materials collected at waste sites that are known or thought to meet the definition of a hazardous material as defined in 49 CFR 171.8. In this procedure “hazardous” does not refer to Resource Conservation Recovery Act (RCRA) hazardous wastes unless so stated.

3.4 Radioactive material — Any material having a specific activity greater than 70 Bq/g (2 nCi/g) per unit mass of the material and in which the radionuclide is evenly distributed.

3.5 Site-Specific Health and Safety Plan (SSHASP) — A health and safety plan that is specific to a site or C&S-related field activity that has been approved by a C&S health and safety representative. This document contains information specific to the project including scope of work, relevant history, descriptions of hazards by activity associated with the project site(s), and techniques for exposure mitigation (e.g., personal protective equipment [PPE]) and hazard mitigation.

4.0 BACKGROUND AND PRECAUTIONS

Note: This SOP is to be used in conjunction with an approved SSHASP. Also, consult the SSHASP for information on and use of all PPE.

4.1 Low-concentration samples that do not satisfy the DOT hazard-class definitions are classified as environmental samples and are not subject to DOT regulations. Historical data, knowledge-of-process, and field screening results will assist the team members in making decisions as to whether a sample can be designated as "environmental" or needs to be treated as a DOT-regulated material.

4.2 The Project Leader will generate the paperwork for the field team.

4.3 The Project Leader is responsible for scheduling chemical analyses in cooperation with participating commercial analytical laboratories.

4.4 All samples must be handled according to applicable C&S Standard Operating Procedures (SOP), and any applicable regulations for DOT-regulated samples. While transporting samples, sample integrity (samples must be locked and/or under constant supervision, and protected from tampering) and chain-of-custody must be maintained. The health and safety of personnel and the environment must be protected from detrimental effects of hazardous materials if the samples are hazardous materials.

4.5 Environmental samples collected for analysis are transported to a laboratory.

5.0 EQUIPMENT

The equipment necessary for this task will depend on the shipping method but should include appropriate materials approved by the DOT.

6.0 PROCEDURE

6.1 Transportation of Samples

The field team member will classify the samples collected at a site as either environmental (non-DOT-regulated) or DOT-regulated (including radioactive) samples according to the DOT requirements. Preliminary classification must be made in the field to ensure that the samples are transported on public-access roads safely and according to regulations. Use Sections 6.2 and 6.3 of this SOP as guides to characterize sample types and the applicable packaging requirements for the samples.

6.1.1 The field team member will preserve and package samples being collected in accordance with Environmental Protection Agency (EPA) requirements.

6.1.2 The field team member will seal and label samples before packing. The field team member will ensure that the sample containers and the containers used for transport exhibit no external contamination.

6.1.3 The field team member will package all samples so as to minimize the possibility of breakage during transportation. For all liquid samples, containers can be placed in resealable plastic bags or bubble-wrap, or sufficient absorbent material can be placed inside the transport container. Seal with custody tape or lock the transportation package so that any tampering can be readily detected.

6.1.4 After all environmental samples are collected, packaged, and preserved, a field team member will transport them to a laboratory under chain-of-custody. After the samples have been verified with the chain-of-custody documentation, a field team member relinquishes custody to laboratory personnel.

6.1.5 The field team member will document all comments and any deviations from this procedure in the Field Log Notebook or Daily Activity Log.

6.2 Environmental Samples

6.2.1 In general, samples collected in non-laboratory use areas (e.g., wetlands, wells, and soils) are not expected to be contaminated with levels of hazardous or radioactive materials high enough to be considered hazardous by DOT.

6.2.2 Samples taken from inactive septic systems are exempt from all DOT and International Air Transport Authority (IATA) requirements if the sample collector can verify that the samples no longer contain infectious material.

