SITE CHARATERIZATION WORK PLAN

SUBJECT SITE:

338 Broadway
City of Kingston, Ulster County, New York

NYSDEC Site No. 356058

PREPARED FOR:
New York State Department of Environmental Conservation
Central Office
625 Broadway
Albany, New York 12233
Attn: Parag Amin

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SITE CHARACTERIZATION WORK PLAN

Site No. 356058

338 Broadway
City of Kingston, Ulster County, New York

Date: March 3, 2020

I, Thomas Giamichael, certify that I am currently a Qualified Environmental Professional as defined in 6 NYCRR Part 375 and that this Site Characterization 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).

Thomas Giamichael, PG #0621
Qualified Environmental Professional

I, Aaron Yecies, certify that I am currently a Qualified Environmental Professional as defined in 6 NYCRR Part 375 and that this Site Characterization 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).

Aaron Yecies, CPG, PG #0128
Senior Hydrogeologist

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1.0 Introduction

1.1 Project Background

Aztech Technologies Inc., dba, Aztech Environmental Technologies (Aztech) was contracted by the New York State Department of Environmental Conservation (NYSDEC) Central Office to perform a Site Characterization (SC) at the property located at 338 Broadway in Kingston, New York (Site). The Site location is shown on **Figure 1**. The Site has been assigned Site No. 356058 and classified as a "P-Site" (sites that have the potential to be listed on the Registry of Inactive Hazardous Waste Disposal Sites) within the NYSDEC State Superfund Program. The primary goals of the SC are to appropriately characterize contamination at the Site related groundwater, soil and soil vapor. The results of the SC will be used to determine the classification of the site and determine whether an Interim Remedial Measure (IRM) is required.

The following Site Characterization Work Plan (SCWP) describes the investigation and technology to determine whether the Site soils and/or groundwater pose a threat to public health and the environment. This SCWP is consistent with the guidance provided in the NYSDEC's "Division of Environmental Remediation Technical Guidance for Site Investigation and Remediation" (May 2010), (DER-10).

The data derived from the SCWP will assist in achieving the primary objectives of the SCWP which is to determine whether the Site poses a significant threat to public health and the environment.

To facilitate performance of the field investigation and SC activities in a manner consistent with NYSDEC protocols, Aztech has also prepared the following Site-specific documents, which are contained in the SCWP Documents Package:

1. Field Sampling Plan (FSP) (Appendix A);
2. Quality Assurance Project Plan (QAPP) (Appendix B); and
3. Health and Safety Plan (HASP)/Community Air Monitoring Plan (CAMP), (Appendix C).

These documents are integral to this SCWP and are referenced throughout this report.

2.0 Site Background

2.1 Site Location and Description

The subject property consists of approximately 0.23 acres and is located in the city of Kingston within Ulster County. The Site is bounded by Broadway and Jensen Avenue toward the south and north, respectively. Immediately east of the Site is an automobile repair shop (Bob's) and a fast food restaurant (Burger King). The building immediately to the west is occupied by a fast food restaurant (Kennedy Fried Chicken) and Grocery Store (El Mercadito).

The Site is comprised of one (1) parcel, Tax Map No. 56.26-11-46. According to the Image Mate Online database for Ulster County, the Site is currently zoned Commercial. The parcel is occupied by a single large building with a portion of that building consisting of three (3) stories. The building currently operates as a clothing boutique. The remainder of the parcel consists of broken pavement.

A Site location map is provided as Figure 1 and a general Site map with approximate property boundaries map is provided as **Figure 2.**

2.2 Site History

The earliest history of the subject Site is identified on the 1897 Sanborn Fire Insurance map. The map identifies a building structure partially resembling the current building form. However the rear of structure at the time of 1887 appears to be connected to another structure residing on the adjoining parcel to the east. During that time the use of the structure is identified as a Saloon. The earliest record of change to the Site building structure and its use is identified on the 1950 Sanborn map. As presented in the 1950 record, the building has been separated from its formerly adjoining building to the east and the structure has been expanded to the north resembling its current structure form. Use of the Site in 1950 is identified as a dry cleaner. It is unclear when dry cleaning operations at the site ceased. A copy of the 1897 and 1950 Sanborn maps are presented in **Figure 3** and **Figure 4**, respectively.

2.3 Previous Investigations and Reports

No records of previous investigation work specific to the onsite property were available for review prior to preparation of this SCWP.

Previous off-site subsurface investigations performed by others documented the presence of chlorinated volatile organic compounds (terachloroethene (PCE), Trichloroethene (TCE), cis-1,2, dichloroethene (DCE) and trans-1,2,DCE) in groundwater samples collected at 322 Broadway (Burger King), to the east of 338 Broadway.

Project work performed under this SCWP will occur in areas to further assess the existence and extent of chlorinated solvent contaminants that were identified on the 322 Broadway property.

3.0 Site Setting

3.1 Surface Features

The subject property primarily consists of broken asphalt pavement and a multi-story building that occupies approximately 0.08 acres of the 0.23 acre parcel. The Site surface is generally level with a slight downward grade towards the north-northeast.

3.2 Geology and Hydrogeology

The Site is situated in the Hudson/Mohawk Lowlands of New York State. Erosion of weak rocks along outcrop belts have shaped the regional topography. Localized outcrops of Devonian limestone occur near the Site, as the overburden sequence thins along valley walls and at hilltops exposing the underlying bedrock. The Catskill Mountains to the West and metamorphosed shale hills of the Taconic range to the east, create regionally high relief, but with the lowlands near the Hudson River, where the Site is located, the topography is generally flat.

The surficial geology of the Site consists primarily of a stratified glacial outwash sequence overlying lacustrine varved silt and clay deposits. According to the Natural Resources

Conservation Service (NRCS) in Ulster County, the Site bedrock is overlain by the Plainfield loamy sand, 0 to 8 percent slopes. The Plainfield series consists of very deep, excessively drained soils formed in sandy drift on outwash plains, valley trains, glacial lake basins, stream terraces, and moraines and other upland areas. Permeability is rapid or very rapid. These soils occupy gently sloping areas of glacial till in the uplands.

Review of the geologic bedrock map of New York, Lower Hudson Sheet published by the University of the State of New York, the State Education Department, dated 1970, indicates that the Site is underlain by the Onondaga limestone. The Onondaga formation is within the Onondaga and Ulster Group, which is lower to middle Devonian in age, and is comprised of carbonate sedimentary rock that are characterized by calcarenitic to cherty to argillaceous limestones and minor shales deposited in a shallow epicontinental sea. The Esopus unit, relative to the Site, is moderately hard, dark gray or buff to light olive sandy shale. Unit thickness ranges from 200 to 300 feet in Ulster County.

According to recent studies in the local area, groundwater is expect to be encountered between eight (8) and 14 feet below ground surface (fbgs). A layer of less permeable glacial deposits (silt-rich clay) is to be expected between shallow groundwater and the bedrock sequence.

The Hudson River is the main regional hydrologic feature, flowing from north to south along the Hudson Valley floor approximately 1½ miles east of the Site. The Roundout Creek, an eastward flowing tributary to the Hudson River, is located approximately ¾ mile south of the Site. The Hudson River and its tributaries are areas of groundwater discharge. As such, groundwater in topographically flat areas near the site will tend to flow towards the river and nearby creeks and streams the flow into the Hudson River.

4.0 Proposed Site Characterization Investigation

4.1 Overview

The SC will be performed in accordance with this SCWP and will involve the fieldwork necessary to complete the soil, soil gas and groundwater investigation components of the Site characterization.

The objective of the SC is to assist in identifying any onsite areas of concern at the Site and help determine if the Site poses a significant threat to public health and the environment. The proposed investigation activities include the following components:

- Initial land surveying;
- Geophysical survey;
- Collection of surface soil samples;
- Installation of soil borings to be completed as groundwater monitoring wells
- Installation of soil gas and sub-slab vapor points;
- Collection and analysis of soil, soil vapor and groundwater samples for parameters of concern.

The investigative activities are briefly summarized in the following sections and described in further detail in the FSP. Samples will be collected and analyzed in accordance with Aztech Standard Operating Procedures (SOPs) and sampling procedures and protocols as described in the FSP (Appendix A). Quality Assurance/Quality Control (QA/QC) samples will be collected and analyzed in accordance with the QAPP (Appendix B).

4.1 Site Survey

Prior to performing any investigation or intrusive work at the site, a property boundaries survey will be conducted at the Site. All surveying work performed for the SC will be conducted by certified land surveyor licensed to practice in the State of New York. The selected surveyor will operate as a subcontractor to Aztech. The objective of the survey will be to define and demarcate the property boundaries for the Site and immediately surrounding parcels. The parcels that will be surveyed during the SC are presented on Figure 2 and are as follows:

- 338 Broadway, Tax Parcel ID 56.26-11-46
- 334 Broadway, Tax Parcel ID 56.26-11-12
- 15 Jansen Ave., Tax Parcel ID 56.26-11-44
- 17 Jansen Ave., Tax Parcel ID 56.26-11-45

Following the SC activities a subsequent survey will be conducted to collect pertinent investigation information for the completed soil borings and monitoring wells. The horizontal coordinates will be tied to the New York State Plane, Central (3102), coordinate system (NAD 83). All elevations will be established with respect to NAVD 1998.

For each soil boring, the surveyor will determine its location and the ground surface elevation. For each monitoring well, the surveyor will determine the location, ground-surface elevation, and measuring-point elevation (defined as the top of the inner well casing).

4.2 Geophysical Survey

Prior to commencing boring installation activities, a geophysical subsurface survey will be completed in accessible areas of the Site. An electromagnetic metal detector, ground penetration radar (GPR) and utility locating instruments will be used identify detectable subsurface utilities and/or structures. The objectives of the geophysical survey are to:

- Locate below-grade remnants of building structures, drums or underground storage tanks (USTs).
- Assess the Site for the location of possible underground utilities.
- Evaluate the depth to a configuration of the bedrock surface (if the bedrock surface is less than approximately 15 feet below grade).
- Fine-tune the locations of soil borings and monitoring wells to be installed during the SC.

All detected utilities and anomalies will be clearly marked on the ground surface with spray paint. Proposed boring locations may be adjusted based on the results of the subsurface clearance survey. Hand clearing will be completed by the drilling contractor if the geophysical subsurface survey techniques are unsuccessful or yield inconclusive results.

The geophysical survey will be completed after the initial Site property survey has been performed.

4.3 Surface Soil Sampling

As part of the SC, up to five (5) surface soil samples are proposed to be collected. Surface soil sampling will be conducted independently of the proposed soil boring installations. The samples will be collected from surficial soils from exposed. Proposed surface sample locations are presented on **Figure 5**.

In general samples will be collected no deeper than six (6) inches below the existing grade using a stainless steel trowel or disposable sampler. Samples for inorganics and semi-volatile compounds will be collected from between the surface and two (2) inches. Samples for VOCs will be collected between two (2) and six (6) inches below grade. Surface soil samples will be field screened with a photoionization detector (PID) and submitted to an off-Site NYSDOH Environmental Laboratory Approval Program (ELAP)-certified laboratory for a select set of parameters as described in Table 1, summarized in Section 5.0 of this SCWP and detailed in the FSP.

4.4 Soil Boring Installation and Soil Sample Collection

For the subsurface component of the SC, up to six (6) soil borings are proposed to be advanced within the Site boundary, using a track-mounted Geoprobe equipped hydraulically driven direct-push equipment. Proposed soil boring locations are shown on **Figure 6**.

Soil core samples will be collected continuously from grade to approximately five (5) feet below the observed water table. A maximum depth of 20 feet bgs is expected, sampling depth may be extended dependent on field observations. Sample cores will be collected in five (5) foot intervals using a Macrocore® sampling device. Each soil sample core will then be screened in the field for visual, olfactory, and photoionic evidence of contamination. The observed soils will be logged in the field using a modified Burmister soil classification method in accordance with the FSP.

Immediately upon opening the soil sampler, a PID will be used to obtain readings along the length of the soil sample. Following this screening, the soils within the soil sampler will be measured, described and photographed. As applicable, soil samples for laboratory analysis will be collected from each borehole in accordance with **Table 1**, summarized in section 5.0 of this SCWP and the protocols outline in the FSP.

4.5 Groundwater Investigation

A groundwater investigation will be conducted as part of the SC. The groundwater investigation will be limited to groundwater within the overburden soils only during the SC. To facilitate this investigation, each of the six (6) proposed soil borings outlined in section 4.3 will be completed as groundwater monitoring wells in the overburden soils. The well construction procedures are detailed in the FSP.

The objectives of the groundwater investigation are to:

- Characterize the general shape of the water table and develop a preliminary assessment of shallow groundwater flow patterns at the Site.
- Determine the presence or absence of dry-cleaning related constituents dissolved in groundwater if present.

The top of each well casing elevation will be recorded during the subsequent Site survey and used in conjunction with well gauging data to develop a groundwater flow map. One (1) round of groundwater samples will be collected from the six (6) newly installed monitoring wells. In addition, the pre-existing offsite monitoring well MW-6, located on the burger King Property, will be included in the sampling event. Groundwater samples will be collected from the monitoring wells using low-flow sampling techniques described in the FSP. Field sampling parameters measured during the groundwater sampling will include pH, turbidity, temperature, conductivity, dissolved oxygen and oxidation reduction potential (ORP).

Groundwater samples will be submitted to a NYSDOH ELAP approved laboratory and analyzed for a select set of parameters as described in in Table 1, summarized in Section 5.0 of this SCWP and detailed in the FSP.

4.6 Soil Gas Investigation

To evaluate potential impacts within in soil vapor, commonly referred to as soil gas, up to ten (10) soil gas monitoring probes are proposed to be installed during the SC. Proposed soil gas probe locations are presented on **Figure 7**.

The vapor probe construction for soil gas and sampling procedures are detailed in the FSP. In general, each probe will be installed through a borehole within the vadose zone using Geoprobe methods and will consist of a stainless steel vapor screen and Teflon lined tubing to the surface. The depth of installation will be determined based upon water table and capillary fringe observations collected during soil boring advancement as outline in section 4.3. Soil gas samples will be collected using summa canisters equipped with 1-hour regulators and submitted to an off-Site NYSDOH ELAP certified laboratory for a select set of parameters as described in Table 1, summarized in Section 5.0 of this SCWP and detailed in the FSP.

The objectives of the soil vapor investigation are to:

- Determine the extent of VOCs in soil gas external from the onsite building at the Site if present.
- Aid in determining potential contaminant source areas at the Site.
- Identify potential soil vapor intrusion pathways to buildings that may be affected by soil gas migration.
- Contribute to development of site conceptual model

4.7 Sub-slab Vapor Investigation

To evaluate potential soil vapor intrusion (SVI) within the onsite building, a sub-slab vapor investigation will be conducted as part of this SC.

The primary purpose for conducting the SVI sampling is to determine if potential VOCs related to dry cleaning solvents in soil and groundwater beneath the Site are having any adverse effect on indoor air quality within the Site building. This will be accomplished by collecting sub-slab soil vapor samples from three (3) locations within the building while congruently collecting indoor and outdoor air samples. Proposed SVI sampling locations are presented in **Figure 8**.

Samples collected as part of this effort will be submitted to an off-Site NYSDOH ELAP certified laboratory for a select set of parameters as described in Table 1, summarized in Section 5.0 of this SCWP and detailed in the FSP. The NYSDOH guidance document entitled "Guidance for Evaluating Soil Vapor Intrusion in the State of New York" (October, 2006) will be followed.

5.0 Proposed Sampling and Analysis Plan

5.1 Overview

The attached **Table 1** presents a detailed summary of the proposed sampling and analysis plan, including the sample identifications, depths (if applicable), analytical parameters, and sampling rationale. All site sampling work will be conducted according to the FSP. All QA/QC samples will be collected according to the QAPP, included as Appendix B. Below is a summary of the parameters to be analyzed from the various media during each phase of the SC field work.

5.2 Surface Soil Sampling

A total of up to five (5) surface soil samples are proposed to be collected during the SC. The proposed surface soil sample locations are presented on **Figure 5**. Samples will be analyzed for the parameters presented on **Table 1** and **Table 2** and summarized below:

A. VOCs using EPA method 8260 will be analyzed from all five (5) samples for the full target compound list (CL) including tentatively identified compounds (TICs);
B. One (1) random sample will be analyzed for the full TCL of SVOCs including 1,4 Dioxane and TICs using EPA method 8270, Pesticides/Herbicides (EPA methods 8081/8151), Polychlorinated Biphenyls (PCBs) using EPA method 8082, TAL Metals (EPA method 6010) and Per- and Polyfluoroalkyl Substances (PFAS), 21 compound list using EPA method 537 modified.
C. One (1) set of QA/QC samples to include field duplicate, matrix spike and matrix spike duplicate to be analyzed for the above noted parameters.

5.3 Subsurface Soil Sampling

A total of up to six (6) soil borings are proposed to be advanced during the SC. A total of three (3) samples will be collected at select intervals from each boring. The proposed soil boring locations are presented on **Figure 6**. Samples will analyzed for the parameters presented on **Table 1** and **Table 2** and summarized below:

A. The full TCL of VOCs including TICs using EPA method 8260 will be analyzed from each of the three (3) intervals sampled in the six (6) soil borings advanced. This will total 18 subsurface soil samples collected during the SC. Sample intervals will be chosen by the onsite representative and will generally consist of one (1) sample from within the vadose

zone exhibiting the highest PID reading, one (1) sample from the saturated zone and one (1) sample from the terminal depth of boring;

B. A total of two (2) random samples will be selected and analyzed for the full TCL of SVOCs including 1,4 Dioxane and TICs using EPA method 8270, Pesticides/Herbicides (EPA methods 8081/8151), PCBs (EPA method 8082), TAL Metals (EPA method 6010) and PFAS, 21 compound list using EPA method 537.1 modified.
C. Two (2) sets of QA/QC samples to include field duplicate, matrix spike and matrix spike duplicate to be analyzed for the above noted parameters.

5.4 Groundwater Sampling

Each of the (6) soil borings will be converted to groundwater monitoring during the SC. One (1) groundwater sample will be collected from each well using low flow sampling techniques as outlined in the FSP. The proposed soil boring locations to be converted to monitoring wells are presented on **Figure 6**. Samples will analyzed for the parameters presented on **Table 1** and **Table 2** and summarized below:

A. Groundwater samples from the six (6) onsite wells and one (1) offsite well (MW-6) will be analyzed for the full TCL of VOCs including TICs using EPA method 8260;
B. A total of two (2) random samples will be selected and analyzed for the full TCL of SVOCs including 1,4 Dioxane and TICs using EPA method 8270, Pesticides/Herbicides (EPA methods 8081/8151), PCBs (EPA method 8082), TAL Metals (EPA method 6010) and PFAS, 21 compound list using EPA method 537.1.
C. One (1) set of QA/QC samples to include field duplicate, matrix spike and matrix spike duplicate to be analyzed for the above noted parameters.

5.5 Soil Gas Sampling

A total of up to ten (10) soil gas samples are proposed to be collected using active soil gas sampling techniques during the SC. The proposed soil gas sample locations are presented on **Figure 7**. Samples will analyzed for the parameters presented on **Table 1** and **Table 2** and summarized below:

A. All ten (10) soil gas samples will be analyzed for VOCs using EPA method TO-15. Samples will be collected using Summa-canister equipped with 1-hr regulators as detailed in the FSP.
B. One (1) ambient air sample will be collected congruently with the sub-slab samples and analyzed using EPA method TO-15.
C. One (1) set of QA/QC samples to include one (1) field duplicate will be collected from a random sample to be analyzed for the above noted parameters.

5.6 Sub-slab Vapor Sampling

A total of three (3) sub-slab soil vapor samples are proposed to be collected using active soil gas sampling techniques during the SC. The proposed soil vapor sample locations are presented on **Figure 8**. Samples will analyzed for the parameters presented on **Table 1** and **Table 2** and summarized below:

A. The three (3) sub-slab soil vapor samples will be analyzed for VOCs using EPA method TO-15. Samples will be collected using Summa-canister equipped with 24-hr regulators as detailed in the FSP.
B. One (1) indoor air sample will be collected congruently with the sub-slab samples and analyzed using EPA method TO-15; and
C. One (1) ambient air sample will be collected congruently with the sub-slab samples and analyzed using EPA method TO-15.
D. One (1) set of QA/QC samples to include field duplicate to be analyzed for the above noted parameters.

6.0 Decontamination and Waste Handling

6.1 Decontamination

All equipment will be decontaminated following the procedures outlined in the FSP (**Appendix A**). In general, all non-disposable equipment, in particular all drilling tools and groundwater sampling equipment, will be decontaminated prior to first use on Site, between each investigation location, and prior to demobilization. The integrity of decontamination will be checked periodically with equipment rinse blanks, as required by the QAPP.

6.2 Waste Handling

All investigation-derived waste (IDW) will be contained on-site for appropriate characterization and disposal. Soil cuttings, personal protective equipment, spent disposable sampling materials, decontamination water and purged groundwater will be segregated by waste type and placed in DOT-approved 55 gallon steel drums. Field staff will maintain an inventory of all IDW drums. All drums will be appropriately labeled with the contents, generator, location, and date. Handling procedures for the IDW have been outlined in the FSP, included as Appendix A.

7.0 Project Schedule and Reporting

7.1 Project Schedule

The field tasks outlined in this SC are estimated to approximately six (6) weeks to complete. The soil borings and monitoring well installations will occur first, followed by soil gas probe deployment/sampling, groundwater gauging/sampling and sub-slab vapor monitoring.

The table below shows the approximate project schedule. The actual project starting date will depend on obtaining NYSDEC's approval for this SCWP.

Project Schedule

Work Activity:	Date:	Duration:
SC Work Plan Approval	February 2020	--
Obtain Subcontractor Solicitations	February 2020	--
Implement SC Work Plan	April 2020	6 weeks
Submit Draft SC Report	July 2020	--
Submit Final SC Report	August 2020	--

7.2 Reporting

Aztech will prepare a SC Report once the field activities are completed and laboratory data are received. The SC Report will be prepared in general accordance with NYSDEC's DER-10 Technical Guidance for Site Investigation and Remediation. The text of the SC Report will include a discussion of the following general topics:

- Site and project background;
- Field activities completed;
- Methodologies used to complete the field activities;
- Findings of the field activities
- An understanding of the Conceptual Site Model (CSM), including the geologic and hydrogeologic site conditions
- Proposed classification of the Site;
- Recommendations for future work, if any.

The text of the SC Report will be supported by subsurface logs, analytical data tables, and figures illustrating Site-specific data, including a groundwater contour map and constituent distribution The. A Data Usability Summary Report (DUSR) of the laboratory analytical reports will also be prepared. The DUSR will be provided as an appendix to the SC Report.

Aztech will receive all laboratory Electronic Data Deliverables (EDD's) prepared by the laboratory during the SC. These data sets will be compiled and submitted into NYSDEC's Environmental Information Management System (EIMS) database using the Environmental Quality Information System (EQUIS) by EarthSoft, Inc.

FIGURES

Aztec Environmental TECHNOLOGIES

N

338 Broadway
Kingston, New York
NYSDEC Site# 356058

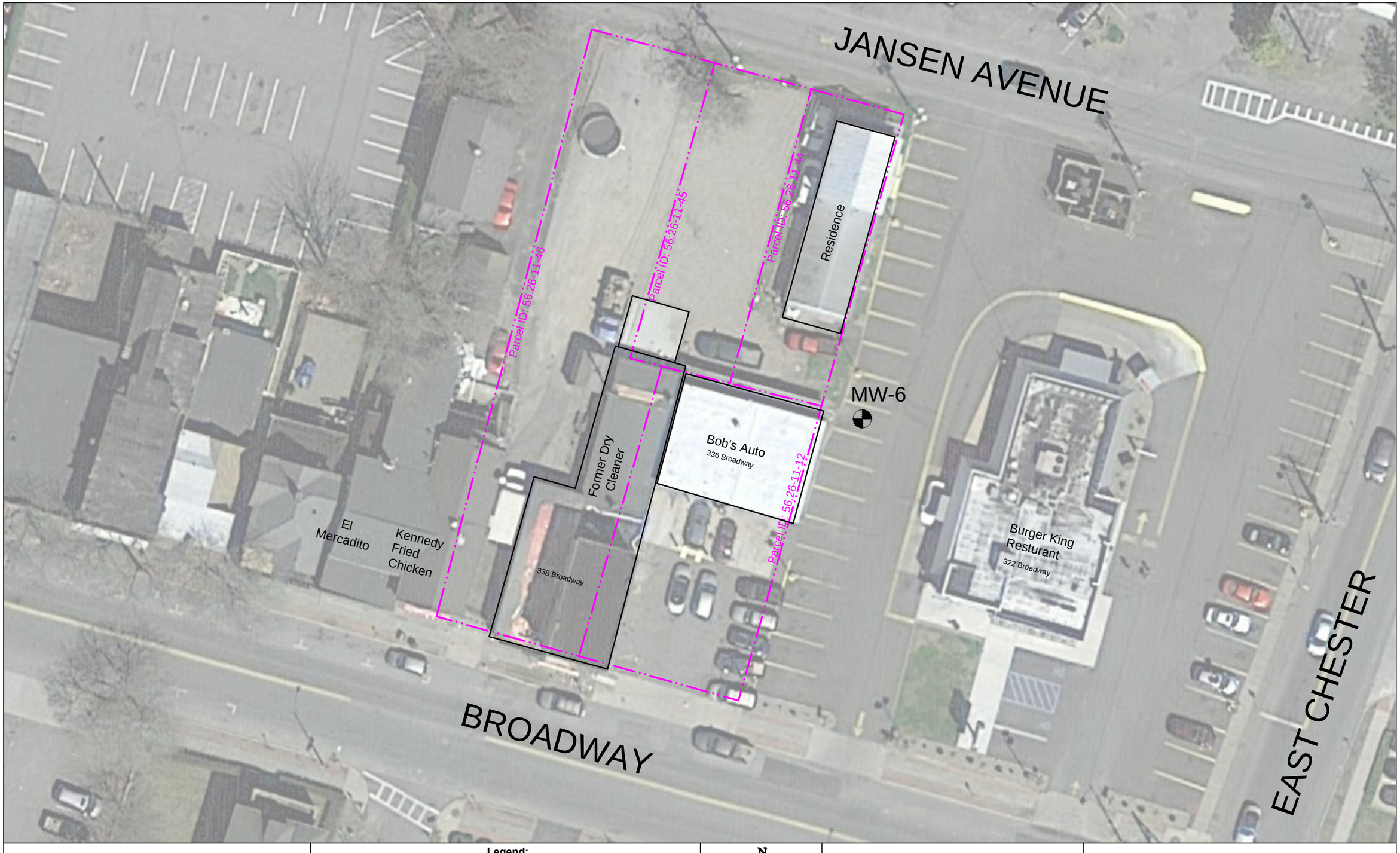
FIGURE 1

DATE: February, 2020

SCALE: 1" = 1,000'

Site Location Map

Topographic Base Map Source
U.S.G.S. Quadrangle - Kingston, NY (2016)



Aztech Environmental TECHNOLOGIES

Legend:

- Approximate Parcel Boundary

MW-6 - Pre-existing Offsite Monitoring Well

N

W E

S

338 Broadway
Kingston, New York
NYSDEC Site# 356058

FIGURE 2

DATE: Ferbruary 2020

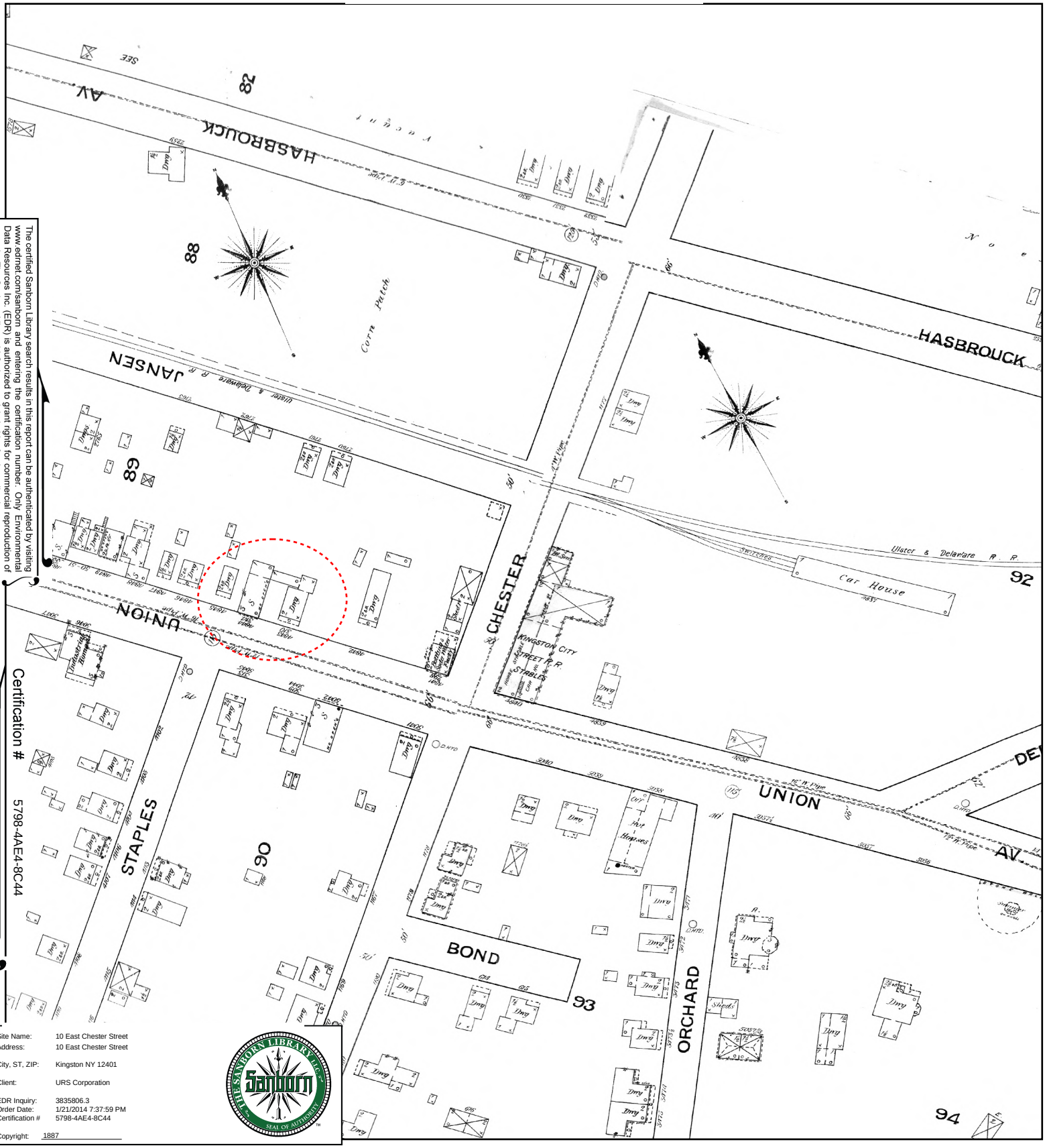
SCALE: 1" = 30'

Site Map

Note: Aerial Image provided by Google Earth 2019

FIGURE 3

1887 Certified Sanborn Map



Certification # 5798-4AE4-8C44

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Address:	10 East Chester Street
City, ST, ZIP:	Kingston NY 12401
Client:	URS Corporation
EDR Inquiry:	3835806.3
Order Date:	1/21/2014 7:37:59 PM
Certification #	5798-4AE4-8C44
Copyright:	1887

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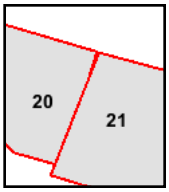
Outlined areas indicate map sheets within the collection.

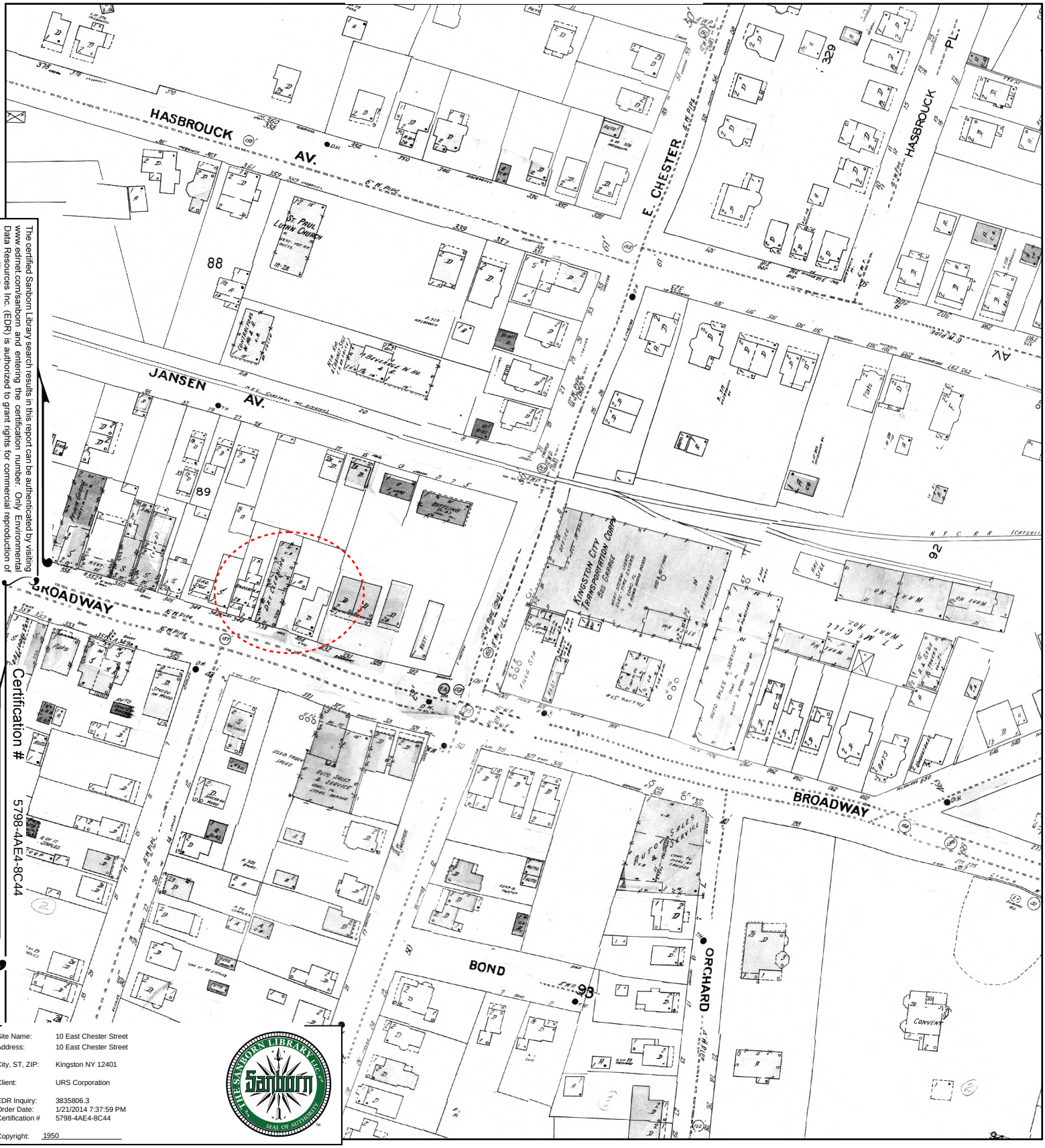


Volume 1, Sheet 20
Volume 1, Sheet 21

0 Feet 150 300 600

N

1950 Certified Sanborn Map



Certification # 5798-4AE4-8C44

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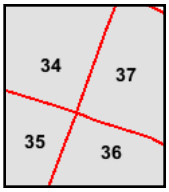
Address:	10 East Chester Street
City, ST, ZIP:	Kingston NY 12401
Client:	URS Corporation
EDR Inquiry:	3835806.3
Order Date:	1/21/2014 7:37:59 PM
Certification #	5798-4AE4-8C44
Copyright:	1950

This Certified Sanborn Map combines the following sheets.
Outlined areas indicate map sheets within the collection.



Volume 1, Sheet 36
Volume 1, Sheet 37
Volume 1, Sheet 34
Volume 1, Sheet 35

0 Feet 150 300 600

N

Aztech Environmental TECHNOLOGIES

Legend:

SURF-1 ● - Proposed Surface Soil Sample

- Approximate Parcel Boundary

N

W E

S

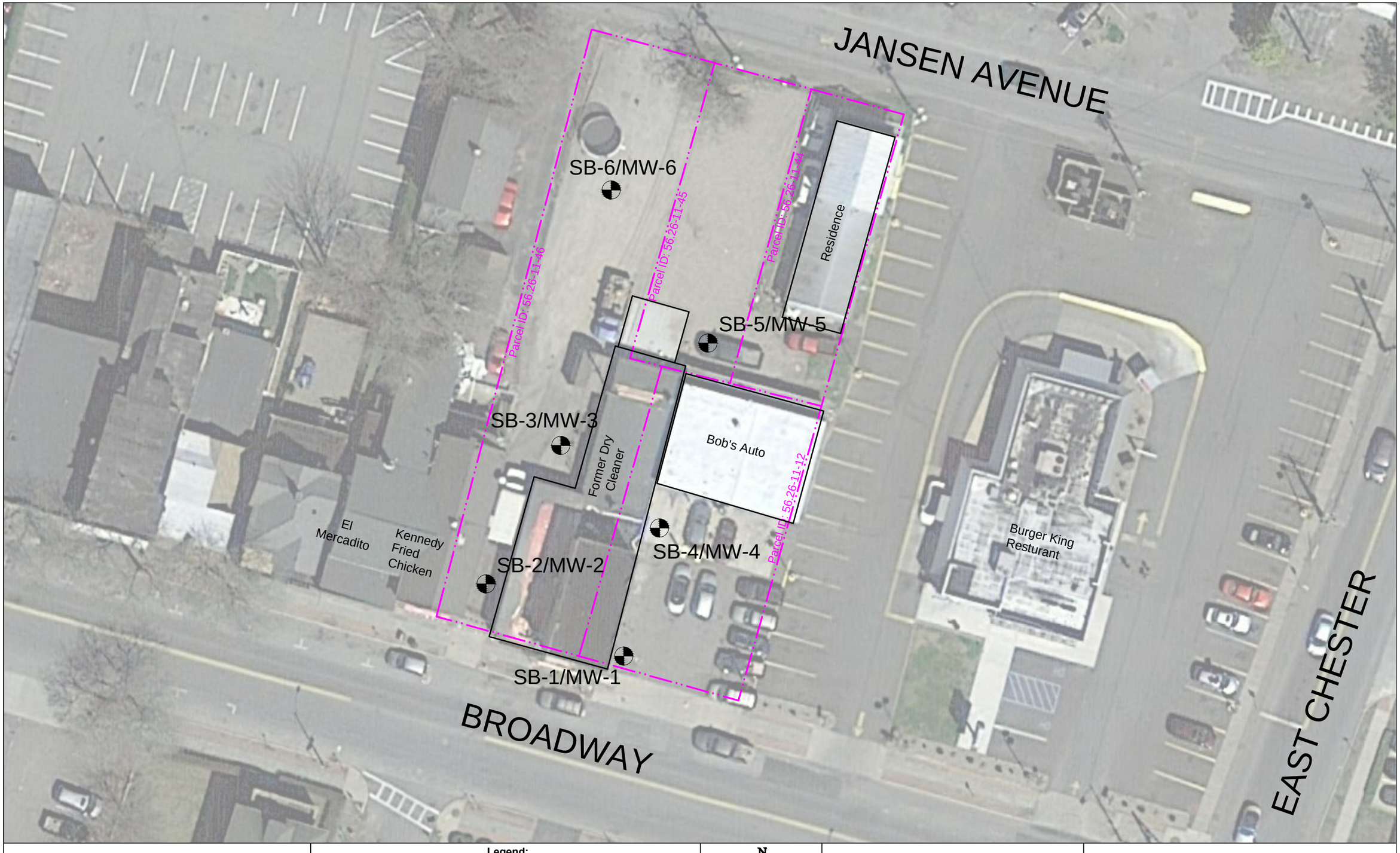
338 Broadway
Kingston, New York
NYSDEC Site# 356058

FIGURE 5

DATE: February 2020 | SCALE: 1" = 30'

Proposed Surface Soil Sample Locations

Note: Aerial Image provided by Google Earth 2019



Aztech Environmental TECHNOLOGIES

Legend:

SB/MW - Proposed Soil Boring / Monitoring Well

- Approximate Parcel Boundary

N

338 Broadway
Kingston, New York
NYSDEC Site# 356058

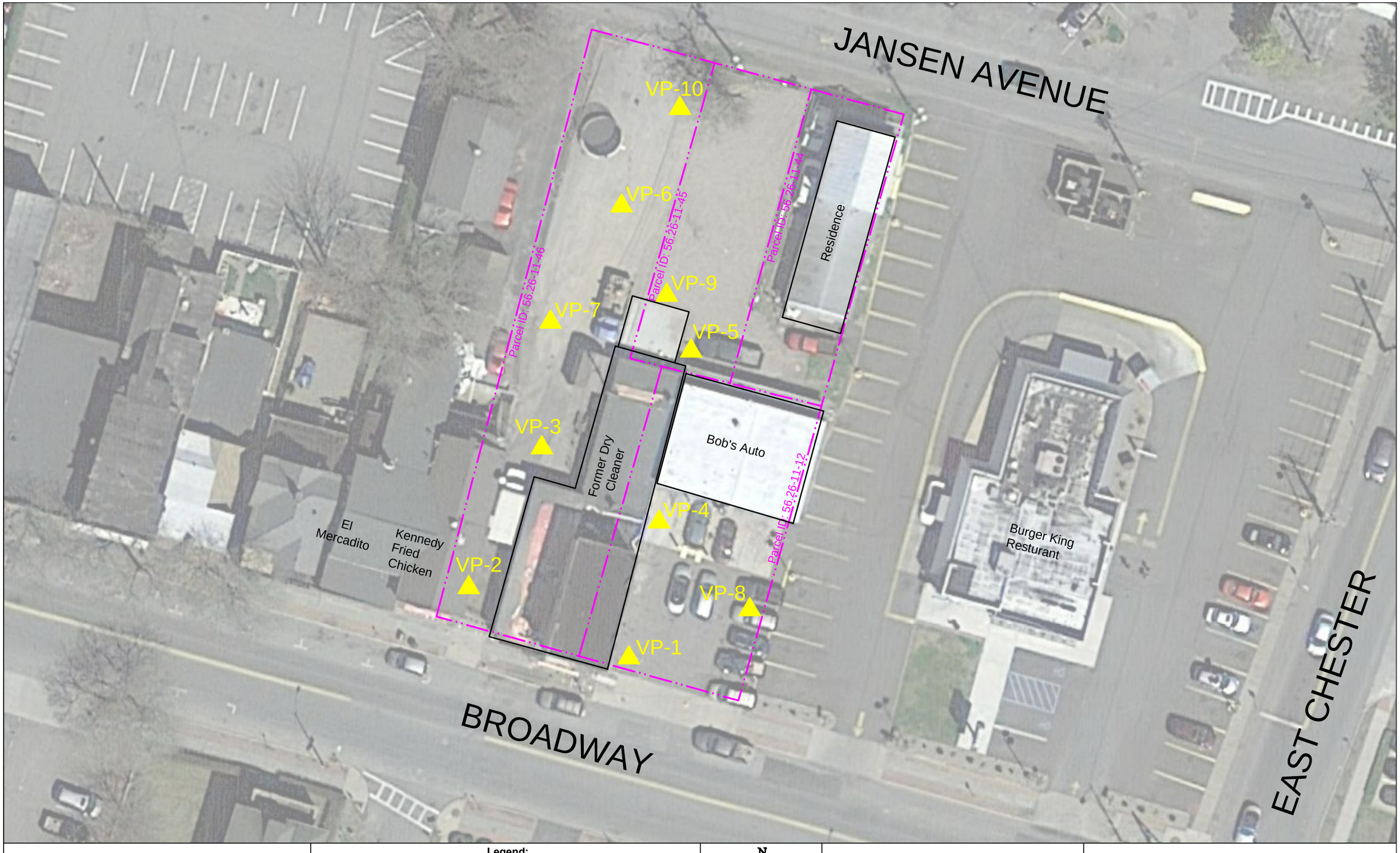
FIGURE 6

DATE: February 2020

SCALE: 1" = 30'

Proposed Soil Boring and Monitoring Well Locations

Note: Aerial Image provided by Google Earth 2019



Aztech Environmental TECHNOLOGIES

Legend:

VP-1 ▲ - Proposed Soil Gas Sample Location

- Approximate Parcel Boundary

N

W E

S

338 Broadway
Kingston, New York
NYSDEC Site# 356058

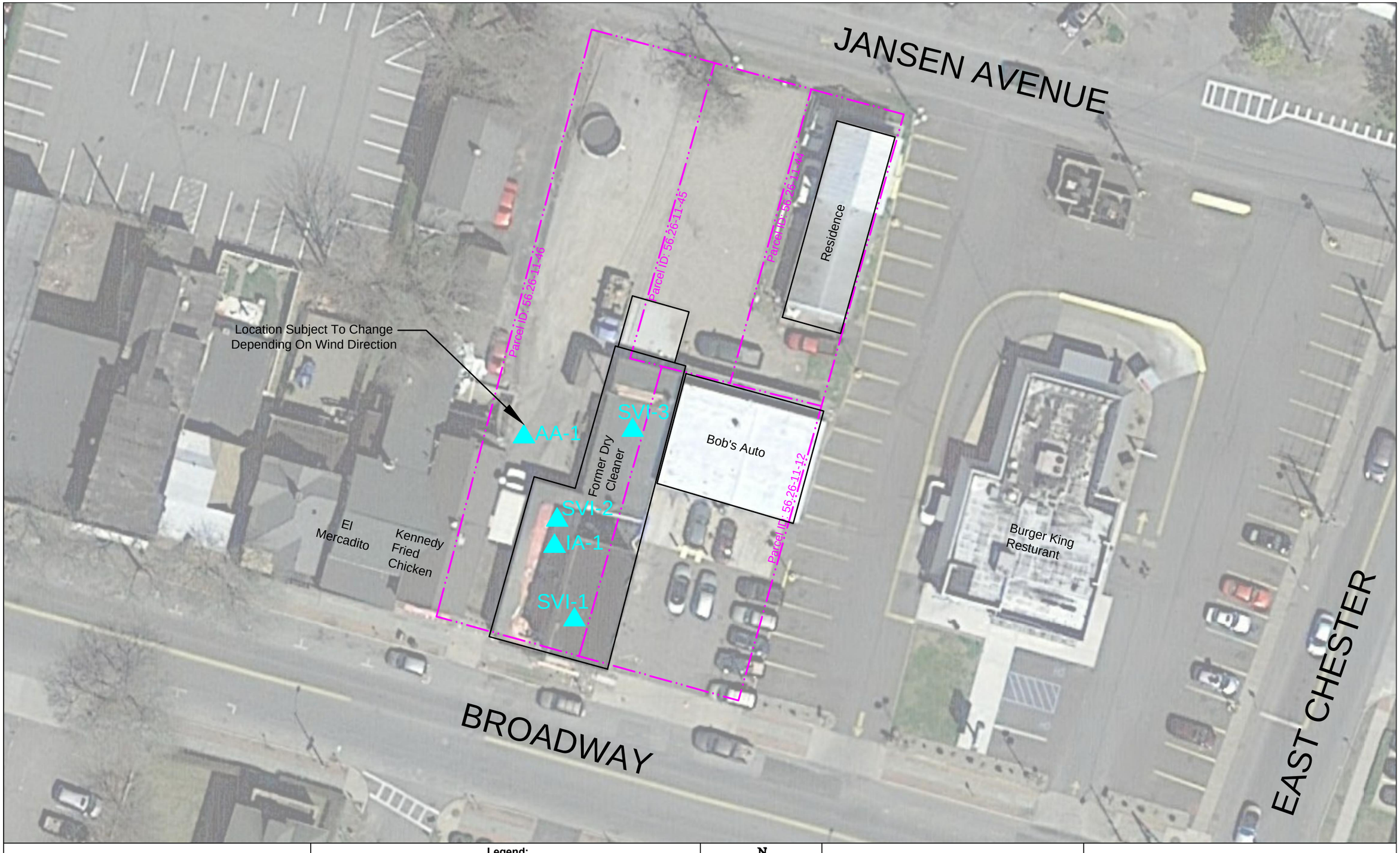
FIGURE 7

DATE: February 2020

SCALE: 1" = 30'

Proposed Soil Gas Vapor Point Locations

Note: Aerial Image provided by Google Earth 2019



Aztec Environmental TECHNOLOGIES

Legend:

SVI-1 ▲ - Proposed Soil Vapor Intrusion Sample

- - - - - - Approximate Parcel Boundary

N

W E

S

338 Broadway
Kingston, New York
NYSDEC Site# 356058

FIGURE 8

DATE: February 2020

SCALE: 1" = 30'

Proposed SVI Sample Locations

Note: Aerial Image provided by Google Earth 2019

TABLES

TABLE 1
SAMPLING RATIONAL

Sampling Phase	Sample ID	Matrix	Sample Depth(s)	Sample Location	Analytcial Parameters	Rationale
Surface Sampling	SURF-1	Soil	Between 0.2' and 0.5'	Figure 3	VOCs	To investigation the potential for surficial contamination related to historical dry cleaning uses at the site.
Surface Sampling	SURF-2	Soil	Between 0.2' and 0.5'	Figure 3	VOCs	To investigation the potential for surficial contamination related to historical dry cleaning uses at the site.
Surface Sampling	SURF-3	Soil	From 0.0' - 0.2'	Figure 3	VOCs, SVOCs,Pesticides/Herbicides, PCBs, TAL Metals, PFAS, 1,4 dioxane	To investigation the potential for surficial contamination related to historical dry cleaning uses at the site. Random sample selected for additonal analysis.
Surface Sampling	SURF-4	Soil	Between 0.2' and 0.5'	Figure 3	VOCs	To investigation the potential for surficial contamination related to historical dry cleaning uses at the site.
Surface Sampling	SURF-5	Soil	Between 0.2' and 0.5'	Figure 3	VOCs	To investigation the potential for surficial contamination related to historical dry cleaning uses at the site.
Surface Sampling	SURF-1-DUP	Soil	Between 0.2' and 0.5'	Figure 3	VOCs	Per QA/QC proceedures, one (1) random duplicate sample will be collected with selected soil samples to determine the precision of laboratory analysis
Surface Sampling	SURF-3-MS	Soil	Same as SURF-3	Figure 3	VOCs, SVOCs,Pesticides/Herbicides, PCBs, TAL Metals, PFAS, 1,4 dioxane	Per QA/QC procedures, one (1) matrix spike (MS) sample is required for every 20 samples (including duplicate sample and field or equipment blank samples).
Surface Sampling	SURF-3-MSD	Soil	Same as SURF-3	Figure 3	VOCs, SVOCs,Pesticides/Herbicides, PCBs, TAL Metals, PFAS, 1,4 dioxane	Per QA/QC procedures, one (1) matrike spike duplicate (MSD) sample is required for every 20 samples (including duplicate sample and field or equipment blank samples).
Soil Boring	SB-1A	Soil	From 0' - 1' or Interval within vadose zone which indicates highest potential for presence of contamination	Figure 4	VOCs	To investigation the potential for subsurface contamination related to historical dry cleaning uses at the site. Additional samples may be collected if impacts are observed
Soil Boring	SB-1B	Soil	Interval within saturated zone which indicates highest potential for presence of contamination	Figure 4	VOCs	To investigation the potential for subsurface contamination related to historical dry cleaning uses at the site.
Soil Boring	SB-1C	Soil	Terminal depth of boring	Figure 4	VOCs	To investigation the potential for subsurface contamination related to historical dry cleaning uses at the site.
Soil Boring	SB-2A	Soil	From 0' - 1' or Interval within vadose zone which indicates highest potential for presence of contamination	Figure 4	VOCs, SVOCs,Pesticides/Herbicides, PCBs, TAL Metals, PFAS, 1,4 dioxane	To investigation the potential for subsurface contamination related to historical dry cleaning uses at the site. Additional samples may be collected if impacts are observed
Soil Boring	SB-2B	Soil	Interval within saturated zone which indicates highest potential for presence of contamination	Figure 4	VOCs	To investigation the potential for subsurface contamination related to historical dry cleaning uses at the site.
Soil Boring	SB-2C	Soil	Terminal depth of boring	Figure 4	VOCs	To investigation the potential for subsurface contamination related to historical dry cleaning uses at the site.
Soil Boring	SB-3A	Soil	From 0' - 1' or Interval within vadose zone which indicates highest potential for presence of contamination	Figure 4	VOCs	To investigation the potential for subsurface contamination related to historical dry cleaning uses at the site. Additional samples may be collected if impacts are observed
Soil Boring	SB-3B	Soil	Interval within saturated zone which indicates highest potential for presence of contamination	Figure 4	VOCs	To investigation the potential for subsurface contamination related to historical dry cleaning uses at the site.
Soil Boring	SB-3C	Soil	Terminal depth of boring	Figure 4	VOCs	To investigation the potential for subsurface contamination related to historical dry cleaning uses at the site.
Soil Boring	SB-4A	Soil	From 0' - 1' or Interval within vadose zone which indicates highest potential for presence of contamination	Figure 4	VOCs	To investigation the potential for subsurface contamination related to historical dry cleaning uses at the site. Additional samples may be collected if impacts are observed
Soil Boring	SB-4B	Soil	Interval within saturated zone which indicates highest potential for presence of contamination	Figure 4	VOCs	To investigation the potential for subsurface contamination related to historical dry cleaning uses at the site.
Soil Boring	SB-4C	Soil	Terminal depth of boring	Figure 4	VOCs	To investigation the potential for subsurface contamination related to historical dry cleaning uses at the site.

TABLE 1
SAMPLING RATIONAL

Sampling Phase	Sample ID	Matrix	Sample Depth(s)	Sample Location	Analytcial Parameters	Rationale
Soil Boring	SB-5A	Soil	From 0' - 1' or Interval within vadose zone which indicates highest potential for presence of contamination	Figure 4	VOCs	To investigation the potential for subsurface contamination related to historical dry cleaning uses at the site. Additional samples may be collected if impacts are observed
Soil Boring	SB-5B	Soil	Interval within saturated zone which indicates highest potential for presence of contamination	Figure 4	VOCs	To investigation the potential for subsurface contamination related to historical dry cleaning uses at the site.
Soil Boring	SB-5C	Soil	Terminal depth of boring	Figure 4	VOCs, SVOCs,Pesticides/Herbicides, PCBs, TAL Metals, PFAS, 1,4 dioxane	To investigation the potential for subsurface contamination related to historical dry cleaning uses at the site. Random sample selected for additonal analysis.
Soil Boring	SB-6A	Soil	From 0' - 1' or Interval within vadose zone which indicates highest potential for presence of contamination	Figure 4	VOCs	To investigation the potential for subsurface contamination related to historical dry cleaning uses at the site. Additional samples may be collected if impacts are observed
Soil Boring	SB-6B	Soil	Interval within saturated zone which indicates highest potential for presence of contamination	Figure 4	VOCs	To investigation the potential for subsurface contamination related to historical dry cleaning uses at the site.
Soil Boring	SB-6C	Soil	Terminal depth of boring	Figure 4	VOCs	To investigation the potential for subsurface contamination related to historical dry cleaning uses at the site.
Soil Boring	SB-1A-DUP	Soil	Same as SB-1A	Figure 4	VOCs	Per QA/QC proceedures, one (1) random duplicate sample will be collected with selected soil samples to determine the precision of laboratory analysis
Soil Boring	SB-2A-MS	Soil	Same as SB-2A	Figure 4	VOCs, SVOCs,Pesticides/Herbicides, PCBs, TAL Metals, PFAS, 1,4 dioxane	Per QA/QC procedures, one (1) matrix spike (MS) sample is required for every 20 samples (including duplicate sample and field or equipment blank samples).
Soil Boring	SB-2A-MSD	Soil	Same as SB-2A	Figure 4	VOCs, SVOCs,Pesticides/Herbicides, PCBs, TAL Metals, PFAS, 1,4 dioxane	Per QA/QC procedures, one (1) matrike spike duplicate (MSD) sample is required for every 20 samples (including duplicate sample and field or equipment blank samples).
Soil Boring	SB-4B-DUP	Soil	Same as SB-4B	Figure 4	VOCs	Per QA/QC proceedures, one (1) random duplicate sample will be collected with selected soil samples to determine the precision of laboratory analysis
Soil Boring	SB-5C-MS	Soil	Same as SB-5C	Figure 4	VOCs, SVOCs,Pesticides/Herbicides, PCBs, TAL Metals, PFAS, 1,4 dioxane	Per QA/QC procedures, one (1) matrix spike (MS) sample is required for every 20 samples (including duplicate sample and field or equipment blank samples).
Soil Boring	SB-5C-MSD	Soil	Same as SB-5C	Figure 4	VOCs, SVOCs,Pesticides/Herbicides, PCBs, TAL Metals, PFAS, 1,4 dioxane	Per QA/QC procedures, one (1) matrike spike duplicate (MSD) sample is required for every 20 samples (including duplicate sample and field or equipment blank samples).
Groundwater Monitring	MW-1	Groundwater	Approximate mid section of screened interval	Figure 4	VOCs	To investigation the potential for contamination to groundwater related to historical dry cleaning uses at the site.
Groundwater Monitring	MW-2	Groundwater	Approximate mid section of screened interval	Figure 4	VOCs	To investigation the potential for contamination to groundwater related to historical dry cleaning uses at the site.
Groundwater Monitring	MW-3	Groundwater	Approximate mid section of screened interval	Figure 4	VOCs	To investigation the potential for contamination to groundwater related to historical dry cleaning uses at the site.
Groundwater Monitring	MW-4	Groundwater	Approximate mid section of screened interval	Figure 4	VOCs, SVOCs,Pesticides/Herbicides, PCBs, TAL Metals, PFAS, 1,4 dioxane	To investigation the potential for contamination to groundwater related to historical dry cleaning uses at the site. Random sample selected for additonal analysis.
Groundwater Monitring	MW-5	Groundwater	Approximate mid section of screened interval	Figure 4	VOCs	To investigation the potential for contamination to groundwater related to historical dry cleaning uses at the site.
Groundwater Monitring	MW-6	Groundwater	Approximate mid section of screened interval	Figure 4	VOCs	To investigation the potential for contamination to groundwater related to historical dry cleaning uses at the site.
Groundwater Monitring	MW-6-DUP	Soil	Same as MW-6	Figure 4	VOCs	Per QA/QC proceedures, one (1) random duplicate sample will be collected with selected soil samples to determine the precision of laboratory analysis
Groundwater Monitring	MW-4-MS	Groundwater	Same as MW-4	Figure 4	VOCs, SVOCs,Pesticides/Herbicides, PCBs, TAL Metals, PFAS, 1,4 dioxane	Per QA/QC procedures, one (1) matrix spike (MS) sample is required for every 20 samples (including duplicate sample and field or equipment blank samples).
Groundwater Monitring	MW-4-MSD	Groundwater	Same as MW-4	Figure 4	VOCs, SVOCs,Pesticides/Herbicides, PCBs, TAL Metals, PFAS, 1,4 dioxane	Per QA/QC procedures, one (1) matrike spike duplicate (MSD) sample is required for every 20 samples (including duplicate sample and field or equipment blank samples).

TABLE 1
SAMPLING RATIONAL

Sampling Phase	Sample ID	Matrix	Sample Depth(s)	Sample Location	Analytcial Parameters	Rationale
Soil Gas Samping	VP-1	Soil Gas	Vapor point depth TBD during boring advancment	Figure 5	VOCs	To investigation the potential for contamination in soil gas related to historical dry cleaning uses at the site.
Soil Gas Samping	VP-2	Soil Gas	Vapor point depth TBD during boring advancment	Figure 5	VOCs	To investigation the potential for contamination in soil gas related to historical dry cleaning uses at the site.
Soil Gas Samping	VP-3	Soil Gas	Vapor point depth TBD during boring advancment	Figure 5	VOCs	To investigation the potential for contamination in soil gas related to historical dry cleaning uses at the site.
Soil Gas Samping	VP-4	Soil Gas	Vapor point depth TBD during boring advancment	Figure 5	VOCs	To investigation the potential for contamination in soil gas related to historical dry cleaning uses at the site.
Soil Gas Samping	VP-5	Soil Gas	Vapor point depth TBD during boring advancment	Figure 5	VOCs	To investigation the potential for contamination in soil gas related to historical dry cleaning uses at the site.
Soil Gas Samping	VP-6	Soil Gas	Vapor point depth TBD during boring advancment	Figure 5	VOCs	To investigation the potential for contamination in soil gas related to historical dry cleaning uses at the site.
Soil Gas Samping	VP-7	Soil Gas	Vapor point depth TBD during boring advancment	Figure 5	VOCs	To investigation the potential for contamination in soil gas related to historical dry cleaning uses at the site.
Soil Gas Samping	VP-8	Soil Gas	Vapor point depth TBD during boring advancment	Figure 5	VOCs	To investigation the potential for contamination in soil gas related to historical dry cleaning uses at the site.
Soil Gas Samping	VP-9	Soil Gas	Vapor point depth TBD during boring advancment	Figure 5	VOCs	To investigation the potential for contamination in soil gas related to historical dry cleaning uses at the site.
Soil Gas Samping	VP-10	Soil Gas	Vapor point depth TBD during boring advancment	Figure 5	VOCs	To investigation the potential for contamination in soil gas related to historical dry cleaning uses at the site.
Soil Gas Samping	ODA-1	Ambient Air	Outdoor air, ~ 4 feet above ground	Figure 5	VOCs	To monitor ambient outdoor air conditions for correlation with soil gas samples
Soil Gas Samping	VP-3- DUP	Soil Gas	Vapor point depth TBD during boring advancment	Figure 5	VOCs	Per QA/QC proceedures, one (1) random duplicate sample will be collected with selected soil samples to determine the precision of laboratory analysis
Soil Vapor Inturion	SVI-1	Soil Vapor	Sub-slab vapor intrusion point, TBD based on floor slab	Figure 6	VOCs	To investigate potential for soil vapor intrusion beneath the site building floor slab
Soil Vapor Inturion	SVI-2	Soil Vapor	Sub-slab vapor intrusion point, TBD based on floor slab	Figure 6	VOCs	To investigate potential for soil vapor intrusion beneath the site building floor slab
Soil Vapor Inturion	SVI-3	Soil Vapor	Sub-slab vapor intrusion point, TBD based on floor slab	Figure 6	VOCs	To investigate potential for soil vapor intrusion beneath the site building floor slab
Soil Vapor Inturion	IA-1	Indoor Air	Indoor air, ~ 4 feet above gorund	Figure 6	VOCs	To monitor ambient indoor air conditions for correlation with soil gas samples
Soil Vapor Inturion	ODA-2	Ambient Air	Outdoor air, ~ 4 feet above ground	Figure 6	VOCs	To monitor ambient outdoor air conditions for correlation with soil gas samples
Soil Vapor Inturion	IA-1-DUP	Indoor Air	Same as IA-1	Figure 6	VOCs	Per QA/QC proceedures, one (1) random duplicate sample will be collected with selected SVI samples to determine the precision of laboratory analysis

TABLE 2
ANALYTICAL PARAMENTERS

Analytical Information - Soil Samples							
Laboratory Analysis	**EPA Method**	**Preservation**	**Container**	**Holding Time**	**Minimum Volume**	**Reporting Limit**	**Notes:**
Volatile Organic Compounds (VOCs)	8260B	Cool to 4 deg C	Glass, Amber	14 Days	8 oz.	5.0 ug/kg	Full Target Compound List (TCL) Plus 30, including Tentatively Identified Compounds (TICS)
Semi-Volatile Organic Compounds (SVOCs)	8270D	Cool to 4 deg C	Glass, Wide mouth	14 Days	4 oz.	Range <830 ug/kg	TCL+30, TICS
Polychlorinated Biphenyls (PCBs)	8082A	Cool to 4 deg C	Glass, Amber	14 Days	8 oz.	0.25 mg/kg	
TAL Metals	6010C	Cool to 4 deg C	Glass, Amber	6 Months	8 oz.	Range 0.2 to 30 mg/kg	
Pesticides/Herbicides	8081A, 8151	Cool to 4 deg C	Plastic or Glass	14 Days	8 oz.	Range 1.67 to 16.7 ug/kg	
1, 4 Dioxane	8270D	Cool to 4 deg C	Glass, Amber	14 Days	4 oz.	0.1 ppm (1 mg/kg)	May be combined with SVOC sample
PFAS	537.1	Cool to 4 deg C	Plastic	14 Days	8 oz.	Range 0.2 to 2.0 ug/kg	Non Teflon lined lid

Analytical Information - Water Samples							
Laboratory Analysis	**EPA Method**	**Preservation**	**Container**	**Holding Time**	**Minimum Volume**		**Notes:**
Volatile Organic Compounds (VOCs)	8260B	1:1 HCL pH<2, cool to 4 deg C	Glass, Vial	14 Days w/HCL	40 mL	Range 1.0 to 10 ug/L	TCL+30, TICS
Semi-Volatile Organic Compounds (SVOCs)	8270C	Cool to 4 deg C	Glass, Amber	7 Days For Extraction, 40 Days after extraction	1,000 mL	Range 5.0 to 10 ug/L	TCL+30, TICS
Polychlorinated Biphenyls (PCBs)	8082A	Cool to 4 deg C	Glass, Amber	7 Days For Extraction, 40 Days after extraction	1,000 mL	0.5 ug/L	
TAL Metals	6010C	HNO3 to pH<2	Plastic	6 Months	100 mL	Range 0.002 to 1.0 mg/L	
Pesticides/Herbicides	8081A, 8151	Cool to 4 deg C	Glass, Amber	7 Days For Extraction, 40 Days after extraction	1,000 mL	Range 0.05 to 0.5 ug/L	
1,4 Dioxane	8270 SIM	Cool to 4 deg C	Glass, Amber	7 Days For Extraction, 40 Days after extraction	1,000 mL	0.2 ug/L	May be combined with SVOC sample
PFAS	537.1	Cool to 4 deg C	Plastic	14 days	250 mL	2.0 ng/L	Non Teflon lined lid

Analytical Information - Air Samples							
Laboratory Analysis	**EPA Method**	**Preservation**	**Container**	**Holding Time**	**Minimum Volume**	**Reporting Limit**	**Notes:**
Volatile Organic Compounds (VOCs)	TO-15	None	SUMMA Canister	30 Days	6 liter	Range 0.4 to 3.7 ug/m3	

Notes:
Reporting limit range based on the highest and lowest reporting limit in the analyte list. Reporting limits provided by Test America.

APPENDIX A

FIELD SAMPLING PLAN (FSP)

FIELD SAMPLING PLAN

SUBJECT SITE:

338 Broadway
City of Kingston, Ulster County, New York

NYSDEC Site No. 356058

PREPARED FOR:
New York State Department of Environmental Conservation
Central Office
625 Broadway
Albany, New York 12233
Attn: Parag Amin

PREPARED BY:
Aztech Environmental Technologies
5 McCrea Hill Road
Ballston Spa, New York 12233
Phone: (518) 885-5383

Table of Contents

ATTACHMENTS:

Figures

Note: Refer to Site Characterization Work Plan for all Figures other than specified below.

1. Figure A-1 – Typical Well Construction
2. Figure A-2 – Typical Vapor Probe Construction

Tables

Note: Refer to Site Characterization Work Plan for all Tables.

APPENDICES:

Standard Operating Procedures – SOP#001 to SOP#013

Appendix A – Field Sampling Plan (This document)
Appendix B – Quality Assurance Project Plan (QAAP)
Appendix C – Health and Safety Plan (HASP) / Community Air Monitoring Plan (CAMP)

1.0 Introduction

1.1 General

This Field Sampling Plan (FSP) supports the Site Characterization (SC) Work Plan prepared by Aztech Technologies Inc., dba, Aztech Environmental Technologies (Aztech) for the property located at 338 Broadway in Kingston, New York (Site). The Site location is shown on **Figure 1** of the SC Work Plan all investigation tasks associated with this FSP are described in that document. The SC Work Plan and this FSP were prepared on behalf of the New York State Department of Environmental Conservation (NYSDEC).

This FSP contains field procedures and sample collection methods to be used during the implementation of the field activities described in the SC work Plan. The FSP should be used in conjunction with the SC Work Plan, the Quality Assurance Project Plan (QAPP), and Health and Safety Plan (HASP) / Community Air Monitoring Plan (CAMP).

The SC Work Plan presents the Site background and defines the field sampling program. The QAPP outlines the procedures that will be used during the SC to ensure that data collected and subsequent reports are of high enough quality to meet project objectives. The HASP/CAMP presents the procedures and practices to be followed during the SC field work to help ensure the safety of workers, and is designed to prevent occupational injuries and worker exposures to chemical, physical and biological hazards. The QAPP and HASP/CAMP are provided in Appendix B and Appendix C, respectively, of the SC Work Plan.

1.2 Project Objectives

The overall objectives of the SC are to:

- Assess whether residual dry cleaning – related contaminants are present at the Site related to the operation of a former dry cleaner;
- Determine whether impacts to soil, soil vapor or groundwater from residual dry cleaning –related contaminants, if present at the Site, have a potential to pose a significant threat to the public or the environment;
- Properly classify the Site under the NYSDEC registry for inactive hazardous waste Sites;
- Determine whether a Remedial Investigation (RI) of the Site is appropriate;

The technical approach to address the above objectives is provided in the SC Work Plan;

1.3 Overview of Investigation Field Activities

To obtain information necessary to meet the investigation objective stated above, the following activities will be conducted:

- Conducting a Site survey
- Conducting a geophysical survey of the Site;
- Collection of surface soil samples
- Drilling soil borings;
- Installing monitoring wells;

- Collecting subsurface soil samples during the advancement of the soil borings and monitoring wells;
- Measuring fluid levels in monitoring wells;
- Installation of soil gas probes and collection of soil vapor samples;
- Perform a soil vapor intrusion (SVI) assessment and collect sub-slab vapor, indoor air and ambient air samples from the onSite building.

The sampling locations and quantities for each field sampling activity are described in detail in the SC Work Plan. The sampling methodologies are further detailed in this FSP.

2.0 Field Activities

2.1 General Field Guidelines

All underground utilities will be identified prior to any drilling or subsurface sampling. Public and privately owned will be located by contacting Dig Safely New York such that responsible agencies can mark their underground utilities at the Site. Site access agreements will be obtained prior to conducting any field work. Other potential hazards such as traffic, overhead lines, and building hazards will be identified during a Site reconnaissance visit.

Field logs book will be maintained by the Field Manager/Site Supervisor and other team members to provide a daily record of significant events, observations, and measurements during the field investigation.

Information pertinent to the field investigation and/or sampling activities will also be recorded in the log books. The books will be bound with consecutively numbered pages. Refer to Aztech Standard Operating Procedure (SOP #001).

Entries in the log book will include, at a minimum, the following information:

- Name of Author, date of entry, and physical and environmental conditions during field activity;
- Name of field crew members;
- Name of any Site visitors;
- Purpose of field work or sampling activity;
- Location of sampling activity;
- Sample media (soil, groundwater, vapor, ect.);
- Sample collection method;
- Number and volume of sample(s) taken;
- Description of sampling points;
- Volume of groundwater removed before sampling (where appropriate);
- Preservatives used;
- Date and time of collection;

- Sample identification number(s);
- Field observations;
- Any measurement made, such as pH, temperature, conductivity, water-level, ect.

All original data recorded in the field log books and Chain of Custody (COC) records will be written with indelible ink. If an error is made in these documents, the individual entering the data will make all corrections simply by crossing a single line through the error and entering the correct information. The erroneous information will not be erased or made illegible. Any subsequent error discovered on an accountable document will be corrected by the person who made the entry. All subsequent corrections will be initialed and dated.

2.2 Sample Handling

A new pair of disposable nitrile gloves will be used at each location sampled for chemical analyses. Additional glove changes will be undertaken as conditions warrant. All proper per-and poly-fluoroalkyl substances (PFAS) sampling protocol, as described in Aztech SOP#006, will be implemented during the collection of the PFAS samples.

Sample containers (SOP#003) will be new and delivered from the laboratory prior to the sampling event. Sample containers will come with the proper volume of chemical preservative appropriate for the type of analysis as detailed in the SC Work Plan. Specific containers (HDPE or polypropylene unlined containers) will be provided by the lab in separate cooler for the soil PFAS samples. Samples for PFAS will be collected in accordance with Aztech SOP#006.
After sample collection, the sample containers will be logged onto a chain of custody record (SOP#004) described in section 2.3 and the QAPP. In general, the sample containers will be placed on ice in laboratory- supplied rigid coolers after collection and labeling. Remaining space will be filled with packing material to cushion the containers during transportation or shipment.

For this project Aztech staff will either mail or hand deliver the sample coolers to the Test America Inc. Service Center located in Albany, New York, or coordinate with their courier service.

Samples will remain under the control of an Aztech field representative until relinquished to the laboratory or commercial courier under chain-of-custody (see QAPP).

2.3 Sample Labeling, Packing, and Shipping

Each sample will be given a unique identification (SOP#002). With this type of identification, no two (2) samples will have the same label.

Samples will be promptly labeled upon collection with the following information:

- Project number and Site;
- Unique sample identification;
- Analysis required;
- Data and time sampled;

- Sample type (compoSite or grab);
- Preservative, if applicable.

Clear tape will be secure over the sample label and the applicable COC will be completed.

If samples are to be shipped by commercial carrier (e.g., UPS), sample bottles/jars will be packed in coolers containing the following:

- One-to-two inches of bubble wrap on the bottom of the cooler;
- Wet ice packed in a water tight plastic bag;
- Sufficient bubble wrap to fill the remaining area;
- The completed COC in a re-sealable plastic bag, taped in place on the inside cover of the cooler.

The cooler will then be sealed with tape. If the cooler contains a drain plug, it must be sealed with duct tape. Appropriate shipping labels, such as "this-end-up" and "fragile" stickers will be affixed to the cooler. Samples will be hand delivered or delivered by an express carrier within 48 hours of sample collection. The express carrier will not be required to sign the COC form; however, the shipping receipt should be retained by the sampler, and forwarded to the project files.

2.4 Equipment Decontamination

In general before any sampling occurs, equipment to be used will be decontaminated. Decontamination procedures will be performed in general conformance with Aztech SOP#007 and discussed below.

2.4.1 Drill Rig Decontamination

A decontamination pad for the drill rig and its tooling will be constructed for use during the SC field investigation. The decontamination pad will be lined with plastic sheeting on a surface sloped to a sump area. The sump must be of sufficient volume to contain approximately 20 gallons of decontaminated water. All drilling equipment including the rear-end of the drilling rig, augers, bits, rods, tools, split spoon or Macrocore® samplers, and tremie pipe will be cleaned on the decontamination pad with a high pressure hot water "steam cleaner" unit and scrubbed with a wire brush, as needed, to remove dirt, grease and oil before beginning work in the project area. In general an all-purpose detergent such as Alconox® will be used as a decontamination cleanser. If accumulations of impacts such as oil or tar become present on the downhole tools, a citrus-based cleaner (e.g., Citra-Solv®) may be used to aid in equipment cleaning. Tools, drill rods and auguers will be placed on sawhorses, decontaminated pallets or polyethylene plastic sheets following steam cleaning. Direct contact with the ground will be avoided. The back of the drill rig and augers, rods, and tools will be decontaminated between each drilling location according to the above procedures. Decontamination water will be contained in a dedicated plastic tank or 55-gallon open-top drums located on Site. All open-top drums will remain closed when not in use.

Unless sealed in manufacturer's packaging, polyvinyl chloride (PVC) monitoring well casings will be decontaminated by the above procedures prior to installation.

Following decontamination of all Site equipment, the decontamination pad will be decommissioned. The decommissioning will be completed by:

- Transferring the bulk of the remaining liquids and solid into the drums.

- Rolling the sheeting used in the decontamination pad onto itself to prevent discharge of the remaining materials to the ground surface. Once rolled up, the polyethylene sheeting will be placed into drums and used for disposal of personal protective equipment (PPE) and disposable equipment.

2.4.1 Sampling Equipment Decontamination

Prior to every entry into each borehole, all non-dedicated bowls, spoons, hang augers, bailers, and filtering equipment will be washed with potable water (such as Alconox). Decontamination may take place at the sampling location as long as all liquids are contained in pail, buckets, etc. The sampling equipment will then be rinsed with potable water, followed by a 10% methanol rinse, and finally distilled, PFAS free, water rinse. Between rinses, equipment will be placed on polyethylene sheets or aluminum foil if necessary. At no time will washed equipment be placed directly on the ground. Equipment will be either used immediately or wrapped in plastic or aluminum foil as appropriate for storage or transportation from the designated decontamination area to the sampling location.

2.5 Drilling Procedures

The drilling and geological logging methods to be used during the subsurface investigation will be performed in general accordance with Aztech SOP#009 and SOP#010. Specific details are discussed below:

- Boreholes in the overburden will be drilled using hollow stem auger or direct push techniques. Direct push technology will be the preferred drilling method. If difficult conditions are encountered in the subsurface soils, alternate drilling methods may be considered;

- Boreholes drilled using direct push techniques will be advanced using either a truck or track mounted push/percussion drill rig such as Geoprobe®. Soil samples will be collected continuously to the terminal depth of the boring using five (5) foot long, 2-inch diameter Macrocore® samplers, equipped with disposable PVC liners, advance five (5) feet per run;

- Boreholes drilled using hollow stem augers will be advanced using a drill rig equipped with three (3) or four (4) inch diameter hollow stem augers. Soil samples will be collected continuously to the bottom of the borings using two (2) foot long, 2-inch diameter discrete split spoon samplers advanced two (2) feet per sample run. Sampling method

ASTM D1586-18 (Standard Method for Penetration Test and Split-Barrel Sampling of Soils) will be followed, unless otherwise authorized by the Field Manager/Site Supervisor;

- For samples that may be submitted for chemical analysis, split spoons will have been decontaminated. Sample descriptions, photoionization detector (PID) readings, and location will be recorded in the field book;

- A plywood sheet or tub may be placed around the auger or casing while drilling to help contain cuttings;

- Drill cuttings will be placed in 55-gallon drums supplied by Aztech or the drilling subcontractor. Decontamination water will be placed in drums or plastic tanks supplied by Aztech of the drilling subcontractor. Soil cuttings and decontamination water will be picked up and containerized at the end of each work day. All residual waste will be characterized and disposed offsite in accordance with SOP#008

- Upon completion of each boring, the borehole will be sealed with a bentonite holeplug or grout tremied in place from the bottom of the borehole up using a bentonite/cement;

Pertinent notes regarding the drilling work will be recorded in the field book. Soil logging procedures are discussed in the following section.

2.6 Sample Description

Collected samples will be described by persons who have been trained in Aztech's soil description procedures and have a degree in geology or a geology-related discipline. The procedure that will be followed for describing soils is discussed in SOP#010 and uses a combination of the Unified Soil Classification System (USCS) and modified Burmister methods.

2.7 Soil Analytical Sampling Procedures

The sampling procedures to be used during the SC field work for surface and subsurface soil samples are discussed below:

2.7.1 Surface Soil Sampling

A total of up to five (5) proposed surface soils samples will be collected as part of the SC. Additional quality assurance/quality control (QA/QC) samples will be collected per the QAPP and Aztech SOP#005.

Surface soils will be collected from exposed soil surfaces at the Site. Soil from immediately beneath asphalt pavement or similar covering may be considered a surface soil. However, for the purpose of SC Work Plan no soil at a depth below one (1) foot below ground surface will be considered a surface soil.

Sampling of surface soils will be conducted using a decontaminated stainless steel trowel or disposable scoop. Samples selected for laboratory analysis will be placed in the appropriate

containers provided by the laboratory. Sample containers for volatile organic analyses will be filled first.

Samples for PFAS will be collected in accordance with Aztech SOP#006.

2.7.2 Subsurface Soil Sampling

Three (3) subsurface samples for laboratory analysis are proposed to be collected from each of the six (6) soil borings installed during the SC field work. Additional QA/QC samples will be collected per the QAPP.

Subsurface soils collected from the unconsolidated fill and soils beneath the Site using split spoon or Macrocore® sampling methods will be selected for laboratory analysis based on:

- Their position in relation to potential source areas.
- The visual presence of source materials.
- The relative levels of volatile organics based on PID field screening measurements.
- The discretion of the field manager.

In general, a sample will be collected from the vadose zone, the observed water table interface and within the saturated zone. Samples selected for laboratory analysis will be placed in the appropriate containers provided by the laboratory. Sample containers for volatile organic analyses will be filled first. Next, a sufficient amount of the remaining soil will be homogenized by mixing the sample in a decontaminated stainless steel tray or bowl with a decontaminated stainless steel trowel or disposable scoop. Laboratory-supplied sample containers for other analytes will then be filled. Duplicate samples will be collected at the frequency detailed in the QAPP (Appendix B) by alternately filling two sets of sample containers.

Where there is sufficient sample volume, representative portions of each soil sample will be placed in a one-pint jar or re-closable plastic bag, labeled, and stored on Site. This container will be labeled with the following:

- Site
- Boring number
- Interval sampled
- Date
- Initials of sampling personnel

2.8 Monitoring Well Installation and Development

Monitoring wells will be installed to the depths and at the locations defined in the SC Work Plan. A total of six (6) monitoring wells are proposed to be installed during the SC field work. After completion of drilling and well installation, all wells will be developed to establish hydraulic connection between the well and the formation. The following procedures will be used to install, and develop monitoring wells.

2.8.1 Monitoring Well Specifications

As indicated **Figure A-1** shows details of a typical monitoring well construction for shallow wells installed in unconsolidated soils that do not penetrate a presumed confining layer. The overburden monitoring wells will be installed according to the following specifications:

- PVC 2-inch diameter, threaded, flush-joint casing and 10-foot-long, 0.010-inch or 0.020-inch slot screens will be installed, depending on the grain size of the material being screened.
- If required due to presence of dense non-aqueous phase liquids (DNAPLs), A sump two (2) feet in length and grouted in place with cement, may be attached to the bottom of the screen for potential collection.
- The annulus around the screens will be backfilled with an appropriate size of silica sand to a minimum height of one (1) foot above the top of the screen, assuming there is sufficient room to install an appropriate surface seal above the sand.
- An approximately 2-foot-thick (depending on conditions) chipped bentonite seal or slurry (30 gallons water to 25 to 30 pounds bentonite, or relative proportions) will be placed above the sand pack.
- The remainder of the annular space will be filled with a cement/bentonite grout to approximately 2 feet below grade. The grout will be placed with a tremie pipe from the bottom up. The grout will consist of a cement mixture of one 94 pound bag of Portland cement, approximately 5 pounds of granular bentonite, and approximately seven (7) gallons of water. The grout will be allowed to set for a minimum of 24 hours before wells are developed
- Each monitoring well will be fitted with a locking gripper cap.
- An 8-inch diameter flush-mount, water tight steel road box set into a 18-inch square concrete pad approximately 6-inches thick will be used for well head protection at the surface.

The following characteristics of each newly installed well will be recorded in the field log book:

- Date/time of construction
- Drilling method and drilling fluid used
- Approximate well location
- Borehole diameter and well casing diameter
- Well depth
- Drilling and lithologic logs
- Casing Material
- Screen materials and size
- Casing and screen joint type
- Screen slot size/length
- Filter pack material/size
- Filter pack placement method
- Sealant materials
- Sealant placement method

- Well development procedure
- Type of protective well cap
- Detailed drawing of well (including dimensions)

2.8.2 Monitoring Well Development

A minimum of 24 hours after installation, the monitoring wells will be developed by surging/bailing, using a centrifugal pump and dedicated polyethylene tubing, or by Waterra positive displacement pumps and dedicated polyethylene tubing, or other methods at the discretion of the Field Manager/Site Supervisor. The development water will be contained in a tank on Site or in drums to be provided by Aztech or the drilling subcontractor. The wells will be developed until the water removed from the well is reasonably free of visible sediment (50 nephelometric turbidity units [NTUs]), if possible, or until the turbidity levels stabilize, assuming a minimum of 10 well volumes of water have been removed from the monitoring well during development.

Following development, wells will be allowed to recover for at least one (1) week before groundwater is purged and sampled. All monitoring well development will be overseen by a field geologist and the duration, method of development, and approximate volume of water removed will be recorded in the field book

2.9 Fluid-Level Measurements

The following procedure will be used to measure fluid-level depths at monitoring wells:

- Decontaminate the water level probe or oil/water interface probe (for wells expected to contain non-aqueous phase liquids [NAPLs]).
- Measure the static fluid-level, fluid interfaces (i.e., NAPL/water interface), and sound the bottom of the well (if applicable) with reference to the surveyed elevation mark on the top of the PVC casing or surface water gauge. Record all measurements to nearest 0.01 foot and record in the field book.

The measurements will be made in as short a timeframe as practical to minimize temporal fluctuations in hydraulic conditions.

2.10 Low-Flow Groundwater Sampling Procedures for Monitoring Wells

This protocol describes the procedures to be used to collect groundwater samples. In general low-flow groundwater sampling activities will be performed in accordance with Aztech SOP#011.

No wells will be sampled until well development has been performed. During precipitation events, groundwater sampling will be discontinued until precipitation ceases. When one (1) round of water levels is taken to generate water-elevation data, the water levels will be taken consecutively at one time prior to sampling or other activities.

The following materials, as required, shall be available during groundwater sampling. Any non-PFAS compliant items will be excluded during the sampling work:

- Peristaltic pump
- HDPE tubing
- Power source (i.e., generator, battery)
- PID
- Appropriate health and safety equipment as specified in the HASP
- Plastic sheeting (for each sampling location)
- Dedicated or disposable bailers
- New disposable polypropylene rope
- Buckets to measure purge water
- Water-level probe
- Six-foot rule with gradation in hundredths of a foot
- Conductivity/temperature meter
- pH meter
- Turbidity meter
- Appropriate water sample containers
- Appropriate blanks (trip blank supplied by the laboratory)
- Appropriate transport containers (coolers) with ice and appropriate labeling, packing, and shipping materials
- Groundwater sampling logs
- COC forms
- Indelible ink pens
- Site map with well locations and groundwater contours maps
- Keys to wells

The following steps detail the monitoring well sampling procedures:

1. Review materials checklist to ensure that the appropriate equipment has been acquired. All sample materials will be ordered from Test America Laboratories.

2. Identify Site and well sampled on sampling log sheets, along with date, arrival time, and weather conditions. Identify the personnel and equipment used and other pertinent data requested on the sampling logs.

3. Label all sample containers using an appropriate label.

4. Use safety equipment, as required in the HASP.

5. Place plastic sheeting, if appropriate, adjacent to the well to use as a clean work area. Plastic sheeting will not be used during PFAS sampling.

6. Establish the background reading with the PID and record the reading on the field log.

7. Remove lock from the well and if rusted or broken replace with a new brass keyed- alike lock.

8. Unlock and open the well cover while standing upwind of the well. Remove well cap and place on the plastic sheeting. Insert PID probe in the breathing zone above the well casing to analyze precense of VOCs in the well head.

9. Set out on plastic sheeting the dedicated or disposable sampling device and meters.

10. Prior to sampling, groundwater elevations will be measured at each monitoring well and the presence of light non-aqueous phase liquid (LNAPL) or DNAPL (if any) within the well will be evaluated. Obtain a water-level depth and bottom of well depth using an electric well probe and record on the sampling log sheet. Clean the well probe after each use with a soapy (Alconox) water wash and a tap water rinse. [Note: water levels will be measured at all wells prior to initiating a sampling event].

11. After groundwater elevations are measured and NAPLs are determined not to be present, groundwater will be purged from the wells. If NAPLs are determined present, then a groundwater sample will not be collected, rather a representative NAPL sample may be collected (if required) using a peristaltic pump or other method determined by the Field Manager/Site Supervisor.

12. Pump, safety cable, electrical lines, and/or tubing (for peristaltic pumps) will be lowered slowly into the well to a depth corresponding to the center of the saturated screen section of the well.

13. Measure the water level again with the pump in the well before starting the pump. Start pumping the well at 200 to 500 milliliters per minute. Ideally, the pump rate should cause little water-level drawdown in the well (less than 0.3 feet and the water level should stabilize). The water level should be monitored every three (3) to five (5) minutes (or as appropriate) during pumping. Care should be taken not to cause the pump suction to be broken or entrainment of air in the sample. Record pumping rate adjustments and depths to water. Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to avoid pumping the well dry and/or to ensure stabilization of indicator parameters. If the recharge rate of the well is very low, purging should be interrupted so as not to cause the drawdown within the well to advance below the pump. However, a steady flow rate should be maintained to the extent practicable. Sampling should commence as soon as the volume in the well has recovered sufficiently to permit sample collection.

14. During well purging, monitor the field indicator parameters (turbidity, temperature, specific conductance, pH, dissolved oxygen [DO], and oxidation-reduction potential [ORP]) every three to five minutes (or as appropriate). The well is considered stabilized and ready for

sample collection when the indicator parameters have stabilized for three (3) consecutive readings as follows (Puls and Barcelona, 1996):

- ±0.1 for pH
- ±3% for specific conductance (conductivity)
- ±10 mV for ORP
- ±10% for turbidity and DO

Note that turbidity and DO usually require the longest time to achieve stabilization. As such, sampling may be allowed prior to stabilization of turbidity and/or DO if all other parameters have stabilized. The decision to sample under this scenario must be agreed to by the Project Manager.

The pump must not be removed from the well between purging and sampling. If the parameters have stabilized, but the turbidity is not in the range of the 50 NTU goal, the pump flow rate should be decreased to no more than 100 millimeters per minute. Measurement of the indicator parameters should continue every three (3) to five (5) minutes. Measurements for parameters may be taken using a flow-thru cell or in a clean container such as a glass beaker. Measurements of DO should be taken from a sample collected using an in-line tee fitting installed before the tubing outlet, prior to connection to the flow-through cell (if one is being used). DO measurements should be measured using a field test kit (e.g., colorimetric).

15. Fill in the sample label and cover the label with clear packing tape to secure the label onto the container.

16. After the groundwater quality parameters have stabilized as discussed above, obtain the groundwater sample needed for analysis directly from the sampling device in the appropriate container and tightly screw on the caps. Note that groundwater samples collected for analysis of VOCs cannot be collected using a peristaltic pump. If purging the well using a peristaltic pump, collect all other types of samples (e.g., SVOCs, inorganics, etc.) prior to collecting the sample for VOC analysis. Once other samples are collected, remove the peristaltic pump tubing and collect the VOC samples using a new disposable polyethylene bailer. The bailer should be gently lowered to the approximate depth that the pump intake was set, and then retrieved.

17. Secure with packing material and store at 4 degrees Celsius on wet ice in an insulated transport container provided by the laboratory.

18. After all sampling containers have been filled, remove one additional volume of groundwater. Check the calibration of the meters and then measure and record on the field log the physical appearance, pH, temperature, turbidity, and conductivity.

19. Record the time sampling procedures were completed on the field logs.

20. Place all disposable sampling materials (plastic sheeting, disposable bailers, and health and safety equipment) in appropriately labeled containers. Go to the next well and repeat Step 1 through Step 21 until all wells are sampled.

21. Complete the procedures for packaging, shipping, and handling with associated COC forms.

2.11 Soil Gas Vapor Probe Installation

A total of up to ten (10) temporary vapor probes used sample soil gas will be installed during the SC field work. General vapor probe installation schematics are presented in **Figure A-2**. The vapor probes will be installed using the following methods:

1. Using direct push drilling methods, advance the vapor probe borehole using 2-inch MacroCore tooling equipped with a disposable point to the terminal depth. Vapor probe borehole depths will be determined based on the water interface depth observed during the soil boring and monitoring well installations. The vapor probe must be installed within the vadose zone and should be clear of seasonal water table fluctuations and capillary fringe. The probes are estimated to be installed below 10 fbg.

2. At the borehole terminal depth, slightly retract the drill tooling to release the disposable point.

3. Using the tooling as a conduit, insert a ½-inch diameter vapor probe implant constructed of stainless steel wire mesh screen attached to a length ¼-inch diameter Teflon-lined silicone tubing. The tubing shall extend above the ground surface and be capped until sampling.

4. Fill the annual space around the vapor probe screen with clean #0 filter sand. Approximately 12-inches will be required.

5. Seal the #0 sand filter pack using hydrated bentonite to within one (1) foot of the surface.

6. Each installed vapor probe will be completed with a 6-inch steel road box set into an 18-inch square concrete pad rated for vehicle traffic.

The following characteristics of each newly installed vapor probe will be recorded in the field log book:

- Date/time of construction
- Installation method
- Approximate location
- Borehole diameter
- Installed probe depth

- Screen materials and size
- Teflon lined tubing length
- Filter pack material/size
- Sealant materials
- Detailed drawing of well (including dimensions)

2.11.1 Soil Gas Vapor Probe Sampling

A total of ten (10) soil gas samples are proposed to be collected during the SC. Additional ambient air and QA/QC samples will be collected as per the QAPP. Soil gas and outdoor air sampling will be performed in general accordance with Aztech SOP#012 and SOP#013 and with protocols outlined in DER-10 and the NYSDOH's Guidance for Evaluating Soil Vapor Intrusion in the State of New York, October 2006. Samples will be collected from the soil gas probes installed in accordance with section 2.11.

All samples will be collected utilizing laboratory certified and cleaned six (6) liter Summa canisters equipped with a 1-hr (0.1 liter per minute (L/min) flow controllers), pressure gauges and particulate filters.

The following guidelines will be used when performing the sampling:

1. All sample canisters will be ordered from the laboratory.
2. Arrive onsite and conduct initial HASP meeting.
3. Identify each of the soil vapor probes to be sampled. Take photographs and complete soil vapor sampling log for each well.
4. Decontaminate/pre-clean equipment and ensure that it is working properly.
5. Begin sampling activities using proper protocol as listed below.
6. Check the integrity of each vapor probe seal at all locations by utilizing helium tracer gas in order to ensure that the soil vapor sample will not be influenced by infiltrating outdoor air while purging the vapor probes:
    a. Check the vapor probe headspace with a photoionization detector (PID) calibrated to detect total VOCs in ppb and record;
    b. A small plastic bucket (dome) with a hole drilled through the top and 2 holes drilled through the bottom will be sealed over the soil vapor probe utilizing bentonite. Tubing from the vapor probe will be pulled through the hole in the top of the bucket;
    c. Helium will then be applied to the bucket dome until the space within the dome is enriched to 95% helium as determined by a helium detector;
    d. The soil Vapor probe will then be purged into a Tedlar bag utilizing a Gilman air purge pump calibrated at a flow rate of 200mL/minute for 15 minutes;
    e. The helium detector will then be utilized to determine the presence of helium within the tedlar bag. Should helium be detected within the Tedlar bag then the surface seal at the soil vapor probe will be evaluated and resealed using bentonite and re-tested prior to sample collection;
    f. The bucket dome will stay in place during sample collection.

7. Summa canisters will then be connected to the soil vapor probe using Teflon lined tubing and stainless steel Swagelok fittings.
8. Commence sampling. Start time/stop time and other required fields on the soil vapor sampling log will be filled in as well as the laboratory chain of custody.
9. The MS-MSD sample will be connected to one (1) of the soil vapor points utilizing a splitting "tee". The corresponding soil vapor point will be indicated on the sampling log.
10. Concurrently, a minimum of one (1) outdoor air samples will be collected. The sampling locations will be appropriately spaced, no closer than approximately 350 feet apart. Locations will be recorded on a Site map. Wind direction, potential air quality interferences and other pertinent information will be recorded. The Summa Canisters will be placed on stands approximately five (5) feet above the ground surface.
11. Retrieve Summa canisters by closing regulator, disconnecting tubing from sampling point. Record Pertinent information on sampling log.
12. Replace the soil vapor probe cap/plug and secure road box lid.
13. Complete necessary chain of custody paperwork.
14. Transport/ship to analytical laboratory.

2.12 Soil Vapor Intrusion Sampling

To assess the impacts of soil vapor intrusion to the onSite building, a total of three (3) sub-slab vapor point samples will be collected during the SC field work. To facilitate sampling sub-slab vapor sampling points will be installed using the following methods:

1. Each of the sub-slab vapor point installations will be initiated by drilling a ¾-inch diameter hole through the concrete slab and approximately 2.0-inches into the underlying material.
2. After completing this initial hole, the upper portion of the concrete slab is over-drilled using a 1-¼-inch diameter drill bit. Once drilling is completed, the concrete dust and debris is removed from the hole via a shop vac.
3. A brass probe is subsequently inserted into the concrete slab and seated into an inert sealant (beeswax, molding clay or permagum) that is placed at the bottom of the 1-¼-inch diameter hole. The top of the brass probe will be set flush to the top of the concrete floor.
4. Hydraulic cement is used to fill the annular space between the brass probe and the walls of the 1-¼-inch diameter hole. After the hydraulic cement sets, the probe is permanently affixed to the concrete slab.
5. The sampling point will be capped flush to the floor with a standard NPT threaded plug until it is ready for sampling.

2.12.1 Sub-Slab Sampling

Sub-slab samples and additional ambient indoor air, outdoor air and quality control samples will be collected in accordance with DER-10 and the NYSDOH's Guidance for Evaluating Soil Vapor Intrusion in the State of New York, October 2006. Prior to commencing with the SVI sampling, the building will be inspected and documented using the NYSDOH Structure Sampling Questionnaire and Building Inventory form.