6.3 DOT-Regulated Samples

Although the sample media in the C&S Project is expected to be soil, water, sediment, or sludge, the C&S Project may occasionally have cause to sample pure product waste or media that contains highly concentrated hazardous material. If the amount of the hazardous material in the sample is small, it may be shipped under the DOT limited- or small-quantity exceptions. Small quantities of hazardous material are exempt from the DOT requirements for packaging, shipping papers, labels, and place cards for that hazardous material and can be shipped as environmental samples. Refer to the exception for small quantities located in 49 CFR 173.4. DOT-regulated materials may be transported under the limited-quantity exception if that material has an exception noted in column 8A of the Hazardous Materials Table located in 49 CFR 172.101. Actual quantities are given in the reference indicated in Column 8A.
The shipment of limited quantities must follow all requirements in the 49 CFR 172.101 reference section. Radioactive samples must be accompanied by the specified information indicated in Section 6.3.2 of this SOP.

6.3.1 Nonradioactive Samples

6.3.1.1 Samples known or expected to be classified as DOT regulated materials must be transported according to DOT requirements.

6.3.1.2 Samples taken from sanitary waste in active septic tanks or sewage lagoons can be classified as Diagnostic Specimens, which 49 CFR 173.196 (h) (1) exempts from special handling during ground transportation. However, because these samples may be shipped by air for off-site analysis, the field team member must collect them in the proper containers with all the appropriate packaging, per IATA.

6.3.1.3 CAUTION: Product nitric acid, which is used as a sample preservative, has restrictive DOT packaging and transportation requirements, with no exceptions allowed. All regulations in 49 CFR 172.101 and 173.158 must be followed when moving any amount of undiluted nitric acid. However, water samples preserved by nitric acid, because of the dilution of the acid (or any other additive) are no longer forbidden according to 49 CFR 172.101 (d)(1) and can be packaged and shipped according to the standard practice for shipping environmental samples.

6.3.1.4 40 CFR 136.3, Table 11, Note 3 also address shipment of samples preserved by DOT-regulated hazardous materials.

6.3.2 Radioactive Samples

- For materials with activities greater than 70 Bq/g (2 nCi/g) but less than Type A quantities, DOT identifies a limited quantity category and provides specifications for excepted packaging. Radioactive materials in the limited-quantity category may be transported with minimum restrictions. Limited-quantity shipments must have the following label:

"This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910."

- Limited Quantity shipments are required to have the word "Radioactive" on the outside of each container in the shipment, or on the outside of the shipping container.

6.4 Preparation of Environmental Samples for Transportation/Shipment

Environmental samples must be prepared for delivery in the following manner:

A. Packaging

Before any samples are placed in their delivery containers, the exterior of the sample containers should be decontaminated, if appropriate, and wiped dry.

For purposes of controlling leakage, sample containers can be placed, properly labeled and securely sealed, into a polyethylene sealable bag (e.g., Ziplock bag) and the bag sealed.

If there are multiple sample containers, care should be taken to prevent breakage. Styrofoam “peanuts”, bubble wrap, or other cushioning material can be used, as appropriate, to prevent multiple samples from being broken during movement.

If the FTL deems it necessary for liquid samples, sufficient absorbent material can be placed in the cooler (or other transport container) to absorb all liquid in the event of a sample container breakage.

For samples requiring preservation at 4°C – 2℃, the samples should be placed in a sturdy ice chest with sufficient ice material to keep the samples cold. The presence of ice or frozen Blue Ice in an amount approximately equal to the volume of samples is sufficient indication that the samples are adequately cooled.

When wet ice is used, it should be placed in sealed containers, such as doubled Ziplock bags, so water does not fill the cooler as the ice melts.

If samples are to be immediately chilled to below 4.C before delivery, they must be totally immersed in a separate cooler containing an ice slush solution that is below 4.C. To ensure this temperature before placing samples in the delivery container, a sample container of the same size filled with distilled water can be checked with a thermometer to determine when the samples have reached the desired temperature. The temperature check must be recorded.

Water samples must not be frozen or transported with dry ice as this increases the possibility for container breakage.

Water or sludge samples that will be analyzed for volatile organic analysis (VOA) should be wrapped with bubble pads to avoid freezing and bursting the 40-ml VOA vial.