All samples will be collected utilizing laboratory certified and cleaned six (6) liter Summa canisters equipped with a 24-hr (0.004 liter per minute (L/min) flow controllers), pressure gauges and particulate filters.

The following guidelines will be used when performing the sampling:

1. Sub-slab samples will be obtained by attaching the summa canister to the sub-slab point via a barbed fitting and teflon-lined tubing.
2. Sampling will be consistent with methods described in section 2.8.1.

2.13 Geophysical Survey

A geophysical investigation will be performed to assist in the delineation of subsurface structures (e.g., foundation walls, utility locations, underground storage tanks [USTs],etc.) that may be present at the Site, and could be potential sources of dry cleaning related chemicals. The geophysical investigation will consist of ground penetrating radar (GPR) and electromagnetic (EM) surveys. These surveys will be performed following the general procedures provided below

2.13.1 EM Survey

The EM survey will be conducted on a 10-foot grid across the accessible areas of the Site. This survey is designed to identify anomalies that may be associated with buried structures and/or areas that have decreased or elevated ground conductivity (as compared to background values), which could represent utilities or UST structures or materials. Areas of decrease or elevated EM measurements will be further investigated using ground penetrating radar (GPR).

2.13.2 Ground Penetrating Radar Survey

The GPR survey will be performed to further investigate the EM anomalies and any additional locations of interest at the Site as identified from historical Site information, to characterize subsurface structures. The GPR data will be used to help identify potential locations for confirmatory test pits and/or soil borings.

The GPR system transmits high-frequency electromagnetic waves into the ground and detects the energy reflected to the surface. Energy is reflected along boundaries of subsurface interfaces that have different electrical properties. Reflections typically occur at lithologic contacts or at changes in subsurface material having high electrical contrasts, including metal objects, concrete structures, and utility pipes. These reflections are detected by an antenna and processed into an electrical signal that is used to create an image of the subsurface feature. The GPR data will be evaluated in the field to determine the location of subsurface features of interest. Subsurface features considered to be of significant interest will be located and marked in the field for potential investigation using intrusive methods (soil borings).

The GPR and EM survey will be performed by a subcontractor, of Aztech, specializing in geophysical surveys. The selected contractor and proposed equipment to be used will be submitted for approval under the NYSDEC solicitation process.

2.14 Air Monitoring

Air monitoring will be conducted in accordance with the procedures detailed in the HASP (Appendix C). Air monitoring will be conducted with a PID and dust monitor during all intrusive land activities and only a PID during sampling activities. The PID will be used to monitor organic vapors in the breathing zone and borehole, and to screen samples for analysis and the dust monitor will be used to monitor particulate concentration in the breathing zone for particulates less than 10 microns in diameter.

The PID and dust monitor readings will be recorded in the field book during times of intrusive work. The instruments will be calibrated at least once each day, and more frequently if needed.

3.0 Field Instruments

3.1 General

At a minimum, all field screening equipment will be calibrated immediately prior to each day's use. Additional calibration may be required if measurements appear erroneous. The calibration procedures will conform to the manufacturer's standard instructions. Records of all instrument calibration will be maintained by the field personnel. Copies of all of the instrument manuals will be maintained on Site by the field personnel.

3.1.1 Photoionization detector

The photoionization detector will be a MiniRae 3000 (or equivalent), equipped with a 10.6 eV lamp or 11.7 eV lamp, depending on the requirements of the HASP. The MiniRae is capable of ionizing and detecting compounds with an ionization potential of less than 10.6 eV. The PID will be used for screening soils, soil vapor and ambient air monitoring.

3.1.2 Dust Monitor

The dust monitor will be a DustTraK II (or equivalent) and will be calibrated at the start of each day of use. Calibration and maintenance of the dust monitor will be conducted in accordance with the manufacturer’s specifications. The calibration data will be recorded in field notebooks

3.1.3 Water-Level Meter

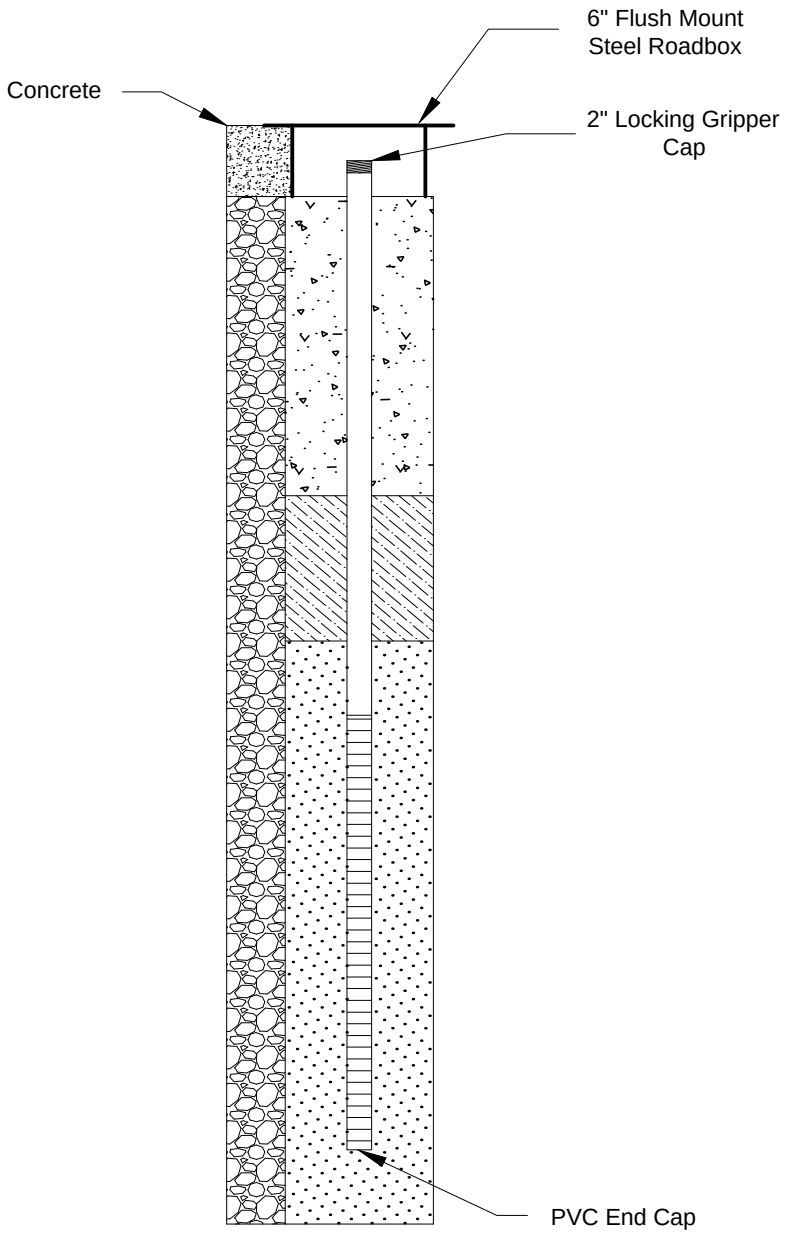
The water-level meter will be a Geotech (or Equvilient) unit equipped with a 100 foot measurement tape graduated in 0.01-inch decimal feet. The cable will be checked once to a standard to assess if the meter has been correctly calibrated by the manufacturer or vendor.

3.1.4 Multi-parameter Probe

The multi-parameter probe will be primarily used during groundwater monitoring and will be capable of measuring pH, conductivity, dissolved oxygen, oxidation-reducing potential, turbidity and temperature. A YSI Pro Plus (or equivalent) unit equipped with a flow-through cell will be used. This unit uses an internal barometer to correct for atmospheric pressure. Calibration and maintenance will be conducted in accordance with the manufacturer’s specifications. Calibration and maintenance information will be recorded in the field notebook.

FIGURES

OVERBURDEN MONITORING WELL
TYP.



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N
W E
S

338 Broadway
Kingston, New York
NYSDEC Site# 356058

FIGURE A-1

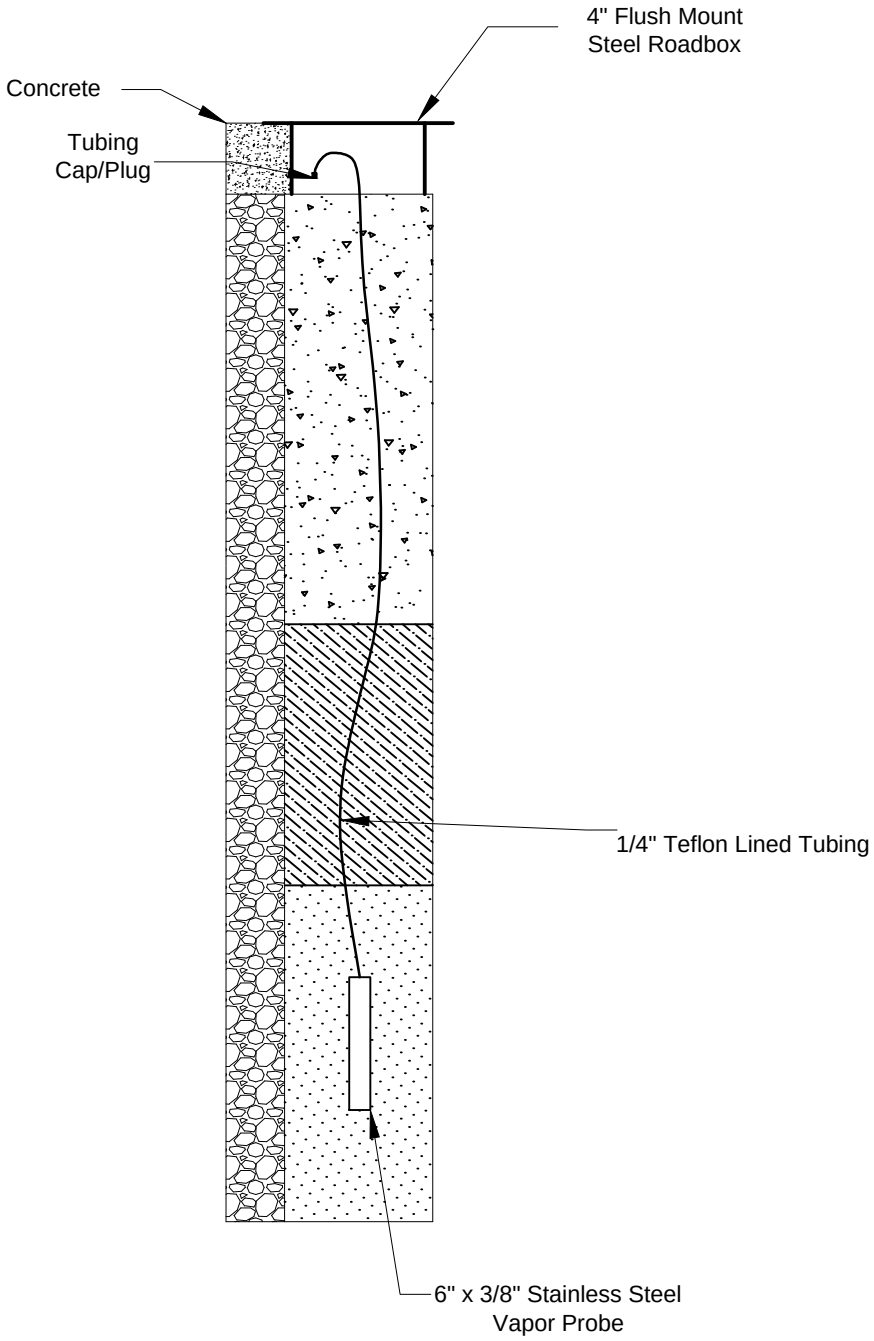
DATE: 2020

SCALE: NTS

Typical Overburden Well

Topographic Base Map Source
U.S.G.S. Quadrangle - Kingston, NY (2016)

SOIL VAPOR PROBE
TYP.



Aztech Environmental
TECHNOLOGIES

N
W E
S

338 Broadway
Kingston, New York
NYSDEC Site# 356058

FIGURE A-2

DATE: 2020

SCALE: NTS

Typical Soil Vapor Probe

Topographic Base Map Source
U.S.G.S. Quadrangle - Kingston, NY (2016)

STANDARD OPERATING PROCEDURES

Aztech Environmental
TECHNOLOGIES
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Field Book and Photographs

Standard Operating Procedure #001

A. Purpose and Scope:

To produce an accurate and reliable record of all field activities, including field observations, sample collection activities, etc.

All pertinent field survey and sampling information shall be recorded in a logbook or on field logs during each day of the field effort.

In addition to keeping logs, photographs will be taken to provide a physical record to augment the field worker's written observations. They can be valuable to the field team during future inspections, informal meetings, and hearings. Photographs should be taken with a camera-lens system having a perspective similar to that afforded by the naked eye. A photograph must be documented if it is to be a valid representation of an existing situation.

B. Equipment and Materials:

- Bound Field Book (with waterproof paper) or Field Logs
- Chain-of-Custody, Other Appropriate Forms
- Indelible Ink Pens
- Digital Camera with 50 mm lens or similar

C. Procedure:

1. At a minimum, entries in a logbook shall include:
   a. Date and time of starting work
   b. Names of all personnel at site
   c. Summary of key conversations with contractors, agency representatives, etc.
   d. Purpose of proposed work effort
   e. Sampling equipment to be used
   f. Field calibration of equipment or documentation of calibration of rented equipment
   g. Description of work area
   h. Location of work area, including map reference. Document sample locations with references to fixed landmarks (e.g., 10 feet from southwest corner of building)
   i. Details of work effort, particularly any deviation from the field operations plan or standard operating procedures
   j. Field observations and field measurements (e.g., pH)
   k. Field laboratory analytical results
   l. Personnel and equipment decontamination procedures
   m. Daily health and safety entries, including levels of protection
   n. Type and number of samples
   o. Sampling method, particularly deviations from the standard operating procedures
   p. Sample location and number
   q. Sample handling, packaging, labeling, and shipping information (including destination)
   r. Time of leaving site

For each photograph taken, several items shall be recorded in the field logbooks:

A. Date and time – Camera set to record on photo
B. Name of photographer
C. General direction faced and description of the subject
D. Sequential number of the photograph
E. Always attempt to include an object in the photograph that helps show scale
F. Always try to shoot at approximately 50mm focal length (what human eye sees)

2. Each day's entries will be initialed and dated at the end by the author, and a line will be drawn through the remainder of the page.

D. QA/QC Requirements:

All entries in the logbook shall be made in indelible ink. All corrections shall consist of single line-out deletions that are initialed.

The field task leader shall be responsible for ensuring that sufficient detail is recorded in the logbooks, and shall review the site logbooks daily.

E. Special Conditions:

Photographs should be downloaded from the camera to the project folder and notes regarding the photographs should accompany the photos. Photographs should be no larger than 3 MB each unless they are being utilized for presentation purposes. Aztech has software available to decrease file sizes if necessary.

As noted above, if a bound logbook is not used, then a field observation form must be used and information above should be captured on the form.

F. References:

None.

G. Appendices or Forms:

None.

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Sample Naming and Numbering

Standard Operating Procedure #002

A. Purpose and Scope:

The success of large environmental programs is greatly affected by the efficiency of data management and analysis. When performing environmental sampling, one of the most critical steps is appropriately naming or numbering samples so that they are uniquely identified and can be distinguished from all other samples by all future users.

Some of the potential benefits that can be obtained by adopting a naming convention include the following:

a) To ensure that every sample collected at a site has a unique identifier

b) To enhance clarity in cases of potential ambiguity

c) To help avoid "naming collisions" that might occur when the data is imported into our Equis or other databases

d) To provide meaningful data to be used in project handovers

Note that many of our sampling programs are performed at sites with previously established sample locations and in these cases, we would not change sample names. Additionally, this process shall be applied at larger, more complex sites, and/or sites that are required to follow a site- specific QAAP. Simpler naming conventions may be implemented for small, simple sites

B. Equipment and Materials:

- Field Logbook
- Field Sample Login Sheet
- Site Map / Work Plan
- Sampling Forms
- Chain of Custody
- Sample Containers with Labels

C. Procedure:

1. Once Each sample shall be uniquely defined by a multi-field name. In general, three fields are required:

   [Project # or Name] – [Media Type] – [Location Name/Sequential Number].

2. If using a site name, abbreviate to 2-3 letters. (e.g., Congress St site would be “CS”).

3. Use the following example abbreviations for media types:

Subsurface Soil.....SOIL
Surface Soil.....SURF
Sediment.....SED
Groundwater.....GW
Surface Water.....SW
Waste Water.....WW
Soil Vapor.....SV
Storm Water.....STORM

4. All samples collected at a site shall be numbered sequentially for each media type, regardless of the field event or project phase. The use of hyphens to separate segments of a sample name is beneficial for sample name readability. It is also beneficial to use enough leading zeros to accommodate the Sequential Number (or sys_loc_code) portion of the sample name, which will assist in sorting sample IDs in the data management program or database (see EQUIS discussion below).

5. Do not include information such as time, sample depths, etc. in the name. This information should be recorded as defined in Section F (below).

6. In no cases shall the multi-field name be longer than 30 characters, including dashes. Ensure that each name is clearly written on both the sample label as well as the Chain of Custody.

7. Do not use special characters (e.g. #, ‘, “, @, !) when naming samples. Including such characters in the Serial Number (sys_loc_codes) or Sample Number (sys_sample_codes) can be incompatible with the database.

8. For QA/QC blank samples use the following abbreviations in place of the media type:

Trip Blank.....TB
Equipment Rinse (Field Blank)..... FB
Duplicate.....DUP
Matrix Spike..... MS
Matrix Spike Duplicate.....MSD

For Duplicate and MS/MSD samples we need to make sure we include the parent sample name. Add the DUP, MS or MSD indicator after the Sequential Number.

For Blind Duplicate samples, use the AZT (Aztech) indicator in place of the Sequential Number. The location should be recorded in the field logs for our evaluation purposes. For example, a blind duplicate sample number for soil collected at the 005 location would be “CS-SOIL-AZT-1.”

You would record in the field log that the blind soil duplicate AZT-1 has SOIL-12345-005 as its parent sample.

9. Option to Include the Sample Collection Date - As an option, the date may be included in the sample name. NYS Electronic Data Deliverable guidance suggests using dates in the YYYYDDMM format. Placing the year first provides for ease of sorting data in the database:

   However, adding the date adds 9 characters to the sample name thus increasing the complexity of sample numbering. The date is captured on the Chain-of-Custody and in field records.

D. QA/QC Requirements:

The All data must be documented on field data sheets or within site logbooks.

Field personnel should verify that all sample data and supporting information in log books is correct prior to leaving the site.

E. Special Conditions:

NYSDEC EQUIS Considerations:

NYSDEC uses EQuIS for data management and generally requires data to be submitted in EQuIS format. EQuIS has three different sample name related fields, a sample_name, a sys_sample_code and a location_ name. Location_name will almost always be simplified to something like SW-1, GW-2 etc. and is usually the last field of the sample name.

In terms of the other two, sample_name is what we record in the field. That is limited to 30 characters of text.

The laboratory generates the sys_sample_code by taking the sample_name field and adding another qualifier, such as the sample delivery group or work order number. EQuIS requires that the sys_sample_code field be unique within a database. This is limited to 40 characters of text so it typically will be the sample name plus up to 10 characters.

It is recommended to keep the Aztech sample name as short as possible to work with the EQuIS format. The basic sample names identified above are 14 to 17 characters long. If the optional date format is used, sample names will be 23 to 26 characters which is near the limit for what EQuIS can accommodate (and you may have issues physically fitting the sample names legibly into the COC form).

References:

NYSDEC, DER-10, Technical Guidance for Site Investigation and Remediation, May 2010, http://www.dec.ny.gov/docs/remediation_hudson_pdf/der10.pdf

NYSDEC, Electronic Data Delivery Manual, January 2013, http://www.dec.ny.gov/docs/remediation_hudson_pdf/eddmanual.pdf

F. Appendices or Forms:

None

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Sample Containers, Volumes, Preservations and Holding Times

Standard Operating Procedure #003

A. Purpose and Scope:

The following standard operating procedure (SOP) presents general guidelines for sample containers, volumes, preservations and holding times associated with air, water and soil/sediment samples. Field personnel are responsible for ensuring that state-specific standards/guidelines/regulations are followed, where applicable.

Proper preserving, storing and handling of air, water and soil/sediment samples are critical if the integrity of the samples are to be maintained. Samples collected in the field may undergo biological, chemical or physical changes following removal from their environment. In order to minimize those changes, many samples must have preservatives in the form of strong acids or bases added prior to delivery to the laboratory. If samples are to be collected as part of a government program, the governing agency typically must be notified 30 days prior to sample collection

B. Equipment and Materials:

Pre-cleaned sample containers along with associated preservations within the sample containers will be provided to Aztech from the analytical laboratory. The field geologist/engineer will provide the necessary personal protective equipment to place samples collected within the appropriate sample containers. However, if field preservation is required the following equipment and materials shall be obtained:

- Hydrochloric (HCl) Acid Reagent A.S.C. 38%
- Nitric (HNO_3) Acid Reagent A.S.C. 71%
- Sodium Hydroxide (NaOH) 97%
- 10 mL glass pipettes
- Narrow range (0-3 and 12-14) pH paper
- Nitrile gloves

C. Procedure:

1. Review Table 1 which details typical parameters of interest at environmental sites and the associated methods, preservation, container type, holding time and required sample volume.
2. Obtain pre-cleaned and pre-preserved sample containers from the laboratory. If pre-preserved sample containers were provided skip to Step 7; if not proceed to Step 3.
3. Put on a clean pair of nitrile gloves.
4. In a clean, non-dusty environment, remove the cap of the sample container.
5. Using a clean, 10 mL glass pipette draw the required amount of acid or base and insert into the sample container.
6. Volatile Organic Compounds – 2 mL of HCl acid (water samples).
7. Total and Dissolved Metals (including mercury) – 5 mL Nitric acid (water samples).
8. Cyanide – 15-20 Sodium Hydroxide pellets (water samples.
9. Chemical Oxygen Demand, Oil and Grease, Organic Carbon, Phenolics, Total Dissolved Phosphorous, Hydrolyzable Phosphorus, Ammonia, Nitrate and Nitrite – 5 mL Sulfuric acid (water samples).

10. Immediately replace and tighten the sample container cap.
11. Collect sample using equipment and procedures outlined in other SOPs as appropriate. The volume of the sample collected shall be sufficient to conduct the analysis required, as well as associated quality assurance/quality control samples (QA/QC).
12. Place samples immediately in the pre-preserved sample containers.
13. Chill all samples to 4°C from sample collection until laboratory analysis.
14. Package and ship samples.

D. QA/QC Requirements:

This section includes QA/QC requirements associated with sample containers, volumes, preservations, and holding times. The following general requirements apply to this SOP:

1. All data must be documented on field data sheets or within site logbooks.
2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan.
3. Equipment checkout and calibration activities must occur prior to sampling/operation, and must be documented.
4. QA/QC samples shall be collected in accordance with SOP #005.

The following procedure shall be conducted to provide a QA/QC check of water (aqueous) samples to ensure the samples were preserved to the proper pH prior to shipping for laboratory analysis.

Volatile Organic Compounds:

1. Collect one additional VOA vial at every third aqueous sampling location.
2. Fill the extra vial with the sample.
3. Using the extra VOA vial, remove the cap and using a clean, 10 mL glass pipette extract approximately 1 mL of water.
4. Place two drops of the water on a 1-inch strip of 0-3 range pH paper.
5. Compare pH strip's color while wet with that of the color key included on the pH paper container.
6. If pH is not less than 2, add additional HCL to the remaining 3 VOA vials prior to collecting the sample.
7. Discard the vial used to check the pH.

Total and Dissolved Metals, Mercury, Ammonia, Nitrate plus Nitrite, Total Dissolved Phosphorus, COD, Oil & Grease, Organic Carbon, Phenolics:

1. Collect sample and tightly reseal the cap.
2. Agitate the sample by gently shaking the sample bottle to mix the acid and water.
3. Remove the cap and using a clean, 10 mL glass pipette extract approximately 1 mL of sample.
4. Place approximately two drops of sample on a 1 inch strip of 0-3 range pH paper.
5. Compare pH strip's color while wet with that of the color key included on the pH paper container.
6. If pH is not less than 2, add appropriate additional Sulfuric Acid to the sample using a clean pipette.
7. Recheck sample using steps 2 through 6 until sample pH is less than 2.

Cyanide:

1. Collect sample and tightly reseal the cap.
2. Agitate the sample by gently shaking the sample bottle until the NaOH pellets are dissolved.
3. Remove the cap and using a clean 10 mL glass pipette extract approximately 1 mL of sample.
4. Place approximately two drops of sample on a 1-inch strip of 12-14 range pH paper.
5. Compare pH strip's color while wet with that of the color key included on the pH paper container.
6. If pH is not greater than 12, add additional NaOH to the sample using standard procedures.
7. Recheck sample using steps 2 through 6 until sample pH is greater than 12.

E. Special Conditions:

None

F. References:

Eurofins Test America

G. Appendices or Forms:

Table 1 Laboratory Analysis: Summarizing parameters, methods, preservations, container type, holding times and minimum sample volumes are included as an attachment to this SOP.

Table 1

Laboratory Analysis	EPA Method	Standard Method and/or SW846 Method	Preservation	Container	Holding Time	Minimum Volume
WATER						
Acid Soluble & Insoluble Sulfide	-----	9030B	Cool to 4 deg C No Headspace	P or G	7 Days	8 oz.
Acidity as CaCO3	305.1	2310B	Cool to 4 deg C	P or G	14 Days	100 mL
Alkalinity	-----	2320B	Cool to 4 deg C	P or G	14 Days	100 mL
Alkalinity as CaCO3	310.1	2320B	Cool to 4 deg C	P or G	14 Days	100 mL
Ammonia	350.2/.3	4500-NH3 B,E	Cool to 4 deg C, H2SO4 to pH<2	P or G	28 Days	400 mL
Aromatic Hydrocarbons	602	8021B	1:1 HCl to pH <2, Cool to 4 deg C 0.008% Na2S2O3 if residual chlorine present	G, Vial screw cap with center hole Teflon- faced silicone septum	14 Days	40 mL
Biochemical Oxygen Demand	405.1	5210B	Cool to 4 deg C	P or G	48 Hrs.	500 mL
Bromide	300	-----	None	P or G	28 Days	250 mL
Calcium	-----	3120B	HNO3 to pH<2	P or G	6 Months	100 mL
Calcium- Hardness	200.7	3111B	HNO3 to pH<2	P or G	6 Months	100 mL
Carbamates	531.1	-----	Cool to 4 deg C, 0.08% Na2S2O3 if residual chlorine present	G, screw cap Teflon faced silicone septum	14 Days	100 mL mL
Carbonaceous BOD	-----	5210B	Cool to 4 deg C	P or G	48 Hrs.	1000 mL
Chloride	300	4500-CL D 4110	Cool to 4 deg C	P or G	28 Days	100 mL
Chloride, Residual Disinfectant	-----	4500Cl-G	Cool to 4 deg C	P or G	Analyze Immediately	200 mL
COD	410.4	5220D	H2S04 to pH<2, Cool to 4 deg C	P	28 days	250 mL
Color	-----	2120B	Cool to 4 deg C	P or G	24 Hrs	100 mL
Conductivity	-----	2510B	Cool to 4 deg C	P or G	28 Days	100 mL
Cyanide	335.4	4500-CN C&E	Cool to 4 deg C NaOH pH>12	P or G	14 Days	250 mL
Cyanide	335.2	9010B, 9012A, 9014	Cool to 4 deg C, NaOH to pH>12 0.6 g ascorbic acid if residual chlorine present	P or G	Sulfide absent, 14 days; sulfide present 24 Hrs	250 mL
Cyanide, Amenable	335.1					
Dioxin	-----	8280A	Cool to 4 deg C 0.008% Na2S2O3 if residual chlorine present	G, Amber Teflon-lined screw cap	7 days until extraction 40 days after extraction	1000 mL
DRO	-----	8015B	Cool to 4 deg C 0.008% Na2S2O3 if residual chlorine present	G, Amber Teflon-lined screw cap	7 days until extraction 40 days after extraction	1000 mL
Escherichia Coli	-----	9222B	0.008% Na2S203 if residual chlorine present 0.3 mL/125 mL 15% EDTA if > 0.01 mg/L heavy metals	Sterile P or G	30 Hrs. for Drinking Water 6 Hrs. for Waste Water	125 mL
Extractable Org. Compounds			Cool to 4 deg C, Store in dark	G, Amber Teflon-lined screw cap	*7 days	4000 mL

Table 1

Laboratory Analysis	EPA Method	Standard Method and/or SW846 Method	Preservation	Container	Holding Time	Minimum Volume
Fecal Coliform	-----	9222B or D	0.008% Na2S203 if residual chlorine present 0.3 mL/125 mL 15% EDTA if > 0.01 mg/L heavy metals	Sterile P or G	30 Hrs. for Drinking Water 6 Hrs. for Waste Water	125 mL
Fecal Streptococci	-----	9230C	Cool to 4 deg C 0.008% Na2S2O3 if residual chlorine present	Sterile P or G	30 Hrs. for Drinking Water 6 Hrs. for Waste Water	125 mL
Fluoride	300	4500 F-B,C S	Cool to 4 deg C	P or G	28 Days	300 mL
Foaming Agents (MBAS)	-----	5540C	Cool to 4 deg C	P or G	48 Hrs	250 mL
Gases	-----	3810	Cool to 4 deg C 0.008% Na2S2O3 if residual chlorine present 1:1 HCl to pH <2	G, Vial screw cap with center hole Teflon- faced silicone septum	7 days without HCl 14 days with HCl	40 mL
GRO	-----	8015B	1:1 HCl to pH <2, Cool to 4 deg C 0.008% Na2S2O3 if residual chlorine present	G, Vial screw cap with center hole Teflon- faced silicone septum	7 days w/o HCl 14 days w/HCl	40 mL
Hardness			HNO3 to pH<2	P	6 months	1000 mL
Heterotrophic Plate Count	-----	9215B	Cool to 4 deg C 0.008% Na2S2O3 if residual chlorine present	Sterile P or G	30 Hrs. for Drinking Water 6 Hrs. for Waste Water	125 mL
Hexavalent Chromium	7196A	3500Cr-D	Cool to 4 deg C	P	24 hours	500 mL
HPLC (Explosive)	------	8330	Cool to 4 deg C	G, Amber Teflon-lined screw cap	7 days until extraction 40 days after extraction	1000mL
HPLC (Explosive)	------	8310	Cool to 4 deg C	G, Amber Teflon-lined screw cap		1000mL
Mercury	-----	7470A	Cool to 4 deg C	P or G	28 Days	8 oz.
Metals	200.7	-----	HNO3 to pH<2	P	6 Months	100 mL
Nitrate	300	-----	Cool to 4 deg C	P or G	48 Hrs.	100 mL
Nitrate (Chlorinated)	353.2	4500-NO3 F	Cool to 4 deg C	P or G	48 Hrs	250 mL
Nitrate (Non- chlorinated)	353.2	4500-NO3 F	H2SO4 to pH<2, Cool to 4 deg C	P or G	14 Days	250 mL
Nitrite	300, 353.2, 354.1	4500-NO3 D	Cool to 4 deg C	P or G	48 Hrs	100 mL
Odor	-----	2150B	Cool to 4 deg C	G only	24 Hrs	200 mL
Oil and Grease		1664	HCl to pH<2, Cool to 4 deg C	G, Amber Teflon-lined screw cap	28 days	1000 mL
Organic Nitrogen	351.1	-----	Cool to 4 deg C, H2SO4 to pH<2	G	28 Days	500 mL

Table 1

Laboratory Analysis	EPA Method	Standard Method and/or SW846 Method	Preservation	Container	Holding Time	Minimum Volume
Organochlorine Pesticides/PCB	608	8081A,8082	Cool to 4 deg C 0.008% $Na_2S_2O_3$ if residual chlorine present If aldrin is to be determined bind to pH 5-9.	G, Amber Teflon-lined screw cap	7 days until extraction 40 days after extraction	1000 mL
Ortho Phosphate	300	4500 P-E	Cool to 4 deg C	P or G	48 Hrs	50 mL
Orthophosphate	365.2	-----	Filter immediately, Cool to 4 deg C	P or G	48 Hrs.	50 mL
pH, Hydrogen ion	-----	4500-H-B	Cool to 4 deg C	P or G	Analyze Immediately	25 mL
Phenols	420.1	9065, 510ABC	Cool to 4 deg C, H_2SO_4 to pH<2	G	28 Days	500 mL
Pseudomanas Aeruginosa	-----	9213E	Cool to 4 deg C 0.008% $Na_2S_2O_3$ if residual chlorine present	Sterile P or G	30 Hrs. for Drinking Water 6 Hrs. for Waste Water	125 mL
Purgeable Halocarbons	601	8021B	Cool to 4 deg C 0.008% $Na_2S_2O_3$ if residual chlorine present	G, Vial screw cap with center hole Teflon- faced silicone septum	14 Days	40 mL
Radiological	-----	-----	HNO_3 to pH<2	P or G	6 Months	100 mL
Residue- Settleable (SS)	160.5	-----	Cool to 4 deg C	P or G	48 Hrs.	1000 mL
Residue-filtered (TDS)	160.1	-----	Cool to 4 deg C	P or G	7 Days	100 mL
Residue-non- filtered (TSS)	160.2	-----	Cool to 4 deg C	P or G	7 Days	100 mL
Residue-Total Volatile Solids	160.4	2540 E	Cool to 4 deg C	P or G	7 Days	100 mL
Salinity	-----	2520 C	Cool to 4 deg C	G	28 Days	100 mL
Semivolatile Organic Compounds (Unregulated)	525.2	-----	If residual chlorine is present, add 40-50 mg Sodium Thiosulfate. If not chlorinated, add 6N HCl to pH<2 Cool to 4 deg C	G, Amber Teflon-lined screw cap	7 Days for extraction, 30 after extraction	1000 mL
Semivolatile Organics	625	8270C	Cool to 4 deg C 0.008% $Na_2S_2O_3$ if residual chlorine present	G, Amber Teflon-lined screw cap	7 days for extraction 40 days after extraction	1000 mL
Silica	200.7	-----	Cool to 4 deg C	P only	7 Days	50 mL
Specific Conductance	120.1	-----	Cool to 4 deg C	P or G	28 Days	100 mL
Sulfate	300	4500-SO_4	Cool to 4 deg C	P or G	28 Days	50 mL
Sulfate	375.4	-----	Cool to 4 deg C	P or G	28 Days	50 mL
Sulfide	376.2	9030 B, 4500S2-AD	Cool to 4 deg C, add zinc plus NaOH to pH>9	P or G	7 Days	50 mL
Sulfite (SO_3)	377.1	-----	None Required	G, Bottle and Top	Analyze immediately	50 mL
Surfactants (MBAS)	425.1	-----	Cool to 4 deg C	P or G	48 Hrs.	250 mL

Table 1

Laboratory Analysis	EPA Method	Standard Method and/or SW846 Method	Preservation	Container	Holding Time	Minimum Volume
TDS			Cool to 4 deg C	P	7 days	500 mL
Temperature	-----	2550B	None	P or G	Analyze Immediately	1000 mL
Temperature	170.1	-----	None Required	G, Bottle and Top	Analyze immediately	1000 mL
Total Kjeldahl Nitrogen	353.3/.1	4500Norg-C	H2S04 to pH<2 , Cool to 4 deg C	P	28 days	250 mL
Total Coliform	-----	9221D	0.008% Na2S203 if residual chlorine present 0.3 mL/125 mL 15% EDTA if > 0.01 mg/L heavy metals	Sterile P or G	30 Hrs. for Drinking Water 6 Hrs. for Waste Water	125 mL
Total Dissolved Solids	160.1	2540C	Cool to 4 deg C	P or G	7 Days	100 mL
Total Hardness	130.2 , 200.7	-----	HNO3 to pH<2 H2SO4 to pH<2	P or G	6 Months	100 mL
Total Kjeldahl Nitrogen	351.3	-----	H2SO4 to pH<2	P or G	28 Days	500 mL
Total Metals	200.7 200.8	6010B, 6020, 7000A	HNO3 to pH<2	P	6 months (Hg 28 days)	500 mL
Total Organic Carbon (TOC)	415.1	9060, 5310C	H2SO4 to pH<2, Cool to 4 deg C	G, Amber Teflon-lined screw cap	28 days	80 mL
Total Organic Halides		5320B	1N H2SO4 to pH<2	P or G	28 Days	50 mL
Total Phosphorus	365.2	-----	Cool to 4 deg C, H2SO4 to pH<2	G	28 Days	50 mL
Total Recoverable Oil & Grease	413.1,166 4A	-----	Cool to 4 deg C, HCL or H2SO4 to pH<2	G	Petroleum Based 3 Days; Non-Petroleum Based 24 hours	1000 mL
Total-Residue (TS)	160.3	2540B	Cool to 4 deg C	P or G	7 Days	100 mL
Turbidity	180.1	2130B	Cool to 4 deg C	P or G	48 Hrs	100 mL
Volatile Organics	624	8260B	1:1 HCl to pH <2, Cool to 4 deg C 0.008% Na2S2O3 if residual chlorine present	G, Vial screw cap with center hole Teflon-faced silicone septum	7 days w/o HCl 14 days w/HCl	40 mL
Volatiles (Regulated)	524.2	-----	Cool to 4 deg C HCl to pH<2	G, Vial screw cap with center hole Teflon-faced silicone septum	14 Days	60-120 mL
SOIL						
Acid Soluble & Insoluble Sulfide	-----	9030B	Cool to 4 deg C, no headspace	P or G	7 Days	8 oz.
Amenable Cyanide	-----	9213	Cool to 4 deg C	P or G	14 Days	4 oz.
Bromide	-----	9211	Cool to 4 deg C	P or G	28 Days	8 oz.
Cation - Exchange Capacity	-----	9080, 9081	None	P	-----	8 oz.
Chloride	-----	9212, 9056, 9253	None	P or G	28 Days	8 oz.
Chlorinated Herbicides	-----	8151A	Cool to 4 deg C	G, wide mouth, teflon liner	14 Days	8 oz.
Corrosivity pH Waste>20% water	-----	9040B	Cool to 4 deg C	P	Analyze Immediately	4 oz.

Table 1

Laboratory Analysis	EPA Method	Standard Method and/or SW846 Method	Preservation	Container	Holding Time	Minimum Volume
Corrosivity Toward Steel	-----	1110	Cool to 4 deg C	P	14 Days	4 oz.
Cyanide		9010B, 4500CN	Cool to 4 deg C	G, Amber	14 Days	4 oz
Dioxin	-----	8280A	Cool to 4 deg C	G	14 Days	8 oz.
DRO	-----	8015B	Cool to 4 deg C	G, Amber	14 Days	4 oz.
Extractable Organic Compounds			Cool to 4 deg C, Store in dark	G	14 days	8 oz
Extractable Sulfide	-----	9031	Cool to 4 deg C, fill top of sample with 2N Zinc Acetate until moistened	P or G	7 Days	8 oz.
Fluoride	-----	9214	None	P	28 Days	8 oz.
Gases	-----	3810	Cool to 4 deg C	G, Amber	14 Days	8 oz.
Grain Size			N/A	G	N/A	8 oz
GRO	-----	8015B	Cool to 4 deg C, check state regulations for proper preservative. NJ (methanol), PA (encore samplers) NY (cool to 4 deg C).	G, Amber VOA vial	14 Days	15 Grams
HPLC (PAH)	------	8310	Cool to 4 deg C	G, Amber Teflon-lined screw cap	14 days until extraction 40 days after extraction	4 oz.
Ignitability	-----	1010	None	P or G	None	8 oz.
Ignitability of Solids		1030	None	P or G	None	8 oz.
Mercury	245.1	7471A	Cool to 4 deg C	G, Amber	28 Days	4 oz.
Metals	-----	6010B, 6020, 7000A	Cool to 4 deg C	G, Amber	6 Months	8 oz.
Moisture Content			Store in airtight jar 3-30 deg C	G	N/A	8 oz
Nitrate	-----	9210	Cool to 4 deg C	P or G	48 Hrs	8 oz.
Oil & Grease (Sludge, Sludge- Hem)	-----	9071B	Cool to 4 deg C	G	28 Days	8 oz.
Organochlorine	-----	8081A	Cool to 4 deg C	P or G	14 Days	8 oz.
Paint Filter Liquids Test	-----	9095A	Cool to 4 deg C	P or G	-----	8 oz.
PCBs	-----	8082	Cool to 4 deg C	G, Amber Teflon-lined screw cap	14 Days	4 oz.
pH	-----	9045C	Cool to 4 deg C	G, Amber	Analyze Immediately	4 oz.
pH, Soil and Waste	-----	9045A	Cool to 4 deg C	G	Analyze Immediately	8 oz.
Phenol	-----	9065, 9066, 9067	Cool to 4 deg C	G, Amber	28 Days	4 oz.
Radiological	-----	-----	Cool to 4 deg C	G	6 Months	8 oz.
Reactivity Cyanide	-----	SW-846 7.3.3.2	Cool to 4 deg C	P	14 Days	8 oz.
Reactivity Sulfide	-----	SW-846 7.3.4.2	Cool to 4 deg C	P	14 Days	8 oz.
Semivolatile Organics	-----	8270C	Cool to 4 deg C	G, Amber	14 Days	8 oz.

Table 1

Laboratory Analysis	EPA Method	Standard Method and/or SW846 Method	Preservation	Container	Holding Time	Minimum Volume
Sulfate	-----	9035, 9036, 9038	Cool to 4 deg C	P or G	28 Days	8 oz.
Sulfides	-----	9215	Cool to 4 deg C	P or G	7 Days	8 oz.
TCLP Metals	-----	1311, 6010B, 6020, 7000A, 7470A	Cool to 4 deg C	G, Amber	180 Days (Hg 28 days)	8 oz
TCLP Herbicides	-----	1311	Cool to 4 deg C	G, Amber	14 Days	8 oz.
TCLP Pesticides	-----	1311	Cool to 4 deg C	G, Amber	14 Days	8 oz.
TCLP Semivolatile Organics	-----	1311, 8270C, 8081A, 8151A	Cool to 4 deg C	G, Amber Teflon Lined	14 Days	8 oz.
TCLP Volatile Organics	-----	1311, 8260B	Cool to 4 deg C	G, Amber VOA Vial Teflon Lined	14 Days	8 oz.
Temperature	-----	2550	-----	P	Analyze Immediately	4 oz.
TOC		Lloyd Kahn Method	Cool to 4 deg C	G, Amber	14 days	4 oz.
Total Coliform	-----	9131	Cool to 4 deg C	Sterile, P or G	6 Hrs	4 oz.
Total Coliform	-----	9132	Cool to 4 deg C	Sterile, P or G	6 Hrs	4 oz.
Total Cyanide	-----	9013	Cool to 4 deg C	P or G	14 Days	8 oz.
Volatile Organic Compounds	-----	8260B	Cool to 4 deg C Check individual state regulations for proper preservative. NJ (methanol), PA (encore samplers), NY (cool to 4 deg C)	G, wide mouth, teflon liner	14 Days	4 oz.
Volatile Organic Compounds	-----	8021		G, wide mouth, teflon liner	14 Days	4 oz.
CLP Sampling and Holding Time Information						
Cyanide (aqueous)	ILM04.1		NaOH to pH>12, Cool to 4 deg C	P	12 Days VTSR	1000ml
Cyanide**	ILM04.1		Cool to 4 deg C	G		8 oz
Mercury (aqueous)	ILM04.1		HNO3 to pH<2, Cool to 4 deg C	P	26 Days VTSR	1000ml
Mercury (solid/soils)	ILM04.1		Cool to 4 deg C	G		8 oz
Metals (aqueous)	ILM04.1		HNO3 to pH<2, Cool to 4 deg C	P	180 Days VTSR	1000ml
Metals (solid/soils)	ILM04.1		Cool to 4 deg C	G		8 oz
PCBs (aqueous)	OLM04.2		Na2S203, Cool to 4 deg C	G	See Note 7	1000ml
PCBs (solid/soils)	OLM04.2		Cool to 4 deg C	G	See Note 6	8 oz
Pesticides (aqueous)	OLM04.2		Na2S203, Cool to 4 deg C	G	See Note 7	1000ml
Pesticides (solid/soils)	OLM04.2		Cool to 4 deg C	G	See Note 6	8 oz
Semivolatile Organic Compounds (aqueous)	OMLO4.2		Cool to 4 deg C	G	See Note 8	1000ml
Semivolatile Organic Compounds (solid/soils)	OLM04.2		Cool to 4 deg C	G	See Note 6	8 oz
Volatile Organic Compounds (aqueous)	OLM04.2		HCL pH < 2, Cool to 4 deg C	G	W/preservative: 10 days VTSR; W/O: 7 days VTSR	40ml
Volatile Organic Compounds (solid/soils)	OLM04.2		Cool to 4 deg C	G	10 Days VTSR	4 oz

Table 1

Laboratory Analysis	EPA Method	Standard Method and/or SW846 Method	Preservation	Container	Holding Time	Minimum Volume
1, 4 Dioxane (Soil)	-	8270D	Cool to 4 deg C	G, Amber	14 Days	4 oz.
1,4 Dioxane (Water)	-	8270 SIM	Cool to 4 deg C	G, Amber	14 Days	1000 mL
PFAS (Soil)	-	537.1 Modified	Cool to 4 deg C	P, Non-Teflon Lined	28 Days	8 oz.
PFAS (Water)	-	537.1 Modified	Cool to 4 deg C	P, Non-Teflon Lined	28 Days	250 mL

Notes:

1. P - Plastic
2. G - Glass
3. Minimum volume is the minimum volume required by the laboratory to conduct analysis. The laboratory will likely require additional sample volume.
4. * Extraction within seven (7) days of collection; analysis within 40 days of extraction.
5. ** When chlorine is present ascorbis is used to remove the interference (0.6 g ascorbic acid).
6. VTSR - Validated time of sample receipt.
7. Ten (10) days from VTSR for extraction and 40 days following extraction.
8. Five (5) days from VTSR for extraction 14 days after extraction.
9. Five (5) days from VTSR for extraction 40 days after extraction.
10. Holding times are from the time of sample collection unless otherwise noted.

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Completing a Chain of Custody Record

Standard Operating Procedure #004

A. Purpose and Scope:

This protocol provides a standard operating procedure (SOP) for initiating and maintaining a Chain of Custody (COC) document. A COC is a legal document designed to track persons who are responsible for the preparation of the sample container, sample collection, sample delivery, sample storage, and sample analysis. A COC is an appropriate format to record important data associated with each individual sample. In general, a sample requiring a COC will follow a path as follows:

Sample Collector → Sample Courier/Operator → Sample Manager

Verification of who has possessed the samples and data and where the samples have been is completed when staff follow chain-of-custody procedures.

B. Equipment and Materials:

- Chain of Custody form
- Ball-point/permanent pens
- Gallon sized Ziploc Bag (to keep document dry)
- Field Logbook
- Custody seals
- Padlock(s) (if needed)

C. Procedure:

1. Once a sample has been determined to require a COC, the Sample Collector must initiate the COC. The Sample Collector must fill in the fields provided on the COC. The words "Chain of Custody" must be located in a conspicuous location at the top of the document.

2. The form is generally a three-page carbon copy document, including a white, yellow and pink sheet. While Aztech generally uses COCs provided by the applicable laboratory, it is important to ensure that the COC from each lab contains places for all necessary information.

3. The COC at that time should include the applicable project number, the project name and location.

4. The Client Information Section must be completed. In most cases the "client" will be Aztech Technologies, Inc. or entity procuring services.

5. The first field of information is the Sample Identification or Sample Identification Number. This identification/number must match the identification/number located on the sample container.

6. An information line for the date, time, phone number, printed name of Sample Collector, signature of Sample Collector, organization name (no acronyms), organization's full mailing address, and sample description must also be included.

7. Sampling personnel should enter the sample Identification or number(s) (which should correspond with a unique number on each sample container, and parameters to be analyzed. The "Sample ID" must be included and must match the number on the sample.

8. Subsequent fields must be provided to allow for documentation of information about any subsequent Sample Couriers/Operators or Sample Managers. These fields must contain the date, time, phone number, printed name of person taking custody of sample, signature of person taking custody of sample and organization name (no acronyms).

9. Field Information - The COC must contain places to enter the following field information: sample number, sampling date, and type of sample. Other field information may be recorded as specified in the field sampling plan or proposal for the project. It is imperative that there be only one (1) sample with a particular sample number per project/study so as to prevent duplicates in Excel files and EQuIS databases.

10. Laboratory Information - Once the sample is delivered to the lab, the laboratory personnel will sign and date the "received by" line located at the bottom of the COC. Other laboratory information may be recorded as specified in the project/study work plan/proposal.

11. Signatures - The COC must contain places for all people who handle the sample to sign his/her name. This is a record of persons who had custody of the sample during all steps of the process from container preparation, sample collection, sample storage and transport, and sample analysis. There should be signature lines to relinquish custody of the sample and to receive custody of the sample.