Completed original Chain-of-Custody forms should be placed in watertight containers, such as a ziplock bag, and placed inside the shipping container.

The cooler or other transport container must be completely closed and secured with tape, if necessary. A chain-of-custody seal should be placed over the lid of the container so that tampering would be easily detected.

B. Marking/Labeling

Per 40 CFR 261.4 (d), all samples must be accompanied by

- The sample collector’s name, mailing address, telephone number
- The laboratory’s name, mailing address, telephone number
- The quantity of the sample
- The date of shipment
- Description of the sample

Some of the required information is contained on the chain-of-custody form.

Transport containers (ice chests) will be marked Environmental Samples.

Preparation of Sanitary Waste Samples for Transportation/Shipping

These instructions are for the handling and transportation and shipping of samples from septic tanks and lagoons that contain sanitary waste. Field team members may want to refer to the Proposed Rule for 49 CFR Part 171, et al, Hazardous Materials: Revision to Standards for Infectious Substances and Genetically Modified Micro-Organisms, which proposed changes for the designation and handling of sanitary waste samples.

A. Samples from Inactive Septic Systems and Lagoons

If the C&S Program is taking samples from these septic systems, the project leader and the field team leader can conclude that the sample media is not infectious using the following prudent and resource conservative philosophy:

- The types of human pathogens found in sanitary waste cannot maintain a viable state because conditions of pH, temperature, oxygen and other gases, etc., are not favorable.

- Without the addition of new waste and new pathogens, the samples are not infectious.

If the project manager and the field team manager decide that samples from inactive sanitary waste systems are not infectious, the decision, with the supporting reasons, should be documented in the Field Log Notebook or Daily Activity Log. These samples can be collected and prepared for transport as soil, sludge, or water samples and designated as environmental samples.

B. Samples from Active Septic Systems and Lagoons

Samples that come from active sanitary systems and are expected to contain human wastes can be designated as diagnostic samples and are excluded from the specific packaging and shipping requirements per 49 CFR 173.196 (h)(1). However, because some C&S Program samples must be shipped by air to meet EPA holding-time requirements, collection and preparation of these samples must satisfy IATA requirements.

For ground transportation of these samples, these samples can be packaged and transported as though they were environmental samples.

According to IATA provisions, these shipments can be identified as Diagnostic Specimens “that have a low probability of containing infectious substances.” The project leader or field team leader may determine the following prudent and resource conservative philosophy:

- Even though there may be infectious substances in the sample, the count would be low, and the probability of sudden illness or death occurring from contact with the infectious substance is low.

- If this determination is made, the responsible party may designate the diagnostic specimen as having a low probability of containing infectious substances.

- This designation reduces the testing requirements for the containers and increases the allowed amounts in a shipping package.

If the project leader and field team leader decide that samples from active sanitary waste systems are diagnostic specimens with low probability for causing illness or death, the decision with the supporting reasons should be documented in the Field Log Notebook or Daily Activity Log.

1. Containers

For material designated as diagnostic specimens, the total volume per shipping container cannot exceed 500 ml, and the maximum volume per inner container must not exceed 100 ml. Therefore, when the samples will be shipped by air, they must be collected in containers that are typically smaller than those used for analyses.

2. Warning Labels

Although DOT does not require place cards or labeling, safety of laboratory personnel requires that the samples should be identified as sanitary waste. A label will alert all personnel handling the samples as to the sample's potential hazard. A typical warning label attached to the outside of the transport container might read:

This package contains samples of sanitary waste. If leakage is noted, take all prudent precautions and notify the sampling team that collected the samples.

DOT Hazardous Material Classification (49 CFR 173.2)

The following is provided to help guide field team members in obtaining additional regulatory information.