D. QA/QC Requirements:

The Field Team Leader or senior person on the sampling team will review the completed COC form to verify that all fields are properly completed. For purposes of this SOP, signing the form under Collected/Delivered by is considered evidence that the COC form has been checked for accuracy and completeness. Any project related questions concerning the COC should be directed toward the Project Manager.

E. Special Conditions:

Whenever samples are split with a source or government agency, a separate chain of custody form should be completed for the samples and the relinquisher (sampler) and recipient should sign. If a representative is unavailable or refuses to sign for the samples, this can be noted in the "remarks" area of the form. When appropriate, as in the case where the representative is unavailable, the custody record should contain a statement that the samples were delivered to the designated location at the designated time. A copy of the chain of custody form for split samples must be kept with the project file.

Samples may require short term storage in field locations prior to delivery to the laboratory for analyses. The storage may be in vehicles or lodging locations. The samples must be secured to limit access to them. A locked vehicle is considered controlled access. However, simply a locked lodging room is not secure due to potential custodial access. If an unattended lodging room is used for sample storage, the samples must be further secured. This may entail a padlock on the ice chest, samples in an ice chest secured in an inner bag with a custody seal on it, and/or ice chest taped shut with custody seal on the outside of it.

F. References:

Sampling Guidelines and Protocols, NYSDEC
https://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpintro.pdf

G. Appendices or Forms:

The COC used should be specific to each laboratory.

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Quality Assurance Quality Control Samples

Standard Operating Procedure #005

A. Purpose and Scope:

This standard operating procedure explains the purpose and correct usage of Quality Assurance/Quality Control (QA/QC) samples. QA/QC samples are intended to validate the results of sample analysis by providing the means to determine the influence of outside factors on the sample and analysis. There are several types of QA/QC samples in use to ensure the best practices are being followed by both the laboratory preforming the analysis and the sampling team in the field. This is a general procedure for the use of QA/QC samples. Also refer to any guidelines provided by the laboratory.

B. Equipment and Materials:

QA/QC samples require the following materials:

- Sample containers:
  - They should be the same containers in number and type of preservative as the containers for the samples for which QA/QC samples are being taken
- Analyte-free water
- Any laboratory supplied QA/QC materials

C. Procedure:

The following are types of QA/QC samples.

1. Duplicate Sample

   A duplicate sample is a sample that is collected concurrently with the routine samples. It consists of an additional set of sample containers to be analyzed for the same parameters as the routine samples. It is taken at a sample point of the samplers choosing and at the same time as the routine sample for that sample point is taken. It is labeled and included on the Chain of Custody (COC) with a name unknown to the laboratory.

   Example:
   - Sample Point ID is **MW-1**
   - Duplicate Sample ID is **AZT-1**

   The duplicate sample is submitted as a 'blind' sample to the laboratory. The purpose of a duplicate sample is to allow the sampler to determine the precision of laboratory analysis. The results of the duplicate sample are compared with the results of the concurrent routine sample by the sampler. These results should be within the margin of error for the test being performed.

   One (1) duplicate sample should be taken for every twenty (20) routine samples. For example if 16 samples points were sampled, there would be 1 duplicate sample taken at one (1) of the sample points for a total of 17 sample sets submitted to the lab.

2. Field Blank

   The Field Blank sample is a type of QA/QC sample used to account for possible external contamination of the routine samples, usually by exposure to the air from being on site. It consists

of an additional set of sample containers to be analyzed for the same parameters as the routine samples. It is common to only conduct a Field Blank for volatile organic compound (VOC) parameters even when sampling to additional parameters. This is because VOCs are more likely to be present in the atmosphere at the site then a parameter like metals. However a Field Blank can be conducted for any parameter.

The containers are prepared prior to sampling by filling the containers with analyte-free water. The containers are then transported with the routine sample containers to the site. Once at the site the containers are placed in a location representative of the site conditions and their caps are removed. At the end of the sampling event the caps are then replaced. The sample is labeled and included on the COC as **Field Blank** or **FB**.

If any results are positive for the Field Blank it can be assumed that the routine samples have also been exposed to a similar amount of contaminant and that contaminant is probably present in the atmosphere at the site.

One (1) Field Blank should be taken as required for each day of sampling at the site. They are only used for the collection of aqueous samples.

3. Equipment Blank

An Equipment Blank is a QA/QC sample designed to measure the effectiveness of the decontamination of field equipment. It consists of an additional set of sample containers being analyzed for the same parameters as the routine samples.

An Equipment Blank is collected by pouring analyte-free water directly over/on/into the decontaminated sampling equipment coming into contact with the samples being collected. The water is then collected in the sample containers. Once the containers are filled they are capped and sent to the lab with the other routine samples. The sample is labeled and included on the COC as **Equipment Blank** or **EQ Blank**.

A positive result for the analysis of the Equipment Blank could signal inadequate decontamination of the equipment which may result in cross-contaminated samples and thus suspect results.

One (1) Equipment Blank should be taken for every twenty (20) routine samples collected. The Equipment Blank is not necessary when using dedicated sampling equipment or sampling equipment that is disposed of between each sample point.

4. Matrix Spike/Matrix Spike Duplicate Sample

The Matrix Spike/Matrix Spike Duplicate (MS/MSD) Sample is a quality control system used by the laboratory to check the accuracy of their instruments. It consists of a set of two (2) samples taken at a sample point concurrently with the routine sample for a total of three (3) sets of containers for that sample point. Therefore, the MS/MSD samples should be collected from sample points with sufficient sample volume (e.g., monitoring wells that have low recharge are not good candidates). They are labeled and included on the COC as 'Sample ID' MS and 'Sample ID MSD'

Example:

- Sample Point ID is **MW-1**
- Matrix Spike would be **MW-1 MS**
- Matrix Spike Duplicate would be **MW-1 MSD**

The MS/MSD samples are submitted to the laboratory with the routine samples. Once at the laboratory, they will have a known amount of an analyte added, known as the spike. The sample will then be run as a routine sample. Once the results are received they are compared to the results of the routine sample (MW-1 results are compared to MW-1 MS results). There should be a difference in the amount of analyte detected between the samples that should be within the margin of error of the amount of analyte spike that was added to the MS sample. This process is repeated for the MSD sample. This process is an internal review of results for the laboratory to determine the accuracy of their instruments.

One (1) MS/MSD set should be taken for every twenty (20) samples (including Duplicate Samples and Field or Equipment Blank Samples). For example if 12 samples are taken, there should also be a set of MS/MSD samples taken for a total of 14 sample sets submitted to the lab. If 20 samples will be taken, only one set of MS/MSD samples needs to be submitted (total number of samples being 22).

The following QA/QC samples are used for only specific analyses or functions.

5. Trip Blank

A Trip Blank is a form of QA/QC that is utilized to account for possible exposure to an external source of VOCs during storage and transport of the sample containers and samples to and from the laboratory. It consists of a VOC sample container prepared by the laboratory and filled with analyte-free water. Trip Blanks are only required when aqueous samples are being collected for VOC analysis, all other parameters do not need one.

The Trip Blank is placed in the cooler with the sample containers when they are sent form the lab to the client. The Trip Blanks will remain in the cooler with the sample containers at all times. When the samples are collected they are placed in the cooler and put on ice with the Trip Blanks for shipment to the lab. At no time should the Trip Blanks be opened or removed from the coolers containing VOC samples. The Trip Blank should be labeled and included on the COC as **Trip Blank** or **TB**.

Each cooler that contains samples for VOC analysis must have a Trip Blank. It is good practice to combine all VOC containers from a site into one (1) cooler to minimize the number of Trip Blanks required. For example if there are five (5) coolers of samples, place all the VOC containers into one (1) cooler and the remaining containers in the other four (4) coolers. Thus only the VOC cooler requires a Trip Blank, which saves on the cost of analysis.

A positive result on the Trip Blank for a VOC could indicate the samples had been exposed during transportation which can have an effect on the results of the routine samples.

Different laboratories have different practices concerning their Trip Blanks. For example some laboratories will include just one (1) VOA vial as their trip blank while others will utilize multiple vials for theirs. The extra vials are often included only as a backup in the event one of the Trip Blank vials is broken during transport, and will not be analyzed unless necessary.

D. QA/QC Requirements:

None

A. Special Conditions:

Temperature Blanks are a type of QA/QC that fall outside of the umbrella of QA/QC Samples.

A Temperature Blank is a container provided by the lab and is used to obtain the temperature of the cooler upon receipt at the lab, usually with an infrared thermometer. It is generally a ~125 mL plastic bottle filled with tap water.

- The Temperature Blank should be left in the cooler during sampling. When the cooler is being prepared for shipment, place the Temperature Blank in the center of the cooler next to the sample containers. There is no need to open the container; it is filled with tap water and therefore harmless unless otherwise noted on the container.

- It should be noted that not all laboratories require a Temperature Blank. There is no cost associated with the Temperature Blanks in the coolers.

B. References:

United States Environmental Protection Agency (July 2007), *Samplers Guide, Contract Laboratory Program Guidance for Field Samplers*, Section 3.4, retrieved April 6, 2009, from http://www.epa.gov/superfund/programs/clp/download/sampler/clp_sampler_guidance.pdf

United States Environmental Protection Agency (May 2002), *Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers*, Page 34, retrieved December 15, 2010, from http://www.epa.gov/tio/tsp/download/gw_sampling_guide.pdf

C. Appendices or Forms:

None

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Sampling Perfluoroalkyl Substances (PFAS) and Perfluorinated Compounds (PFCS)

Standard Operating Procedure #006

A. Purpose and Scope:

The objective of this SOP is to ensure proper and uncontaminated collection of Perfluoroalkyl Substances (PFASs) and other Perfluorinated Compounds (PFCs). PFASs and PFCs are large groups of compounds used in industrial applications, applied to many household products for grease, water, and stain resistance, and heavily used in Aqueous Film Forming Foams (AFFF) which are often used in firefighting. Although there are no federal regulations currently requiring remedial action for these chemicals, many states are adopting rules and regulation regarding these compounds. As rules continue to develop for these contaminants permitted and non-permitted equipment, materials, and procedure are subject to change. The user of this SOP should consult with applicable regulatory agencies to determine a final list of compounds that need to be analyzed.

Note: This SOP has been developed assuming that there are no elevated concentrations of more toxic chemicals present at the site warranting additional personal protective equipment. However, prior to commencing sampling activities, the sampler should consider all potential contaminants at the site and determine if additional protocols are necessary.

Due to the prevalence of these chemicals in common goods, it is imperative that field personnel are conscious of potential cross contamination. This contamination can be from field equipment, field clothing and PPE, sample containers, decontamination, and food.

B. Equipment and Materials:

Field equipment, field clothing, PPE, sample containers, and any other items used or present on site made of or containing the following materials **ARE NOT PERMITTED**:

- Low Density Polyethylene (LDPE) – pumps and tubing Only [permitted for sample containers]
- Aluminum foil
- Glass
- Polytetrafluoroethylene (PTFE) / Teflon™
- Waterproofed clothing or boots
- Clothing containing PTFE material (i.e. GORE-TEX®)
- New clothing (clothing not washed a minimum of 6 times) or clothing washed with fabric softeners
- Tyvek® material
- Waterproof/treated paper or field books
- Plastic clipboards, binders, or spiral hard cover notebooks
- Post-it notes or other adhesives
- Sharpies or other permanent markers
- Paint pens, marking paint, etc.
- Most repellents, sunscreens, moisturizers, cosmetics, or other related products
- Decon 90

This list is a general guideline for items not permitted other items may also not be permitted. Check with the Aztech Project Manager before using an uncertain item.

Materials such as Teflon™ or PTFE may be found in common sampling equipment. It is important that field personnel examine and assess existing equipment to avoid accidental contamination. The following materials are **ALWAYS PERMITTED** in sampling equipment:

- Stainless steel
- High density polyethylene (HDPE)
- PVC
- Silicone
- Acetate
- Polypropylene
- Loose paper on aluminum clipboards
- Ballpoint pens

The following equipment considerations should be noted when sampling for PFASs and PFCs.

Borehole Installation and Sampling:

- If using hollow stem augers/split spoons or similar, they must be carbon steel and not coated
- If collecting a soil or sediment core sample (e.g. Geoprobe®), it must be collected directly from single-use PVC liners that must not be decontaminated or reused at different locations.

Soil Sampling with a Hand Auger:

- A stainless steel hand auger without any coatings must be used when sampling.
- Scoops and spatula used must be stainless steel.

Well Development:

- Do not use bailers, unless entirely made of PVC or stainless steel. Teflon in any part of the baileris not acceptable.
- Do not use bladder pumps, most bladders are made of Teflon. Only bladder pumps with a bladder made of natural rubber are acceptable.
- Other pump types are typically okay but should still be examined for Teflon or other prohibited materials.

Conventional Groundwater Sampling / Low-Flow Groundwater Purging/ Residential Well Sampling:

- Bailers should not be used unless entirely made of PVC or stainless steel. Teflon is not acceptable. Single use disposable polyethylene or silicone materials are also acceptable.
- Tubing can only be made of HDPE or silicone.
- Do not use bladder pumps, most bladders are made of Teflon. Only bladder pumps with a bladder made of natural rubber are acceptable.

- Other pump types are typically okay but should still be examined for Teflon or other prohibited materials.

Surface Soil Sampling:

- A stainless steel spoon and bowl should be used. Cover the bowl with a stainless steel lid where possible between the addition of each aliquot. Do NOT cover the bowl with aluminum foil.

Small Equipment Decontamination:

- Water used for decontamination on site should be laboratory certified "PFAS-free" water.

Field Handling, Packaging, and Shipping:

- Plastic bags must be polyethylene.
- Only ice from water should be used, not chemical (blue) ice.
- These equipment changes can be applied to other SOPs if PFASs and/or PFCs are being sampled.
- Separate coolers that have not stored PTFE or Teflon lids.

C. Procedure:

Standard operating procedures for sampling as outlined in a number of Aztech SOPs should be followed, but with the specific considerations noted below:

Borehole Installation and Sampling:

- When drilling the well use PFAS-free drilling fluids.
- Don't use detergent to decon drilling equipment with the exception of Alconox and Liquinox. Scrub with equipment a plastic brush to remove heavy soiling and rinse thoroughly in tap water. Use a steam cleaner or a triple-rinse of PFOA-free water as the final step. If large quantities of PFOA-free water are not available from the lab, additional QA/QC sampling may be required to verify the source as a potential source of cross-contamination, then triple-rinse in distilled or deionized water.
- Collect a representative water sample used during drilling activities.
- If using an auger, it must be carbon steel and un-coated.

Conventional Groundwater Sampling / Low-Flow Groundwater Purging/ Residential Well Sampling:

- Collect samples from the pump discharge tubing only. Never collect a water sample that has passed through a flow through cell or similar.
- When sampling prioritize drinking water, followed by surface water, followed by groundwater.
- When sampling groundwater; start with the upgradient well(s), then the furthest downgradient of the interpreted or known source, then wells downgradient to the source, and lastly the wells closest to the interpreted or known source.
- When sampling residential wells, any plumber's sealing tape should be noted, as these typically contain PFCs.

- Prior to sample collection, field personnel must wash their hands and wear a new set of nitrile gloves.
- PFAS/PFC samples should be taken first, prior to collecting samples for any other parameters into any other containers. Field personnel should avoid contact with any other type of sample container or package materials.
- When samples are collected and capped, place the sample bottle(s) in an individual sealed plastic bag (i.e. Ziploc®) separate from all other sample parameter bottles, and place in a shipping container packed only with ice made from frozen water.
- After collecting PFOA samples conduct the "Shaker Test:" A small portion of the sample (~10-25 ml) should be shaken by the sample collector on site. If foaming is noted within the sample, this should be documented when samples are submitted for analysis.

Surface Water Sampling:

- Surface water must be collected by inserting a capped sampling container with the opening pointing down to avoid the collection of surface films.
- Where conditions permit, sampling devices should be rinsed with site medium to be sampled prior to collection of the sample.

Surface Soil Sampling:

- PFAS/PFC samples should be taken first, prior to collecting samples for any other parameters into any other containers. Field personnel should avoid contact with any other type of sample container or package materials.

Large Equipment Decontamination:

- Don't use detergent to decon drilling equipment, scrub with a plastic brush and rinse thoroughly in tap water, then triple-rinse in distilled or deionized water.

Field Handling, Packaging, and Shipping:

- Ice should be double bagged and secured to avoid meltwater from contacting sample containers, and/or samples should be in an individual sealed plastic bag

D. QA/QC Requirements:

A variety of blanks should be collected to trace the sources of any artificially introduced contamination. Rinsate or equipment blanks, field blanks, and trip or travel blanks should all be collected during the sampling event. Rinsate or equipment blanks and field blanks should be collected once per day per matrix or once per 20 samples per matrix, whichever comes first. One trip blank is required per cooler. Matrix Spike and Matrix Spike Duplicate samples should be collect at the same one (1) per 20 frequency as noted above.

Samples should be immediately placed in a cooler maintained at 4±2º Celsius.

E. Special Conditions:

In the event of wet weather field personnel must avoid using personal waterproof or water-resistant rain gear unless the gear is made of PVC or Polypropylene. An alternative is to use a gazebo tent that is only touched or moved prior to or after sampling activities.

No food or drink is permitted on-site, except for bottled water and hydration drinks, such as Gatorade. These drinks should only be consumed in the staging area. When field personnel require a break to eat or drink, they should remove their gloves and coveralls and move away from the sampling location, preferably downwind. When finished eating, field personnel should clean up and put their coveralls back on and don a new pair of gloves prior to returning to the work area.

Visitors to the site are asked to remain at least 30 feet from sampling areas.

F. References:

NYSDEC Guidelines for Sampling and Analysis of PFAS (1/2020)

Chiang, D., Ph.D., P.E., Davis, K., Ph.D., Bogdan, D., Ph.D., Aucoin, M., & Woodward, D. (n.d.). PFAS Sampling. AECOM.

Shoemaker, J. A., Grimmet, P. E., & Boutin, B. K. (2009). Method 537. Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS) (EPA/600/R-08/092) (USA, EPA, Office of Research and Development). Cincinnati, OH: U.S. Environmental Protection Agency.

G. Appendices or Forms:

None

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Small Equipment Decontamination

Standard Operating Procedure #007

A. Purpose and Scope:

The Proper decontamination of small equipment prevents cross-contamination of samples, introduction of contaminants to clean sites, and the mixture of incompatible substances. Equipment decontamination also assures the health and safety of all equipment users. Procedures for decontamination procedures vary depending on the matrix sampled, level of contamination, type of contaminants, and the target analytes of the sampling event. The procedure outlined in this SOP is a general procedure for field/ warehouse decontamination of equipment associated with water, soil and other surficial sampling activities.

Decontamination should be performed before sampling work commences and after each sampling event. Decontaminated equipment should be protected from contact with surroundings during storage and transport, and should be handled as little as possible before its use and always with disposable gloves. Note that all waste generated by decontamination procedures including liquids, solids, rags, gloves, etc., will be collected and disposed of properly.

B. Equipment and Materials:

- Alconox®
- Tap water
- Distilled and deionized water
- 10% Nitric acid rinse
- Acetone (or other pesticide grade organic solvent)
- 1-Gallon pressure spray bottles
- Long-handled brushes
- 5-Gallon plastic buckets

C. Procedure:

Note that if it is logistically impractical/ impossible to complete all steps listed below at the field site, Steps 1-4 should be performed prior to transport of equipment to a facility where all steps can be completed if required. All field decontamination should take place over a container and liquids should be properly disposed of.

1. Disassemble equipment as necessary.
2. Remove gross contamination from equipment by scraping, brushing and rinsing with tap water
3. Wash with Alconox® or other laboratory grade detergent to remove all visible particulate matter and residual oils and grease.
4. Rinse with tap water to remove detergent.
5. Rinse with distilled and deionized water.
6. Field personnel will use a new pair of outer gloves before handling sample equipment after it is cleaned.
7. If equipment will not be used immediately, wrap in aluminum foil (unless sampling for metals or PFAS analysis) or seal in plastic bags (unless sampling for organics analysis) and store.
8. Record the date and method of decontamination on foil/bag and equipment log

D. QA/QC Requirements:

When necessary, field equipment rinsate blanks will be collected by pouring analyte-free water over decontaminated equipment and submitting them to the lab with the other blanks and samples. These blanks are used to assess the quality of equipment decontamination.

E. Special Conditions:

Reusable PPE such as respirators, chemical-resistant overboots and gloves shall also undergo the equipment decontamination sequence.

If acetone is a known or expected contaminant another solvent may be substituted. Note that methanol cannot be used for decontamination when sampling gasoline or its by-products.

Additional decontamination procedures may be required for particular contaminants or when samples are to be analyzed at very low concentrations.

F. References:

New Jersey Department of Environmental Protection, August 2005. *Field Sampling Procedures Manual*.

USEPA, 1994. Sampling Equipment Decontamination. Environmental Response Team SOP #2006, Revision #0.0. Edison, NJ. http://www.ert.org.

USEPA, 1996. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*. Region 4, Science and Ecosystem Support Division. Athens, GA. http://www.epa.gov/region04/sesd/eisopqam/eisopqam.html

Wilde, F.D., ed., 2004. *Cleaning of Equipment for water sampling (ver. 2.0)*: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chap. A3, April, accessed January 5, 2009 at http://pubs.water.usgs.gov/twri9A3/

G. Appendices or Forms:

None

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Residual Waste Management

Standard Operating Procedure #008

A. Purpose and Scope:

The following standard operating procedure (SOP) presents a description of the methods generally employed for the management of residual waste. Field personnel are responsible for ensuring that state-specific standards/guidelines/regulations are followed, where applicable. In addition, field personnel are responsible for coordination efforts associated with the waste disposal facility, if known.

Improper handling and storage of residual waste can result in leaks and spills and pose a serious threat to the quality of the environment. Timely characterization and disposal of residual wastes shall be conducted in order to not exceed onsite quantity and/or storage regulations.

B. Equipment and Materials:

Off-Site transportation and disposal of residual waste will be performed by a licensed waste hauler under the direction of Aztech. The company will supply the necessary equipment and materials needed to remove the residual waste from the Site and transport it to an approved waste disposal facility.

The field geologist/engineer will obtain the necessary sample bottles with the associated preservatives, if required, from the analytical laboratory. In addition, a flame ionization detector (FID), photoionization detector (PID) and/or gas meter will be used to screen waste containers soils for the presence of volatile organic compounds (VOCs).

All other equipment required during transportation/disposal activities is the responsibility of the Contractor (waste hauler).

C. Procedure:

1. During remedial activities all residual waste, including, but not limited to, soil cuttings, decontamination wash/rinse water, purge water and personal protective equipment (PPE) shall be containerized in United States Department of Transportation (USDOT) approved 55-gallon drums or similar waste containers, unless the Work Plan indicates otherwise. Each drum shall contain similar materials/matrices (e.g., soil, water, PPE).

2. Label each waste container using a permanent marker and weather proof label with the following:
   a. Description of the container contents
   b. Site name and address
   c. Name of Site contact and associated phone number

Waste container labels shall be legible and easily understood by those unfamiliar with the Site.

3. Upon completion of remedial activities, the field geologist/engineer will conduct waste characterization of the residual waste prior to off-Site transportation and disposal. Depending upon the type of waste present, various waste disposal facilities may have different testing requirements. Aztech will complete the required analytical testing. Upon receipt of analytical data and

coordination with the disposal facility, the field geologist/engineer will supervise the removal of the waste from the Site

4. Waste containers shall be transported and stored in a secure location on-Site. All waste containers shall be located in one location, if possible.

5. If waste containers are stored for a period of time prior to collecting waste characterization samples, all waste containers shall be inspected for signs of the potential presence of explosive/flammable gases and/or toxic vapors. These signs include pressurization (bulging/dimples); crystals formed around the drum opening; leaks, holes, stains; labels, marking; composition and type (steel/poly and open/bung); condition, age, rust; and sampling accessibility. Drums showing evidence of pressurization and crystals shall be further assessed to determine proper drum opening techniques.

6. All metal waste containers not in direct contact with the earth shall be grounded.

7. Open the waste container with spark resistant tools (e.g., brass, beryllium).

8. Screen the waste containers for explosive gases and/or toxic vapor with appropriate air monitoring instruments as necessary.

9. Obtain the necessary sample bottles with the associated preservatives, if required, from the analytical laboratory.

10. Each matrix (e.g., soil, water) shall be sampled for waste characterization purposes. The field geologist/engineer shall determine the quantity of similar waste characterization samples to be collected from the waste containers in conjunction with the project manager and/or waste disposal facility. Containers with similar wastes (e.g., soil, water) generated from one area of the site may require only one composite sample from each of the waste containers. This determination shall also be made in conjunction with the project manager and/or waste disposal facility.

11. Use a decontaminated spade or shovel to collect representative solid waste samples from each waste container or use a beaker, bailer or similar mechanism to collect representative liquid waste samples from each waste container.

12. Immediately place sample in the pre-preserved sample containers and close the waste container(s).

13. Chill all samples to 4^{o}C from sample collection until laboratory analysis.

14. Package and ship samples.

D. QA/QC Requirements:

This section includes QA/QC requirements associated with tank closure activities. The following general requirements apply to this SOP:

1. All data must be documented on field data sheets or within site logbooks.
2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan.
3. Equipment checkout and calibration activities must occur prior to sampling/operation, and must be documented.

E. Special Conditions:

In no case, will Aztech be considered the generator of the waste. The site owner shall always take responsibility for waste disposal. Additionally, Aztech may only act as agent for the owner relative to signing manifests with specific permission from Aztech in-house counsel. In most every case, the owner should sign waste manifests.

F. References:

United States Environmental Protection Agency, Science and Ecosystem Support Division, Waste Sampling Standard Operating Procedure: http://www.epa.gov/region4/sesd/fbqstp/Waste-Sampling.pdf

G. Appendices or Forms:

None

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Borehole Installation and Sampling

Standard Operating Procedure #009

A. Purpose and Scope:

The following SOP presents a description of the methods generally employed for the installation of boreholes and the collection of subsurface soil samples. Boreholes are typically advanced to define geologic conditions; allow the installation of monitoring wells and piezometers; and allow the collection of subsurface soil samples (generally above the water table) for chemical analysis. Although several manual methods are available for the collection of subsurface soils samples (e.g. hand augers, post-hole augers, the most common method used by Aztech to advance boreholes is a drill rig equipped with hollow-stem augers (HSA) or direct-push technology (DPT). Representative samples are most often collected utilizing split-spoon samplers or Macrocore technology.

The purpose of drilling test borings is typically to characterize the lateral and vertical extent of contamination in the unsaturated zone. The test borings may also be used to allow the installation of ground water monitoring wells. Test borings may also be used to determine the subsurface characteristics for the purpose of geotechnical investigations.

B. Equipment and Materials:

Drilling will be performed either by Aztech or by a licensed drilling firm under the direction of Aztech staff. The drilling field crew will consist of a driller, a driller's assistant, and an Aztech field geologist/engineer. The field geologist/engineer will supervise drilling operations and conduct the geologic logging of the boreholes. Typical equipment needed for installation of monitoring wells will vary somewhat between drill rigs but will generally include the following:

- Truck or Track mounted Drill Rig equipped with a rotary head
- Rig with hydraulic hammer for direct push methods
- Split spoon or Macrocore sample Barrels
- Hollow stem augers with cutter head lead auger
- Auger fork
- Flush joint casing with a drive shoe
- Drill rods
- Auger plug or disposable point

C. Procedure:

1. Subcontractor Responsible for Utility Clearance - Subcontractor shall take all reasonable precautions, including contacting the appropriate utility organizations (UFPO, Dig Safe, etc.), in order to verify there are no buried utilities at the test boring and test pit locations.

2. The drilling rig and sampling equipment may be required to be decontaminated by steam-cleaning (high pressure, hot water) prior to drilling and in between borings, depending on the job requirements.

3. The borings will be drilled with direct push technology (DPT), hollow-stem augers, flush joint casing, open hole or any combination depending on the type of information needed, geologic

conditions, and other limitations that may be imposed due to contamination or state or federal guidelines. The boring shall be advanced to match the sampling interval (continuous or standard sampling).

4. Drilling progress and information about the formations encountered shall be recorded by the geologist on the field boring log. The information should include total depth drilled, depths and thickness of strata, problems with borehole advancement, fill materials encountered, and water levels.

Hollow Stem Auger/Flush Joint Driven Casing

a) At the chosen depth interval, drive a clean, standard, 24-inch long, 2-inch O.D. split-spoon sampler into the soil a distance of 24 inches using a 140 lb hammer, free falling 30 inches. Record the number of blows required to drive the sampler every 6 inches on the field boring log. Discontinue driving the sampler if 100 blows have been applied and the sampler has not been driven 6 inches. If 6 inches of penetration has been achieved, discontinue driving the sampler after 50 blows has failed to penetrate fully any of the remaining 6 inch intervals. The first six inches seats the spoon, the next 12 inches represents the Standard Penetration Resistance, and the last six inches is driven to insure sample recovery.

b) Retrieve the sampler from the borehole and place it on a clean, flat surface. Open the sampler and immediately scan the sample with an air monitoring instrument (e.g., PID) if appropriate to the purpose of the investigation. Record instrument readings on the field boring log.

Direct Push Technology

a) The DPT is hydraulically powered and mounted in a customized four-wheel drive vehicle. Position the base of the sampling device on the ground over the sampling location and hydraulically raise the vehicle on the base. As the weight of the vehicle is transferred to the probe, the probe is pushed into the ground.

b) Soil samples will be collected with a Macrocore (or equivalent). The sample tube is pushed and/or vibrated to a specified depth. The interior plug of the sample tube is then removed by inserting small-diameter threaded rods and retracting the plug. Drive the sample tube an additional four (4) to five (5) feet to the sampler terminal depth. Withdraw the probe sections and sample tube.

Sample Review

a) Further, describe and record the following properties of the sample: Sample length recovered, presence of any slough in sampler, basic soil type (e.g., sand, gravel, clay), structure, texture, sorting, grain size, grain shape, degree of saturation, competency, color, odor, staining, and presence of foreign material(s).

b) After the soil within the sampler has been described, it will be placed in sealed sample jars directly from the sampling device.

c) If appropriate to the investigation, the air space surrounding the borehole shall be scanned with a FID or PID and Explosimeter during all drilling activities to determine the presence or absence of volatile organic compounds. Results of this air monitoring shall be recorded on the Geologic Field Log. Activities shall proceed according to the site HSP if the presence of volatile organic compounds is indicated.

5. Upon completion of the test boring, all drill cuttings shall either be placed back in the borehole or will be drummed based on potential contaminants encountered.

6. Note the locations of the borings on a site map and/or mark the locations of the boreholes with a labeled wooden stake

D. QA/QC Requirements:

The Follow QA/QC requirements for field documentation.

E. Special Conditions:

1. Drilling Subcontract - The Field Team Leader must be familiar with the scope, fee, schedule, and all the terms and conditions of the drilling subcontract. When contractual issues or questions arise during the fieldwork, the Field Team Leader should communicate with the Project Manager and with the owner/client as appropriate.

2. Abandoned Borehole - If the contractor is not able to finish the drilling or has to abandon the borehole due to loss of tools, accidents or any unforeseeable circumstances, the contractor should remove the casings or drive pipes already in the hole and refill it with native soil cuttings, sand, grout, or as approved by the Engineer. All materials extracted from the hole, after refilling it will be managed as investigation derived material and will be disposed of accordingly. Typically, another borehole will be attempted in the area of the initial borehole attempt.

3. Subcontractor/Driller Standby Time - Document any conditions that may result in driller/subcontractor standby time. Such conditions may include adverse weather conditions, lack of access to the property, utilities not marked out, etc. Standby time may result in additional costs from our subcontractor that may not be planned for or approved. Communicate any conditions that may result in standby time to the Aztech Project Manager as soon as possible

F. References:

ASTM Standard D 1586
NYSDEC DER-10, May 2010 (or current version)

G. Appendices or Forms:

Standard Boring Log Form

Aztech Environmental Technologies
5 McCrea Hill Rd.
Ballston Spa, New York 12020
Phone: (518) 885-5383 Fax: (518) 885-5385

Boring Log:

Client:
Project:
Street Address:
City / State:
Drilling Co.:
Address:
Driller:

Drilling Method:
Drill Fluid:
Drilled Borehole Dia:
Total Drilled Depth:
Ground Elevation: 0
Depth to water:

Start date:
Finish date:

Depth (Feet)	Sample ID	Sample Interval (feet)	Headspace PID	Recovery	Description	Depth (feet)
1						1
2						2
3						3
4						4
5						5
6						6
7						7
8						8
9						9
10						10
11						11
12						12
13						13
14						14
15						15
16						16
17						17
18						18
19						19
20						20

Notes:
NA - Not Available
fbg - feet below grade
" - inches
PID - Photoionization Detector
ppm - parts per million
' -feet

Geologist:

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Field Description of Soils

Standard Operating Procedure #010

A. Purpose and Scope:

The objective of this SOP is to establish a consistent method for field staff to follow when completing the description of soil samples and entry onto borehole logs. Consistency with description is important because many employees are involved in logging soils, frequently within the same project. Uniformity is critical to allowing meaningful subsurface interpretations using data generated from multiple sources.

This procedure will be used during all field activities when borehole subsurface drilling or surface soil sampling is occurring. These activities should be documented as described herein.

B. Equipment and Materials:

Some or all of the following equipment may be required for completing the procedures outlined in this SOP:

- Hand lens
- Field notebook and borehole log forms
- Pencils
- Stiff scraper
- Standard grain size examples
- Squirt bottle with water
- Small clear containers with lids

C. Procedure:

a. Aztech utilizes a combination of the USCS and Modified Burmister methods of soil descriptions.

The Unified Soil Classification System (USCS) is the most widely used engineering/geotechnical soil classification method. The USCS is based on engineering properties of soil which are effected by grain size, water content, grain size distribution, and compaction. This system is often used for classifying soils encountered in boreholes, test pits, and at the surface. The following properties form the basis of USCS soil classification: SOP:

- Hand lens
- Percentage of gravel, sand, and fines;

1. Shape of the grain size distribution curve; and
2. Plasticity and compressibility characteristics.

b. The Modified Burmister Method is used for the verbal description of soil samples. The Modified Burmister classification system is based on grain size and plasticity, but differs from the Unified Soil Classification System in that it includes nomenclature to describe the soil's texture, color, mineralogy, and geological origin.

c. The following step by step procedure will be used for the field classification of soils encountered during subsurface activities (i.e. borehole drilling, trenching, etc.). References to aid in the development of a soil description are included in Appendix A and Appendix B.

A complete soil description should contain the following information in the order indicated:

1. Color
2. Soil Moisture
3. Major grain size component.
4. Minor grain size component(s) with modifier
5. Gradation or Plasticity
6. Density/Consistency
7. Soil Structure or Mineralogy (if necessary)
8. Evidence of Contamination (odor, staining, etc.)
9. USCS symbol

Example: Brown, wet, SAND, some Silt, trace gravel, no petroleum odor.

a. Grain Size: There are five major grain sizes: Boulders, Cobbles, Gravel, Sand, and Silt/Clay.

- Boulders are > 8"
- Cobbles are 3" to 8"
- Gravels range in size from 0.2" to 3.0" in diameter and are subdivided into Fine gravel (>0.2" to 0.75") in diameter and Coarse gravel (>0.75" to 3.0")
- Sands range in size from 0.002" to 0.2" and are subdivided into coarse, medium and fine. Standard comparison cards are available for field use.
- Silt and clay are difficult to distinguish in the field. An attempt is made, however, to describe the soil as one of the six following classifications: silt, clayey silt, silt and clay, clay and silt, silty clay, or clay. The field description may be later verified in a lab hydrometer test if required by the project. For field descriptions of silts and clays, the following guidelines should be used:

SILT: ----------gritty, no threads can be rolled
Clayey SILT: ----------rough to smooth, difficult to roll threads
SILT and CLAY: -------rough to smooth, difficult to roll threads
CLAY and SILT: -------smooth and dull, threads can be rolled readily
Silty CLAY: ----------smooth and shiny, threads can be rolled very readily
CLAY: ----------very shiny and waxy, threads can be rolled very easily

Grain size descriptions are written with the major grain size component listed first. In order to be considered a major grain size component, the component must constitute greater than 50% of the sample. Major grain size components are written in all capital letters and are underlined. If no grain size component constitutes greater than 50% of the sample, the sample is classified by describing the distribution of the sand component of the sample first (ex. f.m. Sand). Then, the other grain size components are described and the appropriate percentage modifier (see below) is assigned. The reader can then determine the percentage of sand in the sample by subtracting the sum of the modifier percentages from 100%. An example is shown below.

Other grain size components, if present, are listed in order of decreasing percentage.

The following modifiers are used to indicate the relative proportion of a minor grain size component in the soil:

Estimated amount: Modifier

- 35 percent to 50 percent: …. And
- 20 percent to 35 percent: …. Some
- 10 percent to 20 percent: …. Little
- < 10 percent: ……. Trace

Minor grain size components assigned a trace or little modifier are written in lower case letters. Minor grain size components assigned a "some" or "and" modifier are written with the first letter of the grain size capitalized (ex. f. Sand). When multiple minor grain size components are described with the same modifier, finer grain sizes precede coarser grain sizes.

b. Gradation or Plasticity. Granular soils (i.e., sands or gravels) should be described as well- graded, poorly-graded, uniform, or gap-graded, depending on the gradation of the minus 3-inch fraction. Cohesive soils (i.e., silts and clays) should be described as nonplastic, slightly plastic, moderately plastic, or highly plastic, depending on results of the manual evaluation for plasticity.

c. Color: Common colors and their abbreviations are listed below.
   - Orange: ----Or
   - Tan: ---------Tan
   - Black: -------Blk
   - Brown: -----Br
   - Grey: -------Gr
   - Red: --------Red

d. Moisture Content: The moisture content is determined in the field and is described using the following terms:
   - Dry: ---------- (dab finger in soil, no moisture on finger)
   - Moist: ---------- (dab finger in soil, moisture on finger)
   - Wet:---------- (water visible)
   - Saturated: ------ (all pore spaces filled

e. Density/Consistency: The density or consistency of the soils is classified according to the "N" value of the soil. The "N" value is the sum of the middle two blow counts determined during a standard penetration test. The following classifications are used:

Table 1
Standard Penetration Test for Soil Density

N-Blows/Feet	Relative Density
Cohesionless Soils	
0 - 4	Very loose
5 - 10	Loose
11 - 30	Medium
31 - 50	Dense
>50	Very dense
Cohesive Soils	
0 - 2	Very soft
3 - 4	Soft
5 - 8	Medium
9 - 15	Stiff
16 - 30	Very stiff
>30	Hard

f. Odor (if present): Odor is described from a warm, moist sample. The odor should only be described it is organic or unusual. An organic odor will have distinctive decaying vegetation smell. Unusual odors such as petroleum product, chemical, etc. should be described appropriately.

g. Soil Texture and Structure (if present): Description of particle size distribution, arrangement of particles into aggregates, and their structure. This description includes joints, fissures, slicked sides, mottling, bedding, veins, root holes, debris, organic content, and residual or relict structure (laminations, etc.), as well as other characteristics that may influence the movement or retention of water or contaminants.

h. USCS symbol: A USCS symbol is assigned to each symbol. The USCS recognizes 15 soil groups and uses names and letter symbols to distinguish between these groups.

The coarse grained soils are subdivided into gravels (G) and sands (S). Both the gravel and sand groups are divided into four secondary groups. Fine grained soils are subdivided into silts (M) and clays (C).

Soils are also classified according to their plasticity and grading. Plastic soils are able to change shape under the influence of applied stress and to retain the shape once the stress is removed. Soils are referred to either low (L) or high (H) plasticity. The grading of a soil sample refers to the particle size distribution of the sample. A well graded (W) sand or gravel has a wide range of particle sizes and substantial amounts of particles sized between the coarsest and finest grains. A poorly graded (P) sand or gravel consists predominately of one size or has a wide range of sizes with some intermediate sizes missing.

Soils which have characteristics of two groups are given boundary classifications using the names that most nearly describe the soil. The two groups are separated by a slash. The same is true when a soil could be well or poorly graded. Again the two groups are separated by a slash

First and/or second letters	
Symbol	**Definition**
G	gravel
S	sand
M	silt
C	clay
O	organic

Second letter	
Letter	**Definition**
P	poorly graded (uniform particle sizes)
W	well graded (diversified particle sizes)
H	high plasticity
L	low plasticity

Example:

A. Sample with Major Component:
Brown, wet, **f. SAND**, Some Silt, little m.c. sand and f. gravel, trace c. gravel, , m. compact, petroleum odor (SM)

B. Sample with No Major Component:
Brown, moist, f.m.c. Sand, Some Silt and f. Gravel, , v. compact, no evidence of contamination (SM)
(In this sample, the describer classified the sample as containing 30% silt and 30% f. gravel. The percentage of sand would then be determined as: 100%-30%-30%=40%).

D. QA/QC Requirements:

None

C. Special Conditions:

None

D. References:

Burmister, D.M., Suggested Methods of Test for Identification of Soils.

The Unified Soil Classification System (USCS).

Classification of Soils for Engineering Purposes: Annual Book of ASTM Standards, D 2487-83, American Society for Testing and Materials,

E. Appendices or Forms:

ASTM Criteria for Describing Soils

Legend to Subsurface Logs

ASTM CRITERIA FOR DESCRIBING SOIL

Criteria for Describing Angularity of Coarse-Grained Particles

Description	Criteria
Angular	Particles have sharp edges and relatively plane side with unpolished surfaces
Subangular	Particles are similar to angular description but have rounded edges
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges
Rounded	Particles have smoothly curved side and no edges

Criteria for Describing Dilatancy

Description	Criteria
None	No visible change in the specimen.
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.

Criteria for Describing Toughness

Description	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit . The thread and the lump are weak and soft.
Medium	Medium pressure is required to roll the thread to near plastic limit. The thread and the lump have medium stiffness.
High	Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness.

Criteria for Describing Dry Strength

Description	Criteria
None	The dry specimen crumbles into powder with mere pressure of handling
Low	The dry specimen crumbles into powder with some finger pressure
Medium	The dry specimen breaks into pieces or crumbles with considerable finger pressure
High	The dry specimen cannot be broken with finger pressure. Specimen will break into pieces between thumb and a hard surface.
Very High	The dry specimen cannot be broken between the thumb and shard surface

Criteria for Describing Structure

Description	Criteria
Stratified	Alternating layers of varing material or color with layers at least 6 mm thick; note thickness.
Laminated	Alternating layers of varying materials or color with the layers less than 6 mm thick; note thickness.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear polished or glossy, sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness.
Homo-geneous	Same color and appearance throughout.

CRITERIA FOR DESCRIBING SOIL (Cont.)

Criteria for Describing the Reaction with HCl

Description	Criteria
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

Criteria for Describing Consistency

Description	Criteria
Very Soft	Thumb will penetrate soil more than 1 inch (25 mm)
Soft	Thumb will penetrate soil about 1 inch (25 mm)
Firm	Thumb will indent soil about 1/4 inch (6 mm)
Hard	Thumb will not indent soil but readily indented with thumbnail
Very Hard	Thumbnail will not indent soil

Criteria for Describing Cementation

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure

Criteria for Describing Particle Shape

The particle shape shall be described as follows where length, width, and thickness refer to greatest, intermediate, and least dimensions of a particle, respectively (see page 104).

Flat	Particles with width/thickness ratio > 3
Elongated	Particles with length/width ratio > 3
Flat and Elongated	Particles meet criteria for both flat and elongated

Criteria for Describing Plasticity

Description	Criteria
Nonplastic	A 1/8 inch (3 mm) thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

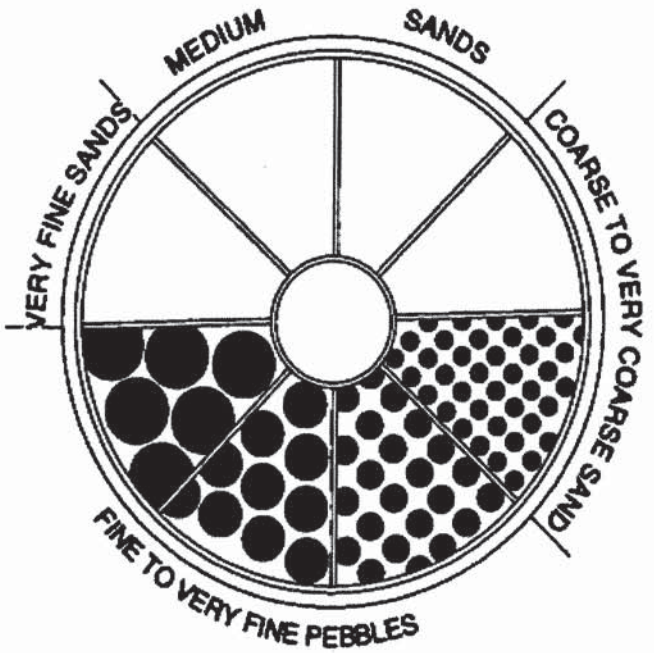
Identification of Inorganic Fine-Grained Soils from Manual Tests

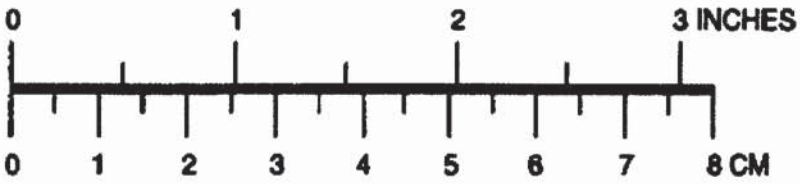
Soil Symbol	Dry Strength	Dilatancy	Toughness
ML	None to low	Slow to rapid	Low or thread cannot be formed
CL	Medium to high	None to slow	Medium
MH	Low to medium	None to slow	Low to medium
CH	High to very high	None	High

Criteria for Describing Moisture Condition

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

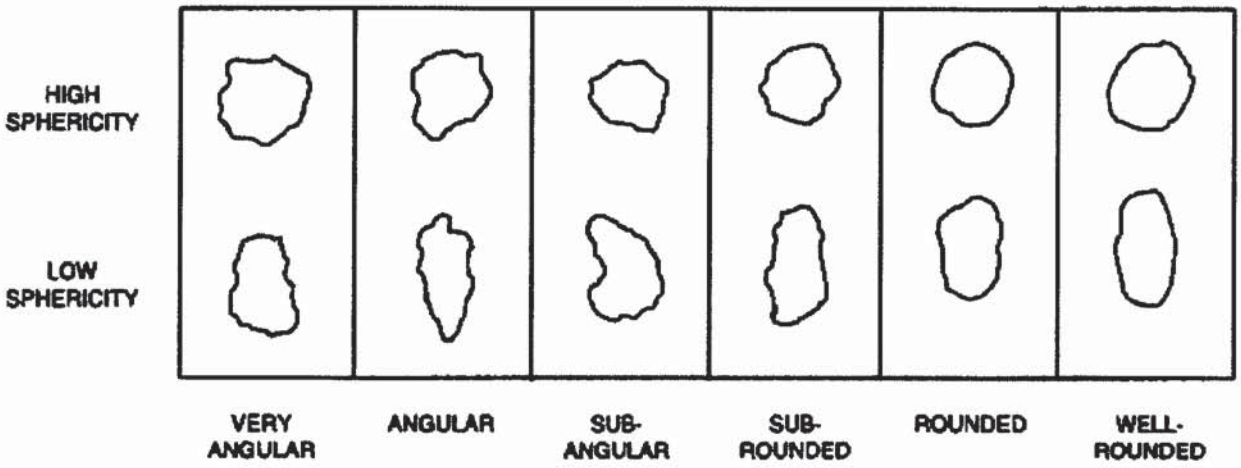
GRAPH FOR DETERMINING SIZE OF SEDIMENTARY PARTICLES





COBBLES RANGE FROM 6.4 TO 25.6 cm (~2.5 TO 10.1 INCHES)
BOULDERS ARE LARGER THAN 25.6 cm (>10.1 INCHES)

SEDIMENT PARTICLE SHAPES



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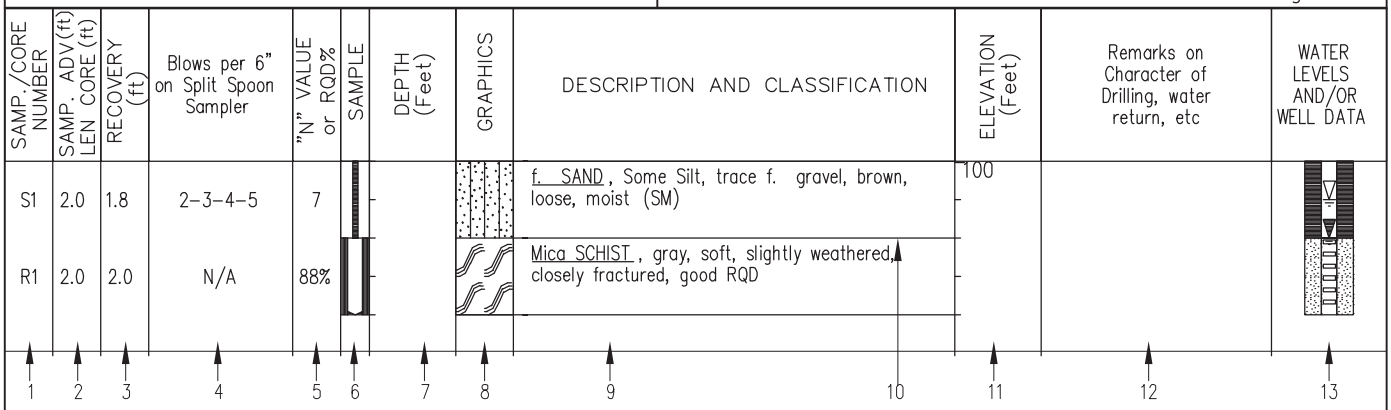
LEGEND TO SUBSURFACE LOGS



Subsurface Logs present material classifications, test data, and observations from subsurface investigations at the subject site as reported by the inspecting geologist or engineer. In some cases, the classifications may be made based on laboratory test data when available. It should be noted that the investigation procedures only recover a small portion of the subsurface materials at the site. Therefore, actual conditions between borings and sampled intervals may differ from those presented on the Subsurface Logs. The information presented on the logs provide a basis for an evaluation of the subsurface conditions and may indicate the need for additional exploration. Any evaluation of the conditions reported on the logs must be performed by Professional Engineers or Geologists.

1. SAMP./CORE NUMBER – Samples are numbered for identification on containers, laboratory reports or in text reports.

2. SAMP.ADV/LEN.CORE – Length of sampler advance or length of coring run measured in feet.

3. RECOVERY – Amount of sample actually recovered after withdrawing sampler or core barrel from bore hole measured in feet.

4. SAMPLE BLOWS/6" – Unless otherwise noted, blow counts represent values obtained by driving a 2.0" (O.D.), 1-3/8" (I.D.) split spoon sampler into the subsurface strata with a 140 pound weight falling 30" as per ASTM International D1586. After an initial penetration of 6" to seat the sampler into undisturbed material, the sampler is then driven an additional 2 or 3 six inch increments. Refusal is defined as a resistance greater than 50 blows per 6" of penetration.

5. "N" Value or RQD % – "N" VALUE – The sum of the second and third sample blow increments is generally termed the Standard Penetration Test (SPT) "N" value. Refusal (R) is defined as a resistance greater than 50 blows for 6 inches of penetration. CORE RQD – Core Rock Quality Designation, RQD, is defined as the summed length of all pieces of core equal to or longer than 4 inches divided by the total length of the coring run. Fresh, irregular breaks distinguishable as being caused by drilling or recovery operations are ignored and the pieces are counted as intact lengths. RQD values are valid only for cores obtained with NX size core barrels.

6. SAMPLE – Graphical presentation of sample type and advance or core run length. See Table 1.

7. DEPTH – Depth as measured from the ground surface in feet.

8. GRAPHICS – Graphical presentation of subsurface materials. See Table 4. Dual soil classification and rock graphics may vary and are not shown on Table 4.

9. DESCRIPTION AND CLASSIFICATION – SOIL – Recovered samples are visually classified in the field by the supervising geologist or engineer unless otherwise noted. Particle size and plasticity classification is based on field observations, and using the Unified Soil Classification System (USCS). See Table 4. USCS symbols are presented in parentheses following the soil description. Where necessary, dual symbols may be used for combinations of soil types. Relative proportions, by weight and/or plasticity, are described in general accordance with "Suggested Methods of Test for Identification of Soils" by D.M. Burmister, ASTM Special Publication 479, 6-1970. See Table 2. Soil density or consistency description is based on the penetration resistance. See Table 3. Soil moisture description is based on the observed wetness of the soil recovered being dry, moist, wet, or saturated. Water introduced into the boring during drilling may affect the moisture content of the materials. Other geologic terms may also be used to further describe the subsurface materials. ROCK – Rock core descriptions are based on the inspector's observations and may be examined and described in greater detail by the project engineer or geologist. Terms used in the description of rock core are presented in Table 5.

10. DIVISION LINES – Division lines between deposits are based on field observations and changes in recovered material. Solid lines depict contacts between two deposits of different geologic depositional environment of known elevation. Dashed lines represent estimated elevation of contacts between two deposits of different geologic depositional environment. Dotted lines depict transitions of deposits within the same depositional environment, such as grain size or density.

11. ELEVATION – Elevation of strata changes in feet.

12. REMARKS – Miscellaneous observations.

13. WATER LEVELS & WELL DATA – Hollow water level symbol, if present, represents level at which first saturated sample or water level was encountered. Solid water level symbol, if present, depicts the most probable static water elevation at the time of drilling or as measured in an installed observation well at a later date. Subsurface water conditions are influenced by factors such as precipitation, stratigraphic composition, and drilling/coring methods. Conditions at other times may differ from those described on the logs. For graphical presentation of observation/monitoring well construction, see Table 6. Elevations of changes in construction are noted at the bottom of each section.

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LEGEND TO SUBSURFACE LOGS

TABLE 1
TYPICAL SAMPLE TYPES

SPLIT SPOON (1 3/8" I.D.)

NX SIZE ROCK CORE

SHELBY TUBE "UNDISTURBED"

AUGER SAMPLE

TABLE 2
SAMPLE MATERIAL PROPORTIONS

ADJECTIVE	PERCENTAGE OF SAMPLE
"and"	35% – 50%
"some"	20% – 35%
"little"	10% – 20%
"trace"	< 10%

Standard split spoon samples may not recover particles with any dimension larger than 1 3/8". Therefore, reported gravel percentages may not reflect actual conditions.

TABLE 3
DENSITY/CONSISTENCY

GRANULAR SOILS		COHESIVE SOILS	
Blows/ft.	Density	Blows/ft.	Consistency
< 5	Very Loose	< 2	Very Soft
5–10	Loose	2–4	Soft
11–30	Med. Compact	5–8	Med. Stiff
31–50	Compact	9–15	Stiff
> 50	Very Compact	16–30	Very Stiff
		> 30	Hard

TABLE 4
USCS CLASSIFICATION, PARTICLE SIZE, & GRAPHICS

	MAJOR PARTICLE SIZE DIVISION	USCS SYMBOL	GRAPHIC SYMBOL	GENERAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL Coarse: 3"–3/4" Fine: 3/4"–#4 Classification based on > 50% being gravel	GW		Well graded gravels, gravel & sand mix.
		GP		Poorly graded gravels, gravel & sand mix.
		GM		Gravel, sand and silt mix.
		GC		Gravel, sand and clay mix.
	SAND Coarse: #4–#10 Med.: #10–#40 Fine: #40–#200 Classification based on > 50% being sand	SW		Well graded sand, sand & gravel mix.
		SP		Poorly graded sand, sand & gravel mix.
		SM		Sand and silt mix.
		SC		Sand and clay mix.
FINE GRAINED SOILS	SILT & CLAY Classification based on > 50% passing #200 sieve.	ML		Inorganic silt, low plasticity.
		CL		Inorganic clay, low plasticity.
		OL		Organic silt/clay, low plasticity.
		MH		Inorganic silt, high plasticity.
		CH		Inorganic clay, high plasticity.
		OH		Organic silt/clay, high plasticity.
	ORGANIC SOILS	Pt		Peat and other highly organic soils.
	FILL	Fill		Miscellaneous fill materials.

TABLE 5
ROCK CLASSIFICATION TERMS

HARDNESS:

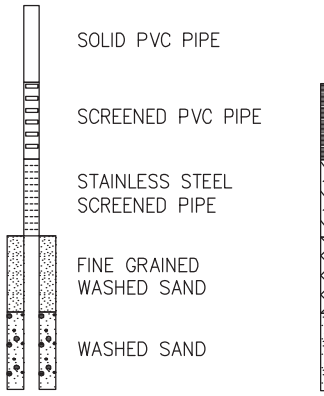
Very Soft	Carves
Soft	Grooves with knife
Med. Hard	Scratched easily with knife
Hard	Scatched with difficulty
Very Hard	Cannot be scratched with knife

WEATHERING:

Fresh	Slight or no staining of fractures, little or no discoloration, few fractures.
Slightly	Fractures stained, discoloration may extend into rock 1", some soil in fractures.
Moderately	Significant portions of rock stained and discolored, soil in fractures, loss of strength.
Highly	Entire rock discolored and dull except quartz grains, severe loss of strength.
Complete	Weathered to a residual soil.

BEDDING:		FRACTURE SPACING:		RQD:	
Massive	> 40"	Massive/V. Wide	> 6'	Excellent	> 90%
Thick	12' – 40"	Thick/Wide	2' – 6'	Good	76% – 90%
Medium	4" – 12"	Med./Med.	8" – 24"	Fair	51% – 75%
Thin	< 4"	Thin/Close	2 1/2" – 8"	Poor	25% – 50%
		V. Thin/V. Close	< 2 1/2"	V. Poor	< 25%

TABLE 6
WELL CONSTRUCTION



SOLID PVC PIPE

SCREENED PVC PIPE

STAINLESS STEEL SCREENED PIPE

FINE GRAINED WASHED SAND

WASHED SAND

BENTONITE PLUG

AIR ENTRAINED CEMENT

NATURAL SOIL/ ROCK FILL

BENTONITE/ CEMENT GROUT

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Low Flow Groundwater Purging and Sampling

Standard Operating Procedure #011

A. Purpose and Scope:

Low-flow purging is purging using a pumping mechanism that produces low-flow rates [less than 1 liter per minute (lpm) or less than 0.26 gallon per minute (gpm)] that cause minimal drawdown of the static water table and usually employs a flow-through cell in which geochemical parameters are continuously monitored. These parameters may include dissolved oxygen content, oxidation-reduction potential (redox), conductivity, turbidity, and pH.

The intent of this sampling protocol is to collect a representative sample from the monitored groundwater zone. A representative sample may be obtained when all the monitored chemical parameters have stabilized, thus qualitatively demonstrating that the groundwater being purged is in equilibrium (refer to Table 3). Samples are collected directly from the pumping mechanism with minimum disturbance to the aquifer groundwater. The low-flow/low volume purging method (purging to parameter stability) tends to isolate the interval being sampled, which provides more accurate water quality measurements and reduces the volume of purge water generated. This method has an advantage in that it can limit vertical mixing and volatilization of volatile organic compounds in solution within the well casing or borehole as compared to high-flow purging and sampling.

Low-flow purging and sampling is appropriate for collection of groundwater samples for all groundwater contaminants, including inorganic compounds, metals, pesticides, PCBs, volatile and semi-volatile organic compounds (VOCs and SVOCs), other organic compounds, radiochemical and microbiological constituents. This method is not applicable to the collection LNAPL or DNAPL.

B. Equipment and Materials:

The require equipment and materials include the following:

- Inertial pump
- Submersible pump
- Disposable bailers
- Generator
- Sample bottles
- Bailing twine and rope
- Field analyses meters
- Sampling gloves
- Water level meters
- Filtration system
- 2-Inch grundfos rediflow pump and controller
- Well sampling forms

Depending on the purging method to be used, there are specific equipment limitations. **Table 1** provides a description of the various methodologies and their applicability. The proper selection of sampling devices or pumps is critical to the quality and representation of the sampling results. The following table provides a summary of the acceptable sampling methods for the various compounds of concern.

LOW-FLOW GROUNDWATER PURGING/SAMPLING

Table 1

Acceptable Sampling Methods for Compounds of Concern

Method	VOCs	Semi-VOCs	Metals and Inorganics	Petroleum Hydrocarbons		General Chemistry
				C3-C16	C16+	
Peristaltic Pump	X	1	3	X	1	2
Centrifugal Pump	2	3	3	2	2	3
Submersible Pump W/Controller	2	3	3	2	3	3
Bailer	2	2	2	2	2	2
Bladder Pump	3	3	3	3	3	3
DPIS	3	3	2	2	2	2
Diffusion Sampler	2	2	X	2	2	X

1 – Not Recommended
2 – Useful with limitations
3 – Recommended method
X – Unacceptable
Note: Centrifugal Pump – assumed at a low-flow rate (no greater than 1 Lpm)

C. Procedure:

The following procedures should be followed:

1. The wells will be sampled in order from the least contaminated well to the most contaminated well.
2. Using a decontaminated measurement probe, determine the water level in the well; then calculate the fluid volume in the casing.
3. Setting up the Pump:
   a. Dedicated Systems

      Installation of any device into a well disturbs the stratification typically exhibited in a well due to laminar flow of groundwater in the well. Insertion also potentially mobilizes suspended solids in the water column due to disturbance of settled and solids in the casing and agitation of water in the filter pack. Dedicated systems result in lower initial turbidity values and lower purge volumes to achieve stabilized indicator parameter readings, and should be considered when a well will be sampled multiple times.

b. Portable Systems

If portable systems are used, they must be placed carefully into the well and lowered into the screen zone as slowly as possible to avoid disturbance of the groundwater resulting in non-equilibrium conditions. As a result, longer purge times and greater purge volumes may be necessary to achieve indicator parameter stabilization. In general, this may require that after installation, the portable pump should remain in place for a minimum of 1-2 hours to allow settling of solids and re- establishment of horizontal flow through the screen zone. If initial turbidity readings are excessive (>50 NTU), pumping should cease and the well should rest for another 1-2 hours before initiating pumping again. In wells set in very fine-grained formations, longer waiting periods may be required.

4. The flow rate used during purging must be low enough to avoid increasing the water turbidity. The following measures should be taken to determine the appropriate flow rate:
    a. The flow rate shall be determined for each well, based on the hydraulic performance of the well.
    b. The flow must be adjusted to obtain stabilization of the water level in the well as quickly as possible.
    c. The maximum flow rate used should not exceed 1 liter per minute (0.26 gpm).
    d. Once established, this rate should be reproduced with each subsequent sampling event.
    e. If a significant change in initial water level occurs between events, it may be necessary to re- establish the optimum flow rate at each sampling event.
5. Water Level Monitoring:
    a. Should not fluctuate more than 0.1 meters (~4 inches).

6. Measurement of indicator parameters (Dissolved oxygen content, redox potential, specific conductance, temperature and pH) is required. Continuous monitoring of water quality indicator parameters is used to determine when purging is competed and sampling should begin. Stabilized values, based on selected criteria listed in **Table 2** should be met prior to sampling. The use of an in-line flow cell (closed) system is recommended for measuring indicator parameters, except for turbidity.

    For turbidity measurement, a separate field nephalometer should be used. Indicator parameter collection is more important when low-flow purging is used compared to the high-flow purging method. Generally, measurements are taken every 3 to 5 minutes and water chemistry parameters are considered to be stable when they are within the following ranges for three (3) consecutive readings:

Table 2
Stability Criteria for Low-Flow Purging

Constituent	Criteria
Dissolved Oxygen Content (DO)	± 10%
Oxidation-Reduction Potential (redox)	± 10 mv
Specific Conductance	± 03% of reading
pH	± 0.1 units
Turbidity	± 10%
Temperature	NA

Turbidity should be below 50 NTU, if possible. If sample turbidity can not be reduced below 50 NTU, a field filtered sample shall be collected for metals analysis in addition to an unfiltered sample. Record these readings on the well sampling log.

7. The order in which samples are to be collected is as follows:
   - Volatile Organic Compounds (VOCs)
   - Semi-Volatile Organic Compounds (SVOCs)
   - Purgeable organic carbon (POC)
   - Purgeable organic halogens (POX)
   - Total organic carbon (TOC)
   - Total organic halogens (TOX)
   - Extractable organics
   - Total metals
   - Dissolved metals
   - Phenols
   - Cyanide
   - Sulfate and chloride
   - Turbidity
   - Nitrate and ammonia
   - Radionuclides

8. When collecting aliquots for analysis of volatile organic compounds, make absolutely certain that there are no bubbles adhering to the walls or the top of the VOA container.
9. Add appropriate preservatives to samples, as required.
10. Label the sample containers with all necessary information and complete all chain-of-custody documents and seals.
11. Place the properly labeled and sealed sample bottles in a cooler with ice and maintain at 4°C for the duration of the sampling and transportation period. Do not allow samples to freeze.

D. QA/QC Requirements:

To the extent possible, all samples should be collected using the same type of equipment and in the same manner to ensure comparability of data.

E. Special Conditions:

Because the methodology requires that disturbance to the water column in the well be minimized, the same pumping device used for purging should be used for sampling.

Sample collection will be performed utilizing either an inertial pump system or disposable bailer. If the inertial pump system is used, samples will be obtained through the dedicated polyethylene tubing while maintaining a low-flow. Should disposable bailers be utilized, the sampling will be performed as follows:

Attach a new bailer line to the disposable bailer equipped with a single check valve. Check the operation of the check valve assembly to confirm free operation. Lower the single check valve bailer slowly into the well until it contacts the water surface. Then lower the bailer just below the water surface with a minimum of disturbance. When filled with groundwater, slowly raise the bailer to the surface. Discharge the first bailer to the ground. Tip the bailer to allow the water to slowly discharge from the top and to flow gently down the inside of the sample bottle with minimum entry turbulence and aeration

A. References:

Low-Flow (Minimal Drawdown) Ground-Water Samp*ling Procedures*" by Robert Puls and Michael J. Barcelona dated April 1996.

B. Appendices or Forms:

Low Flow Sampling Form

Site Name:

Site Location:

Sample By:

Well Information:

Flush Mount or Riser:

Measuring Point:

Elevation:

Riser Diameter:

Calculation:

Dia. Well	Gal/ft
1	0.0408
1.5	0.0918
2	0.1631
3	0.3670
4	0.6525
5	1.0195
6	1.4681
8	2.6100

Well ID:

Date:

Weather:

Pumping Equipment:

Decon Method:

Stabilization is achieved when the following changes are noted over three consecutive 3-5 minute readings:

± 0.1 change in pH

± 3% change in conductivity

± 10 millivolt change in ORP

± 10% change in DO and Turbidity

Time	Volume Removed (Gal.)	Turbidity (NTU)	pH	Temperature (F)	Dissolved 02 (mg/L)	Conductivity (mS/cm)	ORP (mV)	Depth to Water (ft.)	Pumping Rate

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Sub-Slab Vapor Sampling and Analysis Using T0-15 Method

Standard Operating Procedure #012

A. Purpose and Scope:

This standard operating procedure (SOP) describes the procedures to install a sub-slab sampling port and collect sub-slab vapor samples for the analysis of volatile organic compounds (VOCs) by United States Environmental Protection Agency (USEPA) Method TO-15 (TO-15). The TO-15 method uses a 6-liter SUMMA® passivated stainless steel canister. An evacuated SUMMA canister (less than 28 inches of mercury [Hg]) will provide a recoverable whole-gas sample of approximately 5.5 liters when allowed to fill to a vacuum of 2 inches of Hg. The whole-air sample is then analyzed for VOCs using a quadrupole or ion-trap gas chromatograph/mass spectrometer (GS/MS) system to provide compound detection limits of 0.5 parts per billion volume (ppbv). The following sections list the necessary equipment and detailed instructions for installing sub-slab vapor probes and collecting samples for VOC analysis.

B. Equipment and Materials:

The equipment required to install a **permanent sub-slab vapor probe** is presented below:

- Electric impact drill
- 5/8-inch and 1-inch-diameter concrete drill bits for impact drill
- Stainless steel vapor probe (typically 3/8-inch outside diameter [OD], 2- to 2.5- inch long [length will ultimately depend on slab thickness], 1/8-inch inside diameter [ID] pipe, stainless steel pipe nipples with 0.5-inch OD stainless steel coupling, and recessed stainless steel plugs
- Photoionization detector (PID), Report in Parts per billion with PPB Rae
- Polyethylene tubing
- Quick-setting hydraulic cement powder

The equipment required to install a **temporary sub-slab vapor probe** is presented below:

- Electric impact drill
- 5/8-inch-diameter concrete drill bit for impact drill
- 3/8-inch tubing (Teflon® , polyethylene, or similar)
- PID
- Hydrated bentonite
- Teflon® tape

The equipment required for vapor sample collection is presented below:

- Stainless steel SUMMA® canisters (order at least one extra, if feasible)
- Flow controllers with in-line particulate filters and vacuum gauges; flow controllers are pre-calibrated to specified sample duration (e.g., 30 minutes, 8 hours, 24 hours) or flow rate (e.g., 200 milliliters per minute [mL/min]); confirm with the laboratory that the flow controller comes with an in-line particulate filter and pressure gauge (order at least one extra, if feasible)
- 1/4-inch ID tubing (Teflon® , polyethylene, or similar)
- Twist-to-lock fittings
- Stainless steel “T” fitting (if collecting duplicate [i.e., split] samples)
- Portable vacuum pump capable of producing very low flow rates (e.g., 100 to 200 mL/min)

- Rotameter or an electric flow sensor if vacuum pump does not have a flow gauge
- Tracer gas source (e.g., helium)
- PID
- Appropriate-sized open-end wrench (typically 9/16-inch)
- Chain-of-custody (COC) form
- Sample collection log
- Field notebook

C. Procedure:

The following procedures should be followed:

1. Temporary Vapor Probe Installation:

Temporary sub-slab soil vapor probes are installed using an electric drill and manual placement of tubing. The drill will be advanced to approximately 2 inches beneath the bottom of the slab. A 3/8-inch ID hole is installed through the slab. The tubing, wrapped in Teflon® tape, is inserted into the hole. The tubing is purged prior to collection of a vapor sample. Probe locations are resealed after sampling is complete.

a. Remove, only to the extent necessary, any covering on top of the slab (e.g., carpet).
b. Drill a 3/8-inch-diameter hole through the concrete slab using the electric drill.
c. Advance the drill bit approximately 2 inches into the sub-slab material to create an open cavity.
d. Wrap the tubing with Teflon® tape, to the extent necessary, for a snug fit of tubing and hole.
e. Insert the tubing approximately 1.5 inches into the sub-slab material.
f. Prepare a hydrated bentonite mixture and apply bentonite at slab surface around the tubing.
g. Purge the soil vapor probe and tubing with a portable sampling pump prior to collecting the vapor sample (see sample collection section below).
h. Proceed to vapor sample collection.
i. When the sub-slab vapor sampling is complete, remove the tubing and grout the hole in the slab with quick-setting hydraulic cement powder or other material similar to the slab.

2. Sub-Slab Vapor Sample Collection:

a. Record the following information in the field notebook, if appropriate (contact the local airport or other suitable information source [e.g., site-specific measurements, weatherunderground.com] to obtain the information):
    i. wind speed and direction
    ii. ambient temperature
    iii. barometric pressure
    iv. relative humidity

b. Connect a portable vacuum pump to the sample tubing. Purge 1 to 2 (target 1.5) volumes of air from the vapor probe and sampling line using a portable pump [purge volume = 1.5 πr^2h] at a rate of approximately 100 mL/min. Measure organic vapor levels with the PID.
c. If necessary, check the seal established around the soil vapor probe by using a tracer gas (e.g., helium) or other method established in the state guidance documents. [Note: Some states (e.g., New York) may not require use of a tracer gas in connection with sub-slab sampling. See Special Conditions Section of this SOP.
d. Remove the brass plug from the SUMMA® canister and connect the flow controller with in-line particulate filter and vacuum gauge to the SUMMA® canister. Do not open the valve on the SUMMA® canister. Record in the field notebook and on the COC form the flow controller number with the appropriate SUMMA® canister number.
e. Connect the polyethylene sample collection tubing to the flow controller and the SUMMA® canister valve. Record in the field notebook the time sampling began and the canister pressure.
f. Open the SUMMA® canister valves. Record in the field notebook the time sampling began and the canister pressure.
g. Take a photograph of the SUMMA® canister and surrounding area.

3. Termination of Sample Collection:

a. Arrive at the SUMMA® canister location at least 10 to 15 minutes prior to the end of the required sampling interval.
b. Record the final vacuum pressure. Stop collecting the sample by closing the SUMMA® canister valves. The canister should have a minimum amount of vacuum (approximately 2 inches of Hg or slightly greater).
c. Record the date and local time (24-hour basis) of valve closing in the field notebook, sample collection log (attached), and COC form.
d. Remove the particulate filter and flow controller from the SUMMA® canister, reinstall the brass plug on the canister fitting, and tighten with the appropriate wrench.
e. Package the canister and flow controller in the shipping container supplied by the laboratory for return shipment to the laboratory. The SUMMA® canister does not require preservation with ice or refrigeration during shipment.
f. Complete the appropriate forms and sample labels as directed by the laboratory (e.g., affix card with a string).
g. Complete the COC form and place the requisite copies in a shipping container. Close the shipping container and affix a custody seal to the container closure. Ship the container to the laboratory via overnight carrier (e.g., Federal Express) for analysis.

4. Vapor Monitoring Point Abandonment:

a. Once the vapor samples have been collected, a temporary vapor monitoring point will be abandoned by removing the sampling materials and filling the resulting hole with concrete. Replace the surface covering (e.g., carpet) to the extent practicable.

D. QA/QC Requirements:

Vapor sample analysis will be performed using USEPA TO-15 methodology. This method uses a quadrupole or ion-trap GC/MS with a capillary column to provide optimum detection limits. The GC/MS system requires a 1-liter gas sample (which can easily be recovered from a 6-liter canister) to provide a 0.5-ppbv detection limit. The 6-liter canister also provides several additional 1-liter samples in case subsequent re-analyses or dilutions are required. This system also offers the advantage of the GC/MS detector, which confirms the identity of detected compounds by evaluating their mass spectra in either the SCAN or SIM mode. Therefore, separate Matrix Spike/Matrix Spike Duplicate samples are not required.

Field Duplicate samples should be collected at a frequency of one (1) per 20 samples. The field duplicate should be collected using a stainless steel Tee, supplied by the laboratory, and tethered to the SUMMA canister being duplicated.

E. Special Conditions:

a. General Conditions:

Sampling personnel should not handle hazardous substances (such as gasoline), permanent marking pens, wear/apply fragrances, or smoke cigarettes/cigars before and/or during the sampling event.

Care should also be taken to ensure that the flow controller is pre-calibrated to the proper sample collection time (confirm with laboratory). Sample integrity is maintained if the sampling event is shorter than the target duration, but sample integrity can be compromised if the event is extended to the point that the canister reaches atmospheric pressure.

Care must be taken to properly seal around the vapor probe at slab surface to prevent leakage of atmosphere into the soil vapor probe during purging and sampling. Temporary points are fit snug into the pre-drilled hole using Teflon® tape and a hydrated bentonite seal at the surface. Permanent points are fit snug using quick-setting hydraulic cement powder.

b. Administering Tracer Gas:

When collecting subsurface vapor samples as part of a vapor intrusion evaluation, a tracer gas serves as a quality assurance/quality control device to verify the integrity of the vapor probe seal. Without the use of a tracer, verification that a soil vapor sample has not been diluted by surface air is difficult.

Depending on the nature of the contaminants of concern, a number of different compounds can be used as a tracer. Typically, helium or sulfur hexafluoride (SF6) are used as tracers because they are readily available, have low toxicity, and can be monitored with portable measurement devices.

Butane and propane (or other gases) could also be used as a tracer in some situations. Helium is the preferred tracer gas and will generally be used unless site conditions require use of an alternate tracer gas.

The protocol for using a tracer gas is straightforward: simply enrich the atmosphere in the immediate vicinity of the area where the probe intersects the surface with the tracer gas and measure a vapor sample from the probe for the presence of high concentrations (> 10%) of the tracer. A cardboard box, plastic pail, or even a plastic bag can serve to keep the tracer gas in contact with the probe during the testing.

There are two basic approaches to testing for the tracer gas:

1. Include the tracer gas in the list of target analytes reported by the laboratory; or
2. Use a portable monitoring device to analyze a sample of soil vapor for the tracer prior to and after sampling for the compounds of concern. (Note that tracer gas samples can be collected via vacuum pump, syringe, Tedlar bag, etc. They need not be collected in SUMMA® canisters or minicans).

The advantage of the second approach is that the real-time tracer sampling results can be used to confirm the integrity of the probe seals prior to formal sample collection.

Because minor leakage around the probe seal should not materially affect the usability of the soil vapor sampling results, the mere presence of the tracer gas in the sample should not be a cause for alarm. Consequently, portable field monitoring devices with detection limits in the low ppm range are more than adequate for screening samples for the tracer. If high concentrations (> 10%) of tracer gas are observed in a sample, the probe seal should be enhanced to reduce the infiltration of ambient air.

During the initial stages of a subsurface vapor sampling program, tracer gas samples should be collected at each of the sampling probes. If the results of the initial samples indicate that the probe seals are adequate, the Project Manager can consider reducing the number of locations at which tracer gas samples are used. At a minimum, at least 10% of the subsequent samples should be supported with tracer gas analyses. When using permanent soil vapor probes as part of a long-term monitoring program, annual testing of the probe integrity is recommended.

A. References:

New York State Department of Health (NYSDOH). 2006. "Guidance for Evaluating Soil Vapor Intrusion in the State of New York" October 2006.

B. Appendices or Forms:

SVI Sampling Form

Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

Site Name: _____ Site Code: _____ Operable Unit: _____

Building Code: _____ Building Name: _____

Address: _____ Apt/Suite No: _____

City: _____ State: _____ Zip: _____ County: _____

Contact Information

Preparer's Name: _____ Phone No: _____

Preparer's Affiliation: _____ Company Code: _____

Purpose of Investigation: _____ Date of Inspection: _____

Contact Name: _____ Affiliation: _____

Phone No: _____ Alt. Phone No: _____ Email: _____

Number of Occupants (total): _____ Number of Children: _____

☐ Occupant Interviewed? ☐ Owner Occupied? ☐ Owner Interviewed?

Owner Name (if different): _____ Owner Phone: _____

Owner Mailing Address: _____

Building Details

Bldg Type (Res/Com/Ind/Mixed): _____ Bldg Size (S/M/L): _____

If Commercial or Industrial Facility, Select Operations:

If Residential Select Structure Type:

Number of Floors: _____ Approx. Year Construction: _____ ☐ Building Insulated? ☐ Attached Garage?

Describe Overall Building 'Tightness' and Airflows(e.g., results of smoke tests):

Foundation Description

Foundation Type: _____ Foundation Depth (bgs): _____ Unit: FEET

Foundation Floor Material: _____

Foundation Wall Material: _____

Foundation Floor Thickness: _____

Foundation Wall Thickness: _____ Unit: INCHES

☐ Floor penetrations? Describe Floor Penetrations: _____

☐ Wall penetrations? Describe Wall Penetrations: _____

Basement is: _____ Basement is: _____ ☐ Sumps/Drains? Water In Sump?: _____

Describe Foundation Condition (cracks, seepage, etc.) : _____

☐ Radon Mitigation System Installed? ☐ VOC Mitigation System Installed? ☐ Mitigation System On?

Heating/Cooling/Ventilation Systems

Heating System: _____ Heat Fuel Type: _____ ☐ Central A/C Present?

Vented Appliances

Water Heater Fuel Type: _____ Clothes Dryer Fuel Type: _____

Water Htr Vent Location: _____ Dryer Vent Location: _____

Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

PRODUCT INVENTORY

Building Name: _____ Bldg Code: _____ Date: _____

Bldg Address: _____ Apt/Suite No: _____

Bldg City/State/Zip: _____

Make and Model of PID: _____ Date of Calibration: _____

Location	Product Name/Description	Size (oz)	Condition *	Chemical Ingredients	PID Reading	COC Y/N?
						☐
						☐
						☐
						☐
						☐
						☐
						☐
						☐
						☐
						☐
						☐
						☐
						☐
						☐
						☐
						☐

* Describe the condition of the product containers as **Unopened (UO)**, **Used (U)**, or **Deteriorated (D)**

** Photographs of the **front and back** of product containers can replace the handwritten list of chemical ingredients. However, the photographs must be of good quality and ingredient labels must be legible.

Product Inventory Complete? ☐ Were there any elevated PID readings taken on site? ☐ ☐ Products with COC?

Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

Site Name: _____ Site Code: _____ Operable Unit: _____

Building Code: _____ Building Name: _____

Address: _____ Apt/Suite No: _____

City: _____ State: _____ Zip: _____ County: _____

Factors Affecting Indoor Air Quailty

Frequency Basement/Lowest Level is Occupied?: _____ Floor Material: _____

☐ Inhabited? ☐ HVAC System On? ☐ Bathroom Exhaust Fan? ☐ Kitchen Exhaust Fan?

Alternate Heat Source: _____ ☐ Is there smoking in the building?

☐ Air Fresheners? Description/Location of Air Freshener: _____

☐ Cleaning Products Used Recently?: Description of Cleaning Products: _____

☐ Cosmetic Products Used Recently?: Description of Cosmetic Products: _____

☐ New Carpet or Furniture? Location of New Carpet/Furniture: _____

☐ Recent Dry Cleaning? Location of Recently Dry Cleaned Fabrics: _____

☐ Recent Painting/Staining? Location of New Painting: _____

☐ Solvent or Chemical Odors? Describe Odors (if any): _____

☐ Do Any Occupants Use Solvents At Work? If So, List Solvents Used: _____

☐ Recent Pesticide/Rodenticide? Description of Last Use: _____

Describe Any Household Activities (chemical use,/storage, unvented appliances, hobbies, etc.) That May Affect Indoor Air Quality:

☐ Any Prior Testing For Radon? If So, When?: _____

☐ Any Prior Testing For VOCs? If So, When?: _____

Sampling Conditions

Weather Conditions: _____ Outdoor Temperature: _____ °F

Current Building Use: _____ Barometric Pressure: _____ in(hg)

Product Inventory Complete? _____ ☐ Building Questionnaire Completed?

Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

Building Code: _____ Address: _____

Sampling Information

Sampler Name(s): _____ Sampler Company Code: _____

Sample Collection Date: _____ Date Samples Sent To Lab: _____

Sample Chain of Custody Number: _____ Outdoor Air Sample Location ID: _____

SUMMA Canister Information

Sample ID:					
Location Code:					
Location Type:					
Canister ID:					
Regulator ID:					
Matrix:					
Sampling Method:					

Sampling Area Info

Slab Thickness (inches):					
Sub-Slab Material:					
Sub-Slab Moisture:					
Seal Type:					
Seal Adequate?:	☐	☐	☐	☐	☐

Sample Times and Vacuum Readings

Sample Start Date/Time:					
Vacuum Gauge Start:					
Sample End Date/Time:					
Vacuum Gauge End:					
Sample Duration (hrs):					
Vacuum Gauge Unit:					

Sample QA/QC Readings

Vapor Port Purge:	☐	☐	☐	☐	☐
Purge PID Reading:					
Purge PID Unit:					
Tracer Test Pass:	☐	☐	☐	☐	☐

Sample start and end times should be entered using the following format: MM/DD/YYYY HH:MM

Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

LOWEST BUILDING LEVEL LAYOUT SKETCH

Please click the box with the blue border below to upload a sketch of the lowest building level .
The sketch should be in a standard image format (.jpg, .png, .tiff)

Clear Image

Design Sketch

Design Sketch Guidelines and Recommended Symbology

- Identify and label the locations of all sub-slab, indoor air, and outdoor air samples on the layout sketch.
- Measure the distance of all sample locations from identifiable features, and include on the layout sketch.
- Identify room use (bedroom, living room, den, kitchen, etc.) on the layout sket
- Identify the locations of the following features on the layout sketch, using the appropriate symbols:

B or **F**	Boiler or Furnace	o	Other floor or wall penetrations (label appropriately)
HW	Hot Water Heater	**xxxxxxx**	Perimeter Drains (draw inside or outside outer walls as appropriate)
FP	Fireplaces	**######**	Areas of broken-up concrete
WS	Wood Stoves	● SS-1	Location & label of sub-slab samples
W/D	Washer / Dryer	● IA-1	Location & label of indoor air samples
S	Sumps	● OA-1	Location & label of outdoor air samples
@	Floor Drains	● PFET-1	Location and label of any pressure field test holes.

Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

FIRST FLOOR BUILDING LAYOUT SKETCH

Please click the box with the blue border below to upload a sketch of the first floor of the building.
The sketch should be in a standard image format (.jpg, .png, .tiff)

Clear Image

Design Sketch

Design Sketch Guidelines and Recommended Symbology

- Identify and label the locations of all sub-slab, indoor air, and outdoor air samples on the layout sketch.
- Measure the distance of all sample locations from identifiable features, and include on the layout sketch.
- Identify room use (bedroom, living room, den, kitchen, etc.) on the layout sket
- Identify the locations of the following features on the layout sketch, using the appropriate symbols:

B or **F**	Boiler or Furnace	o	Other floor or wall penetrations (label appropriately)
HW	Hot Water Heater	**xxxxxxx**	Perimeter Drains (draw inside or outside outer walls as appropriate)
FP	Fireplaces	**######**	Areas of broken-up concrete
WS	Wood Stoves	● SS-1	Location & label of sub-slab samples
W/D	Washer / Dryer	● IA-1	Location & label of indoor air samples
S	Sumps	● OA-1	Location & label of outdoor air samples
@	Floor Drains	● PFET-1	Location and label of any pressure field test holes.

Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

OUTDOOR PLOT LAYOUT SKETCH

Please click the box with the blue border below to upload a sketch of the outdoor plot of the building as well as the surrounding area. The sketch should be in a standard image format (.jpg, .png, .tiff)

Clear Image

Design Sketch

Design Sketch Guidelines and Recommended Symbology

- Identify and label the locations of all sub-slab, indoor air, and outdoor air samples on the layout sketch.
- Measure the distance of all sample locations from identifiable features, and include on the layout sketch.
- Identify room use (bedroom, living room, den, kitchen, etc.) on the layout sket
- Identify the locations of the following features on the layout sketch, using the appropriate symbols:

B or **F**	Boiler or Furnace	o	Other floor or wall penetrations (label appropriately)
HW	Hot Water Heater	**xxxxxxx**	Perimeter Drains (draw inside or outside outer walls as appropriate)
FP	Fireplaces	**######**	Areas of broken-up concrete
WS	Wood Stoves	● SS-1	Location & label of sub-slab samples
W/D	Washer / Dryer	● IA-1	Location & label of indoor air samples
S	Sumps	● OA-1	Location & label of outdoor air samples
@	Floor Drains	● PFET-1	Location and label of any pressure field test holes.

Aztech Environmental
TECHNOLOGIES
A LaBella Company

Indoor/Ambient Air Sampling and Analysis Using T0-15 Method

Standard Operating Procedure #013

A. Purpose and Scope:

This standard operating procedure (SOP) describes the procedures to collect indoor/ambient air samples for the analysis of volatile organic compounds (VOCs) using United States Environmental Protection Agency (USEPA) Method TO-15 (TO-15). The TO15 method uses a 6-liter SUMMA® passivated stainless steel canister. An evacuated SUMMA® canister (<28 Inches of mercury [Hg]) will provide a recoverable whole-gas sample of approximately 5.5 liters when allowed to fill to a vacuum of 2 inches of Hg. The whole-air sample is then analyzed for VOCs using a quadrupole or ion-trap gas chromatograph/mass spectrometer (GS/MS) system to provide compound detection limits of 0.5 parts per billion volume (ppbv).

The following sections list the necessary equipment and provide detailed instructions for placing the sampling device and collecting indoor/ambient air samples for VOC analysis

B. Equipment and Materials:

The equipment required to perform indoor/ambient air sample collection is presented below:

- Photoionization detector (PID) with VOC detection limit capabilities in the ppb range
- 5/8-inch and 1-inch-diameter concrete drill bits for impact drill
- Flow controllers with in-line particulate filters and vacuum gauges (flow controllers are pre-calibrated by the laboratory to a specified sample duration [e.g., 8-hour, 24-hour]). Confirm with lab that flow controller comes with in-line particulate filter and pressure gauge (order an extra set for each extra SUMMA® canister, if feasible)
- Stainless steel “T” fitting (for connection to SUMMA® canisters and Teflon® tubing to collect split [i.e., duplicate] samples)
- Appropriate-sized open-end wrench (typically 9/16-inch)
- Chain-of-custody (COC) form
- Building survey and product inventory form
- Sample collection log
- Field notebook
- Camera
- Lock and chain
- Ladder or similar to hold canister above the ground

C. Procedure:

The following procedures should be followed:

1. **Initial Building Survey:**
   a. Complete the appropriate building survey form and product inventory form (e.g., state-specific form) at least 48 hours in advance of sample collection.
   b. Survey the area for the apparent presence of items or materials that may potentially produce or emit constituents of concern and interfere with analytical laboratory analysis of the collected sample. Record relevant information on survey form and document with photographs.

c. Using the PID, screen indoor air in the location intended for sampling and the vicinity of potential VOC sources to preliminarily assess for the potential gross presence of VOCs.
d. Record date, time, location, and PID readings in the field notebook.
e. Items or materials that contain constituents of concern and/or exhibit elevated PID readings shall be considered probable sources of VOCs. Request approval of the owner or occupant to have these items removed at least 48 hours prior to sampling.
f. Set a time with the owner or occupant to return for placement of SUMMA® canisters.

2. Preparation of SUMMA® -Type Canister and Collection of Sample:

a. Record the following information in the field notebook (contact the local airport or other suitable information source [e.g., weatherunderground.com] to obtain the following information):
    i. ambient temperature
    ii. barometric pressure
    iii. relative humidity

b. Choose the sample location in accordance with the sampling plan. Place the canister on a ladder, tripod, or other similar stand to locate the canister orifice 3 to 5 feet above ground or floor surface. If the canister will not be overseen for the entire sampling period, secure the canister as appropriate (e.g., lock and chain). Canister may be affixed to wall/ceiling support with nylon rope or placed on a stable surface. In general, areas near windows, doors, air supply vents, and/or other potential sources of "drafts" shall be avoided.
c. Record SUMMA® canister serial number and flow controller number in the field notebook and COC form. Assign sample identification on canister ID tag, and record in the field notebook, sample collection log, and COC form.
d. Remove the brass dust cap from the SUMMA® canister. Attach the flow controller with in-line particulate filter and vacuum gauge (leave swage-lock cap on the vacuum gauge during this procedure) to the SUMMA® canister with the appropriate-sized wrench. Tighten with fingers first, then gently with the wrench.
e. Open the SUMMA® canister valve to initiate sample collection. Record the date and local time (24-hour basis) of valve opening in the field notebook, sample collection log, and COC form. Collection of duplicate/split samples will include attaching a stainless steel "T" to split the indoor air stream to two SUMMA® canisters, one for the original investigative sample and one for the duplicate/split sample.
f. Record the initial vacuum pressure in the SUMMA® canister in the field notebook and COC form. If the initial vacuum pressure does not register less than -28 inches of Hg, then the SUMMA® canister is not appropriate for use and another canister should be used.
g. Take a photograph of the SUMMA® canister and surrounding area.

3. Termination of Sample Collection:

a. Arrive at the SUMMA® canister location at least 10 to 15 minutes prior to the end of the sampling interval (e.g., 8-hour).
b. Stop collecting the sample when the canister vacuum reaches approximately 2 inches of Hg (leaving some vacuum in the canister provides a way to verify if the canister leaks before it reaches the laboratory) or when the desired sample time has elapsed.
c. Record the final vacuum pressure. Stop collecting the sample by closing the SUMMA® canister valve. Record the date, local time (24-hour basis) of valve closing in the field notebook, sample collection log, and COC form.
d. Remove the particulate filter and flow controller from the SUMMA® canister, reinstall brass plug on canister fitting, and tighten with wrench.
e. Package the canister and flow controller in the shipping container supplied by the laboratory for return shipment to the laboratory. The SUMMA® canister does not require preservation with ice or refrigeration during shipment.
f. Complete the appropriate forms and sample labels as directed by the laboratory (e.g., affix card with string).
g. Complete COC form and place requisite copies in shipping container. Close shipping container and affix custody seal to container closure. Ship to laboratory via overnight carrier (e.g., Federal Express) for analysis.

D. QA/QC Requirements:

Indoor air sample analysis will be performed using USEPA TO-15 methodology. This method uses a quadrupole or ion-trap GC/MS with a capillary column to provide optimum detection limits. The GC/MS system requires a 1-liter gas sample (which can easily be recovered from a 6-liter canister) to provide a 0.5-ppbv detection limit. The 6-liter canister also provides several additional 1-liter samples in case subsequent re-analyses or dilutions are required. This system also offers the advantage of the GC/MS detector, which confirms the identity of detected compounds by evaluating their mass spectra in either the SCAN or SIM mode. Therefore, separate Matrix Spike/Matrix Spike Duplicate samples are not required.

Field Duplicate samples should be collected at a frequency of one (1) per 20 samples. The field duplicate should be collected using a stainless steel “Tee”, supplied by the laboratory, and tethered to the SUMMA canister being duplicated.

E. Special Conditions:

Care must be taken to minimize the potential for introducing interferences during the sampling event. As such, care must be taken to keep the canister away from heavy pedestrian traffic areas (e.g., main entranceways, walkways). If the canister is not to be overseen for the entire sample duration, precautions should be taken to maintain the security of the sample (e.g., do not place in areas regularly accessed by the public, fasten the sampling device to a secure object using lock and chain, label the canister to indicate it is part of a scientific project, place the canister in secure housing that does not disrupt the integrity/validity of the sampling event). Sampling personnel should not handle hazardous

substances (such as gasoline), permanent marking pens, wear/apply fragrances, or smoke cigarettes before and/or during the sampling event.

Care should also be taken to ensure that the flow controller is pre-calibrated to the proper sample collection time (confirm with laboratory). Sample integrity is maintained if the sampling event is shorter than the target duration, but sample integrity can be compromised if the event is extended to the point that the canister reaches atmospheric pressure.

A. References:

New York State Department of Health (NYSDOH). 2006. "Guidance for Evaluating Soil Vapor Intrusion in the State of New York" October 2006.

B. Appendices or Forms:

SVI Sampling Form

APPENDIX B

QUALITY ASSURANCE PROJECT PLAN (QAPP)

QUALITY ASSURANCE PROJECT PLAN

SUBJECT SITE:

338 Broadway
City of Kingston, Ulster County, New York

NYSDEC Site No. 356058

PREPARED FOR:
New York State Department of Environmental Conservation
Central Office
625 Broadway
Albany, New York 12233
Attn: Parag Amin

PREPARED BY:
Aztech Environmental Technologies
5 McCrea Hill Road
Ballston Spa, New York 12233
Phone: (518) 885-5383

Table of Contents

ATTACHMENTS

Figures
Note: Refer to Site Characterization Work Plan for all Figures other than specified below.

Tables
Note: Refer to Site Characterization Work Plan for all Tables.

Attachment 1 – Resumes

1.0 Introduction

1.1 General

This Quality Assurance Project Plan (QAPP) presents the policies, organization, objectives, functional activities and specific Quality Assurance (QA) and Quality Control (QC) activities designed to achieve the specific data quality goals associated with the investigation that will be conducted at the site located at 338 Broadway, Kingston, New York. The scope of work associated with the investigation activities and specific areas of concern that will be addressed are summarized in the Site Characterization Work Plan (SCWP).

This QAPP has been prepared to identify procedures for sample preparation and handling, sample chain-of-custody, laboratory analyses, and reporting to be implemented during this investigation to ensure the accuracy and integrity of the data generated during the investigation. This QAPP has been prepared in accordance with the New York State Department of Environmental Conservation's (NYSDEC) Department of Remediation (DER-10) Technical Guidance for Site Investigation and Remediation. Field activities will be performed in accordance with Aztech Environmental Technologies (Aztech) standard operating procedures (SOPs), provided in the Field Sampling Plan (FSP) and included as Appendix A to the SCWP.

1.2 Site Description

The description and project background information are included in SCWP.

1.3 Scope of Work

This QAPP has been prepared in accordance with Section 3.0 of the NYSDEC's "Division of Environmental Remediation program policy 10 (DER-10) Technical Guidance for Site Investigation and Remediation" (May 2010).

The primary objectives of the SCWP include the following:

- Assist in identifying any areas of concern at the Site and help determine if the Site poses a significant threat to public health and the environment; and
- If a threat is identified, determine whether further investigation is required.

In general, the SC program will include the following activities:

- Land survey;
- Geophysical survey;
- Collection of surface soil samples;
- Installation of soil borings to be completed as groundwater monitoring wells;
- Installation of soil gas and sub-slab vapor points;
- Collection and analysis of soil, soil vapor and groundwater samples for parameters of concern.
- Equipment cleaning.

The data derived from the SCWP will assist in identifying any areas of concern at the Site and help determine if the site poses a significant threat to public health and the environment. If a significant threat determination is made, additional investigation may be warranted.

2.0 Project Organization and Responsibility

2.1 Personnel

All SCWP activities are being conducted by Aztech under contract with the NYSDEC. Subcontractors of Aztech will be utilized for the land survey, geophysical survey and drilling. The subcontractors will be selected under the NYSDEC solicitation process and will be submitted to the NYSDEC Project Manager for approval. All work conducted by subcontractor will be overseen in the field by and Aztech field Manager. The Aztech Project Manager is responsible for the delivery of Aztech services. Resumes for Aztech staff providing environmental services are included in **Attachment 1**.