1 (Class Number); Explosives (Name of Class or Division); 173.50 (49 CFR Definition Reference); 172.411 (49 CFR Label Reference)

2 Gases 173.115 172.415, 416 and 417

3 Flammable and combustible liquid 173.120 172.419

4.1 Flammable solid 173.124 172.420

4.2 Spontaneously combustible material 173.124 172.422

4.3 Dangerous when wet material 173.124 172.423

5.1 Oxidizer 173.127 172.426

5.2 Organic peroxide 173.128 172.427

6 Poisonous and infectious materials 173.132 and 134 172.430, 431 and 432

7 Radioactive Material 173.403 172.421 through 425

8 Corrosives 173.136 172.442

9 Other Regulated Material 173.140 172.446

Range of Material Radioactivity's and Corresponding Transportation Requirements

-Packaging: strong, tight, leak proof, and with external rad £ 0.5 mrem.

-Outside of package marked "Radioactive" if there is no inner packaging, the outside of the packaging itself is marked "Radioactive."

-Excepted from: • Shipping papers and Certification • Specification packaging • Labeling • Marking See 49 CFR 173.431 See 49 CFR 173.431

7.0 RECORDS

The Project Leader is responsible for ensuring that the following.

7.1 Completed Chain-of-Custody Form

7.2 Completed Field Log Notebook or Daily Activity Logs

7.3 Completed Sample Collection Logs

Air Sampling

Standard Operating Procedure

CS010

C&S Engineers, Inc.

499 Col Eileen Collins Blvd

Syracuse, New York 13212

February 2022

Air Sampling Procedure

This procedure applies to sampling using equipment provided by Centek Labs. Equipment provided by other labs / rental companies may vary.

To avoid potential interferences and dilution effects, request that the following activities not occur for the 24-hours prior to or during the sampling event:

- opening windows or vents;
- operating ventilation fans;
- painting;
- using auxiliary heating devices, such as kerosene heaters;
- cleaning, waxing, or polishing furniture, floors, or other woodwork with petroleum or oil-based products;
- using air fresheners, scented candles, or odor eliminators;
- engaging in hobbies that use materials containing VOCs;
- using cosmetics while in the building, such as hairspray, nail polish, nail polish removers, or perfume / cologne;
- applying pesticides;
- using building repair or maintenance products, such as caulk; and
- bringing freshly dry-cleaned clothing or furnishings into the building.
- Field sampling personnel will not pump gasoline en route to the sampling event to avoid the potential introduction of VOCs via clothing or contact from such activities.

General Protocol:

- Prepare field notes and sample canister labels with ballpoint pens. Do not use "Sharpie" or similar type markers containing VOCs.
- Record weather conditions (e.g., precipitation, indoor and outdoor temperatures, barometric pressure) and ventilation conditions (e.g., heating system active and windows closed) at sample deployment and retrieval.
- Record pertinent observations, such as odors, readings from field instrumentation, and significant activities in the vicinity (e.g., operation of heavy equipment) at sample deployment and retrieval.
- Record ambient air conditions within the building and near any locations where chemicals or products that may impact indoor air sample results will be screened using a portable photo-ionization detector (PID) equipped with a 10.6 eV lamp.
- Photograph each sample location and its surrounding area, the building and its foundation, all observed foundation penetrations, and any other pertinent features.
- Record sample identification, date & times of sample collection, sampling height, identity of samplers, sampling method & devices, volume of air sampled and vacuum of canisters before-and-after samples are collected.
- Record sample locations, chemical storage areas, doorways, stairways, subsurface drains and utility perforations through building foundations, HVAC system supply and return registers, and any other pertinent information on a floor plan / site sketch of the building.
- Collect samples and purge at a maximum flow rate of 0.2 liters per minute.
- Analyze samples for VOCs by USEPA Compendium Method TO-15.

Equipment Checklist:

- Sampling canisters and regulators
- Tubing (~2' per hole)
- Helium short circuit testing shroud
- Helium short circuit testing meter
- Helium cylinder / canister
- Clay or concrete for grouting / sealing
- Hammer drill and bits
- Extension cord
- Chain of custody
- Razor knife
- Hand broom / shop vac
- Canister tripod
- Do Not Disturb Signs

Sub-Slab Procedure:

Sub-slab samples will be collected through temporary sampling ports installed through the slab foundation, as described below.