Key project personnel are summarized below:

- **Aaron Yecies, PG, CPG – Technical Manager / Project Coordinator**
  1. Provide managerial and technical guidance to Aztech's project group;
  2. Participate in key technical discussions with the NYSDEC, as necessary;
  3. Evaluate data; and,
  4. Assist in preparation and review of final report.
- **Thomas Giamichael, PG – Aztech Project Manager**
  1. Responsible for implementing the approved SCWP, notifying the NYSDEC of any deficiencies, and obtaining approval by the NYSDEC for all modifications to the project;
  2. Provide all day-to-day project management;
  3. Ensure all resources of Aztech are available on an as-required basis;
  4. Prepare and coordinate issuance of reports;
  5. Provide immediate supervision of all onsite activities; and,
  6. Assist in preparation of final report.
- **Randy Hoose, PG – Aztech QA/QC Officer**
  1. Conduct internal review of field investigation and sampling documentation.
  2. Review laboratory reports for completeness, QA/QC;
  3. Review third party Data Usability Summary Report (DUSR);
  4. Determine laboratory corrective actions, if needed; and,
  5. Assist in preparation and review of final report.

- **Ben Strickland – Aztech Field Team Leader and Project Geologist**
  1. Provide oversight of field activities;
  2. Ensure that required QC procedures are followed for soil boring, monitoring well and vapor probe installations and sampling activities;
  3. Ensure health and safety protocols are followed;

4. Initiate corrective actions as necessary;
5. Maintain and report QC records (i.e. chain of custody, field equipment calibration, ect.);
6. Report to the Project Manager;
7. Provide field management of sample collection and field QA/QC;
8. Responsible for maintenance of field equipment; and,
9. Assist in preparation of final report.

2.1.1 Laboratory

Test America, Inc. is the analytical laboratory required to be utilized by the NYSDEC to perform the proposed work and is certified by the New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) Number 10026 to perform the required analyses in accordance with the most recent version of the NYSDEC Analytical Services Protocol (ASP).

- **Project Manager, Analytical Contractor**
  - Ensure resources of laboratory are available on an as-required basis;
  - Coordinate laboratory analyses;
  - Supervise laboratory's in-house chain-of-custody (COC);
  - Schedule analyses of samples;
  - Oversee review of data;
  - Oversee preparation of analytical reports; and,
  - Approve final analytical reports prior to submission to Aztech.

- **Quality Assurance/ Quality Control Officer, Analytical Contractor**
  - Overview laboratory QA/QC;
  - Overview QA/QC documentation;
  - Conduct detailed data review;
  - Decide laboratory corrective actions, if required; and,
  - Provide technical representation for laboratory QA/QC procedures.

- **Sample Custodian, Analytical Contractor**
  - Receive and inspect the sample containers;
  - Record the condition of the sample containers;
  - Sign appropriate documents;
  - Verify chain-of-custodies and their correctness;
  - Notify laboratory project manager and laboratory QA/QC Officer of sample receipt and inspection;
  - Assign a unique laboratory identification number correlated to Aztech sample identification number, and enter each into the sample receiving log;
  - Initiate transfer of the samples to the appropriate lab sections with assistance from the laboratory project manager; and,
  - Control and monitor access to and storage of samples and extracts.

3.0 Quality Assurance Objectives for Measurement Data

3.1 General

The overall QA objective is to develop and implement procedures for sample preparation and handling, sample COC, laboratory analyses, and reporting, in order to provide accurate data. Specific procedures to be followed for sampling, sample custody and document control, calibration, laboratory analyses and data reduction, validation, assessment and reporting are presented in Sections 4.0 through 11.0 of this QAPP.

The purpose of the subsequent sections are to define the goals for the level of QA effort; namely, accuracy; precision and sensitivity of analyses; and completeness, representativeness and comparability of measurement data from the analytical laboratories. QA objectives for field measurements are also discussed.

4.0 Level of QA Effort

4.1 General

To assess the quality of data resulting from the field sampling program, field duplicate samples, field blank samples, samples for laboratory matrix spike/matrix spike duplicate (MS/MSD) analyses, and trip blank samples will be collected (where appropriate) and submitted to the contract laboratory. Aztech SOP#005 will be adhered to for all QA/QC procedures. Aztech SOP#003 will be adhered to for all sample containers, volumes, preservations and holding times.

For soil, groundwater, soil gas and soil vapor intrusion (SVI) field samples collected, field duplicate samples will be submitted at a frequency of one (1) per 20 investigative samples or, in the event that a sampling round consists of less than 20 samples, one field duplicate will be collected. Field duplicate samples for each matrices will be collected and analyzed as a check on the aggregate analytical and sampling protocol precision. MS/MSD samples, for soil and groundwater only, will be analyzed at a minimum frequency of one set per 20 investigative samples. MS/MSD samples will be analyzed as a check on the analytical method's accuracy and precision. MS/MSD samples do not apply for soil gas or SVI samples.

The sampling and analysis program is summarized in **Table 1** of the SCWP and lists the specific parameters to be measured, the number of samples to be collected and the level of QA effort required for each matrix.

4.2 Accuracy, Precisions and Sensitivity of Analysis

The fundamental QA objective with respect to the accuracy, precision and sensitivity of analytical data is to achieve the QC acceptance of each analytical protocol. The method(s) precision (relative percent difference of duplicate analysis) will be determined from the duplicate analyses of MS samples. A minimum of one (1) sample will be spiked and analyzed in duplicate. Additional details are provided in Aztech SOP#005. Analysis will compare with the criteria presented in the appropriate methods identified in Section 4.1.

The method(s) accuracy (percent recovery) for water and soil samples will be determined by spiking selected samples (matrix spikes) with test compounds. Accuracy will be reported as the percent recovery of the test compound and will compare with the criteria given in the appropriate methods as identified in Section 4.1.

Project-specific accuracy and precision goals are identified in Section 10.0.

4.3 Completeness, Representativeness and Comparability

It is expected that all analyses conducted in accordance with the selected methods will provide data meeting QC acceptance criteria for 80 percent of all samples tested. Any reasons for variances will be documented.

The sampling program has been designed to provide data representative of Site conditions. During development of these networks, consideration was given to location of historic activities, existing data from past studies completed for the Site and the physical Site setting. The extent to which existing and planned analytical data will be comparable depends on the similarity of sampling and analytical methods. The procedures used to obtain the planned analytical data are documented in this QAPP. Comparability of laboratory analyses will be ensured by the use of consistent units. Following completion of data collection, the existing database will be evaluated for representativeness.

4.4 Field Documentation

Pertinent field survey and sampling information shall be recorded in a logbook or on field logs during each day of the field effort per Aztech SOP#001 Field Logbook and Photographs.

At a minimum, entries in a logbook shall include:

- Date and time of starting work;
- Names of all personnel at site;
- Weather conditions;
- Purpose of proposed work effort;
- Sampling equipment to be used and calibration of equipment;
- Description of work area;
- Location of work area, including map reference;
- Details of work effort, particularly any deviation from the field operations plan or standard operating procedures;
- Field observations;
- Field measurements (e.g., Photoionization Detector (PID) readings);
- Field laboratory analytical results;
- Daily health and safety entries, including levels of protection;
- Type, number, and location of samples;
- Sampling method, particularly deviations from the standard operating procedures;
- Sample location and number; and,
- Sample handling, packaging, labeling, and shipping information (including destination).

In addition to keeping logs, photographs will be taken to provide a physical record to augment the fieldworker's written observations. For each photograph taken, several items shall be recorded in the field logbooks:

- Date and time;
- Name of photographer; and,
- General direction faced and description of the subject.

Additional protocols specific to each sampling method are presented in the following sections. The general QA objective for measurement data is to obtain reproducible and comparable measurements to a degree of accuracy consistent with the use of standardized procedures.

5.0 Sampling Procedures

5.1 General

The sampling program to be implemented by Aztech will include the collection and analyses of Surface soil, subsurface soil, groundwater, soil gas and soil vapor intrusion samples. Details regarding specific sampling activities are provided in the SCWP and the procedures for collecting samples and for performing related field activities are described in detail in the FSP, included in Appendix A of the SCWP. The number of samples, analytical methods, sample volumes, preservation techniques and holding times are provided in Table 1.

6.0 Sample Custody and Document Control

6.1 General

As per Aztech SOP#004, a COC will be maintained to document the transfer of all samples. Each sample container will be properly sealed. Sample container labels will include the sample name, required analysis, and date and time of collection. Sample containers will be taken to the contract laboratory courier center at 4°C (±2°C) in sealed coolers.

Each sample cooler will contain an appropriately completed COC form. One (1) copy will be returned to Aztech upon receipt of the samples by the laboratory. One (1) copy will be returned to Aztech with the data deliverables package.

Upon receipt of the cooler at the laboratory, it will be inspected by the designated sample manager. The condition of the cooler and sample containers will be noted on the COC record sheet by the sample manager. The sample manager will also document the date and time of receipt of the container and sign the form.

If damage or discrepancies are noticed, they will be recorded in the remarks column of the record sheet, and be dated and signed. Any damage or discrepancies will be reported to the lab supervisor who will inform the lab manager, QA Officer and Aztech Project Manager.

6.2 Sample Documentation in the Laboratory

Each sample or group of samples shipped to the laboratory for analysis will be given a unique identification number by the laboratory. The laboratory sample manager will record the client name, number of samples and date of receipt of samples in the sample login acknowledgment.

The contract laboratory will be responsible for maintaining analytical log books and laboratory data as well as sample inventory on hand for submittal to Aztech on an "as required" basis. Samples will be maintained by the laboratory for a period of 30 days, under the conditions prescribed by the appropriate United States Environmental Protection Agency (USEPA) methods, for additional analyses, if necessary. Raw laboratory data files will be inventoried and maintained by the contract laboratory for a period of five (5) years, at which time Aztech will advise them as to the need for additional storage.

6.2 Storage of Samples

Evidentiary files for the entire project will be inventoried and maintained by Aztech and will consist of the following:

1. Project related plans;
2. Project log books;
3. Field data records;
4. Sample identification documents;
5. Chain-of-Custody records;
6. Report notes, calculations, etc.;
7. References, literature;
8. Miscellaneous - photos, maps, drawings, etc.; and,
9. Copies of all final reports pertaining to the project.

The project file materials will be the responsibility of Aztech's Project Manager with respect to document maintenance and management.

7.0 Calibration Procedures and Frequency

7.1 Instrument Calibration and Tuning

Calibration of instrumentation is required to ensure that the analytical system is operating correctly and functioning at the proper sensitivity to meet established reporting limits. Each instrument is calibrated with standard solutions appropriate to the type of instrument and the linear range established for the analytical method. The frequency of calibration and the concentration of calibration standards is determined by the manufacturer's guidelines, the analytical method, or the requirements of special contracts.

7.2 Field Instrument Calibration

Calibration of the field instruments will be completed prior to each day's use in accordance with the manufacturer's instructions. The field equipment will be maintained, calibrated

and operated in a manner consistent with the manufacturer's guidelines and EPA standard methods. However, since the majority of field measurements will be limited to organic vapor readings (PID readings), pH, dissolved oxygen, conductivity, turbidity, and depth (water level) the calibration procedures will be conducted at a minimum frequency of once per day. Records of calibration, repair or replacement will be filed and maintained by the Field Team Leader.

8.0 Calibration Procedures and Frequency

8.1 General

The contract laboratory will perform analytical data reduction and validation in-house under the direction of the laboratory QA Officer. The laboratory's QA Officer will be responsible for assessing data quality and advising of any data which were rated "preliminary" or "unacceptable" or other qualifications based on the QC criteria outlined in the methods, which would caution the data user of possible unreliability.

Assessment of analytical and field data will include checks for data consistency by looking for comparability of duplicate analyses, laboratory QA procedures, and adherence to accuracy and precision criteria, transmittal errors and anomalously high or low parameter values. The results of these data validations will be reported to the project managers, noting any discrepancies and their effect upon acceptability of the data.

8.2 Field Data

The raw data from field measurements and sample collection activities that are used in project reports will be appropriately identified and appended to the report. Where data have been reduced or summarized, the method of reduction will be documented in the report. Field data will be reviewed for anomalously high or low values that may appear to be inconsistent with other data.

Field sampling data will be reviewed by the Aztech QA/QC Officer to ensure the following information has been properly documented:

- Sample identification;
- Source;
- Date and time of sampling;
- Sampling equipment;
- Person(s) collecting the sample; and,
- Results of field monitoring and/or observations.

In addition, the field sampling data will be evaluated to ensure:

- The use of approved sampling and sample handling procedures;
- Proper packing/shipping procedures were used; and,
- Proper COC was maintained.

8.3 Laboratory Reporting

Reporting and deliverables for groundwater and soil samples will be in accordance with NYSDEC July 2005 ASP, Category B. Reports will be received by Aztech within 30 days of the last day of sampling. Sample data and its corresponding QA/QC data shall be maintained accessible to Aztech either in hard copy or on disk. All other reporting and deliverables (i.e. waste characterization samples) will be in accordance with standard laboratory procedure.

8.4 Electronic Data

The laboratory will also provide the analytical data in an electronic format. The data will be added into the existing database maintained by Aztech staff. From there the data can be processed and compared to existing standards using the existing software. An electronic copy of the analytical data in Category B format and in EQuIS format will be provided to NYSDEC.

8.4 Data Validation

A qualified third party will conduct an independent evaluation of the Category B data reduction and reporting by the laboratory. The data validation will be performed in accordance with the following documents: "USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review EPA 540/R-99-008, October 1999" and "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review EPA 540/R-04-004, October 2004". Data analyzed using methods not covered in these documents will be validated using the general principles used in these documents, and the analytical requirements specified in the methods pertaining to USEPA Data Validation.

9.0 Internal Quality Control Checks and Frequency

9.1 Field Quality Control

The QC procedures for field measurements will be limited to checking the reproducibility of the measurement in the field by obtaining multiple readings and by calibrating the instruments (where appropriate). QC of field sampling will involve collecting field duplicates and trip blanks with the applicable site activities described in the SCWP/FSP. Field QC samples are also discussed in Section 4.0.

9.2 Laboratory Quality Control

Specific procedures related to internal laboratory QC samples (blanks, MS/MSD, surrogates and QC check samples) are described in the following subsections.

9.2.1 Blank Samples

A reagent blank will be analyzed by the laboratory at a frequency of one (1) blank per 10 analyses, or in the event that an analytical round consists of less than 10 samples, one (1) reagent blank will be analyzed. The reagent blank, an aliquot of analyte-free water or solvent, will be carried through the entire analytical procedure.

9.2.2 Matrix Spike/Matrix Spike Duplicates

An MS/MSD sample will be analyzed at a minimum frequency one (1) sample for every 20 investigative samples that are collected. For sampling events consisting of less than 20 investigative

samples, one (1) MS/MSD sample set will be collected. Acceptable criteria and compounds that will be used for matrix spikes are identified in the appropriate methods. Percent spike recoveries will be used to evaluate analytical accuracy while percent relative standard deviation or the relative percent difference (RPD) between matrix spike analyses will be used to assess analytical precision.

9.2.3 Surrogate Analyses

Surrogates are organic compounds which are similar to the analytes of interest, but which are not normally found in environmental samples. Surrogates are added to samples, by the laboratory, to monitor the effect of the matrix on the accuracy of the analysis. Every blank, standard and environmental sample analyzed by GC or GC/MS, including MS/MSD samples, will be spiked with surrogate compounds prior to sample preparation.

Surrogates will be spiked into samples according to the appropriate analytical methods. Surrogate spike recoveries will be compared with the control limits set by procedures specified in the method (or from laboratory specific control limits) for analytes falling within the quantification limits without dilution. Dilution of samples to bring the analyte concentration into the linear range of calibration may dilute the surrogates out of the quantification limit; assessment of analytical quality in these cases will be based on the quality control embodied in the check and MS/MSD samples.

10.0 Procedures Used to Assess Performance

10.1 Precision

Precision will be assessed by comparing the analytical results between duplicate spike analyses. Precision as relative percent difference (RPD) will be calculated as follows:

$$\text{Precision} = \frac{(D_2 - D_1)}{(D_1 + D_2)/2} \times 100$$

D1 = matrix spike recovery
D2 = matrix spike duplicate spike recovery

Acceptance criteria for duplicate soil samples will be ≤30% RPD. Acceptance criteria for duplicate water samples will be ≤20% RPD between field and laboratory data.

Percent relative standard deviation or the RPD between matrix spike analyses will be used to assess laboratory analytical precision. Acceptable criteria and compounds that will be used are identified in the appropriate USEPA methods.

10.2 Accuracy

Accuracy will be assessed by comparing a set of analytical results to the accepted or "true" values that would be expected. In general, MS/MSD and surrogate spike recoveries will be used to assess accuracy. Accuracy as percent recovery will be calculated as follows:

$$\text{Accuracy} = \frac{A-B}{C} \times 100$$

A = The analyte determined experimentally from the spike sample.
B = The background level determined by a separate analysis of the unspiked sample.
C = The amount of spike added.

Percent spike recoveries in MS/MSD and surrogate spike recoveries will be used to evaluate analytical accuracy. Acceptable criteria and compounds that will be used for matrix spikes are identified in the appropriate EPA methods.

The evaluation of accuracy of field measurements will be limited to checking the reproducibility of the measurement in the field by obtaining multiple readings and by calibrating the instruments (where appropriate).

10.3 Representativeness, Completeness and Comparability

Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount that was expected to be obtained under normal conditions.

To be considered complete, the data set must contain all QC check analyses verifying precision and accuracy for the analytical protocol. In addition, all data are reviewed in terms of stated goals in order to determine if the database is sufficient.

When possible, the percent completeness for each set of samples will be calculated as follows:

$$\text{Completeness} = \frac{\text{valid data obtained}}{\text{total data planned}} \times 100 \text{ percent}$$

A completeness goal of 100 percent has been established for this project. However, if the completeness goal is not met, Site decisions may be based on any, or all of, the remaining, validated data. Representativeness will be addressed by collecting the samples as described in this document. Comparability will be addressed by collecting, analyzing, and reporting the data as described in this document.

10.4 Outliers

Procedures discussed previously will be followed for documenting deviations. In the event that a result deviates significantly from method established control limits, this deviation will be noted and its effect on the quality of the remaining data will be assessed and documented.

11.0 Quality Assurance Report to Management

11.0 General

The Aztech Project Manager will receive reports on the performance of the measurement system and the data quality following each sampling round and at the conclusion of the project.

At a minimum, these reports will include:

1. Assessment of measurement quality indicators; (i.e. data accuracy, precision and completeness);
2. Results of systems audits; and,
3. QA problems and recommended solutions.

Aztech's QA/QC Officer will be responsible within the organizational structure for preparing these periodic reports. The final report for the project will also include an overall data assessment and validation in accordance with the data quality objectives outlined in this QAPP.

ATTACHMENT 1
RESUMES

Thomas Giamichael, PG

Senior Hydrogeologist

Education

BA, Geology, State University of New York at Potsdam

Professional Affiliations

Hudson-Mohawk Professional Geologists Association
National Groundwater Association

Professional Registration & Activities

ACI Grade I Certification
Adult First Aid and CPR
Cleared and Fit Tested for Respirator Use
Confined Space Hazard Recognition Training
Loss Prevention System Certified
NY Asbestos Inspector Certification #16-10141
NYSDEC Erosion & Sediment Control Training (GP-0-15-002)
OSHA 40-Hour Hazwoper Training
OSHA 10-Hour Construction Safety Training
PCI Grade I Certification
Powered Industrial Truck Safety Training
QC/QA for Nuclear Density Testing Certification
NGWA Certified Well Driller
Licensed Professional Geologist
- New York

Experience and Qualifications

Mr. Giamichael has over 15 years of experience in environmental consulting and contracting as project manager, geologist, and hydrogeologist.

Aztech Environmental Technologies (Ballston Spa, New York)

2009 to Present

For the past 10 years at Aztech, Mr. Giamichael has functioned as a project manager, geologist, and hydrogeologist. His responsibilities and accomplishments include:

- Conducting and overseeing Comprehensive Environmental Site Investigation / Remediation Projects at:
  - RCRA facilities
  - CERCLA sites
  - Petroleum Bulk Storage facilities
  - Retail facilities
  - Industrial Facilities
  - Construction and Demolition Debris Landfills
  - Hazardous Waste Sites
- Management Experience
  - Maintaining project budgets
  - Development of project specific work plans
  - Oversight of project staff
  - Coordinating data collection and organization of reports
- Technical Experience
  - Developing an understanding of site conditions through analysis and interpretation of geologic and analytical data
  - Performing survey data collection and layout for drilling and excavation projects
  - Oversight of traditional methods drilling for soil borings, monitoring wells, remediation wells and caissons
  - Oversight and field assistance of Sonic drilling projects – Site superintendent for Sonic drilling of the 100 Oser Ave. Superfund Project
  - Well development and well rehabilitation experience for production, remedial injection and monitoring wells.
  - Pump testing experience performing 24 hour step-drawdown, constant rate and recovery tests.
  - Reduction of data, analysis and reporting for pump tests, aquifer performance testing and hydraulic conductivity testing in software such as Aqtesolv
  - Project management and direct field oversight of large scale remedial excavation projects for Hazardous and non-hazardous sites
  - Field inspection of soil bearing capacity at subgrade for foundations
  - Conducting geophysical surveys with Ground Penetrating Radar
  - Compiling and reducing data from sheer-wave velocity testing
  - Seismic refraction and electro-resistivity testing and interpretation of data
  - Petrological analysis of rock samples

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- Performing Atterberg limit tests
- Developing maximum dry density values for structural fills

Prior Professional Involvement

2007 to 2009 **Project Geologist / Case Manager**, Kleinfelder Eastern Division, Albany, New York

- Provided environmental and geological support on environmental and energy based projects from New York to Virginia. Responsibilities included:
  - Site conceptual modeling
  - Soil and groundwater data collection and interpretation
  - Technical report writing and proposal preparation
  - Direct client correspondence and financial management of various projects
  - Oversight of field work including drilling, UST closure and remedial excavation
  - Management of subcontractors and field personnel
  - Rock core logging and data interpretation of soil engineering characteristics
  - Preparation of boring logs
- Notable projects:
  - ExxonMobil Mackerel Program – Massive divestment program conducted through the Northeast.
  - Marble River Wind Farm – Geotechnical investigation for the installation of 70 wind turbines in Clinton County, New York.

2003 to 2007 **Staff Geologist**, CME Associates, Syracuse, New York

- Provided Geotechnical support on various large scale construction projects within the central and upstate areas of New York. Responsibilities included:
  - Soil and rock core logging
  - Oversight of caisson drilling and rock sounding
  - Oversight of pile installation and load testing
  - Shear wave velocity testing of completed borings
  - Test pitting and environmental excavation oversight
  - Inspection of soil competence during construction activities
  - In place field density testing of compacted soils
  - Onsite inspection of concrete
  - Conduct soil proctor analysis, sieve analysis and concrete compressional strength testing in the laboratory.
  - Report preparation

Aaron Yecies, CPG, PG

Senior Hydrogeologist/Director of Professional Services

Education

BA, Environmental Studies, Alfred University
BA, Geology, Alfred University

Professional Affiliations

American Institute of Professional Geologists – Northeast Section
Hudson-Mohawk Professional Geologists Association
National Groundwater Association
New York State Council of Professional Geologists

Professional Registration & Activities

Adult First Aid and CPR
AIPG Certified Professional Geologist
Cleared and Fit Tested for Respirator Use
Confined Space Hazard Recognition Training
DOT Training for Safe Transportation of Hazardous Materials
Lockout / Tagout Training
OSHA 40-Hour Hazwoper Training
OSHA 10-Hour Construction Safety Training
OSHA Site Supervisor Training
Powered Industrial Truck Safety Training
NGWA Certified Well Driller
Licensed Professional Geologist - New York
Transportation Worker Identification Credential (TWIC)

Experience and Qualifications

Mr. Yecies has over 19 years of environmental consulting and contracting experience as a project manager, geologist, hydrogeologist, and qualified environmental professional.

Aztech Environmental Technologies (Ballston Spa, New York)

2003 to Present

For the past 15 years at Aztech, Mr. Yecies has functioned as a project manager, geologist, hydrogeologist and qualified environmental professional. His responsibilities and accomplishments include:

- Conducting and overseeing Expedites Site Assessments (MIP, LIF, UVOST)
- Conducting and overseeing Comprehensive Environmental Investigation and Remediation projects at:
  - Petroleum bulk storage facilities
  - MOSF facilities
  - Retail stations
  - Pipelines
  - Residential and commercial properties
  - Industrial facilities
  - Landfills
- Conducting and overseeing Underground Storage Tank removals at PBS facilities and residential properties
- Conducting and overseeing geotechnical investigations and analysis
- Conducting and managing emergency response activities at retail petroleum facilities
- Management Experience
  - Coordinating emergency response actions with subcontractors and Aztech staff
  - Developing and maintaining project budgets for clients
  - Developing work plans and health and safety plans
  - Oversight of project and professional staff
  - Technical review and preparation of reports
  - Project review, planning and development meetings with clients
  - Understanding of regulatory compliance in New York State
  - Numerous spill case closures
- Technical Experience
  - Developing an understanding of site conditions through the development and execution of soil and groundwater characterization investigations in various media
  - Remediation system evaluations protocols for feasibility testing, design, operation and construction
  - Conducting aquifer pump tests and data analysis
  - Preparing soil management plans for commercial development

Aztech Environmental TECHNOLOGIES

Prior Professional Involvement

1999 to 2003 **Staff Geologist**, Groundwater & Environmental Services, Inc., Buffalo and Syracuse, New York

- Conducted and oversaw Comprehensive Environmental Investigation and Remediation projects at:
  - Petroleum bulk storage facilities
  - MOSF facilities
  - Retail stations
  - Pipelines
  - Residential and commercial properties
- Conducted and oversaw Underground Storage Tank removals at PBS facilities
- Conducted and oversaw geotechnical investigations and analysis
- Conducted Phase I Environmental Site Assessments
- Management Experience
  - Developed and maintained project budgets for clients
  - Developed work plans and health and safety plans
  - Technical review and preparation of reports
  - Project review, planning and development meetings with clients
  - Understanding of regulatory compliance in New York State
  - Numerous spill case closures
- Technical Experience
  - Developed understanding of site conditions through the development and execution of soil and groundwater characterization investigations in various media.
  - Remediation system evaluations protocols for feasibility testing, design, operation and construction.
  - Conducted aquifer pump tests and data analysis
  - Performed emergency response coordination and support at retail petroleum facilities

1996 to 1997 **Mentor/Technical Support**, Alfred University Environmental Studies Department, Alfred, New York

- Maintained field equipment and computer programs for the Environmental Studies Department
- Evaluated equipment needs and calibrate equipment

1995 **Explosives Technician**, St. Lawrence Explosives Company, Adams, New York

- Assisted with the borehole evaluations and pre-blasting site locations
- Conducted pre-blasting and post-blasting vibration monitoring at residences and businesses
- Operated groundwater vacuum extraction equipment prior to setting explosive charges

Abstracts

- Yecies, A., 2011, "Application of ISCO to Treat Aromatic Hydrocarbons in Challenging Conditions at Retail Petroleum Sites". The 27th Annual International Conference on Soils, Sediments, Water and Energy – University of Massachusetts, Amherst, MA

Randolph Hoose, PG

Senior Hydrogeologist

Education
MS, Geology/Hydrogeology, Wright State University
BS, Geology, Waynesburg College

Professional Affiliations
Hudson Mohawk Professional Geologist Association
New York State Council of Professional Geologists

Professional Registration & Activities
Adult First Aid and CPR
Confined Space Hazard Recognition Training
Lockout/Tagout Training
OSHA 40-Hour Hazwoper Training
OSHA 10-Hour Construction Safety Training
Powered Industrial Truck Safety Training
Licensed Professional Geologist
- New York
- Pennsylvania

Rail Safety Training
Supervisor Training

Experience and Qualifications

Mr. Hoose has over 33 years of environmental consulting and contracting experience as a project manager, hydrogeologist and qualified environmental professional.

Aztech Environmental Technologies (Ballston Spa, New York)

1999 to Present

For the past 20 years at Aztech, Mr. Hoose has functioned as a project manager, hydrogeologist and qualified environmental professional. His responsibilities and accomplishments include:

- Conducting and overseeing Environmental Site Investigation and Remediation Projects at:
  - NYS Superfund sites
  - Petroleum Bulk Storage facilities
  - Petroleum Retail facilities
  - Industrial Facilities
  - Hazardous Waste Sites
  - Private Residential Properties
- Management Experience
  - Client Liaison
  - Developing and maintaining project budgets
  - Developing project specific work plans
  - Overseeing project staff
  - Coordinating data collection and organization of reports
  - Interfacing with regulatory agency and public
- Technical Experience
  - Interpreting site-specific geologic and analytical data to develop an understanding of site conditions
  - Evaluating remedial goals and various remedial technologies for applicability to site conditions toward meeting remedial goals

Prior Professional Involvement

1996 to 1999 **Project Manager/Senior Hydrogeologist,** Tyree Organization, Ltd., Latham, New York

- Conducted and oversaw Environmental Site Investigation and Remediation Projects at:
  - Petroleum Bulk Storage facilities
  - Petroleum Retail facilities
  - Industrial Facilities
- Client Liaison
- Maintained project budgets
- Developed of project specific work plans
- Oversaw project staff
- Coordinated data collection and organization of reports
- Interfaced with regulatory agency and public

Aztech Environmental TECHNOLOGIES

- Interpreted site-specific geologic and analytical data to develop an understanding of site conditions.
- Evaluated remedial goals and various remedial technologies for applicability to site conditions toward meeting remedial goals.

1995 to 1996 **Lead Geologist,** Onsite Environmental/Metcalf & Eddy, Rensselaer, New York

- Conducted and oversaw Environmental Site Investigation Projects at:
  - Petroleum Bulk Storage facilities
  - Industrial Facilities
- Developed project specific work plans
- Coordinated data collection and organization of reports
- Interpreted site-specific geologic and analytical data to develop an understanding of site conditions.

1990 to 1995 **Project Geologist/Project Manager,** Dunn Geoscience/RUST Environment & Infrastructure, Albany, New York

- Conducted and oversaw Comprehensive Environmental Site Investigation Projects at:
  - RCRA facilities
  - CERCLA sites
  - Industrial Facilities
  - Construction and Demolition Debris Landfills
  - Hazardous Waste Sites
- Maintained project budgets
- Developed project specific work plans
- Oversaw project staff
- Coordinated data collection and organization of reports
- Interpreted site-specific geologic and analytical data to develop an understanding of site conditions.

1986 to 1990 **Field Geologist/Task Manager**, Environmental Resources Management, Inc., Exton, Pennsylvania

- Conducted and oversaw Comprehensive Environmental Site Investigation Projects at:
  - RCRA facilities
  - CERCLA sites
  - Industrial Facilities
  - Municipal Landfills
  - Hazardous Waste Sites
- Assisted in the development of project specific work plans
- Assisted in coordination of data collection efforts and report preparation
- Interpreted site-specific geologic and analytical data to develop an understanding of site conditions.

Benjamin Strickland

Project Manager

Education

BS, Geology, State University of New York at Potsdam

Professional Registration & Activities

ACL Level 1 Concrete Certified
Adult First Aid and CPR
Cleared and Fit Tested for Respirator Use
Erosion and Sediment Certified
OSHA 40-Hour Hazwoper Training
OSHA 10-Hour Construction Safety Training
Transportation Worker Identification Credential (TWIC™)
WACEL Soils Level 1 Certified

Experience and Qualifications

Mr. Strickland has over eight (8) years of experience in the environmental and geological investigation fields as project manager and geologist.

Aztech Environmental Technologies (Ballston Spa, New York)

2015 to Present

For the past four (4) years, Mr. Strickland has functioned as a project manager and geologist at Aztech. His responsibilities and accomplishments include:

- Overseeing and conducting soil and groundwater investigations
- Supervising subsurface drilling, excavations, pump tests, soil, groundwater, and air sampling
- Reducing field data and produce technical reports
- Gauging and sampling monitoring and remediation wells
- Assisting in construction and installation of subsurface environmental remedial systems
- Performing system checks and maintenance

Prior Professional Involvement

2014 to 2015 **Geologist**, Vermont Testing & Consulting, Waterbury, Vermont

- Conducted site visits.
- Collected soil cores.
- Soil work included use of a nuclear density gauge to measure the amount of compaction and insure minimized settling.
- Concrete work included testing for temperature, slump (how much water was added), and air entrainment.
- Prepared reports based on observations and results of the site visits and inspections.

2013 to 2014 **Geologist**, Specialized Engineering, Frederick, Maryland

- Worked closely with engineers to insure that soil or concrete met their specifications.
- Daily work included construction site visits.
- Measured compaction of soil for use in geotechnical application to minimize settling of soil.

2011 to 2013 **Geologic Assistant**, State University of New York at Potsdam, Potsdam, New York

- Worked in Geology Department as a teaching assistant.
- Taught introductory courses in geology.
- Researched environmental and political impacts of large refinery oil spills.

Aztech Environmental TECHNOLOGIES

APPENDIX C

HEALTH AND SAFETY PLAN (HASP)
COMMUNITY AIR MONIROING PLAN (CAMP)

SITE SPECIFIC HEALTH AND SAFETY PLAN
and
COMMUNITY AIR MONITORING PLAN

SUBJECT SITE:

338 Broadway
City of Kingston, Ulster County, New York

NYSDEC Site No. 356058

PREPARED FOR:
New York State Department of Environmental Conservation
Central Office
625 Broadway
Albany, New York 12233
Attn: Parag Amin

NEW YORK STATE OF OPPORTUNITY. Department of Environmental Conservation

PREPARED BY:
Aztech Environmental Technologies
5 McCrea Hill Road
Ballston Spa, New York 12233
Phone: (518) 885-5383

Aztech Environmental TECHNOLOGIES
A LaBella Company

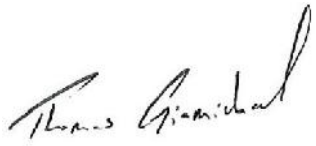
SITE SPECIFIC HEALTH AND SAFETY PLAN

Site No. 356058

338 Broadway
City of Kingston, Ulster County, New York

CERTIFICATIONS

By their signatures, the undersigned certify that this Site Specific Health and Safety Plan for Site characterization activities is approved and will be utilized at 338 Broadway and the surrounding area located in Kingston, New York and covers Aztech's responsibilities for their activities on the Site.



Thomas Giamichael, P.G. #0631
Qualified Environmental Professional

Garth Barrett
Health & Safety Officer

Table of Contents

ATTACHMENTS

APPENDIX A – Forms
APPENDIX B – Chemical SDS Sheets

1.0 Introduction

1.1 General

This Project Specific Health and Safety Plan (HASP) is designed to act as the document covering the work of Aztech's employees at the 338 Broadway project. At all times, Aztech employees will follow all the requirements of the Project Health and Safety Plan (HASP).

This HASP has been prepared to provide details of the health and safety procedures, methods and requirements for the implementation of the remedial activities. Project Site activities include the following components:

- Traffic Safety and Awareness
- Geophysical investigation
- Surface sampling
- Soft digging practices
- Soil gas sampling
- Saw cutting activities
- Soil boring and Drilling
- Soil cutting and waste water containment and disposal
- Drum handling
- Soil and groundwater sampling;
- Surface restoration of borehole locations at the Site;
- Demobilization.

The objective of this plan is to provide a mechanism for establishing safe working conditions at the project Site. The safety organization, procedures and protective equipment have been established based on an analysis of potential physical, chemical and biological hazards. Specific hazard control methodologies have been evaluated and selected to minimize the potential of accident or injury.

This HASP discusses general safety hazards associated with specific field activities outlined in the scope of work for this project. This plan also specifies minimum safety precautions for various field activities. All subcontractors must review these activities and safety procedures with respect to their own standard safe operating procedures, provided the minimum requirements set forth in this HASP, 29 CFR 1910 and 29 CFR 1926 are met. All subcontractors are responsible for operating in a safe and healthful manner in order to protect their personnel and all Site personnel.

1.2 Project Site Information

The 338 Broadway Site is located in the City of Kingston, Ulster County, New York and currently includes 338 Broadway (AAA Well Suited Uniforms). Adjacent properties also included in the study area include 336 Broadway (Bob's Automotive Repair), 15 Jansen Avenue (residence), and 17 Jansen Avenue (unoccupied).

Immediately to the west of the Site is Kennedy Fried Chicken & Pizza at 242 Broadway. Immediately to the east is a Burger King Restaurant (322 Broadway). Jansen Avenue and Broadway border the Site to the north and south, respectively.

The 338 Broadway property includes a three (3) story building on a south side of a single tax parcel totaling approximately 0.23 acres. The Site had been used as a dry cleaning operation in the 1950s.

Previous subsurface investigations performed by others documented the presence of chlorinated volatile organic compounds (PCE, TCE, cis-1,2-DCE & trans-1,2,dichloroethene) in groundwater samples collected at 322 Broadway (Burger King), to the east and hydraulically downgradient of 338 Broadway.

Project work performed under this HASP will occur in areas to further assess the existence and extent of chlorinated solvent contaminants that were identified on the 322 Broadway property.

Aztech has been contracted to perform work activities detailed in the NYSDEC Callout#137372. The general field scope of work includes:

- Land survey;
- Geophysical survey;
- Collection of surface soil samples;
- Installation of soil borings to be completed as groundwater monitoring wells;
- Installation of soil gas and sub-slab vapor points;
- Collection and analysis of soil, soil vapor and groundwater samples for parameters of concern.
- Equipment cleaning.

1.3 Potential Chemical Hazards

Chemicals of concern (COCs) at the Site include volatile organic compounds (VOCs) related to historical dry cleaning operation at the Site. The primary concern at this time includes chlorinated volatile organic compounds (CVOCs) and their subsequent break down components. These compounds are listed below:

- Tetrachloroethene (PCE)
- Trichloroethene (TCE)
- Cis-1,2-Dichloroethene
- Vinyl Chloride
- Carbon Tetrachloride

As noted above these compounds were identified in groundwater samples collected at a nearby offSite property. Other chemicals of concern at the Site may be revealed during the Site characterization work and this HASP will be amended to specifically identify those hazards. Other

chemical hazards may include: metals, Polychlorinated biphenyls (PCBs), Pesticides/Herbicides, Per- and Polyfluoroalkyl Substances (PFAS).

2.0 Emergency Information

2.1 Emergency Telephone Numbers

Hospital	HealthAlliance Hospital	396 Broadway, Kingston, New York (845) 331-3131
Ambulance		911
Fire Department		911
Police Department		911
Gas/Electric	Central Hudson Gas & Electric	Gas Leak only – (800)942-8274 Elec. Haz only - 911
National Response Center (for all emergencies)	USCG	800-424-8802
Aztech Technologies, Inc.		
In case of accident notify:		
Project Manager	Thomas Giamichael	(518)337-7635
Aztech H&S Officer	Garth Barrett	(518)361-8450
Office	Jutta Farrell, Human Resources	(518) 885-5383

2.2 Hospital Route

1. From Site, travel west on Broadway 0.2 miles
2. Turn right at City Hall. 210 feet
3. Hospital is on the right.

Distance: 0.3 miles
Estimated Time: 2min

3.0 Site Organization Responsibilities

3.1 Overview

All personnel will be responsible for continuous adherence to the procedures set forth in the HASP during the performance of on-Site activities. In no case may work be performed which conflicts with the intent of or the inherent safety and environmental cautions expressed in these procedures. If Aztech or subcontractor personnel are found violating safety and health procedures they will be subject to disciplinary action up to and including dismissal.

3.2 Site Access

Prior to initial Site activities the Site primary and secondary emergency evacuation routes will be posted so all workers on Site are aware of the evacuation routes and procedures. Additionally, no worker may be allowed access to the Site until all required Site training has been satisfactorily received. Minimum Site training requirements are presented in the following section.

3.3 Project Safety and Health Training Requirements

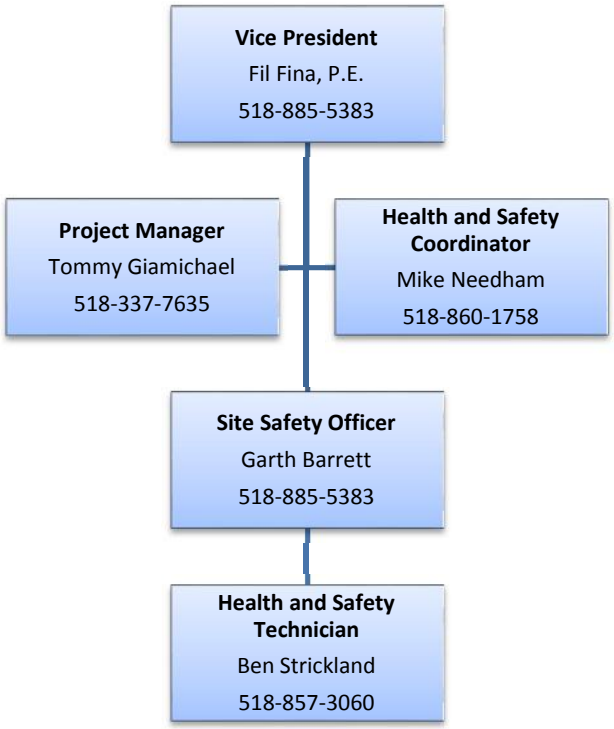
All personnel permitted to access the Site shall at a minimum receive OSHA 24-hr Hazwoper training to satisfy the standards setforth in 29CFR 1910.120(e). Personnel who have previously received training for OSHA 40-hr Hazwoper will supersede the OSHA 24-hr requirement. In addition to holding the proper Hazwoper certificate, each employee permitted to work on the Site will be required to maintain a current 8-hr OSHA refresher certificate. Copies of the appropriate certificates for each employee will be maintained onsite and available for review.

For each new field work assignment, the Project Manager shall initiate a work order that includes hospital and emergency information relevant to the area which will then be provided to the employee responsible for conducting the work who shall return the documentation to the Office Manager where it shall be stamped “Completed”, the information disseminated to the Project Manager and later filed. Each manager or supervisor visiting a field work Site shall complete a Health and Safety Spot Inspection Form for the Site that they have visited. Completed forms (**Appendix A**) shall be returned to the Health and Safety Officer and the relevant Project Manager or Supervisor.

Health and Safety Checklist shall be completed by the job Foreman or Supervisor on the Site at the time of first visit to the location, where it will be completed and sent with the timesheet to the Field Safety Coordinator. The form shall also be used for conducting toolbox talks on Site daily and then forwarded to the Field Safety Coordinator, who will in turn, send documentation to the Health and Safety Officer.

3.3 Project Manager and Site Health and Safety Structure

The project manager is ultimately responsible for field implementation of the safety and health program. This includes communicating specific health and safety requirements to Site supervision regarding planned activities, unforeseen conditions, and resolution of any questions with identified safety procedures or levels of protection to be used. The structural flow of health and safety roles specific to this Site area as follows:



4.0 Chemical, Physical, and Biological Hazards

4.1 Overview

The purpose of this section is to identify the physical, chemical, and biological hazards associated with implementation of the activities at the Site. Subsections of this section will discuss each task or operation for the project in terms of the general hazards associated with it. The following sections will identify the protective measures to be implemented during the performance of each specific activity. If additional activities beyond those identified are conducted onsite by Aztech or its subcontractors, a supplemental health and safety task analysis will be performed specifically for those activities. The purpose of this information is to maintain an accident and injury free work Site. This section will also outline the specific chemical contaminants of concern, as well as anticipated physical hazards that may be encountered at the Site.

4.2 Chemical Hazards

Chemical hazards associated with the 338 Broadway Site involve the potential contact with soils and water containing the contaminants of concern on the Site. Specific chemicals of concern related to the Site are reported in Section 1.3. Their respective safety data sheets are included in **Appendix B.**

In general, skin absorption, inhalation and ingestion are identified as potential routes of exposure for the contaminants. Workers in the exclusion zone where the waste is to be removed may potentially be exposed to significant airborne concentrations of COCs.

The major route of chemical exposure will be from inhalation, ingestion or dermal contact with contaminated material. These routes of chemical exposure will be significantly reduced through the proper use of personal protective equipment and good personal hygiene. Historical monitoring and sampling data indicates that the potential for exposure from contaminated soils occurs mainly during the excavation and transfer of soils.

4.2.1 Chemical Hazards Onsite

At all times Aztech employees exposures must remain below the OSHA PELs for all chemical hazards onsite. At any time that air monitoring identifies airborne contaminants at sustained levels above the PELs for 15 minutes or more, work will be halted until engineering controls and/or an upgrade in PPE is established to reduce worker exposure to below OSHA levels.

4.2.2 Chemical Hazards Brought To Site

When chemicals are used on-Site, workers must adhere to the Hazard Communication Program (i.e., 29 CFR §1910.1200). The following procedures must be followed for all chemicals brought on-Site.

- Labels on incoming primary chemical containers must not be defaced.
- Chemical containers must be stored in appropriate storage cabinets.
- Secondary containers and storage cabinets must be correctly and clearly labeled using the Hazardous Materials Identification System (HMIS).
- Incompatible chemicals must not be stored together.
- A MSDS for each chemical must be included in the onsite MSDS book.
- Workers must receive training on the hazards of the chemicals included in MSDS book.

4.3 Physical Hazards

The topics below identify the type of physical hazards, which may be present on the Site during remedial activities:

- **Slip, Trip, Fall**—These type hazards result from unleveled surfaces, slippery surfaces, and hard to see objects located across walking paths (i.e., rope, cords), and are responsible for a large majority of work-related injuries. A fall hazard may originate as a result of the void created by excavations and uneven surfaces on the Site.

- **Heavy Equipment**—Heavy equipment is necessary for clearing the forest, road construction, excavation and transport of materials. Associated hazards include: energized machinery; poor operator visibility; and inability to be fully aware of surroundings at all times (i.e., people, mobile and stationary objects). Severe slopes may be present which present potential rollover and fall hazards to operators and Site personnel.

- **Excavations**—Excavation at the Site has the potential to create hazards to Site personnel. For example, equipment may fall into open excavations. Workers may also fall into excavated areas. Excavations may cave in if not properly sloped or shored. Also, excavations may fill with water following extensive rainfall.

- **Oxygen-Deficient Atmosphere**—Oxygen-deficient atmospheres may occur in some areas on-Site, including excavation areas. OSHA defines oxygen deficient atmospheres as environments with less than 19.5% oxygen content, by volume. For Site operations, where oxygen deficiency is suspected or may exist, measurements will be performed to quantify oxygen levels prior to any entry. If oxygen deficiency is determined, appropriate ventilation must be performed prior to entry. Also, the requirement for confined space entry [see *Aztech's Permit-required Confined Space Program*] must be followed (testing, approvals, permit, etc.).

- **Drum Handling**—Should Site activities uncover buried drums, unknown containers, or other unknown contaminants, the procedure will be to cease operations, evacuate the immediate area, and notify the Project Manager. Prior to resuming activities in the immediate area, all unknown situations must be evaluated and identified. This may require bringing in a specialized contractor trained in the safe methods for identifying and handling unknown contaminants.

- **Housekeeping and Sanitation**—In order to permit safe and efficient work conditions, all work areas shall be kept clean and free of debris. All office trailers will be mopped and cleaned on a weekly basis. All hand tools will be kept in storage until they will be needed for use. Trash containers will be leak proof, clean and maintained in a sanitary condition. If vermin are encountered, an approved extermination method will be initiated.

- Potable water will be used for first aid, drinking, and personal hygiene purposes. All floors will be kept free of standing water. Disposable drinking cups will be provided along with the water coolers. Community drinking cups will not be permitted.
- Portable toilets will be provided on Site, if required, a minimum of one (1) toilet for each 15 employees, separate and designated by gender. The toilets will be maintained on a weekly basis.

- **Toxic atmospheres** —Toxic atmospheres may exist around the excavation areas, material staging areas, and material load-out areas. By nature of the work to be performed, varying concentrations of toxic airborne contaminants may be generated. In the disturbance of affected soils and dusts, the human sense of smell is not sufficient to provide adequate warning of unsafe levels of airborne substances. Where affected materials may exist, frequent monitoring will be performed by a combination of personal monitoring with analysis of samples and by real time direct-reading instrumentation.

- **Falling Objects**—Operations of tree felling and excavating equipment on-Site can create hazards from falling objects. Hard hats, safety glasses, and steeled-toed footwear will be required for personnel on Site.

- **Lighting Levels**—For work activities scheduled after dusk, poor lighting conditions may increase risk of injury. Low light levels may exist in confined spaces as well. If work is to be performed after dusk or before dawn, supplemental Site and vehicle lighting will be used. No operations will be performed after these periods of the day without both supplemented and vehicle lighting systems.

- **Heat Stress**—Heavy construction work in the summer months can create heat stress conditions for employees. The use of respiratory protective equipment and protective (non-breathable) clothing, boots, and gloves can greatly increase the potential for heat stress.

- **Cold Stress**— Cold-related problems are the result of low ambient temperatures and/or wind velocity. Wind chill is the term used to describe the effect of moving air on human flesh. Frostbite and hypothermia are the two cold-related problems of concern.

- **Electrical**—**Electrical** hazards may exist during maintenance, operation and mobilization activities. Employees will be trained in and shall use Lockout/Tagout procedures as required.

- **Traffic Safety**—During operations, there may be a significant level of traffic coming to and from the Site. Pedestrian traffic on the Site may be at risk as traffic enters and leave the Site.

- **Unleveled Surfaces**—Unleveled surfaces result from excavation activities and the natural terrain in some areas. These areas will be flagged or roped off to eliminate traffic.

- **Flammable Atmosphere**—Flammable atmospheres may exist around buried lines and unidentified tanks, but are not expected. The Project Manager will be notified if any potentially hazardous atmospheres are discovered.

- **Noise**—High noise levels (in excess of 85 dBA for extended periods) can result in temporary and permanent loss of hearing. Areas where noise levels exceed 85 dBA will be posted and hearing protection will be provided and worn. Noise dosimetry will be performed where required by OSHA regulation.

- **Compressed Gases**—Stored energy in cylinders, when released, can result in projectiles. Fire and explosion will result from the ignition of flammable gases. Toxic or oxygen-deficient atmospheres will result from the release of gases in confined spaces.

- **Fire**—Many ignition sources exist on Site, which may cause a fire. Fuel sources may exist in the form of flammable liquids, combustible materials and flammable gases. Accumulation of debris can contribute fuel to fires. Improper storage and use of flammable materials may result in a fire.

4.4 Biological Hazards

It is unlikely biological hazards will be encountered within the designated drilling locations. However, potential biological hazards include plants, ticks, snakes, ants and various stinging insects. Some of the most common biological hazards can be prevented or the effects reduced by over the counter medications. These medications, as recommended by local pharmacists, will be kept in supply in the office first aid kit. Workers who know they are sensitized to any biological hazard should not perform any task that would increase their risk for anaphylactic shock.

4.4.1 Poisonous Plants

Common poisonous plants on Site may include plants from the poison ivy group, including poison oak and sumac. The most distinctive features of poison ivy and oak are that their leaves are composed of three leaflets (Figure 4-1). Both of these plants have greenish-white flowers and berries that grow in clusters. These plants can produce a severe rash characterized by redness,

blisters, swelling, and intense burning and itching. The victim may also develop a headache, high fever and feel very ill. The rash appears within a few hours of contact, but may be delayed from 24 to 48 hours. If contact occurs with a poisonous plant, remove all contaminated clothing and wash any exposed skin thoroughly with soap and water, followed by rubbing alcohol. Apply calamine lotion if rash is mild. Seek medical advice if a severe reaction occurs or if there is a known history of previous sensitivity. If a poisonous plant is found in the work area, the SSHR should be notified so that it can be removed. All personnel working in an area with poison ivy should wear a Tyvek® suit, at a minimum, to avoid skin contact.

Figure 4-1
Poisonous Plants

Poison Oak

Poison Ivy

4.4.2 Poisonous Plants

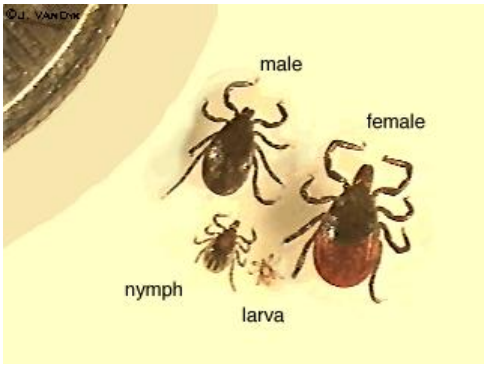
Ticks are wingless, bloodsucking insects. Certain types of ticks can carry diseases such as Rocky Mountain Spotted Fever (RMSF) and Lyme's Disease.

Symptoms of RMSF include the sudden onset of moderate to high fever, severe headache, fatigue, deep muscle pain, chills and rash.

Figure 4-2
American Dog Tick (dermacentar *variables*)

Lyme disease is caused by a bacteria transmitted by the deer tick (Ixodes s*capularis*) (Figure 4.3). The chances of being bitten by a deer tick vary depending on the time of year. Deer ticks in the nymphal stage are active from mid-May to mid-August. Adult deer ticks are most active in mid to late fall. In 60-80% of cases, a large, reddish rash about 2 inches in diameter appears around or near the Site of the bite. This rash is sometimes referred to as the bull's eye rash. Multiple rashes may occur. Symptoms of Lyme disease include chills and fever, headache, fatigue, stiff neck, muscle and/or joint pain, and swollen lymph nodes. If left untreated, serious nerve and heart damage may develop. The rash may develop from three days to a month after the tick bite. Early treatment of Lyme disease symptoms with antibiotics can prevent the more serious medical problems of the later stages of the disease. If you suspect that you have been bitten by a tick or you have symptoms of Lyme disease, notify the SSHR or your physician.

Figure 4-3
All Four Stages of the
deer tick (Ixodes *scapularis*)



When working in high grasses or brush, on-Site personnel should wear Tyvek® coveralls and boot covers with the joints taped. An insect repellant containing DEET is also recommended. It has been proven that the longer an infected tick remains on the body, the greater the chance that it will transmit disease. Because of this, workers should check themselves for ticks on a regular basis.

If an attached tick is found, remove it by grasping the tick with a pair of tweezers as close to the skin as possible. Be careful not to leave any part of the tick attached. The skin area of the victim should be marked or circled to indicate where the bite occurred. The tick should be placed in a container or zip-lock bag and marked as to the date, time and body area from which it was removed. Universal precautions (Section 4.5) should be used during this procedure. The area should be washed with soap and water and then covered with an antibiotic ointment to prevent infection.

4.4.3 Snakes

To prevent snakebites, wear shoes and heavy pants where snakes are likely found (i.e. near water, thick brush). Do not reach into rocky cracks, under logs, or large rocks. Do not touch a snake even if it looks dead. Do not get near or tease a snake. If someone is bitten by a snake, keep warm and rested. Take them to the nearest hospital immediately (if possible, bring the

snake). Do not give them anything to eat or drink. Do not use a tourniquet. Do not cut the bite or suck out the venom. Do not put ice on the Site of the bite.

4.4.4 Insect Stings

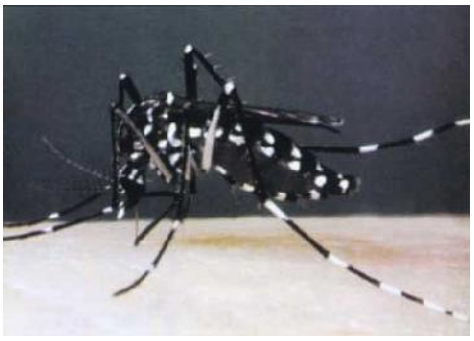
Stings from insects are often painful, cause swelling and can be fatal if a severe allergic reaction such as anaphylactic shock occurs. If a sting occurs, the stinger should be scraped out of the skin, oppoSite of the sting direction. The area should be washed with soap and water followed by an ice pack. If the victim has a history of allergic reaction, he should be taken to the nearest medical facility. If the victim has medication to reverse the effects of the sting, it should be taken immediately. If the victim experiences a severe reaction, a constricting band should be placed between the sting and the heart. The bitten area should be kept below the heart if possible. A physician should be contacted immediately for further instructions.

4.4.5 Mosquitos

Mosquitoes are the vector that is common in the Southeastern United States. Due to the recent outbreaks of the West Nile virus, it is important to be educated on the prevention of mosquito bites. West Nile virus is spread by the bite of infected mosquitoes, and may infect people, horses, birds, and other animals. Most people who become infected with West Nile virus will have either no symptoms or only mild ones. However, on rare occasions, West Nile virus infection can result in a severe and sometimes fatal illness known as West Nile encephalitis (an inflammation of the brain). The population with the highest risk are persons 50 years of age and older. There is no evidence to suggest that West Nile virus can be spread from person to person or from animal to person.

To avoid mosquito bites, apply insect repellent containing DEET (N,N-diethyl-meta-toluamide) when outdoors and wear long-sleeved clothes and long pants during peak mosquito feeding hours (dusk until dawn). Eliminating standing water sources around the jobSite will also prevent mosquitoes from nesting.

Figure 4-4
Mosquito



4.4 Biological Hazards

The majority of the occupational tasks on-Site will not involve a significant risk of exposure to blood, blood components, or body fluids. The highest risk of acquiring any blood-borne pathogen for employees on-Site will be following an injury. When administering first aid care, there are potential hazards associated with blood-borne pathogens that cause diseases such as Human Immunodeficiency Virus (HIV), Hepatitis B (HBV), Hepatitis A (HAV), Hepatitis C (HCV), or the Herpes Simplex Virus (HSV). An employee who has not received the appropriate certification should never execute first aid and/or CPR.

In order to minimize any potential pathogen exposure, all employees should use the hand washing facilities on a regular basis. The decon area will provide an adequate supply of water, soap and single use towels for hand washing. Additionally, the following universal precautions should be followed to prevent further potential risk:

- Direct skin or mucous membrane contact with blood should be avoided.
- Open skin cuts or sores should be covered to prevent contamination from infectious agents.
- Body parts should be washed immediately after contact with blood or body fluids that might contain blood, even when gloves or other barriers have been used.
- Gloves and disposable materials used to clean spilled blood shall be properly disposed of in an approved hazardous waste container.
- First aid responders shall wear latex or thin mil nitrile gloves when performing any procedure risking contact with blood or body substances.
- Safety glasses will be worn to protect the eyes from splashing or atomization of body fluids.
- A CPR mask will be worn when performing CPR to avoid mouth-to-mouth contact.
- Work gloves will be worn to minimize the risk of injury to the hands and finger when working on all equipment with sharp or rough edges.
- Never pick up broken glass or possible contaminated material with your unprotected hands

5.0 Training and Medical Program

5.1 Employee Training Requirements

All Aztech personnel at the Site will have training relative to their job responsibilities or role at the jobSite. Such training will be provided prior to their being allowed to engage in Site activities that could expose personnel to health and safety hazards. The Project Manager or designated alternate has the responsibility to ensure this training is provided—reflective of Site conditions—and is updated as needed.

All personnel who will work on the Site will be required to read this HASP. Prior to work on the Site, each individual must read and sign a **Site Health and Safety Plan Acknowledgement Form** *(Appendix A)* indicating they have read and understand the requirements set forth in this HASP.

5.2 General Medical Program

Aztech will maintain medical surveillance records for its employees and require lower-tier subcontractors to do likewise. These records will be available to the regulatory agencies upon request by appropriate officials following all rules prescribed under 29 CFR 1910.120. A medical clearance form will be kept on Site for each employee and subcontractor personnel. These records will be maintained for the duration of employment plus 30 years.

5.2.1 Respirator Certification

Prior to authorizing the use of any air purifying or supplied-air respirator, OSHA, under 29 CFR 1910.134 and 29 CFR 1925.58, requires that a determination be made regarding the prospective wearer's physical ability to safely use such equipment. Consequently, individuals scheduled to work in areas that require the use of respiratory protection will have current documentation, signed by a qualified physician, regarding the individual's physical ability to wear a respirator on file with the company. The medical clearance form will indicate the employee's ability to wear respiratory protection on the Site. In addition to the medical clearance, an annual fit test will be issued to each employee.

5.2.2 Exposure/Injury Medical Emergency

As a follow-up to an injury or illness, or as a result of potential exposure to either a chemical or physical hazard, all employees are entitled and required to seek appropriate medical attention. The Project Manager or designated alternate must be apprised of the need for seeking such medical attention and assist in determining the immediacy of the situation

6.0 Site Control

6.1 General

Site control will minimize the potential contamination of workers and observers, protect the public from potential on-Site hazards, and prevent vandalism of equipment and materials. Site control measures also enhance response in an emergency. The Site field operations will be divided into three work zones. These zones are described below:

1. **Exclusion Zone (EZ)**—The exclusion zone will encompass: the excavation area; the waste segregation area; and, the waste staging area. This area will be located within the extents of the Brown Field Cleanup Property (BCP). Personal

protective equipment is required in this area. The EZ must be clearly demarcated by barricades or barrier tape that will be placed a minimum of 3 feet from the edge of an active operation. Excavation deeper than three (3) feet is not anticipated. However, in the event that excavation depth totals 6 feet or greater, a barrier (i.e. high visibility fence) must be put up a minimum of 6 feet from the excavation. Some situations may necessitate a distance less than the recommended minimum. These instances should be reviewed by the Project Manager.

Visitors are not permitted into controlled zones (EZ and CRZ) without the approval of management. Additionally, visitors must have satisfactorily completed the required OSHA training, be properly fitted with respiratory protection, and have medical clearance, as required.

2. **Contamination Reduction Zone (CRZ)**—The CRZ will be located in the area immediately to the west of the EZ, adjacent to the staging area. This area is used to minimize the potential for contact with contaminated soils by decontamination and other work practices. The CRZ will include facilities for personnel or equipment decontamination. Personal protective equipment worn in the EZ may not be worn outside the CRZ except during emergencies.
3. **Support Zone (SZ)**—All areas outside the CRZ and EZ. The exposure potential in these zones is minimal. SZs provide a changing area for personnel entering the CRZ and EZ, a lunch area, office space, and clean equipment and material storage. Protective clothing worn in an EZ may not be worn in a Support Zone except in an emergency.

The final locations of these zones will be determined and modified as necessary in the field. In addition, it may be necessary to make modifications as weather and Site conditions change. Movement of personnel between the three zones will be limited through specific access control points to prevent cross-contamination from contaminated to clean areas. If these zones change during progress of the work, the changes will be reviewed at the daily safety meeting with all Site personnel and Site visitors.

7.0 Community Air Monitoring Plan

7.1 General

Community air monitoring will include the following elements:

1. Ambient dust will be monitored using three aerosol / dust meters; one (1) upwind, one (1) in the immediate workzone, and one (1) downwind.

2. Volatile organics will be monitored by three (3) PID meters (in conjunction with the dust meters)
3. Meteorological Weather Data will be obtained from the local weather station via the internet.

7.1.1 Ambient Dust

Dust monitoring will be performed using an aerosol / dust meter (TSI 8530 Dust Trak II or equivalent) and will monitor particulate matter in a range of 0 – 10 microns diameter. Dust monitoring shall be performed when Site activities have the potential to disturb soils or create dust which may contain contaminates of concern (COCs). Dust monitoring will be waived on days where precipitation prevents dust migration or when Site activities are not likely to generate dust.

Particulates will be continuously monitored upwind and downwind. If the downwind particulate levels are 0.1 ug/m3 to 0.15 ug/m3 above background particulate level then dust suppression techniques will be employed or work will be suspended until dust levels are reduced.

7.1.2 Volatile Organics

Volatile Organic and Semi-Volatile Organic compound (VOCs and SVOCs) vapors will be monitored continuously during intrusive Site activities using a photo ionization detector(PID MiniRae 3000 or equivalent).

If the ambient air concentration of total VOCs at any one of the downwind perimeter monitor locations exceeds 5 ppm above the background concentration (determined by the upwind monitoring location) for the 15- minute average, intrusive activities will be temporarily halted while monitoring continues, and, as necessary, engineering controls will be implemented. If the total VOC concentration readily decreases (through observation of instantaneous readings) below 5 ppm above background, then intrusive activities will resume and monitoring will continue.

If the ambient air concentrations of total VOCs at any one of the downwind perimeter locations persist at levels in excess of 5 ppm above background, intrusive activities will be halted, the source of the elevated VOC concentrations will be identified, corrective actions to reduce or abate the emissions will be undertaken, and air monitoring will be continued. Once these actions have been implemented, intrusive activities will resume provided that the 15-minute average VOC concentrations remain below 5 ppm above background at the downwind perimeter of the work area.

7.2 VOC and Dust Control Measures

During times of Site monitoring, action levels may be observed. At those times control measures will be required to rectify the problematic exceedance. Typical VOC and Dust control measures may include:

- Apply water for dust suppression
- Relocate operations, if applicable
- Slow the pace of the excavation/drilling of material processing

8.0 Safe Work Practices

8.1 General

To maintain strong safety awareness and enforce safe procedures at the Site, a list of standing orders has been developed stating the practices that must always be followed and those that must never occur in the EZ and CRZ on-Site. The list of standing orders is as follows:

1. No smoking, eating, or gum chewing will be permitted in the EZ or in the CRZ;
2. Fieldwork will only be conducted during daylight hours unless adequate artificial lighting is provided;
3. All personnel are required to read the HASP, and sign all appropriate forms prior to initiating work;
4. Personnel will be advised of the precautions to be taken against heat/cold stress;
5. Walkways will be kept clear of equipment, sampling materials, and other obstructions.

Appropriate warning signs, devices, and fences will be erected and posted.

In addition to the standing orders, the Site's Hazard Communication Program will include MSDSs, which list the names and properties of chemicals present on the Site. All chemicals that are used on-Site will be properly stored and labeled. Employees will be briefed on this information at the beginning of the project or whenever they first join the work team.

Each sample cooler will contain an appropriately completed COC form. One (1) copy will be returned to Aztech upon receipt of the samples by the laboratory. One (1) copy will be returned to Aztech with the data deliverables package.

Upon receipt of the cooler at the laboratory, it will be inspected by the designated sample manager. The condition of the cooler and sample containers will be noted on the COC

record sheet by the sample manager. The sample manager will also document the date and time of receipt of the container and sign the form.

If damage or discrepancies are noticed, they will be recorded in the remarks column of the record sheet, and be dated and signed. Any damage or discrepancies will be reported to the lab supervisor who will inform the lab manager, QA Officer and Aztech Project Manager.

8.1.1 Personal Protective Equipment (PPE)

With regard to the anticipated tasks and contaminants of concern associated with the Site, Level D protection will be utilized during all phases of work onsite. The personal protective equipment (PPE) required for Level D protection will include but is not limited to the following;

- Hard Hat
- Safety glasses with side shields
- Leather work shoes with steel toe and shank
- Gloves, chemical and abrasion resistant dependant on task
- Hearing protection (as needed)
- Face shield (as needed)

All required Level D PPE shall be donned prior to performing any task associated with Site work. More stringent PPE requirements are not anticipated at the Site. However, the level of protection being used may be upgraded to Level C, which will require the use of a respirator equipped with a particulate filter if conditions during excavation warrant the upgrade. The Site safety officer will monitor the usage of proper PPE in compliance with this HASP.

8.2 Heavy Equipment Operation

Working with tools and heavy equipment (e.g., Drilling and excavation equipment) is a major hazard at the Site. Injuries can result from equipment hitting or running over personnel, impacts from flying objects, burns from hot objects, and damage to PPE. The following general precautions will be followed to help prevent injuries from such hazards:

- Before any heavy equipment, machinery or mechanized equipment is placed in use, it will be in safe operating condition. Records of the inspections (performed each shift and weekly) will be maintained at the Site and will be available on request to the designated authority.
- The Site superintendent will designate a competent person to be responsible for the daily inspection of all machinery/equipment and during use to make sure it is in safe operating condition. Checks will be made at the beginning of each shift. The equipment to be used will be tested to determine that the brakes, safety stops and other operating systems are in proper working condition.

- Preventative maintenance procedures recommended by the manufacturer will be followed.
- Any machinery or equipment found to be unsafe will be sidelined, tagged as unsafe, and its use prohibited until safe conditions have been restored.
- Machinery and mechanized equipment will be operated only by designated, experienced and qualified personnel. Equipment deficiencies observed at any time that affect their safe operation will be corrected before continuing operation.
- Getting off or on any equipment while in motion is prohibited.
- Machinery or equipment will be shut down and positive means taken to prevent its operation while repairs or manual lubrications are being done. (***Exemption:*** *Equipment designed to be serviced while running).*
- Bulldozer and scraper blades, front-end loader buckets, dump bodies, and similar equipment will be either fully lowered or blocked when being repaired or when not in use. All controls will be in a neutral position, with the engines stopped and brakes set, unless work being performed on the machine requires otherwise.
- All points requiring lubrication during operation will have fittings located and guarded as to be accessible to employees without potential for injury.
- When necessary, all mobile equipment and the area in which it is operated will be adequately illuminated while work is in progress.
- Mechanized equipment will be shut down prior to and during fueling operations. Closed systems, with automatic shutoff that will prevent spillage if connections are broken, may be used to fuel diesel-powered equipment left running.
- All towing devices used on any combinations of equipment will be structurally adequate for the weight drawn and securely mounted.
- Personnel will not be permitted to get between a towed object and towing piece of equipment until the towing equipment has been stopped and secured by setting the brakes, placing in neutral, and choking.
- All equipment with windshields will be equipped with powered wipers. Vehicles that operate under conditions that cause fogging or frosting of windshields will be equipped with operable defogging or defrosting devices.
- The controls of loaders, excavators, or similar equipment with folding booms or lift arms will not be operated from a ground position unless so designed.
- All self-propelled construction equipment (except light service trucks, panels, pickups, station wagons), crawler cranes, power shovels, and draglines, whether moving alone or in combination, will be equipped with a reverse signal alarm. The alarm will be audible and sufficiently distinct to be heard above prevailing conditions and will operate automatically upon commencement of backward

motion. The alarm may be continuous or intermittent (not to exceed three-second intervals) and will operate during the entire backward movement.

- All bulldozers, tractors, or similar equipment used in clearing operations will be provided with substantial guards, shields, canopies, and grills to protect the operator from falling and flying objects as appropriate to the nature of the clearing operations.
- Trucks will not trail debris or track mud outside the CRZ. Visible loose dirt will be removed. Pressure washing will be used where required to remove dirt.
- Operators will be required to wear seat belts while operating equipment equipped with a Roll-Over Protection System (ROPS).

8.3 Electrical Safety

Working with electrical systems to install necessary services to buildings and equipment presents safety hazards. Lack of basic electrical safety and sound wiring practices can result in fatalities due to electric shock.

- Three-wire (grounded) systems with ground fault circuit interrupters (GFCI) will be used on all temporary 110-volt electrical systems (extension cords, etc.).
- Wiring and grounding of all new facilities will be in accordance with the latest edition of the NEC.
- Wiring will be performed by a qualified electrician.
- No work will be performed on energized electrical systems capable of delivering current greater than 0.005 amps.
- Any wiring required will be protected from the elements while in use.
- High-voltage overhead lines will be identified to all equipment operators and safe clear distances will be maintained at all times.

8.4 Heat Stress

To minimize the likelihood of employee heat stress, all workers must observe the following at temperatures above 70 ⌈F:

- Avoid prolonged periods of high heat stress;
- Take regular breaks;
- Consume increased amounts of fresh water (or Gatorade) to replenish body fluids;
- Observe coworkers (buddy system) for signs of fatigue; and
- Report any symptoms to the Site superintendent or Project Manager.

The Site superintendent must regularly monitor the condition of the work force for signs of heat stress. Work in high ambient temperatures, coupled with protective clothing, can

quickly result in worker heat stress. Heat stress monitoring and modified work-rest schedules will be instituted in accordance with ACGIH guidelines as required. Specific monitoring of heat stress is delineated in Appendix F.

Alcohol consumption dehydrates the body and increases the likelihood of heat stress. Workers should curb their alcohol consumption after work and arrive at the Site each morning physically fit for work. Any worker deemed unfit for work because of alcohol consumption or for any reason will be restricted from Site activities. If a worker has been placed on restrictive duty by a physician, he will be restricted from activities, which may cause injury/accidents to himself or to coworkers. Aztech Site management will be responsible for ensuring that unfit workers are restricted from Site activities as required

8.5 Cold Stress

Workers should be protected from exposure to cold so that the deep core temperature does not fall below 36^0C (96.8^0F); lower body temperatures will vary and likely result in reduced mental alertness, reduction in rational decision making, or loss of consciousness, with the threat of fatal consequences. Pain in the extremities may be the first early warning of danger to cold stress. During exposure to cold, maximum severe shivering develops when the body temperature has fallen to 35^0C (95^0F). This must be taken as a sign of danger to the workers, and exposure to cold should be immediately terminated for any workers when severe shivering becomes evident. Useful physical or mental work is limited when severe shivering occurs.

Since prolonged exposure to cold air, or to immersion in cold water, at temperatures well above freezing can lead to dangerous hypothermia, whole-body protection must be provided.

8.6 Confined Space Entry

Workplaces that are not intended for human occupancy are defined as confined spaces. Limited openings hinder proper ventilation, escape, and rescue; therefore, creating a potentially life threatening situation for a worker.

Confined space entry will not be undertaken without prior approval from the Site superintendent and the SSHR. Any confined space entry will be governed by the OSHA regulation, 29 CFR 1910.146, and will be conducted in accordance with the company's **Confined Space Entry Procedures**.

8.7 Slips, Trips and Falls

Slips, trips, and falls can easily occur at construction Sites. Pedestrian traffic will be excluded from excavation areas. (Exceptions will be reviewed on a case-by-case basis, with SSHR authorization.) Walkways to and from equipment storage in the CRZ will be established and

maintained as level and free of obstructions as possible. Walking surfaces will be constructed where required and maintained free of obstacles.

Work activity on elevated surfaces must be conducted in accordance with fall protection criteria 29 CFR 1910.23. Proper guardrails or a fall arrest system must be in place for work on surfaces six (6) feet or higher.

8.8 Fire Hazards

Smoking will not be allowed inside the EZ or CRZ. Cigarettes, lighters, chewing tobacco (or any other personal effects) will not be allowed in the Exclusion Zone.

Debris (paper, brush, scrap, wood, etc.) shall be removed from work areas on a daily basis or as needed to preclude accumulation of sources of fuel. Flammable and combustible liquids will be maintained in the smallest quantities possible. No flammable/combustible liquids will be stored inside the office trailer, decon trailers, or Aztech temporary buildings. Fuel cans shall have a designated storage area.

Portable fire extinguishers shall be provided for each trailer and/or office buildings and for each mobile vehicle and piece of heavy equipment. Each employee will have received instruction on the proper operation of a portable fire extinguisher.

Cutting and welding will require an inspection of the area and review of the operation by the SSHR prior to cutting or welding activities being performed. A request to perform cutting or welding activities will be submitted and will require the inspection and testing of the work area. The Site superintendent or SSHR will prepare the cutting and welding permit request form and sign it. The permit will be issued by the SSHR only for the specific operation for a specified time

8.9 Traffic Safety

The offSite work areas for the Marble Quarry project are generally designated near the edge of the road and in potentially high traffic areas. Street work permits have been obtained and will be required to have available at all times during the project. The following guidelines will be followed for all work within the street:

- Before any work is the street is performed, display road work signage to include at a minimum men working signs facing each direction of traffic on the road.
- Use all demarcation barriers as appropriate including cones, stanchions, flags, caution tape and road barriers.
- Fully delineate each work zone to encompas all equipment and workers within the designated work are.
- When moving locations, demark the new work area with traffic safety barriers prior to removing safety devices in use at the current work area.

- Use flaggers as necessary to keep traffic moving safely on the roads and protect the workers within the work areas.
- Employees exposed to heavy equipment or vehicular traffic shall be required to wear a reflective warning vest.

8.10 Hand clearing / Soft Digging

All locations subjected to intrusive work such as drilling will require hand clearing to a minimum of five (5) feet below existing grade. Hand clearing using soft digging practices are implemented to provide a level of protection from impacting a subsurface utility during intrusive work (i.e., excavation, drilling). The following guidelines will be followed for all hand clearing work:

- If the surface consists of asphalt or concrete pavement, use shallow cuts with a demo saw in order to slowly remove the layers until soil or the subsurface substrate is encountered.
- Each location should be cleared to a minimum of four (4) feet using non-intrusive excavation tools (i.e., air knife, hand auger)
- Each location should be cleared to minimum diameter of the largest tool size to be used.
- Should large rocks or other debris be encountered that impede clearing advancement; use an electrical resistant digging bar or shovel to remove the obstruction.
- If obstructions cannot be removed or utilities are positively encountered then the location must be moved a minimum distance of two (2) feet.

All employees working in or around excavations or trenches shall be required to wear personal protective equipment for the head, eyes, respiratory organs, hands, feet and other parts of the body as deemed necessary by the hazards present

9.0 Decontamination Protocols

9.1 General

Decontamination is the process of removing or neutralizing contaminants that have accumulated on personnel, personal protective equipment, and equipment. Decontamination activities are critical to health and safety at hazardous waste Sites. Decontamination protects workers from hazardous substances that may contaminate and eventually permeate the protective clothing, respiratory equipment, tools, vehicles, and other equipment used on-Site; it protects all Site personnel by minimizing the transfer of harmful materials into clean areas, and it protects the community by preventing uncontrolled transportation of contaminants from the Site

9.2 Prevention of Contamination

The first step in decontamination is to establish decontamination procedures that minimize contact with waste and thus the potential for spreading contaminants. Aztech will:

Personnel:

- Stress work practices that minimize contact with hazardous substances (e.g., do not walk through areas of obvious contamination; do not directly touch potentially hazardous substances).
- Use remote sampling, handling, and container-opening techniques.
- Protect monitoring and sampling instruments by bagging. Make openings in the bags for sample ports and sensors that must contact Site materials.
- Wear disposable outer garments and use disposable equipment where appropriate.

Heavy Equipment:

- Limit the surface area of contact, i.e., on Drill Rigs, limit tire contact with soil .
- If contaminated tools are to be placed on non-contaminated equipment for transport to the decon pad, plastic will be used on top of the non-contaminated equipment to keep it clean.
- Material from soil cuttings and waste water will be placed in drums away from personnel and equipment traffic. Drums will be stored at a designated location onsite until disposal is coordinated.

In addition, the following procedures will be used in sequential order, to maximize worker protection. The proper procedures for dressing prior to entering the EZ will minimize the potential for contaminants to bypass the protective clothing and escape decontamination. In general, all fasteners should be used (i.e., zippers fully closed, all buttons used, all snaps closed, etc.). Gloves and boots should be tucked under the sleeves and legs of outer clothing, and hoods (if not attached) should be worn outside the collar. Another pair of tough outer gloves will be worn over the sleeves. All junctures will be taped to prevent contaminants from running inside the gloves, boots, and jackets (or suits, if one-piece construction).

Prior to each use, the PPE will be inspected to ensure that it contains no cuts or punctures that could expose workers to contaminants. Similarly, any injuries to the skin surface, such as cuts and scratches, may enhance the potential for chemicals or infectious agents that directly contact the worker's skin to penetrate into the body. Particular care will be taken to protect these areas. Workers with large areas of damaged skin will not be allowed to work on-Site until the skin heals.

9.3 Types of Contamination

Contaminants can be located on the surface of personal protective equipment and/or adsorbed into the PPE material. Surface contaminants may be easy to detect and remove; however, contaminants that have permeated a material are difficult or impossible to detect and subsequently remove. If contaminants that have permeated a material are not removed by decontamination, they may continue to permeate to the inner surface of the material where they can cause an unexpected exposure.

Five factors, which may affect the extent of permeation, are listed below:

1. **Contact Time** – The longer a contaminant is in contact with an object, the greater the probability and extent of permeation. For this reason, minimizing contact time is one of the most important objectives of a decontamination program. When working with VOCs, respiratory contact time can be reduced by avoiding the vapors from the contaminated soils. Employees can reduce dermal contact time by using the correct PPE to avoid direct contact with hazardous materials. Employees can reduce their overall contact time by washing their exposed body parts, with soap and water, on a regular basis.

2. **Concentration** – Molecules flow from areas of high concentration to areas of low concentration. As concentrations of waste increases, the potential for permeation of personal protective clothing increases. Because of this, workers will be instructed to change their outer layer of work clothing if it becomes heavily soiled.

3. **Temperature** – An increase in temperature generally increases the permeation rate of contaminants. For example, VOCs have the ability to produce vapors, which can become an inhalation hazard. As the ambient temperature increases, the concentration of hazardous vapors may become sufficient to implement or increase the level of respiratory protection. The decision to increase respiratory protection will be based upon the results of the real-time air monitoring performed in the workers breathing zones.

4. **Size of Contaminant –** Molecules and Pore Space. Permeation increases as the contaminant molecule becomes smaller and as the pore space of the material to be permeated increases. Tyvek® coveralls should keep the majority of contaminated soils from contacting the employee's skin. However, workers will be required to tape all PPE junction points to further decrease the opportunity of contact with contaminated soils. Coveralls and other PPE should be checked regularly to ensure there are no tears, rips and holes, which might allow the invasion of contaminated soils to the skin surface.

5. **Physical State of Wastes** – As a rule, gases, vapors, and low-viscosity liquids tend to permeate more readily than high-viscosity liquids or solids. The contaminated material on the Site is primarily capable of producing hazardous vapors, which may create an inhalation hazard. Because of this, the handling of soils will be minimized to reduce vapor generation. Also, stockpiles of contaminated material will be covered to reduce vapors in the work area.

9.4 Personal Hygiene and Decontamination Procedures

Level D PPE is anticipated for use at this Site. However, for potential tasks that require upgraded protective clothing and respiratory protection, a decontamination area will be provided for Aztech employees who work in the area designated as the EZ. Employees will be required to don the PPE before entering and doff the PPE when leaving.

All personnel and equipment leaving the EZ will be thoroughly decontaminated. The procedure for personnel decon is task and Site-dependent, however, the general elements of decon will include:

- Gross boot wash and rinse;
- Suit remove (optional)l;
- Outer/ Inner glove removal;
- Respirator removal and wash (optional);

Workers should check for gross contamination on boots and clothing before leaving the EZ. Protective clothing should be removed in an inside-out fashion and disposed properly in waste receptacles provided. Employees will be required to wash face, hands, and any exposed areas with soap and water. Boots will be cleaned using a series of tubs containing soap, water, and a brush to remove contamination.

These decontamination procedures must be followed each time the employee leaves the contaminated area (EZ), with the exception of emergency escape situations, such as a fire. If employees encounter contaminated materials, portable eyewash bottles and portable showers will be located on-Site for employees to wash affected skin or to flush the eyes (at least 15 minutes). If irritation, redness or swelling arises in the contact area, a physician will be contacted immediately.

Respirators will be removed and properly cleaned and disinfected by either the employee or a designated technician. A specific decontamination station for cleaning respirators will be located at the contamination reduction zone. The respirator, without the cartridge, should be wiped clean with a benzalkonium chloride antiseptic towelette, followed by the use of a wash and rinse solution and then dried with a paper towel. The respirator will be kept in a two-gallon zip-lock bag inside the employee's locker for storage. New cartridges

should be inserted in accordance with OSHA Respiratory Protection Standard 29 CFR 1910.134. The Site superintendent shall monitor effectiveness of the decontamination procedures and, if found ineffective, shall take appropriate steps to correct any deficiencies. If respirators are used on-Site, a monthly inspection of the respirator will be conducted by a member of Site management or his designee.

9.4.1 Equipment Decontamination

All equipment will be decontaminated prior to exiting the Site. Typically, excessive mud and dirt will be kncocked off equipment/vehicles with long-handled shovels or brooms. A high-pressure power washer will then be used to remove the dirt/mud prior to driving on local roads. A decontamination pad with a wash water collection sump will be constructed for decontaminating vehicles and equipment. Wash water will collected and managed in accordance with the jobSite work plan. Prior to heavy equipment being taken offSite, the Aztech Site Superintendent and/or Project Engineer will visually inspect the equipment for signs of excessive dirt. No equipment will be permitted to leave the Site until all excessive soil is removed.

10.0 Emergency Response and Contingency Plan

10.1 General

For each new field work assignment, the Project Manager shall initiate a work order that includes hospital and emergency information relevant to the area which will then be provided to the employee responsible for conducting the work who shall return the documentation to the Office Manager where it shall be stamped “Completed”, the information disseminated to the Project Manager and later filed. Each manager or supervisor visiting a field work Site shall complete a Health and Safety Spot Inspection Form for the Site that they have viSited. Completed forms shall be returned to the Health and Safety Officer and the relevant Project Manager or Supervisor.

Health and Safety Checklist shall be completed by the job Foreman or Supervisor on the Site at the time of first visit to the location, where it will be completed and sent with the timesheet to the Field Safety Coordinator. The form shall also be used for conducting toolbox talks on Site daily and then forwarded to the Field Safety Coordinator, who will in turn, send documentation to the Health and Safety Officer.

10.2 Potential Emergencies

The activities, layout, and hazards of the Site have been evaluated to determine the potential emergencies to be anticipated. As a result, six categories of emergencies have been established. This list may be revised if on-Site conditions or operations warrant. In the

event of a revision or addition to the list, the ERCP will be appropriately updated. The categories of anticipated emergencies are listed below.

- Injury, Illness
- Fire
- Explosion
- Spill/Environmental Release
- Natural Hazards
- Abrasions, Bruises and Lacerations
- Loss of impacted soil off-Site.

Due to the nature of this Site, personnel accidents requiring first aid, exposure to soils and groundwater with chemical constituents, potential fires near mechanical equipment and water-related incidents (e.g., on-Site flooding) are the most anticipated emergencies that may arise

10.3 Plan Implementation

All on-Site personnel will be instructed to notify the field office immediately upon encountering an emergency or near emergency. The emergency coordinator will then institute the response measures and direct other personnel in their duties. Documentation of the incident will be accomplished as soon as possible to ensure accuracy of the reporting. The Emergency Coordinator will complete an **Incident Report** which includes the following information:

1. A description of the emergency (including date, time, and duration);
2. Date, time, and names of all persons/agencies notified and their response; and
3. A description of corrective actions implemented or other resolution of the incident

10.3.1 Site Evacuation

In the event of an emergency during operations that requires evacuation (such as fire, explosion, significant release of toxic gases, etc.); notification will be sounded for approximately 10 seconds indicating the initiation of evacuation procedures. All field personnel will evacuate and assemble near the CRZ or other safe area identified by the Emergency Coordinator. The location will be upwind of the incident if possible. As the safety of all field personnel is being established, appropriate emergency services will be contacted via telephone to respond to the emergency. When making the report to the field office, describe the complete situation including, if possible, the following:

- Type and location of the emergency.
- Is an explosion or fire involved?
- Type of material involved. Contamination released?
- Are there injuries?

- Estimated wind speed and direction?

Personnel will not reenter an evacuated area until instructed to do so by the Emergency Coordinator. In addition, if operations at the Site are stopped in response to an emergency, the Emergency Coordinator will ensure that valves, pipes, and other equipment are monitored for leaks, pressure buildup, gas generation, or ruptures.

10.4 Emergency Response Procedures

Although not all of the following emergencies will be applicable to each activity, the procedures that follow will serve as the basis for decision-making and the actions to be taken during an actual emergency.

Response to an emergency—fire/explosion or spill/environmental release—starts with the identification of trouble and continues after the emergency through the preparation of equipment and personnel for the next potential emergency. The stages of emergency response consist of notification, emergency evaluation, response, follow-up review, and documentation. The stages of emergency response are presented and discussed below in logical order.

Notification—

Upon discovering the emergency, the Emergency Coordinator will be responsible for notifying other on-Site personnel to the emergency. A predetermined internal audio communications device (siren, air horn, and whistle) will be activated to notify personnel to stop work activities, to lower background noise (if possible), and to initiate emergency procedures.

The on-Site emergency response personnel will be notified and informed by the Emergency Coordinator of the following information:

- What happened and how;
- Where and when did it happen and to whom;
- What is the extent of the damage; and
- What form of aid or response is required?

Emergency Evaluation—

Upon review of the emergency information above, emergency response capabilities and needs will be determined. A determination will be made as to what could potentially happen as a result of the emergency. Items to consider include the types of contaminants; the potential for fire, explosion, or release of hazardous materials; the location of on-Site personnel relative to the hazardous area(s); and the potential for impact on the surrounding

population and environment. Next, a determination will be made as to what should be done. The Emergency Coordinator must consider the appropriate emergency response;

- Equipment and personnel resources required for hazard mitigation;
- Number of persons available for response;
- Resources available on-Site and off-Site; and
- Hazards involved in rescue and response.

Response—

At this stage of emergency response, the Emergency Coordinator will decide the type of action required based on the available information. The response action(s) is then implemented. The Site supervisor will also designate on-Site personnel responsibilities in order to accomplish the response actions. Response actions may include the following:

Enforced Buddy System

No one will enter the EZ or hazardous area without a partner. Line-of-sight contact between rescue/response personnel and support will be maintained.

Allocate Resources

Along with the designation of on-Site personnel to aid in the rescue/response operations, the Emergency Coordinator will also allocate on-Site equipment to be used in the rescue/response operation.

Request Aid

The Emergency Coordinator will contact off-Site personnel and/or agencies as required to aid in the rescue-response operation.

Control—

The spill response team will bring the hazardous situation under complete or temporary control. The intent of control is to prevent the spread and impact of the emergency. In the event of a fire, the Emergency Coordinator will immediately call the fire department and decide if attempts should be made by on-Site personnel to control the fire depending upon the degree of the fire. In the event of a spill or chemical release, the spill response team will contain the spill and prevent further migration via the use of booms, absorbent pads, or earthen berms. In the event of cave-in of excavations, the Emergency Coordinator will immediately direct the relocation of excavating equipment and personnel away from the unstable area and evaluate methods to stabilize the excavation.

Stabilize—
The SSHR or designated alternate(s) will administer medical procedures to injured personnel as required and attend to the cause of the emergency, if possible (e.g., turn off leaking valve, shut down treatment system).

Evacuate—
On-Site personnel will be moved a safe distance upwind of the hazardous area. The emergency incident will be monitored for significant changes. The designated public safety personnel will be contacted when there is a potential or actual need to evacuate the off-Site population. Evacuation of off-Site personnel is the responsibility of government authorities.

Follow-Up Review—
Prior to resuming normal Site activities, on-Site personnel must review the cause of the emergency and aid in the revision of this ERCP according to new Site conditions and events that took place during emergency response. Emergencies or accidents that result in any fatalities or five or more hospitalizations per incident must be reported to OSHA immediately.

Documentation—
The Emergency Coordinator will be responsible for documenting the events of the emergency. Documentation of the emergency may be used to prevent reoccurrence of the emergency and as evidence for potential legal actions. Documentation may be accomplished by the use of a bound field notebook and written transcripts of tape recordings made during the emergency.
Documentation of an emergency should include the following:

- Chronological history of the emergency;
- Facts pertaining to the incident when they become available;
- Names and titles of personnel involved;
- Photos;
- Actions taken, orders and instructions given and received, and decisions made by the Site supervisor and other on-Site and off-Site personnel;
- Potential exposures of on-Site personnel; and
- Signature, date, and time of individual entering data.

In response to an emergency, specialized equipment may be necessary and to mitigate hazardous conditions (e.g., contain spills). A list of basic on-Site equipment and supplies for emergency response will be developed prior to Site entry. This list will be updated as necessary to include special equipment that should be obtained depending upon special

conditions or emergencies that may arise during implementation of the Site remedies. After an emergency, Site equipment and supplies must be restocked, repaired, or replaced as necessary.

Evacuation Routes—

In the event of a severe emergency (e.g., fire, explosion), normal Site exit routes may become blocked. Therefore, alternate routes for evacuating on-Site personnel will be established prior to initiation of the remedial activities. Consideration will be given to the following factors when developing alternate evacuation routes:

- Upwind locations;
- Accessibility of potential routes;
- The development of two or more routes;
- Equipment necessary to mark out routes; and
- The mobility of Site personnel wearing protective equipment.

The alternate evacuation routes will be established prior to Site activity and will be shown on detailed Site maps.

10.5 Onsite Personnel Injury and Illness

Emergency first aid will be administered on-Site as deemed necessary. Emergency medical services will be contacted to respond, or the person will be transported to the designated medical facility. The medical data sheet will accompany the injured person in each case. *Figure 12.1* shows the primary hospital route and instructions from the Site. These diagrams will be posted near the command trailer exit in a manner so they can be taken with the driver of the victim. The hospital will be called and notified of the impending arrival while the victim is being transported, and provided with pertinent information regarding the victim, injuries, etc.

If a person working on-Site is physically injured, basic first aid procedures must be followed. Depending on the severity of the injury, emergency medical response may be sought. If the person can be moved, he/she will be taken to the edge of the work area where PPE will be removed and emergency first aid administered. If necessary, transportation to a local emergency medical facility will be provided.

If the person can only be moved by emergency medical personnel, the SSHR will decide what protective equipment (if any) is required to be worn by emergency personnel. Each work area will have extra equipment available for emergencies.

If the injury to on-Site personnel involves chemical exposure, the following first aid procedures must be initiated as soon as possible:

Eye Exposure—If solid or liquid gets into the eyes, wash eyes immediately at the emergency eyewash station, for at least 15 minutes, using water and lifting the lower and upper lids occasionally. Obtain medical attention immediately.

Skin Exposure—If solid or liquid gets on the skin, wash skin immediately at the emergency eyewash station using water. Obtain medical attention immediately.

Inhalation—If a person inhales large amounts of organic vapor, dust, etc.; move him/her to fresh air at once. Obtain medical attention immediately. If breathing has stopped, appropriately trained on-Site personnel and/or medical personnel should perform cardiopulmonary resuscitation. Keep affected person warm and at rest.

Ingestion—If solid or liquid is swallowed, medical attention must be obtained immediately and the Poison Control Center consulted. The SSHR must inform the project manager of the injury/accident, and a written report detailing the incident, its causes, and consequences must be submitted to the project principal within 48 hours of the incident.

10.5.1 Temperature Related Problems

First aid for all forms of heat stress includes cooling the body by removing PPE, moving to an area outside the EZ and CRZ, and allowing the person to rest in a cooler environment.

10.5.2 Emergency Decontamination

In the case of medical emergency, gross decontamination procedures will be implemented and the person transported to the nearest medical facility immediately. If a life threatening injury occurs and the injured person cannot undergo decontamination procedures without causing additional injuries, he/she will be transported in a body bag, plastic wrap, or wrapped in a blanket. The medical facility will be informed that an injured person is on the way and has not been decontaminated. The medical facility will be notified of the potential chemicals present and the exposure prevention measures that can be employed during treatment.

Decontamination measures for other emergencies will be based upon the toxicity of the contaminants on-Site and the immediacy of the emergency.

10.5.3 Fire

Aztech personnel will not respond to fires that are larger than those, which can be handled by the fire extinguishers maintained on-Site. Any fire too large to be extinguished by portable fire extinguishers will be reported at once to the local fire department.

10.6 Explosion

An explosion can be the most difficult emergency situation to deal with for multiple reasons: severe trauma, death, fire, unstable structures, secondary explosions, toxic clouds, and destruction of emergency response and communication equipment may all be

associated with an explosion. Therefore, multiple response measures and backup systems may be required:

- Initiate evacuation procedures.
- Notify appropriate response agencies (fire, police, and ambulance).
- Assess situation: will secondary emergencies be immediately occurring?
- Turn off/remove sources of explosive gases or flammable liquids.
- Attend to the injured.
- Check for exposed live utilities.
- Initiate spill response measures, if necessary.

10.6.1 Explosive Atmospheres

For explosive atmosphere:

- Initiate evacuation procedures if action levels dictate.
- Notify the fire department of a potentially explosive condition.
- Remove sources of ignition.
- Ventilate the area.
- Continue monitoring.

10.6 Spill guidelines

In general, cleanup personnel will:

- Make sure all necessary personnel are removed from the hazard area;
- Wear proper protective clothing;
- If a flammable waste is involved, remove all ignition sources and use spark-proof and explosion-proof equipment and clothing in containment and cleanup;
- If possible, try to stop the leak; and
- Remove all surrounding materials that could be especially reactive with materials in the waste. Determine the major components in the waste at the time of the spill.