1. Select location per work plan and drill hole the depth of the slab. Hole should be slightly larger than the tubing. Clear concrete dust away from the hole location.

2. Insert tubing into the hole, extend to the bottom and then pull back ½".

3. Seal the interface between the hole and tubing with clay. Pack clay down into the hole and around the top of the hole. It's important to pack clay down into the hole because the tubing at the top of the hole pushes on the clay and may affect the top of the seal.

4. Using a syringe, purge one (1) to three (3) times the volume of the sampling tubing to remove air that is not representative of the sub-slab environment. Purge at a flow rate below 0.2 liters per minute to minimize the potential for air from above the slab to be pulled into the sub-slab environment through excessive negative air pressure.

5. Perform helium short circuit leak test.
    a. Connect the downhole polyethylene tubing to the port on the underside of the shroud (top left photo below).
    b. Connect a short piece of tubing (~ 0.5') to the same port on the top side of the shroud (see middle right photo below).
    c. Using a syringe, purge vapor at a flow rate below 0.2 liters per minute to minimize the potential for air from above the slab to be pulled into the sub-slab environment through excessive negative air pressure.
    d. Insert the full syringe into a clean tedlar bag.
    e. Connect the helium meter to the tedlar bag and zero the meter.
    f. Connect the helium canister to the port on the top of the shroud (not the sub-slab tubing) to fill the shroud with helium (see right photo below). Ideally, the shroud should be filled to 10% to 20% helium. Centek advises to open helium canister for a couple seconds to achieve that percentage.
    g. Using a syringe, purge vapor at a flow rate below 0.2 liters per minute to minimize the potential for air from above the slab to be pulled into the sub-slab environment through excessive negative air pressure.
    h. Insert the full syringe into a clean tedlar bag.
    i. Insert the helium meter probe into the tedlar bag to check for helium in the sub-slab. If no helium is detected, move onto the next step. If helium is detected, reseal the hole and perform step 5 again.

6. Remove the shroud and disconnect the tubing from the underside. Be careful not to affect the clay seal.

7. DO NOT REMOVE the dust cap. Connect the regulator to the tubing, and then connect the canister to the regulator. Note that as soon as a regulator without a shutoff valve is connected to a canister, air is collected.

8. On the COC, record the sample start time and initial pressure of the canister (should be -30 psi). Also, be sure to record a sample ID number on the canister and mark the location on the site plan.

9. Return to collect canister no more than 24 hours later.
   a. Record the end sample time as well as the canister pressure on the COC (should be around -1 psi).
   b. Disconnect the tubing, regulator, and canister. Place regulator and canister back into original boxes.
   c. Fill sample hole with clay and concrete mix.

Indoor Air Procedure:

Select locations based on the criteria established in the NYSDOH SVI Guidance Protocols.

1. DO NOT REMOVE the dust cap. Connect the regulator to the canister. Note that as soon as a regulator without a shutoff valve is connected to a canister, air is collected.

2. Secure canister to the tripod 3' to 4' off the ground and secure a do not disturb sign to it.

3. On the COC, record the sample start time and initial pressure of the canister (should be -30 psi). Also, be sure to record a sample ID number on the canister and mark the location on the site plan.

4. Return to collect canister no more than 24 hours later.
    a. Record the end sample time as well as the canister pressure on the COC (should be around -1 psi).
    b. Disconnect the regulator and canister. Place regulator and canister back into original boxes.

Outdoor Air Procedure:

Collect outdoor air samples from an upwind location of the Site. Sample location should be based upon the current wind direction and site features.

The outdoor (upwind) sample location will be positioned away from trees and shrubbery, fences, and other site features that may affect air currents, and away from potential sources of airborne VOCs, such as vehicle parking areas, running gas-powered equipment, and building vents, that may result in elevated outdoor air sample results. Collect the sample at a height of 3-to-5 feet above the ground to represent typical breathing zones. Collect outdoor air samples in the same manner as the indoor air samples.