APPENDIX A

FORMS

Aztech Environmental
TECHNOLOGIES

Health & Safety Site Checklist

Site: _____ Date & Time: _____

Description of Work: _____ Weather Conditions: _____

Potential Hazards

☐ Pinch Points	☐ Inclement Weather	☐ Boom Swing	☐ Hand and Power Tools
☐ Sharps Edges / Impalement	☐ Excavation	☐ Suspended Loads	☐ Grinding
☐ Body Position	☐ Confined Space	☐ Rigging	☐ Pressure Lines
☐ Handling Rods / Casing	☐ One Call / Underground Utilities	☐ Materials Handling	☐ Electrical - General
☐ Vibration	☐ Slopes / Terrain	☐ Manual Lifting	☐ Electrical - Power lines
☐ Repetitive Motion	☐ Vehicle Safety / Traffic	☐ Heavy Equipment	☐ Grout Burns
☐ Noise	☐ Tracking Equipment	☐ Overhead Work	☐ Dust / Mist / Fumes
☐ Exposure to Poisonous Plants / Animals / Insects	☐ Congested Area	☐ Working at Heights	☐ Silica / Asbestos
	☐ Loading / Unloading Equipment	☐ Trip / Slip / Fall Hazards	☐ Chemical Exposure
☐ Heat/Cold Stress	☐ Rotating Equipment	☐ Hot Work	☐ Spills

Required Safety Precautions

☐ Safety Glasses	☐ Utility One-Call	☐ Crane Mats	☐ Point of Operation Guards
☐ Hard Hat	☐ Personal Fall Arrest System	☐ Taglines	☐ Whipchecks
☐ Safety Boots	☐ Personal Flotation Device	☐ Spotter / Qualified Signal Person	☐ Back-up Alarms
☐ Gloves	☐ Hearing Protection	☐ Lockout-Tagout	☐ Visqueen / Silt Fencing
☐ Safety Vest	☐ Fire Extinguisher	☐ GFCI's	☐ Fuel Containment
☐ Face / Welding Shield	☐ Fire Watch	☐ Confined Space Attendant	☐ Spill Kit
☐ Respirator	☐ Barricades / Warning Signs	☐ Atmospheric Monitoring	☐ Topical Creams / Repellants
☐ FR Clothing	☐ Guardrails / Hole Covers	☐ Ladders Tied off / Spotted	☐ First Aid / Eye Wash

Site Specific Health & Safety Topics Discussed

_____

_____

_____

Name	Company	Sign	Date

APPENDIX B

CHEMICAL SDS SHEETS

SAFETY DATA SHEET

Creation Date 10-Dec-2009 **Revision Date** 23-Jan-2018 **Revision Number** 5

1. Identification

Product Name **Tetrachloroethylene**

Cat No. : **AC445690000; ACR445690010; AC445690025; AC445691000**

CAS-No 127-18-4
Synonyms Perchloroethylene

Recommended Use Laboratory chemicals.
Uses advised against Not for food, drug, pesticide or biocidal product use

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number
For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Skin Corrosion/irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2
Skin Sensitization	Category 1
Carcinogenicity	Category 1B
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Central nervous system (CNS).	
Specific target organ toxicity - (repeated exposure)	Category 2
Target Organs - Kidney, Liver, Blood.	

Label Elements

Signal Word
Danger

Hazard Statements
Causes skin irritation
Causes serious eye irritation
May cause an allergic skin reaction
May cause drowsiness or dizziness
May cause cancer
May cause damage to organs through prolonged or repeated exposure

Precautionary Statements
Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Use personal protective equipment as required
Wash face, hands and any exposed skin thoroughly after handling
Contaminated work clothing should not be allowed out of the workplace
Do not breathe dust/fume/gas/mist/vapors/spray
Use only outdoors or in a well-ventilated area
Wear protective gloves/protective clothing/eye protection/face protection
Response
IF exposed or concerned: Get medical attention/advice
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Skin
IF ON SKIN: Wash with plenty of soap and water
Take off contaminated clothing and wash before reuse
If skin irritation or rash occurs: Get medical advice/attention
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
If eye irritation persists: Get medical advice/attention
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Toxic to aquatic life with long lasting effects
WARNING. Cancer - https://www.p65warnings.ca.gov/.

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Tetrachloroethylene	127-18-4	>95

4. First-aid measures

General Advice If symptoms persist, call a physician.

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. If skin irritation persists, call a physician.

Inhalation Move to fresh air. If not breathing, give artificial respiration. Get medical attention if symptoms occur.

Ingestion Clean mouth with water and drink afterwards plenty of water.

Most important symptoms and effects	None reasonably foreseeable. May cause allergic skin reaction. Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting: Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain or flushing
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Unsuitable Extinguishing Media	No information available
Flash Point	No information available
Method -	No information available
Autoignition Temperature	No information available
Explosion Limits	
Upper	No data available
Lower	No data available
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Thermal decomposition can lead to release of irritating gases and vapors. Containers may explode when heated.

Hazardous Combustion Products
Chlorine Hydrogen chloride gas Phosgene
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
2	0	0	N/A

6. Accidental release measures

Personal Precautions	Use personal protective equipment. Ensure adequate ventilation.
Environmental Precautions	Do not flush into surface water or sanitary sewer system.
Methods for Containment and Clean Up	Soak up with inert absorbent material. Keep in suitable, closed containers for disposal.

7. Handling and storage

Handling	Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Ensure adequate ventilation. Avoid ingestion and inhalation.
Storage	Keep containers tightly closed in a dry, cool and well-ventilated place. Protect from sunlight.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Tetrachloroethylene	TWA: 25 ppm STEL: 100 ppm	(Vacated) TWA: 25 ppm (Vacated) TWA: 170 mg/m^3 Ceiling: 200 ppm TWA: 100 ppm	IDLH: 150 ppm	TWA: 100 ppm TWA: 670 mg/m^3 TWA: 200 ppm TWA: 1250 mg/m^3 STEL: 200 ppm STEL: 1340 mg/m^3

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures Use only under a chemical fume hood. Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection Long sleeved clothing.

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	Characteristic, sweet
Odor Threshold	No information available
pH	No information available
Melting Point/Range	-22 °C / -7.6 °F
Boiling Point/Range	120 - 122 °C / 248 - 251.6 °F @ 760 mmHg
Flash Point	No information available
Evaporation Rate	6.0 (Ether = 1.0)
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	18 mbar @ 20 °C
Vapor Density	No information available
Density	1.619
Specific Gravity	1.625
Solubility	0.15 g/L water (20°C)
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	> 150°C
Viscosity	0.89 mPa s at 20 °C
Molecular Formula	C2 Cl4
Molecular Weight	165.83

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability Stable under normal conditions.

Conditions to Avoid Incompatible products. Excess heat. Exposure to moist air or water.

Incompatible Materials Strong acids, Strong oxidizing agents, Strong bases, Metals, Zinc, Amines, Aluminium

Hazardous Decomposition Products Chlorine, Hydrogen chloride gas, Phosgene

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Tetrachloroethylene	LD50 = 2629 mg/kg (Rat)	LD50 > 10000 mg/kg (Rat)	LC50 = 27.8 mg/L (Rat) 4 h

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation Irritating to eyes and skin

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Tetrachloroethylene	127-18-4	Group 2A	Reasonably Anticipated	A3	X	A3

IARC: (International Agency for Research on Cancer)

NTP: (National Toxicity Program)

ACGIH: (American Conference of Governmental Industrial Hygienists)

Mexico - Occupational Exposure Limits - Carcinogens

IARC: (International Agency for Research on Cancer)
Group 1 - Carcinogenic to Humans
Group 2A - Probably Carcinogenic to Humans
Group 2B - Possibly Carcinogenic to Humans
NTP: (National Toxicity Program)
Known - Known Carcinogen
Reasonably Anticipated - Reasonably Anticipated to be a Human Carcinogen
ACGIH: (American Conference of Governmental Industrial Hygienists)
A1 - Known Human Carcinogen
A2 - Suspected Human Carcinogen
A3 - Animal Carcinogen
Mexico - Occupational Exposure Limits - Carcinogens
A1 - Confirmed Human Carcinogen
A2 - Suspected Human Carcinogen
A3 - Confirmed Animal Carcinogen
A4 - Not Classifiable as a Human Carcinogen
A5 - Not Suspected as a Human Carcinogen

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure Central nervous system (CNS)

STOT - repeated exposure Kidney Liver Blood

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting: Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain or flushing

Endocrine Disruptor Information

Component	EU - Endocrine Disrupters Candidate List	EU - Endocrine Disruptors - Evaluated Substances	Japan - Endocrine Disruptor Information
Tetrachloroethylene	Group II Chemical	Not applicable	Not applicable

Other Adverse Effects Tumorigenic effects have been reported in experimental animals.

12. Ecological information

Ecotoxicity

Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. The product contains following substances which are hazardous for the environment.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Tetrachloroethylene	EC50: > 500 mg/L, 96h (Pseudokirchneriella subcapitata)	LC50: 4.73 - 5.27 mg/L, 96h flow-through (Oncorhynchus mykiss) LC50: 11.0 - 15.0 mg/L, 96h static (Lepomis macrochirus) LC50: 8.6 - 13.5 mg/L, 96h static (Pimephales promelas) LC50: 12.4 - 14.4 mg/L, 96h flow-through (Pimephales promelas)	EC50 = 100 mg/L 24 h EC50 = 112 mg/L 24 h EC50 = 120.0 mg/L 30 min	EC50: 6.1 - 9.0 mg/L, 48h Static (Daphnia magna)

Persistence and Degradability Insoluble in water Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility . Is not likely mobile in the environment due its low water solubility. Will likely be mobile in the environment due to its volatility.

Component	log Pow
Tetrachloroethylene	2.53 - 2.88

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Tetrachloroethylene - 127-18-4	U210	-

14. Transport information

DOT

UN-No UN1897
Proper Shipping Name TETRACHLOROETHYLENE
Hazard Class 6.1
Packing Group III

TDG

UN-No UN1897

Proper Shipping Name TETRACHLOROETHYLENE
Hazard Class 6.1
Packing Group III

IATA
UN-No UN1897
Proper Shipping Name TETRACHLOROETHYLENE
Hazard Class 6.1
Packing Group III

IMDG/IMO
UN-No UN1897
Proper Shipping Name TETRACHLOROETHYLENE
Hazard Class 6.1
Subsidiary Hazard Class P
Packing Group III

15. Regulatory information

All of the components in the product are on the following Inventory lists: X = listed

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Tetrachloroethylene	X	X	-	204-825-9	-		X	X	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Tetrachloroethylene	127-18-4	>95	0.1

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Tetrachloroethylene	-	-	X	X

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Tetrachloroethylene	X		-

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Tetrachloroethylene	100 lb 1 lb	-

California Proposition 65 This product contains the following proposition 65 chemicals

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Tetrachloroethylene	127-18-4	Carcinogen	14 µg/day	Carcinogen

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Tetrachloroethylene	X	X	X	X	X

U.S. Department of Transportation

Reportable Quantity (RQ): Y
DOT Marine Pollutant Y
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security
This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade No information available

16. Other information

Prepared By
Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 10-Dec-2009
Revision Date 23-Jan-2018
Print Date 23-Jan-2018
Revision Summary This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

SAFETY DATA SHEET

Creation Date 03-Feb-2010 **Revision Date** 07-Mar-2018 **Revision Number** 1

1. Identification

Product Name **Trichloroethylene**

Cat No. : **L14474**

CAS-No 79-01-6
Synonyms Triclene; Trichloroethene; Ethylene trichloride

Recommended Use Laboratory chemicals.
Uses advised against

Details of the supplier of the safety data sheet

Company
Alfa Aesar
Thermo Fisher Scientific Chemicals, Inc.
30 Bond Street
Ward Hill, MA 01835-8099
Tel: 800-343-0660
Fax: 800-322-4757
Email: tech@alfa.com
www.alfa.com

Emergency Telephone Number
During normal business hours (Monday-Friday, 8am-7pm EST), call (800) 343-0660.
After normal business hours, call Carechem 24 at (866) 928-0789.

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Skin Corrosion/irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2
Skin Sensitization	Category 1
Germ Cell Mutagenicity	Category 2
Carcinogenicity	Category 1A
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Central nervous system (CNS).	
Specific target organ toxicity - (repeated exposure)	Category 2
Target Organs - Kidney, Liver, Heart, spleen, Blood.	

Label Elements

Signal Word
Danger

Hazard Statements
Causes skin irritation
Causes serious eye irritation
May cause an allergic skin reaction

May cause drowsiness or dizziness
Suspected of causing genetic defects
May cause cancer
May cause damage to organs through prolonged or repeated exposure

Precautionary Statements
Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Use personal protective equipment as required
Wash face, hands and any exposed skin thoroughly after handling
Contaminated work clothing should not be allowed out of the workplace
Do not breathe dust/fume/gas/mist/vapors/spray
Use only outdoors or in a well-ventilated area
Wear protective gloves/protective clothing/eye protection/face protection
Response
IF exposed or concerned: Get medical attention/advice
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Skin
IF ON SKIN: Wash with plenty of soap and water
Take off contaminated clothing and wash before reuse
If skin irritation or rash occurs: Get medical advice/attention
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
If eye irritation persists: Get medical advice/attention
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Harmful to aquatic life with long lasting effects
WARNING. Cancer and Reproductive Harm - https://www.p65warnings.ca.gov/.

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Trichloroethylene	79-01-6	>95

4. First-aid measures

General Advice Show this safety data sheet to the doctor in attendance. Immediate medical attention is required.

Eye Contact In the case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Immediate medical attention is required.

Inhalation	Move to fresh air. If not breathing, give artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Immediate medical attention is required.
Ingestion	Do not induce vomiting. Call a physician or Poison Control Center immediately.
Most important symptoms and effects	May cause allergic skin reaction. Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting: Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain or flushing
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Unsuitable Extinguishing Media	No information available
Flash Point	No information available
Method -	No information available
Autoignition Temperature	410 °C / 770 °F
Explosion Limits	
Upper	44.8 vol %
Lower	8 vol %
Oxidizing Properties	Not oxidising
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Thermal decomposition can lead to release of irritating gases and vapors. Containers may explode when heated. Keep product and empty container away from heat and sources of ignition.

Hazardous Combustion Products
Hydrogen chloride gas Chlorine Phosgene Carbon monoxide (CO) Carbon dioxide (CO_2)
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Thermal decomposition can lead to release of irritating gases and vapors.

NFPA

Health	Flammability	Instability	Physical hazards
2	1	0	N/A

6. Accidental release measures

Personal Precautions	Ensure adequate ventilation. Use personal protective equipment. Keep people away from and upwind of spill/leak. Evacuate personnel to safe areas.
Environmental Precautions	Should not be released into the environment. Do not flush into surface water or sanitary sewer system.
Methods for Containment and Clean Up	Soak up with inert absorbent material. Keep in suitable, closed containers for disposal.

7. Handling and storage

Handling	Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Use only under a chemical fume hood. Do not breathe vapors or spray mist. Do not ingest.

Storage Keep containers tightly closed in a dry, cool and well-ventilated place. Protect from light. Do not store in aluminum containers.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Trichloroethylene	TWA: 10 ppm STEL: 25 ppm	(Vacated) TWA: 50 ppm (Vacated) TWA: 270 mg/m³ Ceiling: 200 ppm (Vacated) STEL: 200 ppm (Vacated) STEL: 1080 mg/m³ TWA: 100 ppm	IDLH: 1000 ppm	TWA: 100 ppm TWA: 535 mg/m³ STEL: 200 ppm STEL: 1080 mg/m³

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures Use only under a chemical fume hood. Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection Long sleeved clothing.

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	Characteristic
Odor Threshold	No information available
pH	No information available
Melting Point/Range	-85 °C / -121 °F
Boiling Point/Range	87 °C / 188.6 °F
Flash Point	No information available
Evaporation Rate	0.69 (Carbon Tetrachloride = 1.0)
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	44.8 vol %
Lower	8 vol %
Vapor Pressure	77.3 mbar @ 20 °C
Vapor Density	4.5 (Air = 1.0)
Specific Gravity	1.460
Solubility	Insoluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	410 °C / 770 °F

Decomposition Temperature	> 120°C
Viscosity	0.55 mPa.s (25°C)
Molecular Formula	C2 H Cl3
Molecular Weight	131.39

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability Light sensitive.

Conditions to Avoid Incompatible products. Excess heat. Exposure to light. Exposure to moist air or water.

Incompatible Materials Strong oxidizing agents, Strong bases, Amines, Alkali metals, Metals,

Hazardous Decomposition Products Hydrogen chloride gas, Chlorine, Phosgene, Carbon monoxide (CO), Carbon dioxide (CO_2)

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Trichloroethylene	LD50 = 4920 mg/kg (Rat) LD50 = 4290 mg/kg (Rat)	LD50 = 29000 mg/kg (Rabbit) LD50 > 20 g/kg (Rabbit)	LC50 = 26 mg/L (Rat) 4 h

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation Irritating to eyes and skin

Sensitization May cause sensitization by skin contact

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Trichloroethylene	79-01-6	Group 1	Known Reasonably Anticipated	A2	X	Not listed

IARC: (International Agency for Research on Cancer)

IARC: (International Agency for Research on Cancer)
Group 1 - Carcinogenic to Humans
Group 2A - Probably Carcinogenic to Humans
Group 2B - Possibly Carcinogenic to Humans

NTP: (National Toxicity Program)

NTP: (National Toxicity Program)
Known - Known Carcinogen
Reasonably Anticipated - Reasonably Anticipated to be a Human Carcinogen

ACGIH: (American Conference of Governmental Industrial Hygienists)

A1 - Known Human Carcinogen
A2 - Suspected Human Carcinogen
A3 - Animal Carcinogen
ACGIH: (American Conference of Governmental Industrial Hygienists)

Mutagenic Effects Mutagenic effects have occurred in humans.

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure Central nervous system (CNS)
STOT - repeated exposure Kidney Liver Heart spleen Blood

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting: Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain or flushing

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment. Do not empty into drains. The product contains following substances which are hazardous for the environment. Contains a substance which is:. Harmful to aquatic organisms. Toxic to aquatic organisms.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Trichloroethylene	EC50: = 175 mg/L, 96h (Pseudokirchneriella subcapitata) EC50: = 450 mg/L, 96h (Desmodesmus subspicatus)	LC50: 31.4 - 71.8 mg/L, 96h flow-through (Pimephales promelas) LC50: 39 - 54 mg/L, 96h static (Lepomis macrochirus)	EC50 = 0.81 mg/L 24 h EC50 = 115 mg/L 10 min EC50 = 190 mg/L 15 min EC50 = 235 mg/L 24 h EC50 = 410 mg/L 24 h EC50 = 975 mg/L 5 min	EC50: = 2.2 mg/L, 48h (Daphnia magna)

Persistence and Degradability Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its volatility.

Component	log Pow
Trichloroethylene	2.4

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Trichloroethylene - 79-01-6	U228	-

14. Transport information

DOT

UN-No UN1710
Proper Shipping Name TRICHLOROETHYLENE
Hazard Class 6.1
Packing Group III

TDG

UN-No UN1710
Proper Shipping Name TRICHLOROETHYLENE
Hazard Class 6.1
Packing Group III

IATA

UN-No	UN1710
Proper Shipping Name	TRICHLOROETHYLENE
Hazard Class	6.1
Packing Group	III

IMDG/IMO

UN-No	UN1710
Proper Shipping Name	TRICHLOROETHYLENE
Hazard Class	6.1
Packing Group	III

15. Regulatory information

All of the components in the product are on the following Inventory lists: X = listed

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Trichloroethylene	X	X	-	201-167-4	-		X	X	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

Component	TSCA 12(b)
Trichloroethylene	Section 5 Section 6

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Trichloroethylene	79-01-6	>95	0.1

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Trichloroethylene	X	100 lb	X	X

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Trichloroethylene	X		-

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA This material, as supplied, contains one or more substances regulated as a hazardous

substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Trichloroethylene	100 lb 1 lb	-

California Proposition 65 This product contains the following proposition 65 chemicals

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Trichloroethylene	79-01-6	Carcinogen Developmental Male Reproductive	14 µg/day 50 µg/day	Developmental Carcinogen

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Trichloroethylene	X	X	X	X	X

U.S. Department of Transportation

Reportable Quantity (RQ): Y
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security
This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade No information available

16. Other information

Prepared By Health, Safety and Environmental Department
Email: tech@alfa.com
www.alfa.com

Creation Date 03-Feb-2010
Revision Date 07-Mar-2018
Print Date 07-Mar-2018
Revision Summary SDS authoring systems update, replaces ChemGes SDS No. 79-01-6.

Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

Safety Data Sheet

Revision Date: 06/05/19
www.restek.com

2 Letter ISO country code/language code: US/EN

1. IDENTIFICATION

Catalog Number / Product Name:	**30279 / cis-1,2-Dichloroethene Standard**
Company:	Restek Corporation
Address:	110 Benner Circle Bellefonte, Pa. 16823
Phone#:	814-353-1300
Fax#:	814-353-1309
Emergency#:	800-424-9300 (CHEMTREC) 703-527-3887 (Outside the US)
Email:	www.restek.com
Revision Number:	11
Intended use:	For Laboratory use only

2. HAZARD(S)IDENTIFICATION

Emergency Overview:

GHS Hazard Symbols:

GHS Classification:	Specific Target Organ Systemic Toxicity (STOT) - Single Exposure Category 1 Flammable Liquid Category 2 Acute Toxicity - Inhalation Dust / Mist Category 3 Acute Toxicity - Dermal Category 3 Acute Toxicity - Oral Category 3
GHS Signal Word:	Danger
GHS Hazard:	Highly flammable liquid and vapour. Toxic if swallowed, in contact with skin or if inhaled. Causes damage to organs.
GHS Precautions:	
Safety Precautions:	Keep away from heat/sparks/open flames/hot surfaces. – No smoking. Ground/bond container and receiving equipment. Use explosion-proof electrical/ventilation and lighting equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Do not breathe dust/fume/gas/mist/vapours/spray. Wash hands and skin thoroughly after handling. Do not eat, drink or smoke when using this product. Use only outdoors or in a well-ventilated area. Wear protective gloves/protective clothing/eye protection/face protection.
First Aid Measures:	IF SWALLOWED: Immediately call a POISON CENTER/doctor/.... IF ON SKIN: Wash with plenty of soap and water. IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower. IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Specific treatment see section 4. Rinse mouth. Take off immediately all contaminated clothing and wash it before reuse. In case of fire: Use extinguishing media in section 5 for extinction.
Storage:	Store in a well-ventilated place. Keep container tightly closed.

Store in a well-ventilated place. Keep cool.
Store locked up.

Disposal: Dispose of contents/container according to section 13 of the SDS.

Single Exposure Target Organs: Specific target organ toxicity - Single exposure - STOT SE 1: H370 Causes damage to organs. (C >= 10 %; No information to prove exclusion of certain routes of exposure); Specific target organ toxicity - Single exposure - STOT SE 2: H371 May cause damage to organs. (3 % <= C <10 %; Concentration limits for acute toxicity cannot be translated into GHS from the DSD especially when minimum classifications are given)

Repeated Exposure Target Organs: No data available

3. COMPOSITION / INFORMATION ON INGREDIENT

Chemical Name	CAS #	EINEC #	% Composition
methanol	67-56-1	200-659-6	99.8
cis-1,2-dichloroethylene	156-59-2	205-859-7	0.2

4. FIRST-AID MEASURES

Inhalation: Remove to fresh air. If breathing is difficult, have a trained individual administer oxygen. If not breathing, give artificial respiration and have a trained individual administer oxygen. Get medical attention immediately

Eyes: Flush eyes with plenty of water for at least 20 minutes retracting eyelids often. Tilt the head to prevent chemical from transferring to the uncontaminated eye. Get immediate medical attention.

Skin Contact: Wash with soap and water. Remove contaminated clothing and launder. Get medical attention if irritation develops or persists.

Ingestion: Do not induce vomiting and seek medical attention immediately. Drink two glasses of water or milk to dilute. Provide medical care provider with this SDS.

5. FIRE- FIGHTING MEASURES

Extinguishing Media: Use alcohol resistant foam, carbon dioxide, or dry chemical extinguishing agents. Water may be ineffective but water spray can be used extinguish a fire if swept across the base of the flames. Water can absorb heat and keep exposed material from being damaged by fire.

Fire and/or Explosion Hazards: Vapors may be ignited by sparks, flames or other sources of ignition if material is above the flash point giving rise to a fire (Class B). Vapors are heavier than air and may travel to a source of ignition and flash back.

Fire Fighting Methods and Protection: Do not enter fire area without proper protection including self-contained breathing apparatus and full protective equipment. Fight fire from a safe distance and a protected location due to the potential of hazardous vapors and decomposition products. Flammable component(s) of this material may be lighter than water and burn while floating on the surface.

Hazardous Combustion Products: Carbon dioxide, Carbon monoxide

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions and Equipment: Exposure to the spilled material may be severely irritating or toxic. Follow personal protective equipment recommendations found in Section 8 of this SDS. Personal protective equipment needs must be evaluated based on information provided on this sheet and the special circumstances created by the spill including; the material spilled, the quantity of the spill, the area in which the spill occurred, and the expertise of employees in the area responding to the spill. Never exceed any occupational exposure limits.

Methods for Clean-up: Prevent the spread of any spill to minimize harm to human health and the environment if safe to do so. Wear complete and proper personal protective equipment following the recommendation of Section 8 at a minimum. Dike with suitable absorbent material like granulated clay. Gather and store in a sealed container pending a waste disposal evaluation.

7. HANDLING AND STORAGE

Handling Technical Measures and Precautions: Toxic or severely irritating material. Avoid contacting and avoid

Storage Technical Measures and Conditions:	breathing the material. Use only in a well ventilated area. Use spark-proof tools and explosion-proof equipment Store in a cool dry ventilated location. Isolate from incompatible materials and conditions. Keep container(s) closed. Keep away from sources of ignition

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

United States:

Chemical Name	CAS No.	IDLH	ACGIH STEL	ACGIH TLV-TWA	OSHA Exposure Limit
methanol	67-56-1	6000 ppm IDLH	250 ppm STEL	200 ppm TWA	200 ppm TWA; 260 mg/m3 TWA

Personal Protection:

Engineering Measures:	Local exhaust ventilation is recommended when generating excessive levels of vapours from handling or thermal processing.
Respiratory Protection:	Respiratory protection may be required to avoid overexposure when handling this product. General or local exhaust ventilation is the preferred means of protection. Use a respirator if general room ventilation is not available or sufficient to eliminate symptoms.If an exposure limit is exceeded or if an operator is experiencing symptoms of inhalation overexposure as explained in Section 3, provide respiratory protection.
Eye Protection:	Wear chemically resistant safety glasses with side shields when handling this product. Do not wear contact lenses.
Skin Protection:	Wear protective gloves. Inspect gloves for chemical break-through and replace at regular intervals. Clean protective equipment regularly. Wash hands and other exposed areas with mild soap and water before eating, drinking, and when leaving work

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance, color:	No data available
Odor:	Mild
Physical State:	Liquid
pH:	Not applicable
Vapor Pressure:	No data available
Vapor Density:	1.1 (air = 1)
Boiling Point (°C):	64.7 °C at 760 mmHg (HSDB)
Melting Point (°C):	-98 °C
Flash Point (°F):	52
Flammability:	Highly Flammable
Upper Flammable/Explosive Limit, % in air:	36
Lower Flammable/Explosive Limit, % in air:	6
Autoignition Temperature (°C):	464 deg C
Decomposition Temperature (°C):	No data available
Specific Gravity:	0.791 - 0.792 g/cm3 at 20 °C
Evaporation Rate:	No data available
Odor Threshold:	No data available
Solubility:	Moderate; 50-99%
Partition Coefficient: n-octanol in water:	No data available
VOC % by weight:	99.8
Molecular Weight:	32.04

10. STABILITY AND REACTIVITY

Stability:	Stable under normal conditions.
Conditions to Avoid:	None known.
Materials to Avoid / Chemical Incompatiability:	Strong oxidizing agents
Hazardous Decomposition Products:	Carbon dioxide Carbon monoxide

11. TOXICOLOGICAL INFORMATION

Routes of Entry:	Inhalation, Skin Contact, Eye Contact, Ingestion
Target Organs Potentially Affected By Exposure:	Eyes, Central nervous system stimulation, Skin, GI Tract, Respiratory Tract
Chemical Interactions That Change Toxicity:	None Known

Immediate (Acute) Health Effects by Route of Exposure:

Inhalation Irritation:	Can cause moderate respiratory irritation, dizziness, weakness, fatigue, nausea and headache.
Inhalation Toxicity:	Harmful! Can cause systemic damage (see "Target Organs)Methanol can cause central nervous system depression and overexposure can cause damage to the optic nerve resulting in visual impairment or blindness.
Skin Contact:	Can cause moderate skin irritation, defatting, and dermatitis. Not likely to cause permanent damage.
Eye Contact:	Can cause moderate irritation, tearing and reddening, but not likely to permanently injure eye tissue.
Ingestion Irritation:	Irritating to mouth, throat, and stomach. Can cause abdominal discomfort, nausea, vomiting and diarrhea.Highly toxic and may be fatal if swallowed.
Ingestion Toxicity:	Toxic if swallowed. May cause target organ failure and/or death.May be fatal if swallowed.

Long-Term (Chronic) Health Effects:

Carcinogenicity:	No data.
Reproductive and Developmental Toxicity:	No data available to indicate product or any components present at greater than 0.1% may cause birth defects.
Inhalation:	Upon prolonged and/or repeated exposure, can cause moderate respiratory irritation, dizziness, weakness, fatigue, nausea and headache.Harmful! Can cause systemic damage upon prolonged and/or repeated exposure (see "Target Organs)
Skin Contact:	Upon prolonged or repeated contact, can cause moderate skin irritation, defatting, and dermatitis. Not likely to cause permanent damage.
Ingestion:	Toxic if swallowed. May cause target organ failure and/or death.

Component Toxicological Data:
NIOSH:

Chemical Name	**CAS No.**	**LD50/LC50**
Methanol	67-56-1	Inhalation LC50 Rat 22500 ppm 8 h

Component Carcinogenic Data:
OSHA:

Chemical Name	**CAS No.**
No data available	

ACGIH:

Chemical Name	**CAS No.**
No data available	

NIOSH:

Chemical Name	**CAS No.**
No data available	

NTP:

Chemical Name	**CAS No.**
No data available	

IARC:

Chemical Name	**CAS No.**	**Group No.**

12. ECOLOGICAL INFORMATION

Overview:	Moderate ecological hazard. This product may be dangerous to plants and/or wildlife.
Mobility:	No data
Persistence:	No data
Bioaccumulation:	No data
Degradability:	Biodegrades slowly.
Ecological Toxicity Data:	No data available

13. DISPOSAL CONSIDERATIONS

Waste Description of Spent Product:	Spent or discarded material is a hazardous waste.Mixing spent or discarded material with other materials may

render the mixture hazardous. Perform a hazardous waste determination on mixtures.

Disposal Methods: Dispose of by incineration following Federal, State, Local, or Provincial regulations.

Waste Disposal of Packaging: Comply with all Local, State, Federal, and Provincial Environmental Regulations.

14. TRANSPORTATION INFORMATION

United States:

DOT Proper Shipping Name: Methanol
UN Number: UN1230
Hazard Class: 3
Packing Group: II

International:

IATA Proper Shipping Name: Methanol
UN Number: UN1230
Hazard Class: 3(6.1)
Packing Group: II

Marine Pollutant: No

Chemical Name	CAS#	Marine Pollutant	Severe Marine Pollutant
No data available			

15. REGULATORY INFORMATION

United States:

Chemical Name	CAS#	CERCLA	SARA 313	SARA EHS 313	TSCA
methanol	67-56-1	X	X	-	X

The following chemicals are listed on CA Prop 65:

Chemical Name	CAS #	Regulation
Methanol	67-56-1	Prop 65 Devolop Tox

State Right To Know Listing:

Chemical Name	CAS#	New Jersey	Massachusetts	Pennsylvania	California
methanol	67-56-1	X	X	X	X
cis-1,2-dichloroethylene	156-59-2	-	X	X	-

16. OTHER INFORMATION

Prior Version Date: 10/29/18

Other Information: Any changes to the SDS compared to previous versions are marked by a vertical line in front of the concerned paragraph.

References: No data available

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SAFETY DATA SHEET

Vinyl Chloride

Airgas
an Air Liquide company

Section 1. Identification

GHS product identifier : Vinyl Chloride

Chemical name : vinyl chloride

Other means of identification : chloroethylene; Ethene, chloro-; Chloroethene; Vinyl chloride, monomer; Ethene, chloro- (vinyl chloride); Vinyl chloride monomer; Monochloroethylene; Monochloroethene; Ethylene monochloride; VCM; VC

Product type : Gas.

Product use : Synthetic/Analytical chemistry.

Synonym : chloroethylene; Ethene, chloro-; Chloroethene; Vinyl chloride, monomer; Ethene, chloro- (vinyl chloride); Vinyl chloride monomer; Monochloroethylene; Monochloroethene; Ethylene monochloride; VCM; VC

SDS # : 001067

Supplier's details : Airgas USA, LLC and its affiliates
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

24-hour telephone : 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : FLAMMABLE GASES - Category 1
GASES UNDER PRESSURE - Liquefied gas
CARCINOGENICITY - Category 1
SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) (liver) - Category 2

GHS label elements

Hazard pictograms :

Signal word : Danger

Hazard statements : Extremely flammable gas.
May form explosive mixtures with air.
Contains gas under pressure; may explode if heated.
May cause frostbite
May displace oxygen and cause rapid suffocation.
May cause cancer.
May cause damage to organs through prolonged or repeated exposure. (liver)

Precautionary statements

General : Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction. Always keep container in upright position. Approach suspected leak area with caution.

Prevention : Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Wear protective gloves. Wear eye or face protection. Wear protective clothing. Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Do not breathe gas.

Section 2. Hazards identification

Response : Get medical attention if you feel unwell. IF exposed or concerned: Get medical attention. Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so.

Storage : Store locked up. Protect from sunlight. Store in a well-ventilated place.

Disposal : Dispose of contents and container in accordance with all local, regional, national and international regulations.

Hazards not otherwise classified : In addition to any other important health or physical hazards, this product may displace oxygen and cause rapid suffocation.

Section 3. Composition/information on ingredients

Substance/mixture : Substance

Chemical name : vinyl chloride

Other means of identification : chloroethylene; Ethene, chloro-; Chloroethene; Vinyl chloride, monomer; Ethene, chloro-(vinyl chloride); Vinyl chloride monomer; Monochloroethylene; Monochloroethene; Ethylene monochloride; VCM; VC

Product code : 001067

CAS number/other identifiers

CAS number : 75-01-4

Ingredient name	%	CAS number
vinyl chloride	100	75-01-4

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Continue to rinse for at least 10 minutes. Get medical attention. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Ingestion : As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

Section 4. First aid measures

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : No specific treatment.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media : None known.

Specific hazards arising from the chemical : Contains gas under pressure. Extremely flammable gas. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide
halogenated compounds

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. If involved in fire, shut off flow immediately if it can be done without risk. If this is impossible, withdraw from area and allow fire to burn. Fight fire from protected location or maximum possible distance. Eliminate all ignition sources if safe to do so.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : Accidental releases pose a serious fire or explosion hazard. No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Section 6. Accidental release measures

Environmental precautions : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment.

Large spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Do not get in eyes or on skin or clothing. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Use only non-sparking tools. Empty containers retain product residue and can be hazardous. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Do not breathe gas. Avoid exposure - obtain special instructions before use. Do not handle until all safety precautions have been read and understood.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Eliminate all ignition sources. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F). Store locked up. Keep container tightly closed and sealed until ready for use. See Section 10 for incompatible materials before handling or use.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
vinyl chloride	**ACGIH TLV (United States, 3/2017).** TWA: 1 ppm 8 hours. **OSHA PEL (United States, 6/2016).** STEL: 5 ppm 15 minutes. TWA: 1 ppm 8 hours. **OSHA PEL 1989 (United States, 3/1989).** STEL: 5 ppm 15 minutes. TWA: 1 ppm 8 hours.

Appropriate engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Section 8. Exposure controls/personal protection

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state : Gas. [COLORLESS GAS OR LIQUID (BELOW 7 F) WITH A PLEASANT ODOR AT HIGH CONCENTRATIONS. [NOTE: SHIPPED AS A LIQUEFIED COMPRESSED GAS.]

Color : Colorless.

Odor : Characteristic.

Odor threshold : Not available.

pH : Not available.

Melting point : -153.8°C (-244.8°F)

Boiling point : -13.4°C (7.9°F)

Critical temperature : 158.45°C (317.2°F)

Flash point : Closed cup: -78°C (-108.4°F)
Open cup: -78°C (-108.4°F)

Evaporation rate : Not available.

Flammability (solid, gas) : Not available.

Lower and upper explosive (flammable) limits : Lower: 3.8%
Upper: 29.3%

Section 9. Physical and chemical properties

Vapor pressure : Not available.

Vapor density : 2.2 (Air = 1)

Specific Volume (ft ^{3}/lb) : 6.25

Gas Density (lb/ft ^{3}) : 0.16129 (21.1°C / 70 to °F)

Relative density : Not applicable.

Solubility : Not available.

Solubility in water : 1.1 g/l

Partition coefficient: n-octanol/water : 1.38

Auto-ignition temperature : 472°C (881.6°F)

Decomposition temperature : Not available.

Viscosity : Not applicable.

Flow time (ISO 2431) : Not available.

Molecular weight : 62.5 g/mole

Aerosol product

Heat of combustion : -18924336 J/kg

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition.

Incompatible materials : Oxidizers

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Not available.

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Section 11. Toxicological information

Classification

Product/ingredient name	OSHA	IARC	NTP
vinyl chloride	+	1	Known to be a human carcinogen.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Name	Category	Route of exposure	Target organs
vinyl chloride	Category 2	Not determined	liver

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Ingestion : As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : May cause damage to organs through prolonged or repeated exposure.

Carcinogenicity : May cause cancer. Risk of cancer depends on duration and level of exposure.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Section 11. Toxicological information

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
vinyl chloride	1.38	-	low

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

United States - RCRA Toxic hazardous waste "U" List

Ingredient	CAS #	Status	Reference number
Vinyl chloride; Ethene, chloro-	75-01-4	Listed	U043

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1086	UN1086	UN1086	UN1086	UN1086
UN proper shipping name	VINYL CHLORIDE, STABILIZED	VINYL CHLORIDE, STABILIZED	VINYL CHLORIDE, STABILIZED	VINYL CHLORIDE, STABILIZED	VINYL CHLORIDE, STABILIZED

Section 14. Transport information

Transport hazard class(es)	2.1 	2.1 	2.1 	2.1 	2.1 
Packing group	-	-	-	-	-
Environmental hazards	No.	No.	No.	No.	No.

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Additional information

DOT Classification : **Reportable quantity** 1 lbs / 0.454 kg. Package sizes shipped in quantities less than the product reportable quantity are not subject to the RQ (reportable quantity) transportation requirements.
Limited quantity Yes.
Quantity limitation Passenger aircraft/rail: Forbidden. Cargo aircraft: 150 kg.
Special provisions 21, B44, T50

TDG Classification : Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2).
Explosive Limit and Limited Quantity Index 0.125
ERAP Index 3000
Passenger Carrying Road or Rail Index Forbidden

IATA : **Quantity limitation** Passenger and Cargo Aircraft: Forbidden. Cargo Aircraft Only: 150 kg.

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption**: Not determined
Clean Water Act (CWA) 307: vinyl chloride
Clean Air Act (CAA) 112 regulated flammable substances: vinyl chloride

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

Section 15. Regulatory information

SARA 311/312

Classification : Refer to Section 2: Hazards Identification of this SDS for classification of substance.

SARA 313

	Product name	CAS number	%
Form R - Reporting requirements	vinyl chloride	75-01-4	100
Supplier notification	vinyl chloride	75-01-4	100

SARA 313 notifications must not be detached from the SDS and any copying and redistribution of the SDS shall include copying and redistribution of the notice attached to copies of the SDS subsequently redistributed.

State regulations

Massachusetts : This material is listed.

New York : This material is listed.

New Jersey : This material is listed.

Pennsylvania : This material is listed.

California Prop. 65

⚠ **WARNING**: This product can expose you to Vinyl chloride, which is known to the State of California to cause cancer. For more information go to www.P65Warnings.ca.gov.

Ingredient name	No significant risk level	Maximum acceptable dosage level
Vinyl chloride	Yes.	-

International regulations

Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

Montreal Protocol (Annexes A, B, C, E)

Not listed.

Stockholm Convention on Persistent Organic Pollutants

Not listed.

Rotterdam Convention on Prior Informed Consent (PIC)

Not listed.

UNECE Aarhus Protocol on POPs and Heavy Metals

Not listed.

Inventory list

Australia : This material is listed or exempted.

Canada : This material is listed or exempted.

China : This material is listed or exempted.

Europe : This material is listed or exempted.

Japan : **Japan inventory (ENCS)**: This material is listed or exempted.
Japan inventory (ISHL): This material is listed or exempted.

Malaysia : This material is listed or exempted.

New Zealand : This material is listed or exempted.

Philippines : This material is listed or exempted.

Republic of Korea : This material is listed or exempted.

Taiwan : This material is listed or exempted.

Thailand : Not determined.

Turkey : This material is listed or exempted.

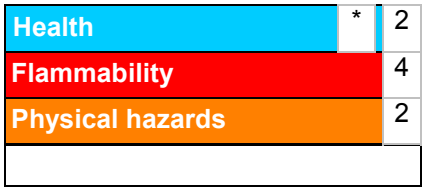
Section 15. Regulatory information

United States : This material is listed or exempted.

Viet Nam : Not determined.

Section 16. Other information

Hazardous Material Information System (U.S.A.)



Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings and the associated label are not required on SDSs or products leaving a facility under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered trademark and service mark of the American Coatings Association, Inc.

The customer is responsible for determining the PPE code for this material. For more information on HMIS® Personal Protective Equipment (PPE) codes, consult the HMIS® Implementation Manual.

National Fire Protection Association (U.S.A.)

Reprinted with permission from NFPA 704-2001, Identification of the Hazards of Materials for Emergency Response Copyright ©1997, National Fire Protection Association, Quincy, MA 02269. This reprinted material is not the complete and official position of the National Fire Protection Association, on the referenced subject which is represented only by the standard in its entirety.

Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Procedure used to derive the classification

Classification	Justification
FLAMMABLE GASES - Category 1	Expert judgment
GASES UNDER PRESSURE - Liquefied gas	Expert judgment
CARCINOGENICITY - Category 1	Expert judgment
SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) (liver) - Category 2	Expert judgment

History

Date of printing : 7/9/2018

Date of issue/Date of revision : 7/9/2018

Date of previous issue : 10/11/2016

Version : 0.02

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United Nations

Section 16. Other information

References : Not available.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

SAFETY DATA SHEET

Creation Date 24-Nov-2010 **Revision Date** 19-Jan-2018 **Revision Number** 3

1. Identification

Product Name **Carbon tetrachloride**

Cat No. : **AC167720000; AC167720010; AC167720025; AC167720100; AC167721000; AC167725000**

Synonyms Tetrachloromethane

Recommended Use Laboratory chemicals.
Uses advised against Not for food, drug, pesticide or biocidal product use

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number
For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Acute oral toxicity	Category 3
Acute dermal toxicity	Category 3
Acute Inhalation Toxicity - Dusts and Mists	Category 3
Carcinogenicity	Category 2
Specific target organ toxicity - (repeated exposure)	Category 1

Label Elements

Signal Word
Danger

Hazard Statements
Toxic if swallowed
Toxic in contact with skin
Toxic if inhaled
May cause cancer
Causes damage to organs through prolonged or repeated exposure

Precautionary Statements
Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Use personal protective equipment as required
Wash face, hands and any exposed skin thoroughly after handling
Do not eat, drink or smoke when using this product
Use only outdoors or in a well-ventilated area
Do not breathe dust/fume/gas/mist/vapors/spray
Response
IF exposed or concerned: Get medical attention/advice
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Call a POISON CENTER or doctor/physician
Skin
IF ON SKIN: Wash with plenty of soap and water
Call a POISON CENTER or doctor/physician if you feel unwell
Remove/Take off immediately all contaminated clothing
Wash contaminated clothing before reuse
Ingestion
IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician
Rinse mouth
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Harmful to aquatic life with long lasting effects
Harms public health and the environment by destroying ozone in the upper atmosphere
WARNING. Cancer - https://www.p65warnings.ca.gov/.

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Carbon tetrachloride	56-23-5	>95

4. First-aid measures

Eye Contact Immediate medical attention is required. Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Immediate medical attention is required.

Inhalation Move to fresh air. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Immediate medical attention is required. If not breathing, give artificial respiration.

Ingestion	Do not induce vomiting. Call a physician or Poison Control Center immediately.
Most important symptoms and effects	Drowsiness. Dizziness. Breathing difficulties. Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Substance is nonflammable; use agent most appropriate to extinguish surrounding fire.
Unsuitable Extinguishing Media	No information available
Flash Point	No information available
Method -	No information available
Autoignition Temperature	982 °C / 1799.6 °F

Explosion Limits

Upper	No data available
Lower	No data available
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Thermal decomposition can lead to release of irritating gases and vapors. Keep product and empty container away from heat and sources of ignition.

Hazardous Combustion Products
Hydrogen chloride gas Carbon monoxide (CO) Carbon dioxide (CO_2) Phosgene
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
3	0	0	N/A

6. Accidental release measures

Personal Precautions	Use personal protective equipment. Ensure adequate ventilation. Avoid contact with the skin and the eyes. Keep people away from and upwind of spill/leak.
Environmental Precautions	Do not flush into surface water or sanitary sewer system.
Methods for Containment and Clean Up	Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust). Keep in suitable, closed containers for disposal. Do not let this chemical enter the environment.

7. Handling and storage

Handling	Ensure adequate ventilation. Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Avoid ingestion and inhalation.
Storage	Keep in a dry, cool and well-ventilated place. Keep container tightly closed.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Carbon tetrachloride	TWA: 5 ppm STEL: 10 ppm Skin	(Vacated) TWA: 2 ppm (Vacated) TWA: 12.6 mg/m^3 Ceiling: 25 ppm TWA: 10 ppm	IDLH: 200 ppm STEL: 2 ppm STEL: 12.6 mg/m^3	TWA: 5 ppm TWA: 30 mg/m^3 STEL: 20 ppm STEL: 126 mg/m^3

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	No information available
Odor Threshold	No information available
pH	No information available
Melting Point/Range	-23 °C / -9.4 °F
Boiling Point/Range	76 °C / 168.8 °F
Flash Point	No information available
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	121 mbar @ 20 °C
Vapor Density	No information available
Specific Gravity	1.594
Solubility	No information available
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	982 °C / 1799.6 °F
Decomposition Temperature	> 100°C
Viscosity	0.97 mPa.s at 20 °C
Molecular Formula	C Cl4
Molecular Weight	153.82

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability Stable under normal conditions.

Conditions to Avoid Incompatible products.

Incompatible Materials Strong oxidizing agents, Fluorine, Metals

Hazardous Decomposition Products Hydrogen chloride gas, Carbon monoxide (CO), Carbon dioxide (CO_2), Phosgene

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Carbon tetrachloride	LD50 = 2350 mg/kg (Rat)	LD50 = 5070 mg/kg (Rat)	LC50 = 8000 ppm (Rat) 4 h

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation No information available

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen. Limited evidence of a carcinogenic effect.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Carbon tetrachloride	56-23-5	Group 2B	Reasonably Anticipated	A2	X	A2

Mutagenic Effects Not mutagenic in AMES Test

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure None known

STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

The product contains following substances which are hazardous for the environment. Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Carbon tetrachloride	EC50: = 830 mg/L, 24h	LC50: 9.68 - 11.3 mg/L, 96h	EC50 = 34 mg/L 10 min	EC50: = 28 mg/L, 24h

	(Tetrahymena pyriformis)	static (Pimephales promelas) LC50: 23 - 33 mg/L, 96h static (Lepomis macrochirus) LC50: 36.3 - 47.3 mg/L, 96h flow-through (Pimephales promelas)	EC50 = 5.6 mg/L 5 min	(Daphnia magna) EC50: = 29 mg/L, 48h (Daphnia magna)

Persistence and Degradability Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its volatility.

Component	log Pow
Carbon tetrachloride	2.75

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Carbon tetrachloride - 56-23-5	U211	-

14. Transport information

DOT
- **UN-No** 1846
- **Proper Shipping Name** CARBON TETRACHLORIDE
- **Hazard Class** 6.1
- **Packing Group** II

TDG
- **UN-No** 1846
- **Proper Shipping Name** CARBON TETRACHLORIDE
- **Hazard Class** 6.1
- **Packing Group** II

IATA
- **UN-No** UN1846
- **Proper Shipping Name** CARBON TETRACHLORIDE
- **Hazard Class** 6.1
- **Packing Group** II

IMDG/IMO
- **UN-No** UN1846
- **Proper Shipping Name** CARBON TETRACHLORIDE
- **Hazard Class** 6.1
- **Packing Group** II

15. Regulatory information

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Carbon tetrachloride	X	X	-	200-262-8	-		X	X	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.

S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Carbon tetrachloride	56-23-5	>95	0.1

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Carbon tetrachloride	X	10 lb	X	X

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Carbon tetrachloride	X	X	-

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Carbon tetrachloride	10 lb 1 lb	-

California Proposition 65 This product contains the following proposition 65 chemicals

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Carbon tetrachloride	56-23-5	Carcinogen	5 µg/day	Carcinogen

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Carbon tetrachloride	X	X	X	X	X

U.S. Department of Transportation

Reportable Quantity (RQ): Y
DOT Marine Pollutant Y
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security
This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade No information available

16. Other information

Prepared By	Regulatory Affairs Thermo Fisher Scientific Email: EMSDS.RA@thermofisher.com
Creation Date	24-Nov-2010
Revision Date	19-Jan-2018
Print Date	19-Jan-2018
Revision Summary	This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS